THURSDAY, OCTOBER 28, 1886

## HISTORY OF ETHICS

*Outlines of the History of Ethics for English Readers.* By Henry Sidgwick, Knightbridge Professor of Moral Philosophy. (London: Macmillan and Co., 1886.)

FROM the earliest times of Greek thought the foremost philosophic minds of Europe have restlessly sought for sanctions of the moral code; and the last quarter of the nineteenth century sees but little unanimity of opinion on the subject. The purely intuitional moralist dreads, in the determinist ethics of evolution and of utilitarianism, the deathblow of virtue properly so called. The followers of Bentham and of Spencer foresee the downthrow of morality unless some sanction more solid than the intuitionalist can supply be found for the ethical creed, unless "morality be established on a scientific basis." Neither can bring himself to understand how the creed of the other can really influence conduct; and both believe in their inmost hearts that the conduct of the other is really determined by something that goes deeper than the outward profession of faith.

Amidst the divergencies of ethical opinion, however, practical morality has undergone but little modification. Notwithstanding the momentous change wrought by the introduction of Christianity into Europe the ideal at which the good man aims to-day differs but little from that towards which the ancient Greek directed his endeavours. It is true that the Christian virtue of *humility* takes the place of the Greek *highmindedness;* but it is questionable whether the standard of excellence practically set before himself by the bishop who preaches the one differs materially from that of the philosopher who inculcated the other. This uniformity of practice amid diversities of faith, notwithstanding that the practice is in a high degree the outcome of the faith, receives perhaps sufficient explanation when it is remembered that the conduct of the individual is determined by a triple service—the service of Self, the service of Man, and the service of God. But the service of God—mediæval monkism notwithstanding—takes practical expression in every-day life in the service of Man, while the pure service of Self is rendered impossible by the exigencies of the social life. In this way conduct is practically reduced to a subtle compound of Egoism and Altruism. Whether the welfare of others is sought from motives of self-interest, or the improvement of self is ennobled by the thought that in this way the level of humanity is being raised, matters not practically. The material morality is the same, however wide may be the essential and formal difference.

But man is an inquiring animal, especially in the scientific and philosophical varieties of the genus. He cannot rest content with the mere possession of moral intuitions, he must also endeavour to ascertain their cause and mode of origin. He is also in his higher developments essentially a rational animal. He is not satisfied with the promptings of ethical desires, he must also justify the resulting conduct on rational grounds. Hence the science of ethics, which deals with the questions "What is right?" and "Why?"

In Prof. Sidgwick's "Outlines of the History of Ethics" we have a remarkably clear and succinct account of the answers that have been given to these questions. In dealing with the subject as a separate province of thought there is this peculiar difficulty, that ethical theory is in a very high degree determined by philosophic creed. The ethical theory of the Platonist for whom the Universe has thought itself out from the abstract to the concrete, inevitably differs from that of the modern evolutionist who believes that material and mental groupings have gradually advanced from the simple to the complex until the extraordinary complexity of the human brain and human thought-processes has been reached. Prof. Sidgwick has met this difficulty as fully as the space at his disposal rendered possible, and by not unduly narrowing the limits of his province has presented a tolerably complete bird's-eye view of the history of ethical thought.

His work begins with an *Introduction* intended to assist the reader in grasping and arranging the somewhat compressed historical matter presented to him in the body of the book. The student who comes fresh to the subject will probably find the study of this introduction more valuable at the end of his first perusal of the work than at the outset of his labours. Then follows in Chapter I. a general account of ethics, in which the subject is defined, and its relations to theology, politics, and psychology are clearly indicated. It may be useful to give here the "summary view of ethics" with which this chapter closes:—

"The subject of Ethics, most comprehensively understood, includes (1) an investigation of the constituents and conditions of the Good or Well-being of men considered individually, which chiefly takes the form of an examination into the general nature and particular species of (*a*) Virtue or (*b*) Pleasure, and the chief means of realising these ends; (2) an investigation of the principles and most important details of Duty or the Moral Law (so far as this is distinguished from Virtue); (3) some inquiry into the nature and origin of the Faculty by which duty is recognised, and, more generally, into the part taken by Intellect in human action, and its relation to various kinds of Desire and Aversion; (4) some examination of the question of human Free Will. It is connected with Theology, in so far as a Universal Good is recognised, inclusive of Human Good, or analogous to it; and again, so far as morality is regarded as a Code of Divine appointment. It is connected with Politics, so far as the well-being of any individual man is bound up with the well-being of his society; and again with Jurisprudence (or Politics), so far as morality is identified with Natural Law. Finally almost every branch of ethical discussion belongs at least in part to Psychology; and the inquiries into the origin of any moral faculty and the freedom of the Will are purely psychological."

The three following chapters form the main body of the work. The first deals with Greek and Græco-Roman ethics. In this chapter the author brings out clearly the Socratic paradox, that men's ignorance of justice is the sole cause of their unjust acts, that, in a word, no one is voluntarily bad; and its justification as the outcome of a pair of apparent truisms, (1) that every one wishes for his own good, and would get it if he could, and (2) that those who knew how to do just and righteous acts would prefer nothing else, while those who did not know could not do them if they would. Unfortunately, as a practical fact, men too often desire in their moments of passion what in their hours of reflection they know to be wrong. And since action takes the line of least resistance at the moment of temptation, there follows remorse in the hour of bitter remembrance. In the moment of trial, knowledge of right is not absent but submerged. The development of ethical doctrine as it passed through the hands of Plato and Aristotle, of Zeno and Epicurus, is treated with marked clearness and ability.

In the chapter on Christianity and mediæval ethics the main characteristics of Christian morality occupy a considerable space, the only writer whose doctrines are expounded at any considerable length being Thomas Aquinas.

The last chapter deals with modern ethics, chiefly English. The author, however, tells us, in his preface, that he has not attempted to deal with contemporary modes of ethical thought—with which he has been engaged controversially—except in a very brief and summary way. The motive is admirable; but the fact is to be regretted. As a "manual for students" the book would have been more complete had contemporary ethics formed the subject of a concluding chapter. There are many who will take up this book as a summary of the subject as a whole from the hands of one of its masters, and who will be disappointed to find so meagre an account of modern transcendental ethics and of the moral theory as "sanctioned" by evolution. The writer who has treated the ethics of twenty centuries with such marked impartiality could safely have been trusted to preserve a due "objectivity" of treatment in dealing with the modes of ethical thought in his own time.

All genuine students of human thought and endeavour will thank Prof. Sidgwick for having presented them with this altered and enlarged edition, in a handy form, of his article in the "Encyclopædia Britannica."

C. LL. M.

## *PROFESSOR CHRYSTAL'S "ALGEBRA"*

*Algebra: an Elementary Text-Book for the Higher Classes of Secondary Schools and for Colleges.* By G. Chrystal, M.A. Part I. (Edinburgh: Adam and Charles Black, 1886.)

"THERE are few things where the want of an enlightened scientific public strikes an expert more than the matter of scientific text-books." "For our teaching of algebra, I am afraid, we can claim neither the sanction of antiquity nor the light of modern times. Whether we look at the elementary, or at what is called the higher teaching of this subject, the result is unsatisfactory. . . . In the higher teaching, which interests me most, I have to complain of the utter neglect of the all-important notion of algebraic form." "The logic of the subject, which, both educationally and scientifically speaking, is the most important part of it, is wholly neglected. The whole training consists in example-grinding. What should have been merely the help to attain the end has become the end itself. The result is that algebra, as we teach it, is neither an art nor a science, but an ill-digested farrago of rules, whose object is the solution of examination problems." "The problem for the writer of a text-book has come now, in fact, to be this—to write a book so neatly trimmed and compacted that no coach, on looking through it, can mark a single passage which the candidate for a minimum pass can safely omit. . . . When our system sets such mean ends before the teacher, and encourages such unworthy conceptions of education, is it to be wondered at that the cry arises that pupils degenerate beneath even the contemptible standards of our examinations. . . . The cure for all this evil is simply to give effect to a higher ideal of education in general, and of scientific education in particular. Science cannot live among the people, and scientific education cannot be more than a wordy rehearsal of dead text-books, unless we have living contact with the working minds of living men."

Such being some of the author's weighty utterances in his famous British Association address to Section A (NATURE, vol. xxxii. pp. 446-449), it was with much interest we read the announcement that he was writing a treatise on algebra, and it is with much pleasure we have perused this first instalment of 542 pages. This is no ordinary treatise: school text-books abound, and more are on the way. This bears traces everywhere of a master's genius; those are but clever arrangements of well-known materials.

This is an elementary volume because "it begins at the beginning of the subject"; it is not written, however, for babes. It will have been noticed how the address quoted above insisted upon the "all-important notion of algebraic form": at the commencement Prof. Chrystal lays down generally the three fundamental laws, and thence proceeds deductively. This he does because this idea of algebraic form is "the foundation of all the modern developments of algebra, and the secret of analytical geometry, the most beautiful of all its applications." The following abstract of the interesting preface will best indicate the writer's aim. Outside algebra proper the reader is expected to be familiar with the definition of the trigonometrical functions, and to have a knowledge of their fundamental addition-theorem. The first object is to "develop algebra as a science, and thereby to increase its usefulness as an educationa discipline." Sources of information are indicated, and a most admirable feature is the introduction of numerous historical notes. With regard to some of the early chapters, which are specially hard reading for junior students, Prof. Chrystal writes that they were "written as a suggestion to the teacher how to connect the general laws of algebra with the former experience of the pupil. In writing this chapter I had to remember that I was engaged in writing, not a book on the philosophical nature of the first principles of algebra, but the first chapter of a book on their consequences."

The subject is broken up into twenty-two chapters, and, as the arrangement—"the result of some ten years' experience as a University teacher"—deviates somewhat from ordinary usage, we give the headings:—(1) Fundamental laws and processes (association, commutation, and distribution, with historical note); (2) laws of indices, theory of degree; (3) theory of quotients, first principles of theory of numbers; (4) distribution of products ($\Sigma$ and $\Pi$,) principle of substitution, homogeneity, symmetry, principle of indeterminate coefficients; (5) transformation of the quotient of two integral functions; (6) G.C.M. and L.C.M.; (7) factorisation of integral functions;

(8) rational fractions; (9) continuation of theory of numbers (Lambert's theorem); (10) irrational functions; (11) arithmetical theory of surds; (12) complex numbers; (13) ratio, proportion, variation; (14) on conditional equations in general (elimination, transformation); (15) variation of a function; (16) equations and functions of first degree (determinants, contour lines); (17) equations of the second degree; (18) general theory of integral functions (Newton's theorem, Lagrange's interpolation formula, maxima and minima); (19) solution of problems; (20) arithmetic, geometric, and allied series; (21) logarithms; (22) theory of interest and annuities. There is a large collection of exercises: with regard to these, after reading the address, we are prepared to find that the author deprecates the idea of a reader's working through all these at the first reading: they are given for the sake of variety, and to be worked at different times of reading. Answers are given at the end. We have put the writer's own words in the forefront, that our readers may be reminded of what he has said in the past and informed of what he has now attempted to do. The result is a work of singular ability and freshness of treatment. It follows no previous leader, it will give rise to shoals, possibly, of imitators, but it will bear boiling down by the "fifth-rate workmen" whom the Professor lashes. It is not a book for our elementary classes, but it will be an excellent work to put into the hands of some of our sixth-form pupils. It is admirably adapted for thoughtful students at our Universities who have not the dread of examinations before their eyes, but can afford to go deeper into the subject than the ordinary run of our students do. The book is excellently printed and is of a handy size. We hope the second part is well advanced.

## *THE MAMMALS OF CENTRAL AMERICA*

*Biologia Centrali-Americana. Mammalia.* By Edward R. Alston. With an Introduction by P. L. Sclater, M.A., F.R.S. 4to. (London: R. H. Porter, 1879–82.)

THE progress of various portions of the great work upon the fauna and flora of Central America undertaken by Messrs. Salvin and Godman has been from time to time noted in our columns. Each section of the extensive and almost exhaustive mass of material which the industry and liberality of the projectors and editors of the work have accumulated, has been placed in the hands of some one specially qualified to render them available for the purposes of science. No one could have been found more fitting to undertake the description of the mammals than the late Edward R. Alston, whose lamented and untimely death deprived zoology of one whose careful and conscientious method of work gave promise of a career of great benefit to the progress of the special branch to which he had devoted himself. He was unfortunately unable even to complete the work under review, which owes its finishing touches to the pen of Mr. Sclater.

Compared with the general mammalian fauna of the world, that of the region treated of by Mr. Alston is rather limited. 181 species are enumerated, of which 52 are Bats, and 60 Rodents. Of the *Primates*, 10 species of *Cebidæ* and 1 of *Hapalidæ* are described, all forms proper to the Neotropical region. Their extension into Central America is a subject of much interest which has been particularly investigated by Mr Sclater, whose observations are extended or confirmed by Mr. Alston. One species only (*Ateles vellerosus*) is known to inhabit Mexico, reaching as far north as the 23rd parallel. The *Insectivora* are represented only by 5 small species of *Soricidæ*. The *Carnivora* are more numerous. The *Felidæ* comprise the southern Jaguar, Ocelot, Margay, Eyra, and Jaguarondi, the widely distributed Puma, and the northern Bay Lynx. The dogs are all northern forms, viz., *Canis lupus*, *C. latrans*, and *Vulpes virginianus*. The *Mustelidæ* are well represented by both Neotropical and Nearctic forms. The two North American Bears, *Ursus horribilis* and *U. americanus*, both extend as far as Northern Mexico, and are therefore included within the scope of the work. But the most interesting of the *Carnivora* are the curiously generalised group of *Procyonidæ*. Of 8 recognised species of this family, 7 are included in the limits of Central America, the Brazilian *Nasua rufa* being the one exception. Of special interest are the rare and little known *Bassaris astuta* and *B. sumachristi* (of which a new figure is given), and *Bassaricyon gabbi*. The *Ungulata* are, as is well known, very poorly represented in the actual fauna of the American continent, though so abundant and varied in former ages. Four deer of the genus *Cariacus*, the northern Big-Horn and Prong-buck, two Peccaries and two Tapirs are all that can be mustered as denizens of the Central American region. It should be mentioned that the distinguishing cranial characters of Dow's Tapir are carefully worked out and figured. A fair proportion of the essentially Neotropical Edentates and Marsupials extend beyond the Isthmus of Panama, including the three modifications of the Anteater type, an Armadillo, three Sloths, and seven Opossums.

The Cetacea of the coast are not included in the work, but there is a full notice of the Manatee, containing copious extracts from Dampier's quaint but graphic description of the habits and distribution of the animal in his time. As in so many other cases, the correct scientific designation of this creature is a matter of considerable perplexity. We quite agree with Mr. Alston in keeping *Manatus* for the generic name, but *australis* can hardly be accepted for any of the species at present discriminated. It was originally applied to a combination of the African and American forms, as opposed to *borealis*, the northern Manatee or Rhytina, and if retained should belong to the former, as the African habitat is mentioned first by Gmelin (1788) and Tilesius (1812), and is the only one given by Shaw (1800). Cuvier (1809) first distinguished the African from the American species by their osteological characters, calling them respectively "Lamantin du Senegal" and "Lamantin d'Amérique," which names were subsequently Latinised by Desmarest (1817) into *M. senegalensis* and *M. americanus*. This last name is therefore certainly preferable to *M. australis* for the West Indian animal. In a recent monograph of the genus, Dr. C. Hartlaub (*Zoologische Jahrbuch*, Bd. I.) has carefully investigated the synonymy, and admits two species as inhabitants of the New World, *M. latirostris* (Harlan) and *M. inunguis* (Natterer), *M. americanus* being suppressed as a compound of the two. The Central American form is referred by Hartlaub to *M. latirostris*, *M. inunguis* being apparently confined to the upper waters of the Amazon and Orinoco; but we cannot say that we are quite satisfied with the supercession of Cuvier's name for that of Harlan.

The work is illustrated by twenty excellent coloured plates by Wolf, Keulemans, and Smit, representing new or little-known species. We cannot conclude our notice without again expressing our admiration for the scientific enthusiasm and public spirit shown by Messrs. Godman and Salvin in the manner in which they are carrying out their great undertaking. W. H. F.

## PACKARD'S "FIRST LESSONS IN ZOOLOGY"

*First Lessons in Zoology, adapted for Use in Schools.* By A. S. Packard, M.D., Ph.D., Professor of Zoology and Geology in Brown University. American Science Series, Elementary Course. (New York: Henry Holt and Company, 1886.)

ONE of the principal objects of the American Science Series, we are told, is to supply "authoritative books the principles of which are, so far as is practical, illustrated by familiar American facts." Another "lack" intended to be supplied by the series is that of text-books which "do not *at least contradict* the latest generalisations." Whatever success Dr. Packard may have attained in the first of these objects, we fear he has not always kept clear of the many pitfalls into which writers of compilations in any branch of science are in these days nearly sure to stumble. Some of his statements are certainly in contradiction to the latest generalisations of zoological science.

On p. 28 we find, in the account of *Millepora*, two forms of zooids, distinguished as "nutritive" and "reproductive." The so-called "reproductive" zooid is nothing of the kind, but simply a tentacle-bearing zooid unprovided with mouth and stomach. Its function is to assist the nutritive or gastro-zooids in obtaining nutrition, by directing small particles of food towards the latter. Of the reproduction of *Millepora* nothing is yet certainly known, but Prof. Moseley has suggested that it may probably give off a free-swimming *Medusa*.

Again our author, in enunciating the differences of animals and plants, states (p. 6) that plants "inhale carbonic acid gas, and exhale oxygen," and that animals do just the reverse. This seductive and oft-repeated antithesis is unfortunately not strictly accurate. Both plants and animals inhale oxygen and exhale carbonic acid gas. But in the case of the chlorophyll-bearing plants this process is obscured by an opposite process, by means of which the carbonic acid gas ($CO_2$) is broken up into its constituent elements, the carbon (C) is absorbed into the plant, and the oxygen ($O_2$) is set free. This process is, however, rather a nutritive than a respiratory process.

Speaking of *Amphioxus* (p. 139) Dr. Packard states that the water after passing through the gill-slits "enters the general body-cavity." This is an error: the water enters the *peribranchial* cavity—a perfectly distinct structure of quite different origin. Nor has *Amphioxus* "two eye-spots," but only one.

In the chapter (XXIII.) upon the "Lung-fish" (*scr.* Lung-*fishes*), the African *Protopterus annectens* seems to have been mixed up with *Polypterus bichir*, which does not belong to this order at all. The former fish is correctly figured (p. 168), but is named *Polypterus* just above, and is stated to be found in the "Nile," which is the case with *Polypterus*, but not with *Protopterus*.

These inaccuracies occur to us as we turn over the leaves of the "First Lessons in Zoology": we fear it would not be difficult to find others. We must also say that the woodcuts are mostly of coarse execution, and not always well drawn. On the other hand, it may be allowed that as great, or greater, faults might be found with every other attempt that has yet been made to supply a school-book of zoology. We are not acquainted with a really satisfactory work of this kind. A good text-book of zoology for beginners has still to be written. In the meanwhile, Dr. Packard's "first lessons," although going rather too deeply into certain portions of the subject, may be use fully employed for this purpose, without fear of teaching much that will have to be unlearnt.

## OUR BOOK SHELF

*Russland: Einrichtungen, Sitten, und Gebräuche.* Geschildert von Friedrich Meyer von Waldeck.

*Die Schweiz.* Von Prof. Dr. J. J. Egli. (Leipzig: G. Freytag, 1886.)

THESE volumes are amongst the latest of that encyclopædic work, "Das Wissen der Gegenwart," which has now passed its fiftieth volume. Although, so far as the publication has at present gone, there are more volumes devoted to popular descriptions of countries than to any other, yet general scientific subjects are by no means unrepresented. Thus, volumes have appeared on meteorology; insects, useful and injurious; the sun and planets; light and heat; the fixed stars; the earth and the moon; comets and meteors; electricity and its applications; the nourishment of plants; sound; the ocean, &c., &c. The series is progressing rapidly, we are glad to see, with very short intervals between the successive volumes, from which it is to be presumed that the undertaking is meeting with the success which it deserves amongst the German people, although, we regret to believe, it would ruin any publisher who projected and attempted to carry out a series of this scope and magnitude in this country. In both of the volumes before us the work appears to be done as thoroughly as the space admits. Herr Meyer von Waldeck's book is the second part of a work on Russian laws, customs, and manners, and specially deals with the system of administration, and national defence, the church and clergy, and the grades of society. Prof. Egli's account of Switzerland contains a large amount of information compressed with much skill into a very small space. It is not merely a tourist's book, although the tourist who would not take a more intelligent interest in Switzerland after having read it must know a good deal about the country; it is an excellent account of Switzerland which might be read with instruction even by persons who never look forward to seeing that country. The first paragraph of the first chapter deals with the *Urzeit*, or prehistoric period; the last chapter in the book sketches the history of the St. Gothard railway. The numerous excellent illustrations must add largely to the attractiveness and popularity of the series, which, however, the books well deserve on more substantial grounds.

## LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.*]

### On the Connection between Chemical Constitution and Physiological Action

In his letter to Nature last week (p. 594), Dr. Blake considers that I have not only misunderstood the scope of his experiments, but have been led into error on account of my having no definite idea of the meaning of the term chemical constitution, which he thinks I have evidently confounded with that of chemical composition.

In regard to the first of these points, I shall be very sorry if, by mishap, I have not rightly understood, or have failed to appreciate at their true value, Dr. Blake's experiments (most of which were published before I was born), for I regard him as a true pioneer in the field of pharmacology.

The scope of Dr. Blake's researches, as defined by himself in the Report of the British Association for the Advancement of Science for 1846, was "fully to establish the law of the analogous action of isomorphous substances."

I should no doubt have described Dr. Blake's researches more correctly had I used the word "isomorphous" instead of translating it into popular language, for my translation undoubtedly does not give the full meaning of the word; but my whole address was an attempt to make a difficult subject as popular as I could, and I thought that I had sufficiently acknowledged Dr. Blake's priority by observing that the present epoch of pharmacology might be dated from his researches, although it was those of Crum Brown and Fraser which fairly started pharmacological investigation in a new direction. Perhaps Dr. Blake will be inclined to regard my shortcomings in regard to him more leniently if he will read over my address again, for, if he does so, I think he will see that if on my part I have failed to give him due credit, he on his part has completely misunderstood the whole drift of my address, which was to show the importance of chemical constitution as distinguished from chemical composition.

T. Lauder Brunton

### The Origin of Species

It has already been pointed out by Mr. Evershed that the "physiological selection" of Dr. Romanes is identical with the theory outlined by me nearly two years ago in these pages (vol. xxxi. p. 4). As all the objections which have been raised apply equally to my theory, I may perhaps be allowed to give my answer to some of them; it will probably differ in some points from that promised by Dr. Romanes in the *Fortnightly*.

I quite agree with Mr. Wallace (in the *Fortnightly*) that it is only among the group of animals which have at least one common parent that the corresponding variations of the sexual organs which are required for physiological insularity would be likely to occur. But when he maintains that not more than two or three of such a group would reach maturity, and that therefore they would soon die out, he seems to me to forget that it is only on the average that the number would be so small. Many groups would be small, and would die out; exceptional families would be more numerous and more lucky; just as we can all point to human families where twelve or more children have reached maturity, though the average number of those who do so is under three in a family.

The survivors, more or less numerous, would generally not be scattered far from their common birthplace, so that their chance of finding one another would not be very small, especially if the sexual instinct was correspondingly modified, and this might well be the case from what we know of the connection between the psychical and physiological parts of the reproductive function. This presupposes some difference of smell, form, colour, &c., to enable an animal to distinguish those of its own family from the rest of the species, but this probably exists between any two animals.

They might thus be under no great disadvantage compared with the parent species, and they would have a counterbalancing advantage in the much greater adaptability to circumstances which a small group possesses. Any useful variation occurring in a large group, if not swamped by the effect of interbreeding with a large number of unimproved forms, must take many generations to modify the whole mass; while a similar useful variation occurring in one member of a small and physiologically isolated group could modify the whole group in a few generations. The existence of a six-fingered man in England would not appreciably modify the inhabitants in a thousand years, even if it was a slight advantage to have six fingers; while if a six-fingered man was introduced into an island with five other inhabitants, a fair proportion of the population would probably be six-fingered in three generations.

It is perhaps worth pointing out that the curious connection between colour and fertility, in which Mr. Wallace seeks for the explanation of the sterility of species, follows at once as a corollary from the doctrine of physiological selection. For, apart from any special modification of the sexual instinct, all animals seem to prefer to breed with those of their own colour, and hence *any* change of colour in the isolated family would be an advantage, and would indeed remove the one disadvantage under which such a family lies. So a change of colour, otherwise useless, would in such cases be preserved, and be found accompanying sterility with the parent species.

Another of Mr. Wallace's objections seems to me a strong argument in favour of my (and Dr. Romanes's) theory. He says that some animals, not only of different species but of different genera, can produce hybrids, and he instances the pheasant and black grouse. Now this is just what we ought to find on our theory, and ought not to find on any other. If either structural divergence or divergence in colour produces infertility, then the pheasant and the black grouse should be sterile, since they differ more, both in structure and colour, than many sterile pairs. But if species are produced sometimes by physiological isolation, but sometimes by other causes, such as geographical isolation, spontaneous distaste (not disability) for pairing, or even unaided natural selection, then those species which have been produced by aid of any of these latter processes will be fertile in spite of any ordinary amount of divergence, since nothing has occurred to render them otherwise; while those which have been formed by physiological isolation will be sterile even though they have hardly diverged at all. We cannot tell, without assuming what I am trying to prove, what form of isolation has been at work, except in the case of island species; but we can tell that there ought to be both very divergent fertile forms and slightly divergent non-fertile forms, and this is the case.

It has also been objected that the gradual increase of sterility, as we pass from different species to different genera and families, proves that divergence produces sterility. But it would exist on my theory; for if physiological isolation, more or less complete, occurs before each species is formed, it will have occurred at least twice between the members of two genera, and more often between those of two families. If B is separated from A by being nearly infertile, and C from B in the same way, C is likely to be still more infertile with A. But in some cases geographical or other isolation takes the place of physiological isolation, and then any number of successive divergences may occur without any accompanying infertility.

It has been said (I have lost the reference) that a certain amount of sterility has resulted in some cases from the divergence produced by artificial selection. It may be so. But on my theory, physiological isolation, the spontaneous occurrence of a fertility circumscribed by the boundary of common parentage, must be of very common occurrence, since it must have occurred not only once for each of most of the recognised species, but many more times when the resulting species has died out, and in some cases where the two species, though still existing, have not diverged in any way so as to suggest to observers that they are not one, (just as many island species do not differ perceptibly from those on the mainland). If spontaneous physiological isolation is so common, it would be certain to occur, at any rate in its commoner partial form, among the great variety of our domesticated animals, even if, as I believe, ordinary variation has no tendency to produce it.

Edmund Catchpool

Friends' Institute, E.C., October 13

### Note upon the Habits of Testacella

Between four and five months ago I found eleven specimens of this slug upon a low wall surrounding the garden of a house near the Oxford University Parks, and on the following day I captured eleven more in the same place. There had been exceptionally heavy rain, extending over some days, immediately previous to those on which I found the specimens, and it therefore seems probable that these animals are driven out of the earth when it becomes sodden with moisture. Thus it is possible to account for the capture of a very unusual number of specimens, for, as far as I can learn, the species has hitherto only been met with singly in this locality.

I have also ascertained what happens to the animals when the earth in which they are contained becomes hard and dry from the loss of water. A few of the twenty-two specimens were killed and hardened, and the remainder were put in a box containing earth, in which they buried themselves. In the press of other work the box was neglected, and remained untouched in my laboratory until to-day, the earth having quickly dried into a hard cake. To-day I emptied the box, and fully expected to find the slugs dried up dead, but to my surprise I found twelve specimens alive, each encysted in a thin transparent capsule formed of the hardened mucous secretion of the animal's skin. The body was contracted, and oval in shape, but it had been so completely protected from evaporation that there was no noticeable reduction in bulk after these hottest months of the year, during which water had been entirely withheld. One or two specimens had died almost immediately after capture, and a few escaped, so that all those which had been exposed to the heat and dryness in the box had become encysted, and survived in apparent health. EDWARD B. POULTON

Wykeham House, Oxford, October 19

### Lepidoptera and Migration

THE subject of migration in connection with Lepidoptera is beginning to receive some attention at the hands of our best lepidopterologists. I am decidedly of opinion that the abundance or scarcity of many species of Lepidoptera is largely regulated by migrations from abroad. Last year our southern shores were visited by an abnormal number of rare *Sphingidæ*, but this year there have scarcely been any records of captures published concerning them. It would be interesting to know what are all the influences which cause these migrations, and if there is a periodicity to the phenomenal occurrences.

Birmingham, October 12 W. HARCOURT BATH

### The Earthquake of October 16 in the Vosges, &c.

MAY I be allowed to call attention to the fact that Alsace lies on the direction of the great circle, "boundary of Tertiary formation of the United States," mentioned in my letter which appeared in your number of the 14th inst. (p. 570), and furthermore that Strasburg has been repeatedly shaken since 1355, the first date which I found recorded as having been marked by a shock. It is quite true that the interval between that shock and the next recorded (1556) was 201 years; but the greatest subsequent interval, that between the shocks of 1577 and 1655, was only of 78 years. This interval represents a multiple of 13, being $= 13 \times 6$. The interval of 13 is of frequent recurrence, as I purpose to show in a paper which I have about terminated on this question of intervals and periods of earthquakes.

J. P. O'REILLY

Royal College of Science for Ireland, Stephen's Green, Dublin, October 23

## RECENT ORNITHOLOGICAL WORKS

THE future student of British birds ought to have little difficulty in working out the distribution of species within the shores of Great Britain, so much excellent work having been done in the way of local lists during the last few years, and certainly one of the most useful will be the little work on "The Birds of Cumberland and Westmoreland," just issued by the Rev. H. A. Macpherson and Mr. W. Duckworth.[1] The situation of these two counties is interesting, especially to the student of migration, and the notes on the passage of water-birds and sea-birds are particularly good. The completeness of the information, and the concise and simple form in which it is conveyed, render this small book a model of what a faunistic work should be, and it forms a worthy accompaniment to the many excellent county lists of birds which have appeared in England during the last twenty years. It would be well if every expiring species in Great Britain had had its death-song as well sung as is the case with the Dotterell, by Mr. F. Nicholson, in the present work. While Protection Acts are spreading their ægis over many birds in the breeding season, so that the numbers are visibly increasing, and the enlightened care of a few landed proprietors aids the work of bird-preservation, there are still a certain number of species whose nesting days in this country are numbered, and which, like the Great Bustard and the Bittern, are doomed by the inexorable advance of civilisation to seek less over-crowded countries in which to breed. The (too probably final) breeding of the Dotterell in Cumberland is therefore appropriately described by Mr. Nicholson, who has himself taken the eggs in the county. An excellent account is likewise given of the breeding of the Pied Flycatchers.

We learn with some surprise that the White-headed Long-tailed Titmouse of Scandinavia, the true *Acredula caudata* (Linn.), "may be detected in Cumberland in mid-winter," when "the appearance of a flock of adults in their snow-white caps is refreshing to an insular observer." We should like to see some of these Titmice, and may state that an example is a desideratum to the national collection, where we should be glad to receive a specimen. Our experience in France, where we have shot *all three* races of the *Acredula caudata*, is that it is impossible to detect the difference of the forms when in the open, though a difference in note led to our recognising *A. irbii*. We can only consider the true *A. caudata* to be a very occasional, though not impossible, migrant to our shores, and we by no means sympathise with the authors of the "Birds of Cumberland" in their suppression of the name of *Acredula rosea* for the British Long-tailed Titmouse, from a dislike to the "needless multiplication of species." As regards Great Britain the facts are perfectly plain. The resident *Acredula* is always recognisable, and the white-headed form is only a very occasional winter visitant, and however much they may interbreed in the Rhine Provinces or elsewhere on the Continent, there is nothing of the kind in England, where perfect differentiation exists; and therefore to say that our English Long-tailed Titmouse should be called *Acredula caudata* of Linnæus, is a mistake and nothing else, for that name belongs to the Swedish form. Those ornithologists who continue to do this suppress a most interesting fact in nature, viz. that the isolation of the British Islands from the rest of Europe has produced a well-marked modification in the colour of some of our birds, amounting in certain instances to a subspecific value. The same reasoning applies to the Coal Titmouse, where our authors state that "British specimens have *generally* olive backs, as contrasted with the slate-gray backs of typical German specimens, but intermediate forms occur." This is not our experience. In summer plumage, when the olive-brown tips and the feathers become shed, the back of the English Coal Titmouse is gray, and then it is difficult to tell it from a summer-plumaged *P. ater* from the Continent. But if two winter-killed birds are compared, the difference between the British and Continental specimens is very strongly marked, for the back in the latter remains gray, whereas in the British form it is olive-brown. Having been the first, as we believe, to detect this modification in the British form, we have, ever since we first gave it the name of *Parus britannicus*, assiduously collected a series of specimens in the British Museum, and we have never seen reason to modify our original opinion, nor have we yet seen the intermediate forms for which our authors vouch.

[1] "The Birds of Cumberland critically studied, including some Notes on the Birds of Westmoreland." By the Rev. H. A. Macpherson, M.A., and William Duckworth. (Carlisle, 1886.)

We must not conclude our notice of this interesting volume without calling attention to the excellent plate (by Keulemans) of the Dotterell in summer plumage, and of the useful coloured map, an indispensable adjunct for the proper comprehension of a well-written local avifauna such as the present.

We have recently received from America two publications of the highest value, dealing with the expeditions prosecuted under the auspices of the United States Government in the high north. In the *Bulletin* of the United States National Museum, Dr. Leonard Stejneger gives his "Results of Ornithological Explorations in the Commander Islands and Kamchatka." Dr. Stejneger has worked hard for several years at Palæarctic and Nearctic ornithology, and of the many important contributions from his pen the present *Bulletin* is perhaps the most noteworthy. Although Kamchatka has been visited by several of the Russian naturalists, the published information respecting its ornithology has been meagre enough, if we except the labours of Dr. Dybowski, whose collections have been described by himself and Dr. Taczanowski. Dr. Stejneger divides his work into three parts: (1) a review of the species of birds collected or observed by himself on the Commander Islands and at Petropaulowski in Kamchatka; (2) a synopsis of the birds reported to inhabit Kamchatka; and (3) conclusions. One hundred and forty species were obtained by Dr. Stejneger himself, and of all of these he gives a full account, with synonymy and measurements. Naturally, the Auks, which abound in the Japanese and Kamchatkan seas, come in for a large share of attention, and Dr. Stejneger's description of these difficult species is very complete, especially as regards the shedding of the lamellæ of the bill, on which Dr. Bureau and Dr. Dybowski have had much to say in their writings. As these observations are accompanied by illustrations coloured on the spot by the author from freshly-killed birds, there can be no doubt that they will be of inestimable value to the future student. Several new species are described, most of them, as might be expected, being extreme forms of Siberian birds. *Cuculus peninsulæ* represents *C. kelungensis* of Japan, *Dryobates purus* and *D. immaculatus* take the place of the Palæarctic Woodpeckers, *D. major* and *D. minor*; *Pica Kamchatica* that of the Magpie, *P. caudata*. The synonymy of the Redpolls is well treated, and a series of exhaustive measurements given. We can scarcely believe in the new race of the Scarlet Grosbeak, *Carpodacus erythrinus grebnitzkii*, seeing the variation which takes place in a series of *C. erythrinus* from other localities; nor can we distinguish the Kamchatkan race of the Yellow Wagtail, *Budytes flava leucostriatus*, which seems to us to be inseparable from *B. flava* of Europe, of which species it is an Eastern colony. If the differences pointed out by Dr. Stejneger hold good, it will solve an interesting problem in geographical distribution, because it will be much more simple to recognise three forms of *B. flava*: the ordinary one breeding in Europe and wintering in Africa; an Eastern form, *B. leucostriatus*, breeding in Eastern Siberia and wintering in the Malay Archipelago; and a central one, *B. beema*, breeding in Siberia and wintering in India. At present we have fully recognised the latter, whereas the European and East Siberian birds appear to be identical, though possessing well-defined breeding and wintering habitats, with the Central Siberian bird interposed as regards its breeding and winter range. Our synonymy of the Pied Wagtails in the "Catalogue of Birds" does not appear to be quite the same as Dr. Stejneger's, but the ground has now been cleared for Mr. Nicholson or the next bold man who makes the *Motacillidæ* a special study. The problems concerning the Wrens of the East which our author presents us with require careful consideration, and show that these representative forms cannot be disposed of in the off-hand way recently attempted by Mr. Dresser. Let no ornithologist neglect to study the "Conclusions" with which Dr. Stejneger finishes his work, as there are some admirable critical notes; and in conclusion we congratulate America on having gained from Europe such a thorough worker as the author of this volume shows himself to be. We have perused every page of his "Review" with interest, only regretting that our series of Kamchatkan birds is so poor in the British Museum that we have not been able to study, as we should have liked to do, with the specimens in our hands.

The bulky volume entitled a "Report of the International Polar Expedition to Point Barrow, Alaska" contains 24 pages of ornithology, by Dr. Murdoch, and many excellent notes on the birds are given. The chief interest centres round Ross's Gull, of which the Expedition "succeeded in obtaining a large series—more, in fact, than there were before in all the museums of the world put together." Coloured figures of the adult and young are given. So, slowly but surely, are the great desiderata of bird collections being rendered available for science. Only a few months ago this Gull was reckoned one of the greatest prizes to be obtained, and now we not only know the immature plumages, but something of its migrations and habits. Its previous rarity may be imagined from the fact that until the present year no specimen existed in the British Museum, where now, thanks to the liberality of Mr. Henry Seebohm, a fine adult bird is exhibited.

Our colleague, Mr. A. G. Butler, has varied his entomological pursuits by publishing a little work on British Birds' eggs,[1] the figures of which he has drawn himself; and he has shown himself as capable a draughtsman of eggs as he is admitted to be of Lepidoptera. The plates bear evidence of the difficulty which the author has experienced in mastering the shadows of the objects, as several plates are differently treated in this respect; and perhaps it would have been better if Mr. Butler had redrawn some of the earlier plates which did not satisfy him. The chromolithography, for which Messrs. Mintern are responsible, is certainly on the whole satisfactory, and may be found available for this kind of illustration, though we notice a tendency to heighten the colour, which in our opinion has hitherto proved an obstacle for the employment of the process as regards birds themselves. The figures of the eggs are, however, undoubtedly good, and no book yet published in this country shows in a better degree the variation in form and colour which eggs are subject to. In this respect Mr. Butler's little work will be useful to all oologists, and it can confidently be recommended to the young beginner as a hand-book. The letterpress is too short for a complete account of the nidifications of the birds, but contains a good deal of information in a narrow compass.

An "Oxford Tutor" in his little work, "A Year with the Birds," discourses pleasantly enough about his feathered favourites; and whether in the classic grounds of a college garden or in the mountains of Switzerland shows himself an observant student of Nature. We have read this book with considerable pleasure, and it has carried us back in memory to many such scenes as the author describes, though we have lacked his easy facility of recording his experiences. As he is interested in migration, we recommend his spending an autumn holiday on the milder parts of the south coast, where he may really meet with a "flock" of Blackbirds, and even of Robins and Hedge-sparrows. So keen an observer will find scope for his energy in the unravelling of some of the difficult problems which yet surround the study of some of our British species, and we may venture to point out to him one or two facts which have occurred to us during the perusal of his book. Thus, when he speaks of the Wheatear in Switzerland (p. 61) as "an English species,"

[1] "British Birds' Eggs: A Hand-book of British Oology." By A. G. Butler, F.L.S. 8vo. (London, 1886.)

we want to know whether it is the large or the small form which he met with. Again, on p. 73, when he talks of the "sheet of water or marshy ground which might attract the waders and sea-birds so commonly found near Oxford," is it not the east wind which drives the latter along the course of the Thames, rather than any peculiar attraction of the country near Oxford? The fact of the Cuckoo carrying her egg in her bill for deposit in the nest of her victims is now universally admitted; but what concerns ornithologists is the greater or less resemblance of the egg deposited by the female Cuckoo to the eggs of the foster-parents which she selects to bring up her young. The Spotted Flycatcher has undoubtedly a song (p. 83), but it is a poor affair, and is heard only, according to our experience, at daybreak. It is true that the Green Sandpiper (p. 86) has really only the legs greenish, but the reason of the perpetuity of the name to which our author objects, is because Linnæus called the species *ochropus*, and the name adopted by the older English writers was the *Green* Sandpiper, which has been handed down to the present generation, as is also the case with the Grey Wagtail. The author knows his "Dresser" and his "Harting," but he can learn something of the affinity of Robins and Redstarts (pp. 88, 101) from Mr. Seebohm in the British Museum "Catalogue" (vol. v.), or in his "History of British Birds." The little essay on the "Birds of Virgil" is most interesting, especially with regard to the *Alcyon*, which, we agree with the author and his authorities, was probably *not* our Kingfisher, though the presence of the latter on the sea-shore in some numbers is a fact at the season of the autumn migration. We offer these few remarks to the author as points of further study on which we should be glad to have the observations of a true naturalist, such as he evidently is.

The Rev. Gregory Smart has recently published a little book on the "Birds on the British List," which is a *critique* on the list issued by the British Ornithologists' Union, which he collates with the works of Mr. Dresser, Mr. Seebohm, and the fourth edition of "Yarrell." The book is disfigured by a slovenly style of writing, for which the printers' errors can scarcely account, and this is the greater pity, as the author's intentions are good, and he scores distinctly on several occasions when dissecting the evidence on which some birds are admitted to the British List while others are rejected; but the English in which he endeavours to record his conclusions is, to say the least of it, a little mixed. The author confesses to "having had but little experience," and it would therefore have been better to have restricted himself to the main object of his book, viz. the criticism of the evidence on which some species are retained or rejected in the works above alluded to. When he gets outside the boundary of his *critique*, he talks in some instances simple nonsense, as in his remarks on the Gold-vented Bulbul (p. 18). Mr. Dresser and Mr. Bidwell, in aiding and abetting Mr. Smart in his hap-hazard identification of his Bulbul's egg, could scarcely have expected the punishment of having their rash opinion published to the world. On p. 41 some more nonsense appears about *Anthus ludoricianus* and *A. campestris* being conspecific! The author would seem to be unaware that "Ungaru" is generally spoken of as "Hungary" by English writers, and that "Los Angelos Cala" is a locality which will puzzle many an "inexperienced" collector for whose benefit Mr. Smart professes to write. We would advise the author, before publishing another book, to get some friend to look over his manuscript for him, as a good deal of the difficulty of unravelling the meaning of his sentences would have been avoided by a simple attention to stops and commas, which is not too much to expect from a "late Scholar of Trinity College, Cambridge."

R. BOWDLER SHARPE

## SOLAR PHYSICS[1]

MOST of our readers are aware that the sun, as constructed by Zöllner, was a white-hot, liquid body, that its spots were scoriaceous products of local cooling, and that its atmospheric circulation was closely modelled upon the terrestrial, with trades and anti-trades, an equatorial belt of calms, land- and sea-breezes, the last due to the contrast of temperature between the slag-islands constituting spot-nuclei, and the incandescent ocean in which they floated. On these lines M. Schulz has reared a solar edifice out of materials to a large extent new. Sixteen additional years of results in one of the most rapidly progressive branches of modern physical astronomy, give him an advantage over his predecessor, utilised to the utmost in modifying, extending, and generalising views of which he is the intrepid, though not blind, partisan. The upshot, we venture to assert, is to prove them wholly untenable. If M. Schulz's ingenious advocacy fail to recommend them, their inherent weakness must be great. Our readers shall judge for themselves of its success.

In the work before us it is undertaken to account for the whole array of solar phenomena, from the conservation, through long geological ages, of the solar activity, and its cyclical fluctuations, to the production of a pore or a facula. With this alluring prospect in view we are invited to regard the sun as a liquid globe composed of unknown substances, glowing at a temperature somewhere between 10,000° and 20,000° C. Although the heat rises towards the centre by a very low gradient, the inequality suffices to insure the distribution of the loss by radiation throughout the bulk of the globe, vertical convection-currents carrying down the cooler and heavier outer layers, and replacing them with hotter and more buoyant materials from the interior. Thus the danger is averted of the light-and-heat-giving career of our luminary being brought to a premature close by the untimely formation of a crust. The relative permanence of that career is further secured by the application to a liquid sun of Helmholtz's gravitational principle of the maintenance of solar heat.

The extensive atmosphere surrounding this molten mass is composed mainly of the unknown gas emitting Kirchhoff's "1474" line. This, in M. Schulz's opinion, is the primitive and simplest form of matter. Its atoms, many times lighter than those of hydrogen, are the fundamental units by the various aggregation of which the atoms of all other substances whatsoever are constructed. It plays, as we shall presently see, a very important part in the solar economy devised by our author. The solar supply of it is on a prodigious scale, since it fills, mixed with small percentages of hydrogen, helium, and metallic vapours, the vast spherical shell visible during total eclipses in the form of a "corona."

In the lowest strata of this gaseous envelope the photosphere hangs suspended at a height of a few thousand miles above the real surface of the sun. Its structure resembles that of our cirrus-clouds, only that metallic and incandescent condensing particles are substituted for aqueous frozen ones. The Fraunhofer absorption M. Schulz brings about by the customary machinery of the "reversing layer," regardless of the growing objections on the part of leading solar physicists to its exclusive employment in that capacity. Indeed the details of spectroscopic evidence scarcely receive from him the minute attention they deserve. Mr. Lockyer's researches on "lines widened in spots" give an example of the kind of work that has henceforth to be done on the solar spectrum. Summary explanations of its phenomena no longer suffice. Each one of its thousands of dusky rays has an individual story to tell, well worth the trouble of

[1] "Zur Sonnen-Physik." Von J. F. Hermann Schulz. Separatabdruck aus der *Gaea*, Bände xxi. und xxii., 1885-86. (Leipzig: W. Drugulin, 1886.)

inquiring into. Each has its own significance, and might be made the subject of a separate, and not unfruitful, study.

Prominences and spots are, by our author, connected together as cause and effect, but in the inverse order of their probable occurrence. There are strong grounds for the belief that the initial disturbance is that which occasions a spot, eruptive appearances ensuing consequentially. But, if M. Schulz's account of the matter were correct, no spot could arise without an introductory display of spontaneous and preliminary flames. Prominences, in his scheme, are composed exclusively of the green coronal gas "1474." It is true that in the spectroscope lines of hydrogen and helium are visible, but their meaning, we are told, has been misinterpreted. They take their origin, not from the body of the prominence, but from the glowing sheath with which the resistance of the solar atmosphere to its upspringing encompasses it. This surprising contention refutes itself. The implied resistance would, in a few seconds, shatter into inconspicuousness the rushing volumes evoking it. "Quiescent prominences," moreover, would on this theory be impossible; yet they are often plainly visible, for weeks together, in virtually unchanging forms; to say nothing of spectroscopic incompatibilities, too obvious to need dwelling upon.

The mechanical power consumed in the projection upwards of these bodies is derived from the expansive force of gas escaping from tremendous pressure. In dilating, however, it loses heat, and at such a rate that by the time the pressure upon it is reduced from ten million terrestrial atmospheres to one tenth of an atmosphere, its temperature has fallen from 12,000° to – 216° Centigrade. The ensuing condensation to the liquid and thence to the solid state brings about a fall of "1474 snow" upon the photosphere. When the shower is a light one, a "pore" is the consequence; when it is heavy and long-continued, the cold falling matter reaches the liquid sheet beneath, a group of "slag-islands" is formed from the chilly contact, and a spot becomes apparent to distant onlookers. The overlying photospheric clouds then arrange themselves, under the influence of atmospheric currents, into the characteristic funnel-shape of the penumbra, at the bottom of which lies the obscure solid nucleus, more or less veiled in dense absorbing vapours.

Improbability raised to an infinite degree becomes impossibility; and we may safely assert that that degree has here been reached. Criticism is silent in the presence of a supposition so fantastic as that of a substance presumably far less condensable than hydrogen existing frozen in the very depths of the thrice-heated furnace of the sun.

So much for prominences and spots: we now come to faculæ. They are regarded by M. Schulz as mere optical effects of irregular refraction in the agitated vicinity of spots. Yet the plainest ocular proof of their being real elevations above the general level of the photosphere is afforded by their not unfrequent visibility as projections from the smooth border of the limb, as well as by Dr. De la Rue's relief-pictures obtained by the stereoscopic combination of photographs.

The (not undisputed) higher equatorial temperature of the sun supplies M. Schulz, as it supplied Zöllner, with a "trade-wind" circulation, by means of which the retarded transport of spots remote from the equator are, with some difficulty, accounted for. Their slight displacements in latitude prescribe the mode of the sun's bodily circulation. A stupendous system of verticose currents—set going by differences of specific gravity through surface-cooling—is disposed so as to impel such objects slowly towards the poles from about 15° of north and south latitude, while minor equatorial whirlpools give the observed opposite drift within those limits. But such an arrangement, even were it otherwise possible, would reverse Carrington's noted law of solar rotation, the angular rate of which would, under the supposed circumstances, *quicken* with advance poleward, while the maximum retardation would occur somewhere between ten and twenty degrees of latitude.

This rolling movement from within outward of the entire substance of the liquid solar globe, save a small dense nucleus, serves, however, a further purpose. It explains the spot-period.

The occurrence of spots, it must be remembered, depends primarily upon the escape of "1474" gas (which we may designate "coronium") from the interior. But how does it get there? M. Schulz's reply is to the following effect.

Coronium has a powerful affinity for a certain hypothetical solar constituent described as "spot-stuff." In middle and high latitudes a temperature as low perhaps as 9000° C. permits combination which accordingly takes place freely over a vast area. Huge masses of a compound of coronium with "spot-stuff" thus enter into the general circulation, and are gradually carried down to depths where a temperature enforcing dissociation is encountered, giving rise to the formation, under enormous pressure, of gigantic bubbles of pure coronal gas. By their variously-conditioned outbursts these finally occasion prominences and spots, which are more or less numerous according as the distribution of "spot-stuff" is more or less plentiful. Admitting some degree of permanence in its localisation, and assuming that the great vortices whirl once completely round in eleven years, the spot-cycle is established. The equatorial spot-and-prominence minimum finds its *rationale* in the higher temperature by which the occurrence of chemical association in any part of the separate equatorial vortices is prohibited.

We have endeavoured, while omitting details which it would be waste of time to dwell upon, to do no injustice to M. Schulz's ideas in our brief sketch of them. Yet it is difficult to treat them quite seriously; and we confess to a feeling of regret in seeing a writer of M. Schulz's ability and acquirements apply them to the elaboration of so baseless a series of hypotheses—baseless in this sense, that they rest upon a number of postulates which few will be disposed to allow. With sufficient liberality of assumption almost anything can be explained on any desired principles. But this is just the kind of supply which a prudent investigator is most chary of granting either to himself or others. For its misuse undermines the foundations of science, and involves in common discredit illusory theories and legitimate schemes of inductive reasoning.

It is not without cause that solar physicists have adopted what M Schulz calls the "gas-ball theory" of the solar constitution. A mainly liquid sun is for many reasons inadmissible. At a temperature of 10,000° C. and upwards, to begin with, no substance known to us upon the earth can exist otherwise than in a state of vapour. Hence the necessity for having recourse to unknown elements with preternaturally high boiling-points. But a theory of Nature built upon the unknown has, it must be admitted, no very secure basis. Further, the internal stores of heat of a liquid sun could not be made available at the surface. The heterogeneous materials presumably composing it would necessarily arrange themselves, in the order of their specific gravities, into a succession of shells growing in density towards the centre, which no possible convection-currents would have power to disturb. The result would be the formation of a crust, and—so far as we can see—the speedy and final cessation of the radiative function of our luminary.

Some of the points touched upon by M. Schulz are of great interest, and we cannot but feel grateful to him for emphasising them, however little we agree with his methods of elucidation. He shows, for instance, that an atmosphere of hydrogen could not, on any probable assumption as to temperature, extend much more than

3000 kilometres from the photosphere without producing an amount of pressure at its base which certainly does not exist. Yet the spectroscope tells us that incandescent hydrogen is actually present at a couple of hundred times that height. Nor can the anomaly be reconciled by supposing, with our author, the solar atmosphere to be chiefly composed of a very much lighter gas ("1474"), merely, as it were, adulterated with hydrogen. Even if we were satisfied to ascribe to "coronium" an almost impossible degree of elasticity, it would not avail to lift the mingled hydrogen one inch above its natural level. The law of diffusion does not abrogate the law of gravity. Each gaseous ingredient of a mixed atmosphere obeys its own law of equilibrium, as if it existed alone. It is true that the anticipated thinning out of oxygen at great heights in our own atmosphere has not been experimentally verified; but the incessant agitation of the air is believed to mask an effect which should otherwise be perceptible.

The action of a repulsive force, such as is visibly exerted on comets, has been invoked as a means of escape from this difficulty. The supposition has much to recommend it, and would remove a good deal of perplexity; it is, besides, countenanced by the authority of Dr Huggins. But the more tempting it appears, the more severely it should be tested previous to its admission, on other than a provisional footing, among the theories of science.

The slightness of resistance to motion in the solar neighbourhood is one among many indications of the extreme tenuity of matter there. Comets well-nigh graze the sun's surface without experiencing perceptible retardation; and millions of cubic miles of hydrogen sweep onwards or upwards at rates up to 250 miles a second, almost as if *in vacuo*. Since both the moving substance and the medium are incandescent, the varying viscosity of gases at high temperatures would claim attentive consideration in the matter, were it not that reliable data are unfortunately deficient.

The rotational peculiarity of the sun may, however, be said to dominate the problem of its constitution. Three classes of explanation are possible, and have found various degrees of favour. It may be produced by the fall of matter upon the photosphere, by the ascent of matter from beneath it, or by surface-currents. The last was the theory of Zöllner, and has been inherited from him by M. Schulz, but may be dismissed without hesitation as contradictory of known facts. M. Faye's hypothesis of vertical currents bringing up with them a smaller linear velocity is more plausible, but needs peremptory treatment to fit it to the required shape. It is remarkable that M. Belopolsky has lately deduced theoretically, on some not improbable assumptions, Spörer's empirical formula of the diminishing rate of the sun's rotation north and south from his equator (see NATURE, vol. xxxiv. p. 54). The coincidence is striking; but it must not mislead us. It is not enough that a cause be true; it must also be sufficient. Is there any likelihood of its being such in this case? We apprehend that the effects, even supposing them realised to the full, would be microscopic compared with those actually observed. If we take the mean density of the sun at double its superficial density (an outside admission), the maximum of gravity will occur below the surface, at a depth of one-sixth of the radius, and there the *theoretical* rotation-period comes out, by a rough calculation, about twenty-two days. But this period is not in reality complied with. The tremendous hindering power of friction intervenes. It occurs on paper only, and belongs even there but to a single stratum. The effects in superficial acceleration must be quite inconsiderable.

Acceleration from below failing, we turn to acceleration from above. And it has to be borne in mind that the mode of the sun's rotation is inferred from the movements of spots, and from them alone. But if spots be due, as generally supposed, to vaporous down-rushes, they must share in the augmented velocity brought by the materials forming them from regions of wider circumference; and this theoretical necessity is confirmed by the characteristic plunge forward attending the sudden development of these objects. If we assume further that the height of fall, consequently the added linear velocity, diminishes progressively with distance from the equator, the phenomena of spot-transport in longitude are satisfactorily accounted for. Just such a graduated elevation of the sources of spot-supply forms an integral part of Mr. Lockyer's "meteoric-ring theory" of sunspots, communicated to the Royal Society in May last (NATURE, vol. xxxiv. p. 251). The line thus struck out, however it may be modified by future experience, seems to lead, more naturally and easily than any other yet tried, to the solution of the problem of the sun's apparent rotation. A. M. CLERKE

## *THE NEW OPTICAL GLASS*

EVERYTHING that falls from the pen of Prof. Abbé of Jena relating to optical matters commands respect. His announcement therefore of the discovery of new kinds of glass specially adapted for the manufacture of lenses has been received with peculiar interest; and although details of information on various points are still wanting, enough has been published respecting the new optical glass to be worthy of more than passing notice.

All who have had anything to do with optical instrument-making know only too well the existence of the defect termed "irrationality of dispersion." When Hall and Dollond had independently shown that the chromatic dispersion of a crown glass lens might be corrected by combining it with a second lens of flint glass, a new impetus was given to optical research. The so-called "achromatic" lens in the hands of successive generations of opticians constituted the basis both of the modern microscope and of the modern telescope. But as greater and greater perfection in the construction of the "achromatic" lens was attained, it became apparent that perfect achromaticity was very far from being realised; for though two lenses might be found which should perfectly bring together two widely differing rays, such, for example, as the red of the line C of the spectrum and the blue of line G of the spectrum, it by no means followed that this pair of lenses would bring together to the same focus all other rays. On the contrary, owing to the "irrationality" of dispersion a "secondary spectrum" would always remain uncorrected.

The relation between the chemical constitution of a medium and its action on waves of light of different periods is one of those matters about which we are still profoundly ignorant. We know that a prism of glass does not spread out the waves in proportion to their wave-length, or to the frequency of their periods. A simple case of irrationality is afforded in the fact that a green ray which when viewed through one prism may lie exactly half-way between C and G in the spectrum will not lie exactly half-way when viewed through a prism of a different kind of glass. All that a combination of two lenses can do is to achromatise for two rays of the spectrum: it may very nearly achromatise for the neighbouring rays, but strictly speaking it only achromatises for two. For ordinary optical purposes we seek to achromatise for the red and the blue, so reconciling the end regions of the visible spectrum. For photographic purposes we achromatise for green and violet (or even ultra-violet) rays, reconciling the end regions of the photographically active spectrum.

To Dr. Blair, whose observations were published in the *Transactions* of the Royal Society of Edinburgh for 1791, we owe the suggestion to achromatise for three rays by using compound lenses of three different media. Blair, indeed made a most extensive examination into the dispersive powers of various media, and in particular of liquid media, which he proposed to use in his compound lenses; a fluid lens being formed in a cavity between two lenses of glass. He also suggested combinations of two or more fluid lenses. He found that in the spectrum of hydrochloric acid the green rays lay much nearer the violet than in the spectra of most metallic solutions; and he proposed to use the chlorides of antimony and of mercury in various proportions along with hydrochloric acid, or with sal-ammoniac, in order to obtain a fluid which, while having a different absolute dispersion from crown glass, should have its relative dispersion or relative distribution of the rays of different colours proportionately identical throughout the spectrum. Blair's object-glasses for telescopes, though regarded at the time as of singular merit, never came into use. The only recent serious attempt to revive a triple lens for approximating to a correction of the secondary spectrum by achromatising for three rays has been that of Prof. C. S. Hastings, of Yale, who has used three kinds of glass.

What Blair proposed to effect with his liquid combinations Prof. Abbé claims to have now achieved by his discovery of new kinds of optical glass. To Abbé we owe the remark that, in addition to the secondary chromatic aberration of our so-called achromatic lenses, there exists a second defect, termed by him the chromatic difference of the spherical aberrations. This term he uses to denote the fact that with the crown and flint glasses used by opticians, though the curves of the lenses be calculated to correct the spherical aberration, taking in each case the mean refractive power, there will be a slight residual spherical aberration for all rays not of mean refractive index; the lens being spherically under-corrected for red rays and spherically over-corrected for blue.

Having realised so far back as 1880 that these defects were inherent in the use of such glass as opticians had at their disposal, Abbé determined to make a resolute attempt to discover new kinds of glass which should be free from these vices. The research involved no less a field of work than the examination of the optical properties of all known chemical substances which undergo vitreous fusion and solidify in non-crystalline transparent masses, together with a detailed comparison of their physical and chemical properties. The work was begun so far back as January of the year 1881 by Prof. Abbé and his coadjutor, Dr. Schott, then of Witten in Westphalia, now of Jena. Dr. Schott undertook the chemical portion and the melting processes; Prof. Abbé and his assistant, Dr. Riedel, conducted the optical examinations of the products. At first only small quantities, from 20 to 60 grammes in weight, were melted at once; all kinds of chemical elements being tried with the view of ascertaining their influence on the refractive and dispersive powers. Not only were glasses of ordinary kinds having silicic acid for their chief constituent tried, but also glasses, resembling Faraday's famous "heavy-glass," made from boric acid and also phosphoric acid. So, by the end of 1881, a series of fundamental facts in chemical optics were gathered together for future use. The next point was to use these chemical researches as the basis for the production of real glass possessing the necessary qualities of hardness, colourlessness, and unalterability. To carry out this work, Dr. Schott moved to Jena early in 1882, and set up a special laboratory for scientific glass-making with proper blast-furnaces, and smelting-pots in which quantities of 10 kilogrammes could be melted at once. Until the end of the year 1883 this research-laboratory was occupied almost exclusively in working toward the solution of two practical problems. The first of these was the production of pairs of kinds of flint and crown glass, such that the dispersion in the various regions of the spectrum should be, for each pair, as nearly as possible proportional. The object of this was to permit of a higher degree of achromaticity than hitherto possible, by diminishing the secondary colouring effects inseparable from the irrationality of the ordinary silicate flint and crown glasses. The second problem was the production of a greater multiplicity in the gradations of optical glass in respect of the two chief optical constants, the index of refraction and the mean dispersion. Though this has not generally been regarded as an important need in optics, it was considered by Prof. Abbé and Dr. Schott as of quite equal importance to the first. For the silica glasses hitherto used constitute, according to their composition, a simple series, from the lightest crown to the densest flint, in which, with an increase in refractive index, there is practically always an increase in the mean dispersion. But there is no doubt that for many purposes of practical optical instrument-making, particularly in the designing of optical combinations for special purposes, it would be a great benefit for the optician to have at his command other kinds of glass in which the refraction and dispersion are not related in the way in which they are in the silica glasses; for example, a glass having great refraction and small dispersion. Hence the multiplication in the available kinds of optical glass opens out new possibilities of great practical moment. Pending the publication of these very valuable scientific investigations, only a very brief account can be given of the actual results. The first problem has been satisfactorily solved, with the result that achromatic lenses of a much more perfect kind than has ever been attainable are now in the market; and the second has also been successfully carried out, a whole series of new glasses of graduated properties having been introduced into the optical trade.

Down to the autumn of 1883 the matter was one of systematic scientific research; but at that date, encouraged by the substantial fruit borne by the investigations, a further step was taken. In conjunction with the brothers Dr. Carl Zeiss and Dr. Rod. Zeiss, of Jena, whose names are household words to every microscopist, a commercial enterprise was set on foot for establishing a new glass-foundry. This establishment, which, under the style of Schott and Company, has been at work since the autumn of 1884, produces glass of all kinds, old and new, on a large scale. The first application of the new glass to the microscope comes naturally from the famous firm of Zeiss. To his new microscope lenses Prof. Abbé gives the distinctive name of *apochromatic objectives*. He claims for them great superiority in the finer qualities of definition, the new dry apochromatic lens giving an image equal to that of an ordinary achromatic water-immersion objective. He also claims that the more perfect corrections permit equal magnification to be obtained by using a longer-focus objective with an eye-piece of higher power than hitherto has been usual, thus obviating some of the difficulties of very short-focus objectives. Moreover the foci for visible and for photographic purposes are identical. Special compensating eye-pieces have been also devised for use with the new apochromatic objectives.

Whether these new appiiances are found to fulfil under the test of experience all that their inventor claims for them remains yet to be seen; but it cannot be doubted that a great step has been taken. It ought also to be recorded to the credit of all concerned that no attempt is being made to secure to one firm a monopoly of the new materials, but that the new optical glass is offered to the optical trade without any restriction or patent to stand in the way of further development. Nor less honourable or significant is it that the researches of the "Glass-technical Laboratory" of Jena should have been supported by a very liberal and several times repeated subvention from the Prussian Government. Such a result arising from the endowment of research makes ample answer to the easily-uttered assertion that such endowments, if given, would be wasted on useless fancies and trifling schemes. We sincerely congratulate Prof. Abbé and Dr. Schott on the completion of their most meritorious labours.

## THE GERMAN NAVAL OBSERVATORY[1]

IT will be remembered by our readers that in the spring of the present year a review of the sixth yearly Report of the German Naval Observatory at Hamburg was given (NATURE, vol. xxxiii. p. 411), in which the objects and the general system of working in the several departments, as well as some special papers on subjects connected with the Observatory, were noticed.

In this, the seventh yearly Report, there is the same evidence of the progress of useful work in all departments described in the first of the four papers which it contains, but not requiring special remark. In Paper No. 2, however, there is a detailed account of the building in which this work is carried on, and a general description of the instruments employed, which can hardly fail to be of interest even to those who may have personally visited the Observatory.

The traveller approaching the docks of Hamburg by the Elbe, will see a square sandstone building in the Renaissance style situated on an eminence which rises abruptly 100 feet above the river, between Altona and Hamburg. This is the Naval Observatory, in an excellent position for observations, and commanding an extensive view of surrounding objects for many miles, close to the shipping for the welfare of which it was chiefly established, and as it were inviting the commanders to come and partake of the advantages held out to them. The main building—which in plan forms a hollow square, and consists of a basement, ground floor, and two stories above, with ample internal galleries and staircases for communication with the various rooms—was commenced in 1879 and completed in October 1881, a Naval Exhibition in the lower rooms having been opened in the previous month by the Emperor of Germany in person.

Over the principal entrance, which faces towards the south-west, are three busts of well-known scientific worthies, that of Dove being in the middle, with Maury and Rümker right and left. The square inside the building is roofed with glass, giving protection to the galleries and the Combe apparatus which occupies the floor, whilst it proves but a small obstruction to the light.

A view from the north-west side of the building will be found on Plate 1, and on Plate 2 a plan showing the general disposition of the adjoining structures.

Preceded by some historical references to the site now occupied by the Observatory—where fortifications formerly existed—in pp. 5-12 will be found a description of the uses to which the various rooms are devoted, with references to the twenty-nine excellent plates, showing their size, and the mounting of the various instruments in them, both in elevation and plan. At each angle of the building there is a low square tower. On the western of these the anemometers and wind-vane are mounted, with electrical communications to the registering apparatus. In the south tower is the apparatus for proving sextants, for which the known angles between well-defined distant objects are used, it being a rare occurrence for the latter to be obscured by fogs. A transit instrument occupies the eastern tower, and an alt-azimuth instrument the northern.

From pp. 12-26 detailed accounts are given of the principal normal and self-registering instruments, the laboratory, the compass observatory, and the museum with its contents. Amongst the special apparatus a registering rain-gauge is described at p. 27, with an illustration; this, with the sliding-weight barograph described on p. 29, was designed by Dr. A. Sprung.

The magnetic pavilion in the garden is chiefly devoted to experimental determinations of the induction-coefficients for various kinds of iron, and instruction to students in magnetism.

[1] "Aus dem Archiv der Deutschen Seewarte." VII. Jahrgang, 1884. Herausgegeben von der Direcktion der Seewarte. (Hamburg, 1886.)

Some remarks on the uses of the Combe apparatus, founded on information of a later date than that of the present Report, may possibly be of interest. A doubt has already been expressed (NATURE, vol. xxxiii. p. 411) as to the value of the effects produced on chronometers by machinery for simulating the rolling and pitching motion of a ship at sea. This doubt has been confirmed by experience, and some additions have been made to the apparatus by which the effects of shaking such as might be caused by the racing of the engines on board ship or the blow of a heavy sea are introduced. These effects of shaking are clearly shown in the rates of the chronometers tried.

As the Combe apparatus can be rapidly revolved by means of a gas engine, its uses have been extended to the trial of anemometers and the measurement of wind-pressure, the arrangements for which may be seen on Plate 18, and a description of the same on pp. 12-15. It is reported that the results obtained are satisfactory with the exception of minor effects on the anemometers caused by draughts passing through the arched openings to the adjoining corridor, but this is in a fair way to be accurately accounted for.

In Paper No. 3, the course of instruction used by students at the Observatory on the mathematical treatment of the deviation of the compass, with examples, is shown in detail. A certain knowledge of mathematics and mechanics is required of the students preliminary to this instruction, but they have the assistance of Dr. Neumayer's deviation model (NATURE, vol. xxxiii. p. 587) for experimental illustration.

The formulæ used are, with one exception, those of the Admiralty Manual for Deviations of the Compass, published in London in 1869.

The exception will be found on pp. 29 and 30, where it may be seen that a new term is introduced into each of the equations representing the fore-and-aft and transverse magnetic forces of an iron ship. The object is to give a mathematical expression for the temporary changes which are produced in an iron ship's magnetism when her course lies in a given direction for a few days, or even hours, under certain conditions—the change only becoming apparent on alteration of the course. The amount of change experienced depends upon the quality of the ship's iron, the position of the compass, the length of time she is kept on the given course, the degree of shaking she is subjected to during that time, and is proportional to the earth's magnetic force at her mean geographical position. The question is more fully discussed in the *Archiv der Deutschen Seewarte* for 1879, No. 4, where some values of the changes denoted by the constants $V$ and $V'$ for certain ships are tabulated, but these values are dependent on so many contingencies, that nothing but carefully-conducted observations systematically made for each ship can give exact results. It may be remarked, however, that from results of the kind just described properly analysed, much useful information might be deduced and furnished to iron vessels proceeding on a voyage, as to the probable changes in their magnetism under various conditions.

The general rule at present is to depend entirely on observations of the deviations of the compass and their registration for future guidance when observations cannot be obtained. There is much to be said in favour of this rule, but there is also much to be hoped for from the more scientific treatment. It may be added that as similar results are often obtained in vessels of like types of construction, the analysis of observations from many vessels is much to be desired for the guidance of commanders of vessels starting on their first voyage, possibly, in weather when objects on land or in the sky are invisible.

In the fourth and concluding paper an account is given of the observations made by Dr. Richard Neuhauss during a voyage from Germany to Australia by the Suez Canal route, returning by New Zealand, Samoa, the Sandwich Islands, San Francisco, and New York. The observations relate principally to barometrical heights, temperature of air and sea, moisture of the atmosphere, and twilight phenomena, including zodiacal light, whilst passing through the Red Sea and tropical portions of the Indian and Pacific Oceans.

Although in previous yearly Reports Dr. Neumayer has published much information respecting the internal working, aims, and results of the Observatory he so ably directs, it is only from the perusal of this seventh Report that a full idea of the pains which Germany has taken on behalf of her sea-going population, in building and equipping at considerable expense the noble Naval Observatory at Hamburg, can be obtained. It should also be remembered that there are several minor affiliated institutions in Germany of like intent.

## THE INSTITUTION OF MECHANICAL ENGINEERS

AT the recent meeting of the Institution of Mechanical Engineers, held in Leeds under the presidency of Mr. Jeremiah Head, a paper was read "On Triple-Expansion Marine Engines," by the late Mr. Robert Wyllie of Hartlepool. During the last few years the high-pressure triple-expansion engine has proved the successful rival of the double-expansion compound, and the object of the paper was to bring forward the results of recent experience with this new type of engine, and to consider briefly the various points which have a direct bearing on its efficiency, as well as the most suitable design for marine purposes. The general conditions of efficiency were stated to depend on the approximate equality in the range of temperature in each cylinder, in the initial stress on each crank, and in the indicated horse-power of each engine. As complementary to these are steam-jacketed cylinders and other matters which are first treated of. As regards steam-jackets, when in triple-expansion engines attention is paid to the equal division of the total range of temperature amongst the cylinders in which the successive stages of expansion take place, the benefits arising from the use of steam-jackets are naturally not so great as in single-cylinder engines with a high rate of expansion; but however carefully the triple engine may be designed, the jacketing of at least the intermediate and low-pressure cylinders is essential to maximum efficiency. The ratio of the cylinder capacities depends on the pressure of the steam and type of engine, the high-pressure cylinder being larger in proportion where large range of power and economy of fuel is not so important, as in war-ships as compared with cargo steamers. To obtain even approximate equality in powers, temperatures, and stresses requires the greatest care in designing the steam-passages throughout the engine, so that the velocities of the steam at the various points and the degrees of cut-off by the valves may be carefully proportioned. Too much care cannot be taken in the design of the steam-ports and exhaust-passages of the low-pressure cylinder. The ports should be as small as possible to reduce the clearance to a minimum, and the speed of the entering steam should not be so high as to cause excessive frictional resistance, nor that of the exhaust so high as to augment the back-pressure, and consequently the greatest efficiency is obtained when the revolutions and indicated horse-power are not required to vary to any great extent. Contracted or indirect exhaust-passages in the high-pressure and intermediate cylinders have the effect of causing a larger difference between the back-pressure on one piston and the initial pressure on the next, thus diminishing the efficiency of the steam. The cut-off necessary for the highest efficiency is governed to a great extent by the speed of the entering steam and the nature of the passages. In the intermediate and low-pressure cylinders, too high a velocity of the entering steam will produce excessive frictional resistance, causing a drop in the expansion-curve, as well as unduly high receiver-pressure, thus disturbing the equality of temperatures and of initial stresses. Some diversity of opinion has existed as to the order of sequence for the three cranks. The author considered the best sequence to be the high-pressure leading, low-pressure following, and intermediate last. As regards the number of cranks, the best design is to have two cylinders on each crank for a two crank engine on the triple-expansion system, as it is then possible to get an approximately equal initial stress on each crank, the arrangement necessitating one of the three stages of expansion taking place in two cylinders instead of in one. A marine engine should be so designed that any working part can be easily examined or removed, the arrangement of cylinders on three cranks fulfilling the required conditions more nearly than any other design. The requirements of a good valve-gear are, that it shall give at both ends of the cylinder an equal distribution of steam at all grades of expansion, with a minimum of working parts and no undue strains. The four principal methods are: by the single eccentric, by the double eccentric, by taking the motion from the connecting-rod, and by a compound motion derived from both the piston-rod and the connecting-rod; all have their advantages and defects, and vary considerably in complexity and multiplicity of parts. A comparison of practical results with compound- and triple-expansion engines is in favour of the latter, as regards dead-weight carried, speed, indicated horse-power, and coal-consumption, the latter being so low as 1·41 lbs. per h.p. per hour, proving this class of engine to be most efficient. The paper concluded with a reference to artificial draught for boilers, in the special arrangement described the air being heated both inside and outside the uptake, balanced fire doors being applied, which on being opened shut off automatically the hot air supplied by the fan both above and below the fire-bars.

An important discussion followed the reading of the paper. Mr. Wm. Parker, of Lloyd's, looked upon the triple-expansion engine as the engine of the future. Profs. Kennedy and Smith drew attention to the high initial pressures employed in the triple engine, 150 lbs. per square inch as compared with 75 lbs. per square inch in the compound engines being the cause of their higher efficiency; and other speakers having drawn attention to special features in the designs, the further discussion of the paper was put off to the spring meeting of the Institute.

Afterwards the President, by request, declared the Leeds Engineering School of the Yorkshire College open, and spoke in hopeful terms of the useful work it had doubtless before it.

## NOTES

WE regret to have to announce the death last week of Dr. Guthrie, Professor of Physics at the Normal School of Science.

WE understand that the Jardin des Plantes has acquired for its botanical collections the herbarium of Lamarck. We do not know under what circumstances this had travelled so far from France. But until recently it was the property of Dr. Roeper, Professor of Botany in the University of Rostock. He incorporated it with his own herbarium, and the whole was purchased at his death by the University for 21,000 marks (1050*l.*). Lamarck's plants have however been separated, and as we understand purchased by the French Government.

THE front and sides of the new building for the galleries of natural history in the Jardin des Plantes are now nearly complete. But it will be two years or nearly so before the interior and the fittings can be finished. The collections will then be moved into the new portion, and the present galleries rebu lt to form the back of the squa-e. The hollow interior will be covered with a glass roof, and will thus be available for the reception of large objects. In the new front the mammals will occupy the ground-floor and the birds the gallery above.

THE French National Museum has received a valuable collection of mammals obtained during M. de Brazza's recent expedition in the Congo district. In it are examples of two new and well-marked species of monkeys of the genus *Colobus*, and specimens of a very fine new *Cercopithecus*, allied to *C. diana*, which M. Milne-Edwards has named *C. brazzæ*. There are also examples of several other mammals of considerable interest. Looking at these discoveries and others recently made in Somaliland, it is evident that the mammal-fauna of Africa is by no means yet exhausted.

THE experiment has been tried at the Finsbury Technical College of giving free Saturday evening popular lectures and of afterwards allowing the visitors to see over the laboratories and workshops. The lectures were given by the Professors of the College on the following dates:—October 2, Prof. S. P. Thompson, D.Sc., on "Waves of Light"; October 9, Prof. J. Perry, F.R.S., on "Spinning Tops"; October 16, Prof. R. Meldola, F.R.S., on "Coal, and what we get out of it." The concluding lecture was given on Saturday last, October 23, by Prof. Thompson, on "Magnets and Electro-magnets," the Lord Mayor taking the chair for the occasion. The numbers of visitors filling the lecture theatres on these occasions show that the movement has been appreciated by the public.

PROF. FREDERICK MCCOY, of the University of Melbourne, has been appointed a Companion of the Order of St. Michael and St. George.

WE are glad to hear that the completed volume of the "Zoological Record" may be expected before the end of the year; the reports on mammals, birds, and reptiles were issued to subscribers six weeks ago, and those on insects are now ready.

Two new botanical journals have recently made their appearance in Italy, named—according to the fashion of *Linnæa*, *Grevillea*, and *Hedwigia*—after the two distinguished botanists De Notaris and Malpighi. Three quarterly numbers have now been published of *Notarisia*, a journal devoted to the interests of phycology, issuing from Venice, and edited by Sigg. De Toni and Levi. A very useful feature in this publication is the list, in each number, of the phycological literature, and the descriptions of all new species published during the quarter. *Malpighia*, of which the first monthly number is issued, edited by Sigg. Borzi, Penzig, and Pirotta, and published at Messina, is of a more general character. Besides reviews, short notices, and a bibliography, it contains articles "On the Atomic Weights of Living Things," by L. Errera; "On the Structure of the Nectaries of *Erythronium dens canis*," by S. Calloni; "On Soredial Sporidia of *Amphiloma murorum*," by A. Borzi; and "Researches on a Species of *Aspergillus*," by F. Morini.

A CURIOUS custom of the natives of Java in the neighbourhood of the Bromo volcano is recorded in the *Straits Times* of Singapore. It is said that whenever an eruption takes place, the natives, as soon as the fire (the molten lava no doubt is meant) comes down the mountain, kindle at it the wood they use as fuel for cooking. They keep in the fire thus made for years, and whenever it goes out through neglect, or for any other reason, they never kindle it anew from matches, but they get a light from their nearest neighbours, whose fire was originally obtained from the volcano. The fires in use up to the late outburst in the native cooking-places were all obtained from the Bromo eruption of 1832.

THE issue for last year (No. 16) of the *Journal* of the Straits Branch of the Royal Asiatic Society does not contain much of specially scientific interest, although there are interesting papers on various subjects connected with the Malay Peninsula. Mr. Perham translates a very old and popular Dyak myth, and Mr. Hale, Inspector of Mines at Kinta in Perak, writes on mines and miners there. Some of the customs described are very curious. The Malay miner, the writer says, has peculiar ideas about tin and its properties. He believes that it is under the protection and command of certain spirits whom he considers it necessary to propitiate. He thinks the tin itself is alive and has many of the properties of living matter, that of its own volition it can move from place to place, that it can reproduce itself, and that it has special likes and dislikes towards certain persons and things. Hence he thinks it advisable to treat tin-ore with a certain amount of respect, to consult its convenience, and to conduct the business of mining in such a way that the tin-ore may, as it were, be obtained without its own knowledge. There is also an interesting vocabulary of the language of the Sulu archipelago, which is said to be a variety of the Bisaya of the Philippines.

ON Saturday M. Miclucho Maclay opened at St. Petersburg his small exhibition of ethnological objects from New Guinea and the Malay Archipelago in one of the halls of the Academy of Sciences, and delivered a lecture on Russian colonisation in New Guinea to the assembled visitors.

THE International Congress of Hydrology and Climatology met at Biarritz in the first week of October under the presidency of M. Durand Fardel. The number of members reached from 800 to 900.

THE National Fish Culture Association are constructing a new hatchery, and making other improvements at their establishment at Delaford Park, towards the expense of which they have received 200 guineas from the Fishmongers' Company. Donations have also been received from the Duke of Bedford, the Marquess of Exeter, Sir Albert K. Rollit, Mr. Mann, and others, towards the same object.

WE have received the report of the West Kent Natural History, Microscopical, and Photographic Society for the past year. The Presidential Address by the Rev. Andrew Johnson dealt mainly with the progress made in one branch of mycological science, the *Agaricini*, during the last twenty years, starting from the publication of Berkeley's "Outlines of British Fungology," local Societies such as this are, we think, best judged by the local work they do, not by the lecturers they may succeed in getting to address them. Good-natured scientific men of eminence who will consent to address local Societies can be obtained without very great difficulty if approached in the proper way, but to have good local papers a Society must have local members capable of good steady scientific work. In this respect the West Kent Society is not wanting, for the principal paper in this report is one by Mr. Spurrell, entitled "A Sketch of the History of Rivers and Denudation of West Kent," which is an exhaustive account of the geology of the neighbourhood, which may be presumed to be specially within the scope of the Society's work. It occupies about fifty pages, and has a considerable number of plates and illustrations.

FROM the Report for 1885 of the Australian Museum, Sydney, we learn that the Museum is open to the public from 10 until 5 o'clock (or in summer till 6 o'clock) on week-days, on Sundays from 2 o'clock to 5. The largest attendance on any one day was 1686. The greatest Sunday attendance was 1230. The average daily number of visitors throughout the year was 264 on week-days and 844 on Sundays. The total for the year was 126,512. The collections are still being increased, by means of purchases, exchanges, and donations; also by collecting and dredging expeditions. A list of these additions, under separate heads, is given in appendixes. Among these may be specially mentioned presentations in exchange from the Royal Museum at Florence; about 2000 Indian fishes from Dr. Day; three whales, caught on the coast of New South Wales; and sundry specimens of ethnology from the South Sea Islands, casts of natives of Micronesia and Polynesia, from Dr. Finsch, &c. A compass and collecting-jar belonging to Capt. Cook, purchased by the Agent-General and presented by the Colonial Secretary, are not without interest. Great alterations and improvements are still in progress, by the erection of additional glass cases. It is contemplated shortly to re-fit the old wing of the Museum with cases suitable for the mineralogical collections, which will then be exclusively placed there. Rooms have been fitted up for the osteological collections, which are now being removed thither from other parts of the building. The want of sufficient space in the present building for the constantly-increasing number of exhibits is still felt as a serious drawback to the usefulness of the Institution. The trustees are preparing a proposal for consideration by the Government, which, if adopted, will provide a useful and permanent extension now urgently required, at a comparatively small cost. Catalogues, not only of the various collections in the Museum, but also of all branches of Australian zoology, are still in course of preparation. The following new publications have been issued during the past year:—"Catalogue of Hydroid Zoophytes"; "Catalogue of Echinodermata, Part I. Echini"; "Catalogue of Minerals." Catalogues of Sponges and Medusæ are in the printer's hands; and it is hoped that, by the liberality of the Government, the continuation of "Scott's Lepidoptera" will soon be commenced.

A TELEGRAM from Srinagar, Cashmere, states that a severe and prolonged earthquake was felt there early on the morning of the 20th inst. The damage caused is not yet known. Sharp shocks of earthquake were felt early on the morning of the 22nd at Charleston, Savannah, Augusta, Columbia, Orangeburg, Wilmington, North Carolina, and several other places. The first shock of earthquake was felt at 5 o'clock in the morning, and some sharp shocks followed at 3 o'clock in the afternoon. No damage is reported to have been done. A shock was felt at Louisville in the afternoon. The shocks of earthquake felt in the evening were more severe than any that have been experienced since the great earthquake of August 31. The shock was severely felt at Summerville, where some persons were thrown down and slightly injured. Several geysers have appeared in the neighbourhood of that town.

A CORRESPONDENT of the *Times* (October 21) who appears to have made a special study of Burmah, referring to the ethnology of that country, says that tradition points to three main streams of colonisation into Burmah. The northern sea-board, now known as Aracan, is said to have received its earliest population and polity from the Buddhist kingdoms of Bengal. The southern sea-board, or Pegu, with Rangoon as its modern capital, is supposed to owe its civilisation to settlers who crossed the sea from the Madras coast. The ancient kings of the inner country, which we call Upper Burmah, also claimed an Indian affinity. But, as a matter of fact, they and their people poured across the mountains and down the river valleys from the confines of China and Mongolia. These three prehistoric divisions have left their mark on the political geography of Burmah at the present day. Each of them has in turn advanced upon and crushed its neighbours, while the whole has been from time to time submerged by fresh avalanches of wild races from the north and east.

NEXT March the railway from Oran to Tunis *viâ* Algiers and Constantine, will be completed, and will be between 800 and 900 miles long.

WE have received from Messrs. Goolden and Trotter a small illustrated pamphlet descriptive of their dynamos, which appear to be well-designed modifications of the familiar Gramme machine, lamps, and other appliances for electric light. The pamphlet is also a price-list, and though with the latter feature we have nothing to do, we may remark on a curious and scientific innovation in stating the price of dynamos in a mathematical relation to their output, being, in fact, stated as 8*l*. 10*s*. per 1000 watts plus a constant of 25*l*. Trotter's dioptric shades, which are another speciality of this house, are an example of a great improvement effected in a common manufacture by the application of good geometrical and optical principles, and we have pleasure in noticing them on this account.

THE additions to the Zoological Society's Gardens during the past week include a Macaque Monkey (*Macacus cynomolgus* ♂) from India, presented by Mrs. H. Reader; two Green Monkeys (*Cercopithecus callitrichus* ♂ ♀) from West Africa, presented respectively by Mr. J. W. Bacon and Mr. G. D. W. Ingham; a Canadian Beaver (*Castor canadensis* ♀) from Canada, presented by the Earl of Carnarvon; a Crested Porcupine (*Hystrix cristata* ♀) from Ceylon, presented by Mrs. E. Dunn; a Grey Seal (*Halichœrus grypus* ♀) from the North Atlantic, presented by Mr. H. Overton; a Quail (*Coturnix communis*), an Asiatic Quail (*Perdicula asiatica*) from India, presented by Dr. A. Günther, F.Z.S.; a Pig-tailed Monkey (*Macacus nemestrinus* ♂) from Java, six Mute Swans (*Cygnus olor*), a Cormorant (*Phalacrocorax carbo*), British, deposited; a Scarlet Ibis (*Eudocimus ruber*), a Common Boa (*Boa constrictor*) from South America, received in exchange; a Vulpine Phalanger (*Phalangista vulpina*), born in the Gardens.

## OUR ASTRONOMICAL COLUMN

THE DISTRIBUTION OF THE STARS IN SCHÖNFELD'S "DURCHMUSTERUNG."—The extension of Argelander's survey of the heavens from the North Pole to 2° of south declination undertaken by his successor, Prof. Schönfeld, has recently been published, and contains the places of stars down to mag. 10, situated between 2° and 23° of south declination. Prof. Seeliger, in a paper entitled "Ueber die Vertheilung der Sterne auf der Südlichen Halbkugel nach Schönfeld's 'Durchmusterung,'" published in the *Proceedings* of the Mathematico-Physical Section of the Bavarian Academy of Sciences, has discussed the question of the distribution of these stars. He divides the stars into eight classes. Class I. contains those of mag. 1–6·5, Class II. those of mag. 6·6–7·0, and so on down to Class VIII., which contains stars of mag. 9·6–10·0. Prof. Seeliger then gives the number of stars in each class arranged in zones embracing 1° in declination, and grouped by intervals of 40m. in R.A. The totals for each class are: Class I. 1265, Class II. 1276, Class III. 1828, Class IV. 3516, Class V. 7601, Class VI. 18,633, Class VII. 55,565, and Class VIII. 43,896. The total number of stars thus counted is 133,580, and adding to this 79 objects which are classified as nebulæ or variables, there results the grand total 133,659. This total agrees with the summation of the numbers given by Prof. Schönfeld. Comparing the results contained in this paper with those in a similar paper on the stars in Argelander's "Durchmusterung," Prof. Seeliger finds that, as far as Schönfeld's work can be considered typical of the southern hemisphere as a whole (it must be remembered, however, that it only embraces one-third thereof), the influence of the Milky Way on stellar distribution, at least for stars down to mag. 8, appears to be less marked for the southern than for the northern hemisphere. With regard to the question as to which hemisphere is the richer in stars, it appears that there is no decided difference shown by the two surveys under consideration. Reducing Argelander's numbers so as to make them comparable with Schönfeld's, and taking stars down to mag. 9 inclusive, we have for the former the total 34,324, and for the latter 34,119, a difference which may reasonably be attributed to accidental circumstances.

## ASTRONOMICAL PHENOMENA FOR THE WEEK 1886 OCTOBER 31—NOVEMBER 6

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

*At Greenwich on October* 31

Sun rises, 6h. 54m.; souths, 11h. 43m. 44·1s.; sets, 16h. 34m.; decl. on meridian, 14° 11′ S.: Sidereal Time at Sunset, 19h. 13m.

Moon (at First Quarter on November 3) rises, 11h. 9m.; souths, 15h. 35m.; sets, 20h. 0m.; decl. on meridian, 18° 56′ S.

| Planet | Rises | Souths | Sets | Decl. on meridian |
|---|---|---|---|---|
| | h. m. | h. m. | h. m. | ° ′ |
| Mercury | 8 56 | 13 0 | 17 4 | 21 42 S. |
| Venus | 6 3 | 11 14 | 16 25 | 10 17 S. |
| Mars | 10 44 | 14 32 | 18 20 | 24 5 S. |
| Jupiter | 5 14 | 10 41 | 16 8 | 7 11 S. |
| Saturn | 20 57* | 4 59 | 13 1 | 21 18 N. |

* Indicates that the rising is that of the preceding evening.

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

| Nov. | Star | Mag. | Disap. | Reap. | Corresponding angles from vertex to right for inverted image |
|---|---|---|---|---|---|
| | | | h. m. | h. m. | ° ° |
| 1 | *d* Sagittarii | 5 | 17 15 | near approach | 195 — |
| 3 | B.A.C. 7263 | 6 | 15 16 | 16 32 | 56 288 |

| Nov. | h. | |
|---|---|---|
| 3 | 23 | Saturn stationary. |

*Variable Stars*

| Star | R.A. | Decl. | | | |
|---|---|---|---|---|---|
| | h. m. | ° ′ | | h. m. | |
| U Cephei | 0 52·2 | 81 16 N. | Nov. 3, | 4 10 | *m* |
| λ Tauri | 3 54·4 | 12 10 N. | ,, 2, | 20 15 | *m* |
| | | | ,, 6, | 19 7 | *m* |
| S Orionis | 5 23·4 | 4 47 S. | ,, 1, | | *M* |
| U Monocerotis | 7 25·4 | 9 32 S. | ,, 6, | | *M* |
| S Geminorum | 7 36·2 | 23 43 N. | ,, 3, | | *M* |
| U Ophiuchi | 17 10·7 | 1 20 N. | ,, 3, | 2 51 | *m* |
| | | and at intervals of | | 20 8 | |
| U Sagittarii | 18 25·2 | 19 12 S. | Nov. 1, | 0 0 | *m* |
| | | | ,, 4, | 0 0 | *M* |
| β Lyræ | 18 45·9 | 33 14 N. | ,, 3, | 2 30 | *M* |
| η Aquilæ | 19 46·7 | 0 43 N. | Oct. 31, | 0 0 | *m* |
| S Cephei | 21 36·6 | 78 7 N. | Nov. 4, | | *M* |
| δ Cephei | 22 24·9 | 57 50 N. | ,, 3, | 5 0 | *m* |

*M* signifies maximum; *m* minimum.

*Meteor Showers*

The *Taurids*, radiant R.A. 60°, Decl. 18° N., continue through the present week. Slow bright meteors from a radiant near δ Arietis, R.A. 45°, Decl. 22° N.; and meteors from a radiant in Cygnus, R.A. 348°, Decl. 52° N., are also seen at this season. Fireball dates: November 1 and 5.

*Stars with Remarkable Spectra*

| Star | R.A. 1886·0 | Decl. 1886·0 | Type of spectrum |
|---|---|---|---|
| | h. m. s. | ° ′ | |
| D.M. + 65° 369 | 3 39 3 | 65 10·2 N. | III. |
| 54 Eridani | 4 35 27 | 19 53·5 S. | III. |
| 41 Schjellerup | 4 39 24 | 67 57·9 N. | IV. |
| o′ Orionis | 4 46 4 | 14 3·6 N. | III. |
| D.M. + 6° 810 | 4 55 39 | 6 29·0 N. | III. |
| 51 Schjellerup | 4 59 52 | 1 1·8 N. | IV. |

## GEOGRAPHICAL NOTES

THE October number of *Petermann's Mitteilungen* begins with an article, with numerous maps, on the canal between the German Ocean and the Baltic, by Herr Beseke. It describes in detail the numerous early projects—sixteen in all—for the construction of a canal across the isthmus, and then the origin and progress of the project of a canal called *par excellence* the Imperial Canal. The last section of the paper deals with the influence of the canal on navigation, and its military and commercial advantages. But the most important paper in the number, and one of the most interesting that we have read for some time, is one on the changes wrought by man in the flora of Chili, by Dr. R. A. Philippi. Only the first part is published in the present number. These changes are enormous. The traveller in Chili, says the writer, as he passes by the fields and gardens, can scarcely believe that he is in America, not in Europe, so greatly has the native vegetation disappeared. The trees and plants of Europe, and only these (with the exception of the native potato), are found everywhere near habitations. The original native flora has to be sought with care and system, and is to be found only miles away from cultivation and the abodes of men. In fact, the native vegetation is destroyed by that of Europe as effectually as the native himself disappears before the white man. Dr. Philippi treats first of timber-trees introduced from Europe or North America, then of fruit-trees, then cereals, roots which serve for fodder, industrial plants such as the hop, sugar-cane, &c., vegetables, and finally weeds. The last class owes its origin to ordinary cultivated plants running wild, and to seeds which have found their way to Chili in other seed. Herr Wichmann concludes with a short sketch of the Galla States to the south of Abyssinia, with an elaborate map showing the routes of Cecchi and Chiarini in Southern Abyssinia between 1876 and 1881.

To the *Bollettino* of the Italian Geographical Society for September, Count L. dal Verme sends an account of an excursion to the new crater, which made its appearance during the recent eruption of Mount Etna, and which has been named Monte Gemmellaro, in honour of the distinguished geologist of Catania. It lies 300 metres below Monte Nero, at an altitude of 1500 metres above sea-level, and may now be approached without much risk from the side of Nicolosi, the route passing by the Convent of Monte S. Nicola (940 metres), and thence by Monte Gervasi and to the west of Albano Pinitello and other older but now quiescent cones. There is an alternative, but much more difficult and dangerous, route further east, running also from S. Nicola straight to the foot of Monte Albano, where the explorer must dismount, whereas by the longer road he may ascend beyond Ca' dei Cervi, close to the new crater, by a bridle-path easily accessible to mules. The cone appears to rise 140 metres above the old level, and has a diameter of about 200 with a depth of perhaps 40 metres, showing at the bottom two openings 3 or 4 metres wide, ejecting a little vapour at short intervals, accompanied by a slight rumbling noise. There was a third aperture with a diameter of some 10 metres, which emitted such a continuous stream of vapour that it was impossible to form any idea of its depth. During the eruption, Gemmellaro appears to have ejected about 66,000,000 cubic metres of eruptive matter, covering a space of 5½ square kilometres on the flank of the mountain, and approaching close to the village of Nicolosi (700 metres), near the upper limit of the vine. During the eruption, which lasted twelve days, the vineyards of this district were wasted to the extent of some 20,000*l.*; but scarcely any other loss was suffered by the inhabitants, not one of whom perished from the all-devouring stream of molten lava.

THE same number of the *Bollettino* has an instructive paper by S. Raineri, on the rise and development of submarine telegraphy from the first tentative experiments of Watson (1747) and Schilling (1812) to the last cable laid on the floor of the Atlantic between Valentia and New York. The historical labours and discoveries of West, Wheatstone, Newall, Brett, and other pioneers are briefly described, and a full account given of all the oceanic cables at present girdling the globe in all directions. The paper is accompanied by two comprehensive charts and tables containing the names, dates, and lengths of all the lines completed down to the year 1885.

FROM the Report of the Council of the Straits Branch of the Royal Asiatic Society for the past year, we learn that an entirely new map of the Malay Peninsula is now in course of preparation, and will shortly be sent to England for publication. Recent explorations in Pahang, and the work of surveyors in the service of the native States have added greatly to geographical knowledge during the last few years, so that it has been found possible to make great improvements in the map of the Peninsula published for the Society in 1879 by Mr. Stanford. The Council further suggest as a subject worthy of the attention of the Colonial Government and of the Society, the preparation of an authorised Statistical Gazetteer, to which residents, students, travellers, and men of science may turn for authentic information regarding the Straits Settlements and the native States of the Malay Peninsula. Such a work, the Council thinks, should embody a full account of these regions, their inhabitants and productions, in the departments of geography, geology, ethnology, religion, manners and customs, history, arts, manufactures, agriculture, commerce, zoology, ornithology, ichthyology, &c., and should give a concise account of every town and village of importance within these limits. It would carry on in the Far East the work already performed in British India and Burmah.

A SPANISH Expedition under Capt. Cervera has been exploring Adrar in the Western Sahara. Capt. Cervera describes Port Rio de Oro, where he landed from the Spanish cruiser *Ligera*, as rather difficult of entry, but, once entered, as secure from all winds, with good anchoring ground, and from 10 to 30 metres' depth of water. "Rio de Oro" is a misnomer, as there is only one well of fresh water, and that very dirty. There are, however, good wells in the interior, and at four days' journey there is a running spring. The Expedition proceeded, between latitude 22° and 23°, south-eastwards 425 kilometres through an arid country of gneiss and granite, and struck the boundary of Adrar. The population is composed of four tribes—the Uled Delim, speaking and nearly all capable of writing pure Arabic, mixed with a few words of Berber origin. These tribes are nomadic, moving their tents from well to well for the pasture of their dromedaries, goats, and sheep. The capital of Adrar is Aatar, not Wadan, as hitherto believed. Wadan lies more to the south.

## "HYBRID" WHEAT

IT is probably not generally known that the cereal from which we obtain our bread corn is almost invariably self-fertilised in nature, and that only a skilful expert can perform the delicate operation involved in the cross-breeding of wheat. The anthers, when near maturity, must be removed from a number of wheat-flowers, and on the following day the pollen of the male parent must be placed on the stigma. The opening of the glumes, however, is dependent on the swelling of the "lodicules," which only occurs when the temperature of the atmosphere is not less than about 75°. Below that minimum the florets will not open so as to expose the reproductive parts to the operator. The angle of opening of the glumes corresponds to this swelling, and when fertilisation has been performed the lodicules shrivel up and the glumes again close over the pistil. It had long been obvious that half a dozen different varieties of wheat, blossoming at the same time, may be grown in adjacent fields or in contiguous rows without the occurrence of interbreeding, in spite of the clouds of pollen which sunshine and warmth develop at the time of blossoming; and considering the remarkable results from the cross-fertilisation of numerous plants in gardens, it seems surprising that the same process should not have been applied to wheat. Many years ago a well-known selector and "improver" of cereals, the late Mr. Patrick Sheriff, tried some experiments in this direction. His usual method of improvement consisted in the selection and careful cultivation of "sports," and he was approaching the end of his career when his earliest attempts at cross-breeding were made. The increased vigour of wheat, the moulding of the ear, the production of a larger and fuller ear, with superior grain, earlier maturity, and the modification of the straw so as to render it stronger, or shorter, and less liable to become laid as in the present season, are all improvements which may certainly be accomplished in regard to this cereal, just as analogous modifications have beeen effected in animals and some other plants by the recognised methods of breeders.

The wheat-crop of the United States reaches at present 50,000,000 quarters, or four times that of England, and this may in some measure account for the numerous experiments in cross-breeding by scientific American farmers, and especially by some of the professors of agriculture in the colleges of that country. The same remark applies to France, where the cultivation of wheat is relatively far more important than in England, and where the noted seed-firm of Vilmorin are now in the midst of the work of cross-breeding. But even in England, disheartened as farmers may be as regards wheat-culture, their prospects might certainly be improved if the average production of this cereal could be increased, its quality improved, and its liability to disease and injury from indifferent weather diminished. Both growers and consumers, therefore, have an interest in the undertaking of Messrs. Carter and Co., the seedsmen, who for several years past have been engaged in the cross-breeding of wheat at their trial-grounds and gardens at Forest Hill. The collection of different sorts of wheat at this establishment includes varieties from every country which exports this grain to England. Some of them are not hardy, and the wretched appearance of the growing specimens of Persian and Indian varieties was probably due to their depreciation in our climate. Some of the colonial and other sorts were excellent, but none could compare to the so-called hybrids.

The operations commenced in 1882 by the sowing of a number of the best English and American varieties, and in the following summer twenty crosses were effected by experts who are usually employed by the firm in delicate manipulations of a similar kind in connection with garden vegetables and flowers. In the following autumn the hybrids, as they are usually called for convenience, were sown between the rows of the male and female parents for the sake of comparison, and in the succeeding year the mixture of the breeds became apparent. In one plot, for example, the female parent was a short-strawed velvet-chaffed variety, and the male a very large, bearded, and tall American wheat, and the offspring attained a stature exceeding that of the former by a foot, with smooth chaff, and stout thick-set ears bearing minute awns at the apex of the chaff of each grain. This last-named peculiarity, the occurrence of defensive points in serrated order from top to bottom of the ear, may be referred to as one of the many advantageous peculiarities which have been developed in the course of the experiments, and it has gained for the new variety the appropriate name of "Bird-proof."

Another of the cross-breeds, having the earliest of English varieties, Talavera, for one of its parents, was almost ready for cutting this year on July 21, when we inspected the new sorts, a very early date in the case of a late backward harvest. Another has the grains very firmly set, and therefore not liable to shell out even when the crop is dead ripe, as it usually is before the time of cutting in New Zealand, where this wheat will probably prove popular.

Another of the crosses proved to be a wheat with shorter straw than any other variety in cultivation, and this too will prove a valuable modification, since neither soil nor season, however productive of straw they might be in certain years, could throw the crop down. Now does it surprise the experts that the offspring of two parents which are both of average height, should prove to be a dwarf in regard to the length of its straw, since they have had occasion to observe the same thing in the breeding of peas—two sorts of peas, each 4 feet high, and requiring the support of sticks, having produced a very useful seedling of 2½ feet, which requires no such artificial assistance.

We cannot attempt a detailed description of the numerous other peculiarities—some of them promising to be highly advantageous—which have been developed in the course of these wholesale experiments. But we may here observe that the most tiresome part of the business has proved to be the fixing of the types after the crossing had been accomplished. The work, however, has proved sufficiently successful to encourage the experimenters to undertake the cross-breeding of barley as well as wheat, and to lead them to anticipate a large demand for their new varieties, not only in this country, but in the colonies.

H. E.

## DR. AUGUST WEISMANN ON THE IMPORTANCE OF SEXUAL REPRODUCTION FOR THE THEORY OF SELECTION[1]

IN NATURE, vol. xxxiii. p. 154, was given an article on Prof. Weismann's most interesting and important memoir on "The Continuity of the Germ-Plasma considered as the Basis of a Theory of Heredity." The present memoir also abounds with interest, and may be regarded as following naturally from the former one as a continuation and further elaboration of some of the questions raised in it. The main aim of the memoir is to establish the position that the process of sexual reproduction is the prime agent by which all the varied differentiations of the complicated phyla of the Metazoa has been brought into existence. A strong part of the argument is devoted to the establishment of the position that peculiarities acquired by the parent are not transmitted to the offspring, and to showing that the hypothesis that such acquired peculiarities are transmitted is not necessary for the explanation of the known phenomena of heredity and the mode of origin of the series of organic forms. It will be remembered that the assumption of this position forms an important and necessary factor in the theory of the

[1] "Die Bedeutung der sexuellen Fortpflanzung für die Selektions Theorie." (Jena: G. Fischer, 1886.)

continuity of the germ-plasma, but it was one which in the former memoir was only lightly touched upon.

A large part of the contents of the present memoir was delivered as a lecture at a meeting of the German Naturalists' Association at Strasburg in September 1885; but numerous alterations and additions have been made, and six appendixes on special points have been added.

At the outset, special attention is drawn to the essential difference between "those special new characters which are correctly to be included under the term 'acquired,'" and the much broader class of new characters generally. Only those new characters can be termed "acquired" the origin of which is due to external influences, and not those which depend on the mysterious collaboration of the different tendencies of heredity which meet one another in the impregnated germ. These latter are not acquired, but "inherited." If, as the author holds, acquired characters are incapable of being transmitted to the progeny by the parent, then a much wider field of action must be ascribed to the processes of selection in the transformation of species than hitherto, since the modifying influences of external conditions being confined to the individual, can, in the vast majority of instances, have no effect on the transformation of species.

After discussing Nägeli's postulation of the existence in organisms of a special internal modifying force to account for the phenomena of adaptation, and showing that such a force has no existence at all, and that there are no reasons or justification for assuming it, the author dwells on the adequacy of the theory of selection to account for the facts. He insists specially on the necessity that the changes occurring during the transformation of a species, both in the organism itself and in the conditions of existence, shall take place by the smallest possible stages with the utmost slowness, so that at no moment of the entire process of transformation shall the species remain inadequately adapted to its conditions.

The possibility of the transmission of acquired characters being excluded, it is assumed that, in the case of all animals and plants which are reproduced by real germs, only those characters can be transmitted to a succeeding generation which were already present in the germ at the time of its formation.

On the theory of the continuity of the germ-plasma, a certain minimum of the active substance of the germ, the germ-plasma, always remains unchanged when the germ develops into the organism, and this remains of the germ-plasma becomes the basis from which the germ-cells of the new organism are formed. Thus there is a continuity of germ-plasma from one generation to another, and the impossibility of the transmission of acquired characters follows directly from this position, since the molecular structure of the germ-plasma is already determined within the embryo.

There are no facts which really prove that acquired characters can be inherited, although many attempts have been made to render such a supposition plausible. On the contrary, the evidence against it is abundant. The children of highly-civilised races of mankind, when brought up in isolation, show no trace of a language, and the results of experiments made on plants tell markedly on the same side.

Twenty-two pages of appendixes are devoted to demonstrating this most important position—the influence of which on future speculation with regard to organic evolution can hardly be over-estimated—that acquired peculiarities are not hereditarily transmissible. Only some of the statements with regard to the familiar instance of Brown-Séquard's hereditarily epileptic guinea-pigs can here be given.

Brown-Séquard, as is well known, produced artificially epilepsy in guinea-pigs by means of section of certain parts of the central or even peripheral nervous system in the living healthy animals. The progeny of these guinea-pigs inherited the disease of the parents. The experiments were repeated by Obersteiner, and there is no doubt of the fact. Still, urges our author, this is not to be taken as a proof that acquired peculiarities can be inherited. Epilepsy is no morphological peculiarity, but a disease.

If there were found in the epileptic offspring a distinct and evident morphological alteration in the nervous structures caused by and corresponding with that produced by injury in the parent, and which was at the same time the cause of the epilepsy in the offspring, then the question of the actual transmission of an acquired morphological peculiarity might be justly raised.

That such is the case is, however, not only not proved, but very improbable. What is certain is that many of the young of such artificially epileptic parents are small and feeble, and often die early; others show deformities and sores on various parts of their bodies. In rare instances certain of these young exhibit epileptic symptoms. Two only out of thirty-two young of epileptic parents showed the symptoms, and these soon died, having but very little vitality.

The facts may be fairly expressed by stating that the guinea-pigs artificially rendered epileptic transmit to a part of their offspring the disposition to various diseases of the nerves, to diseases of the motor nerves, and in a less degree to those of sensory nerves, and most markedly to those of trophic nerves. In rare instances, those in which paralysis is most developed in the offspring, the epilepsy is also transmitted with it.

If the pathological change in the nervous structures which follows injury and produces the epilepsy be due, as is possible, to some as yet unknown microbe growing within its substance, it is far easier to understand the transmission of such a microbe from the parent to the offspring in the adult sperm-cell or ovi-cell than to conceive of the disease being communicated in the form of a molecular change in the germ-cell. That such a transference of a microbe in the ovi-cell or sperm-cell occurs in the case of syphilis and tuberculosis is probable, and it is certain that such does occur in the case of the muscardine silkworm disease. Such an explanation would account, in the case of the guinea-pigs, for the fact that the various offspring exhibit various forms of nerve diseases, which remains unexplained if it be assumed that this is a case in which there is an hereditary transmission of a morphological character, namely, a pathological change of structure of a nervous centre. The way in which the artificial epilepsy develops itself in the guinea-pigs after the operation, creeping gradually over the body, and ensuing in the same way after injury to the most varied parts of the nervous organs, is a proof of its infectious nature. The change produced by section of the nerves is obviously not the direct cause of the epilepsy, but only serves to originate a process of disease which is propagated centripetally, with the final result of the appearance of epileptic symptoms.

The germ-plasma is immensely complex in its finest structure, but it has a remarkable power of persistence, since it absorbs nourishment and grows enormously without in the least changing its complicated molecular structure in so doing. This follows from the fact that many species (*e.g.* the Egyptian ibis or the crocodile) have reproduced themselves for thousands of years without change. Further, since the quantity of germ-plasma contained in the single germ-cell must be regarded as extremely small, and as only a minute fraction of this remains unchanged when the germ-cell becomes developed into the new individual, the growth of this fraction in the individual must be a most enormous one, as usually thousands of germ-cells are produced by it.

Since the germ-plasma can remain unchanged in molecular structure in spite of such vast increase in bulk, it is obvious that it is not easily to be modified, and it is probable that the direct influence of modifications in surrounding conditions on the germ-plasma has no effect of any importance on the production of hereditary individual variations. These must have another origin, and this, according to Weismann, is to be sought in the mode of reproduction occurring amongst most organisms at present existing—sexual, or as Haeckel terms it, amphigonic reproduction. This consists, as is well known, in the fusion of two antithetic germ-cells, or possibly nuclei only, which contain the germ-plasma, which in virtue of its peculiar molecular structure, is the bearer of the hereditable tendencies of the organism from which the germ-cell originates. Thus in amphigonic reproduction two different sets of hereditable tendencies are to a certain extent mingled with one another. It is this process of mingling which is the cause of the occurrence of hereditarily transmissible individual peculiarities, and it is the production of these peculiarities which it is the office of amphigonic reproduction to effect. Amphigonic reproduction supplies the material for the development of individual variation out of which selection produces new species.

This is a most startling conclusion, and directly opposed to almost all former views on the action of sexual reproduction. The amphigonic process has been regarded as having the effect of rapidly obliterating any deviations from the specific type which may arise in the members of a species. With regard to specific characteristics this may still hold true, since the deviations from them are of so rare occurrence that they are unable to hold their own against the great mass of normally-formed individuals. But it is otherwise in the case of the minute differences which are characteristic of the individual, because every individual possesses them, and each in a different manner. Here a compensation of the differences could occur only if the entire species were composed of but few individuals, but the number of individuals which constitute a species is in most cases practically unlimited, and thus an intercrossing of all of these with all the others with the result of the compensation of the individual differences is impossible.

The process of amphigonic reproduction is able to bring about what is absolutely essential to the working of selection as an all-powerful agent in development, namely, the summing up of the small individual differences it has to deal with in the direction of the result aimed at, and the production by this means of new characters. Such summing up of minute characters is impossible in the case of species with non-sexual reproduction. In the course of successive sexual generations the differences between the individuals of a species must continually increase, not as regards the greater differences, but as regards the constantly new combinations of individual peculiarities which are formed. Imagine a number of individuals of a species distinguished each from the others by a few hereditable peculiarities; in the next generation no single individual could be like the others, they must all be different. Further, not one of the progeny could be identical with one of their parents, since each has combined in it the hereditable tendencies of two parents, its organism being as it were a compromise between the developmental tendencies of both. In the third generation the hereditary tendencies of two individuals of the second generation are combined. But since the germ-plasma is no longer simple, but is already compounded of two individual kinds of germ-plasma, an individual of the third generation will represent a compromise between four different hereditable tendencies. In the fourth generation eight such tendencies must be combined; in the fifth, sixteen; in the sixth, thirty-two. Each of these tendencies may show its effect more or less marked in this or that part of the organism as it is developed, and thus in the sixth generation a number of the most different combinations of the individual peculiarities of the ancestors may be exhibited; combinations such as never before existed in the history of the species, and such as never can occur again.

The prepotency of the various kinds of idioplasma which compose the germ-plasma of the germ-cells of each individual must vary in intensity at various periods of its life. This must be assumed in order to account for the fact that the several children of the same parents are never exactly alike. The presence of the small individual peculiarities postulated as displayed in the hypothetical series of individuals of the first generation is accounted for as having arisen, not amongst the higher organisms, the Metazoa, but amongst their unicellular Protozoan ancestors. Amongst these there is no distinction between body-cells and germ-cells; their reproduction is by division, and in this case every modification of the body of the organism, every individual peculiarity, however produced during the course of life, must be directly transmitted to the offspring. Here parent and child are in a certain sense still one and the same being. The child is a portion of the parent, and commonly half the parent. The conditions are entirely different from those occurring in the sexual reproduction of the Metazoa, by which acquired peculiarities are not transmitted.

Hereditarily transmissible variation having arisen in the Protozoa by the direct action of external causes, was retained by the Metazoa when they became developed; and as amphigonic sexual reproduction arose at the same time, the variation became thereby enhanced and increased in complication, and preserved in ever-changing combinations.

In the theory of sexual reproduction put forward by Prof. W. K. Brooks, of Baltimore, in 1883,[1] there is a resemblance to the views here maintained, in that sexual reproduction in it also is regarded as the means which is employed by Nature to produce variations, but the mode in which the influence is supposed to act is entirely different in the two theories, Brooks attributing the main effects in variation to the inheritance of acquired peculiarities, and to what may be termed the "circulation of the germ-plasma." His theory is a modification of Darwin's "pangenesis." He assumes, like Darwin, that each cell of the body of higher organisms throws off minute gemmules, not always and under all conditions, but only when they encounter unusual circumstances of existence. Whenever the normal functions of any component cell of the body are disturbed, "it throws off small particles which are the germs or gemmules o this particular cell." These gemmules are, according to Brooks, capable of passing to all parts of the body, and may pass into an ovarian ovum or a bud, but the male germ-cell has a special attractive force for them, gathering them within itself and storing them up. It is one of the peculiar merits of the theory of the continuity of the protoplasm that it dispenses with all necessity for any hypothesis of a circulation of gemmules or germ-plasma, so complicated and difficult to understand as these hypotheses are. As soon as the inheritance of acquired peculiarities is denied, such hypotheses are not required. Brooks further differs widely from Weismann in ascribing to the two germ-cells concerned in impregnation a different *rôle* in the process, the egg-cell or conservative principle being supposed to be charged with comparatively few gemmules, the sperm-cell, or radical principle, with many. This view, that the male germ-cell has a different part to play during the construction of the embryo from the female germ-cell is considered by Weismann to be untenable, because it is in contradiction with the simple matter of observation that human children on the whole are able to inherit just as many characteristics from the mother as from the father.

Apparently, the only function of amphigonic reproduction is the production of a supply of hereditable individual peculiarities on which selection may work, and as the development of the whole higher organic world depends on these processes, the part which amphigony has to play in Nature is one of the most stupendous conceivable, and hence its wide, almost universal, distribution in the animal and vegetable kingdoms. Nevertheless, it is not in any way contended that amphigonic reproduction originally came into existence in order to render the production of species possible. The process must have been already present before it evoked the hereditable variability, and its first appearance must therefore have had another cause. This cannot at present be explained with any certainty, but the key to the problem lies in the conjugation of the Protozoa, the predecessor of amphigonic generation. The fusion of two unicellular individuals into one, the simplest form of conjugation, must have a direct and immediate action which is of advantage to the existence of the species concerned. The view taken by Hensen and E. Van Beneden and others, that conjugation, as well as sexual reproduction generally, effects a rejuvenescence of the organism, is discussed and rejected as unsatisfactory. "The entire conception of rejuvenescence has something indefinite and nebulous about it. The assumption of the necessity of a rejuvenescence of life, brilliant as it is, is scarcely to be reconciled with our other conceptions of the nature of life based on purely physical and mechanical forces. How can it be conceived that an infusorian which has at last by repeated division exhausted its power of reproduction can recover this power by fusion with another similarly effete infusorian? Twice nothing does not make one, and if it be assumed that each infusorian retains half its reproductive force, the two combined would result only in one whole, but this could hardly be termed rejuvenescence. It amounts only to an addition such as, under other conditions, would be produced by simple growth."

It is best to assume in the present state of knowledge that living matter is endowed with a power of unlimited assimilation and consequently unlimited capability of reproduction, and that the form of reproduction, whether sexual or asexual, of itself exercises no influence on the duration of the process. It has not been proved that reproduction by division can never take place indefinitely. The phenomenon of parthenogenesis is strongly against the hypothesis of rejuvenescence, for, if impregnation represents a rejuvenescence, and essentially consists in a combination of energies and materials which in virtue of their differences give rise to the development of reproductive force, it is difficult to understand how occasionally the same reproductive force can be produced by one of the two materials, only the egg-cell. The common assumption that in the case of parthenogenesis a single impregnation suffices for a whole series of generations has no grounds of support, and is at variance with the fact that the same egg which may develop parthenogenetically (in the queen bee) is also capable of fertilisation.

The primitive action and meaning of conjugation may at present be best provisionally defined as a strengthening of the forces of the organism in relation with reproduction, which occurs when, on account of external causes, such as atmosphere, temperature, and want of food, the growth of the single animal to the size necessary

[1] W. K. Brooks, "The Law of Heredity: a Study of the Cause of Variation and the Origin of Living Organisms" (Baltimore, 1883).

for reproduction is not possible. This cannot be regarded as equivalent to rejuvenescence, since rejuvenescence is a process necessary for the maintenance of reproduction, and ought to occur periodically entirely independently of external conditions, whilst according to the above view conjugation originally only presented itself under unfavourable conditions of life and helped the species to surmount them.

Amongst the higher Protozoa the original import of conjugation seems already to have dropped into the background, as shown in the change in the nature of the process itself. The higher Infusoria are only temporarily fused with one another in conjugation, and it appears possible, and even probable, that the process has here already attained the full significance of sexual reproduction, and is to be regarded as functional as a source of variability only.

Amphigonic reproduction, having existed through countless generations of Protozoa in the form of conjugation, passed over to the Metazoa, and, though its original physiological effect lost importance or retired altogether into the background, was preserved from extinction and firmly retained because of the immeasurable advantages which are conferred by it in endowing the species with the power of adapting itself to new conditions of existence. The formation of new species which was possible amongst the lower Protozoa even without amphigony, amongst the Metazoa and Metaphyta was to be attained only by that process.

Amphigony has been lost in certain cases, either partially, as in the case of some lower Crustacea amongst which parthenogenetic generations alternate with sexual, or entirely, as in the case of certain gall-insects and plant-lice amongst which parthenogenesis has become the only form of reproduction. Such restriction to parthenogenetic reproduction may act so as to secure the existence of a species for a time, but according to the views as to the origin of hereditary variability here maintained, such a species dependent on parthenogenesis alone for reproduction must be near its period of dying out, as unable to adapt itself to any new conditions of existence which may arise, since in the loss of amphigonic reproduction it has lost the capability of mingling and increasing the individual hereditable peculiarities which occur amongst its members.

This conclusion is supported by the fact that no whole groups or genera occur the species of which are entirely parthenogenetic in their reproduction.

The persistence of functionless organs in species which are reproduced parthenogenetically is a further corroboration of the general view as to the import of amphigonic reproduction here maintained. Since acquired peculiarities are not inherited, organs which fall out of use cannot become vestiges in a direct way, as has been hitherto assumed to be the case. The functionless organ becomes indeed weaker and less fully developed in the individual which does not use it, but this reduction in the organ is not transmitted to the offspring.

The explanation of the undoubted fact that such organs do become vestiges must be sought elsewhere. In order that any particular part of the body in any species may be maintained at the height of its functions, all individuals which possess this part in less completely perfect development must be excluded from participation in the act of reproduction by perishing in the struggle for existence. As soon, however, as an organ ceases to be useful, this uninterrupted selection of the individuals with the best organs for the purpose of reproduction ceases also, and a condition arises which the author terms "panmixia." Now not only the individuals with the best organs participate in reproduction, but also those with inferior ones. A mixture of all kinds of gradations in goodness and badness in the organ must be the inevitable result, and thus in the course of time a universal deterioration in the organ must be produced. The remarkable fact that the gradual disappearance of functionless organs is extremely slow appears much more in keeping with the above views as to the nature of the process than with those hitherto adopted. The effect of disease of an organ in the course of a single life is a very well marked one, and if it were transmissible even to a reduced extent direct to the offspring, the organ must become reduced to a minimum even in a hundred generations. Yet how many million generations must have elapsed since the whalebone whale abandoned the use of its teeth?

If this new view of the cause of the reduction of disused organs is assumed as correct, it follows that vestiges of organs can occur only amongst species with amphigonic reproduction, not amongst those with parthenogenetic reproduction only, and this appears to be the case. Superfluous organs do not become rudimentary in species parthenogenetically reproduced. As far as the author's investigations extend, the receptaculum seminis does not become aborted in such species, although it is entirely without function. Thus in Chermes, which is without males, the receptaculum seminis is present in the females unchanged; whilst, on the other hand, in Aphis, another plant-louse in which amphigonic reproduction is not extinct, but alternates regularly with parthenogenesis, the receptaculum seminis has become lost in the summer female.

These evidences in favour of the general views here expressed form, of course, no absolute proof of their correctness, but only give evidence in favour of their probability. Further evidence cannot be offered at present, the phenomena dealt with being extremely complicated and their explanation being such as can only be approached gradually.

The author, however, considers that he has plainly shown that the selection theory is by no means incompatible with the conception of the "continuity of the germ-plasma," and further, that as soon as this conception is accepted as correct sexual reproduction appears in an entirely new light, displays a reason for its existence, and becomes to a certain extent comprehensible. H. N. MOSELEY

N.B. A criticism of Prof. Weismann's above theories by Prof. von Kolliker appears in the *Zeitschrift für Wissenschaftliche Zoologie*, in the October part just issued.

## THE FUNCTION OF A UNIVERSITY[1]

I GRATEFULLY accept the honour with which I have been invested thus publicly, and with such kindly feeling. In the future, as in the past, I shall give you my best endeavours.

By a fortunate accident it has happened that I am not called upon to speak to you on behalf of the University of California before I know somewhat of it. The six months which have elapsed since I entered upon the duties of the high office which I now hold, I have utilised in studying with minute care the University in its main features and in some of its details. This is not the place nor the time to speak of minor matters. It is, however, the very place and the very time for me to say to this audience that no friend of the University has any cause to fear, so long as all of us, Regents, Professors, and students alike, remain united in the future, as we are at this present moment, in a single effort toward the same high ends.

For nearly a hundred years the American Republic lived, and grew, and prospered, and the community of nations hardly knew her, and barely gave her place. So, on a smaller scale, it has been in California. The University here has lived, and grown, and prospered, and the communities outside of our own small circle hardly know us, and grant us our place reluctantly. It is a perfectly safe prediction that within the next twenty years, possibly within the next ten, the State of California will find suddenly that here in her midst she has a force on which she never reckoned—a reserve on which she never counted.

It is easy to see what advantages would come if this conviction were now wide-spread and firmly held. It is easy to seek feverishly to make ourselves quickly known, in order that we may be more widely useful. But, I am more and more convinced that if we are always ready, like a strong man, our opportunity will be here almost before we realise it.

*Vital Points and Fundamental Principles.*—What, then, are the aims upon which our eyes must be ever fixed, and toward which our energies must be ever directed? I will not name them all, nor count them over one by one. But I think that I can point out certain vital points that must be guarded; certain principles that must be fundamental. Let us consider the demands which the community makes of the University, and again, the standards which the University should set for its individual members.

In the first place we must carefully examine what it is that we, as citizens, demand from the University. We must see to it that what we demand is consonant with what we ought to demand. If we find that we disagree with what seems to us to be the position of the University, ought we not in fairness to calmly inquire which of the two is right? Is there not at least a certain presumption that the efforts of a body of intelligent scholars cannot be all misdirected? The usual and careless way of meeting this question, even on the part of those who count

[1] Inaugural Address by President Holden at the University of California.

themselves firm friends of the University, is to pass over these differences of opinion lightly, and to lay them to the errors of the intelligent scholars themselves. "What does a college professor know about life?" we say; "he knows his speciality, his mathematics, his political economy, his physics. Let him keep to that and we are satisfied. But let us, who are engaged in the practical business of life, judge of life and its needs."

We, the faculties of the University, might admit this provisionally and for the sake of peace, and inside our web here at Berkeley go on spinning our theories and trusting to their truth for their commanding influence in the future of the State. We will do that most certainly, and if the theories are right they will prevail. If they are wrong we shall be brought to confusion.

*The University Useful and Practical.*—But we claim more than this. We claim that the University is one of the most useful, and in a high sense practical parts of the machinery of the State. It has a function as important, or more important than any other. It shares this function with the Church, and the voices of both are to be your guide. The chief and highest function of the University is to assert and perpetually prove to you that general principles—laws—govern man, society, nature, life, and to make unending war on the reign of temporary expedients.

Think how fundamental is this use of the University. Think in how many ways we accomplish it. In the lecture-room, in the laboratories, in the machine-shop, we bring the student face to face with history, with nature, with fixed qualities. In history, in philosophy, in politics, in physics, we see that definite causes produce their definite and inevitable results. In the laboratories we find that nature, candidly interrogated, gives unambiguous answers; that mathematical prediction,—the modern prophecy—is inevitably fulfilled in experiment. In the machine-shop we learn that the hard results in brass and iron will not lie, but that they point relentlessly to careless, shiftless errors, if they exist, or testify to faithful, honest, laborious work if it has been done.

*General Principles against Temporary Expedients.*—There is no day and there is no hour of the student's life that he is not brought face to face with results, and taught to see that these flow from principles of universal application. Just in so far as a teacher can bring forth this great truth is he a successful teacher. Just in so far as a graduate has learned it, is the work of the University priceless to him. Just in so far as our professors and our students alike go forth into society and proclaim and prove the unending reign of general principles and the utter folly of putting temporary expedients in their place, is the University of prime value and use to the State. There was never a period or a country in which the reign of fundamental law needed more constant assertion and more perpetual proof than in our own period and our own country. All our modern inventions which give quick locomotion and quick transmission of thought tend to exalt the temporary expedient and to debase the general principle. The merchant of old time sent his ships to the Indies with their orders for two years or more; the diplomatist in a foreign country was separated by weeks or months from instructions by the Foreign Office. Now it requires but an hour to reach the uttermost parts of the earth. We have cable despatches which recount the doings of the King of Dahomey. The merchant changes his orders in Bombay as he reads the morning paper; the Secretary of State arranges the affairs of Tuesday on the afternoon of Monday.

The immediate and harmless effect of all this is to paralyse continuous effort based on sound belief, and to substitute a wavering policy of daily temporising. But the living danger is that society may come to permanently distrust the reign of laws. Recollect that we have to train our young men to appreciate this vital truth in the midst of a society where there are apparently many glaring exceptions to the rule; in a society where wealth has come, it seems by accident, and where power seems not to have been gained by work. And when you remember this, remember also how deep and profound your gratitude should be to any institution which is by its traditions and its very nature devoted to the incessant announcement and to the perpetual proof of the fundamental truth of all life here and hereafter, namely, that it is governed by unchanging principles which cannot be evaded nor shirked, and that a national or a personal life built on the expedients of the day, like a house built on the sand, will inevitably come to ruin. When this truth is grasped and firmly builded into the character, then it is that the steam-engine and the telegraph and all the myriad inventions of the day first become truly useful. The man who can command them aright has his powers doubled and trebled. It is the highest use of the University to train such men.

*President Gilman's Test of a University.*—You must not for one moment forget that the power of a university lies in its *men*. In its governors, its professors, and in its students. If you come here to our beautiful grounds and see them fair as they are to-day and always, if you see fine buildings and many of them, if you find our laboratories stocked with costly apparatus and our libraries with splendid books, you must not for that reason suppose you have a university fitted to the needs of the State. You are to inquire about far other things. And it is of prime importance that every citizen should know exactly what questions to ask. Nowhere have these questions been more eloquently or more pregnantly put than in a splendid address recently delivered by our former President, Dr. Gilman, at the noble University over which he now presides: "Remembering that a university is the best organisation for the liberal education of individuals and the best organisation for the advancement of science, apply the double test—what is done for personal instruction, and what is done for the promotion of knowledge?—and you will be able to judge any institution which assumes this name.

"Ask, first, is it a place of sound education? Are the youth who are trained within its walls honest lovers of the truth? Are they learned, are they ready, are they trustworthy? When they leave the academic classes do they soon find a demand for their services? Do they rise in professional life? Are they sought for as teachers? Do they show aptitude for mercantile, administrative, or editorial life? Do they acquit themselves with credit in the public service? Do the books they write find publishers? Do they win repute among those who have added to the sum of human knowledge? Have they the power of enjoying literature, music, art? Can they apply the lessons of history to the problems of our day? Are they always eager to enlarge their knowledge? Do they become *conservative* members of society, seeking for progress by steady improvements rather than by the powers of destruction and death? Are they useful, courteous, co-operative citizens in all the relations of life? Do the charities, the churches, the schools, the public affairs of the community receive their constant consideration? Are there frequent manifestations among them of unusual ability in science, in literature, in oratory, in administration? As the roll of the alumni increases, and the graduates are counted by hundreds and not by scores, does it appear that a large proportion are men of honourable, faithful, learned, and public-spirited character? These are the questions by which, as the years go on, a university is to be tested; or, to sum up all questions in one, Is it proved to be a place for the development of manliness?"

It is to be noticed that the stress is laid upon one chief thing—manliness—and that two main questions are to be asked. What does the University do for personal instruction? and what does it do for the promotion of knowledge?

The answers to these questions will depend in every case upon the men whom the University has chosen as its teachers. It will depend not only on their intellectual attainments, but upon their personal characters. It is a most fortunate thing that the following out of a life of true devotion to learning brings, in so vast a majority of cases, the excellences and beauties of character which we desire and look for. We can all point to eminent examples of this in our midst—and it is so everywhere. We should see in a true University the true spirit of research kept alive and eagerly active. How can you teach a young and ardent mind by means of examples culled from books alone? The vast panorama of nature lies before us, glorious by day, resplendent by night, and it is only from the actual pursuit of knowledge at first hand from nature itself that true teaching power is to be derived. Mere information can be gained from books and libraries. True knowledge must be attained by studies that develop mind and character at once.

*The Genuine Issues of Life.*—How, then, are we, the faculties of this University, to send forth from our midst men and women who are genuine, true, high, noble, sincere, simple? Men and women whose natures are such, and whose training has developed, harmonised and rounded out their natures? We must be constantly on the watch to put the genuine issues of life before ourselves and before our pupils. We are constantly tempted to put the name for the thing. How hard it is to avoid this even in our personal conduct, and how doubly hard it is in our public acts to point always to the essence, and not to indicate the accidents. We, all of us, suffer from the complexity of modern life which presents masses of detail, demanding attention, and distracting our imaginations with what seems to be but "a multitude of single instances." We lose the thread of logic and law and only grasp the tangled skein of various issues. We are prone to class quickly a man, an action, a belief, and have done with it and him. It seems to save our time. In reality it dissipates and degrades our life. Let us take a familiar example. We meet a man for the first time. Our friend classifies him for us. He is introduced to us as a man of affairs, a physician, or a lawyer. We accept the crude classification based on what he *does*, and we forget the divine possibilities of what he *is* or may be. We indolently accept a commercial classification and omit the reckoning with all the unknown possibilities within a human being. We do him an injustice, and we go on to dull our own minds and souls by repeated iterations of this stupid act until we become puppets meeting our like and not men meeting with our fellow-men. It is a lazy and a shiftless way, and unworthy of all of us. It inevitably dulls the mind by putting a word before a thought, a phrase before a principle, and this process ceaselessly repeated gradually eliminates all thought, and living men become mere dead automata in each other's eyes. Hardly any man is so dull that there are not possibilities unknown to you within him. To classify him at a glance and by a phrase is to deny the divine spark in him and a perceptive sense in your own heart. It is true that the higher a man's profession is the nearer should his life approach to the type signified by the name of that profession. It is safer to think you know somewhat of a poet when you hear that he is such than to predict the quality of a physician from his degree of doctor.

*Complete Human Beings.*—The University has no higher ideal than to train its students so that their practice may agree with their professions. But their complete professions are by no means signified by the formal degrees with which we invest them.

We grant the degree of A.B. to successful candidates. But A.B. does not really stand for what we have tried to teach. What we wish to teach our students and ourselves is to be complete human beings. Nothing *less* than this. There *can* be nothing more. We wish them to be H.B.'s first—human beings—and A.B.'s afterwards. Let any one of us try to see what is meant by a deserved title such as this. What *is* a human being complete in every way? Is there a manly virtue, is there a feminine grace, is there a divine aspiration which we can conceive to be lacking to such a personality? How carelessly we use the phrase, and with what debased significance! Is the man who has sacrificed his very nature to the service of money deserving of the title? Is it any better if power be the thing he has sold his birthright for? or vanity? or pleasure? or fame?

The moment we reflect upon the inner senses and upon the connoted meaning of the word, we see how we have debased it. We are used to lift a beggar from the ditch and to say with a pity that is half repulsion—at least he is a human being. But when we reflect we see that we can give no higher praise than this to the men who are the chiefest glories of the race. Think of David, King of Israel. How can we praise him, appreciate him, feel his power over us at this day, better than to recognise that he was a complete being human in every part? That is allied directly with Divinity. St. Peter, Socrates, the great Emperor Marcus Aurelius—these touch us through a chord of complete unison of their human natures with ours. What is it that is common to the great Alfred of England and to the poet who sang the beauties of the daisy overturned by the plough? What but this human nature that embraces our own and harmonises with its every part?

In America, young as we are, we have had our complete human beings. We can point to the oration at Gettysberg and know that the man who wrote it did so out of the fulness of a complete human nature. The soldier whose forces were overcome on that fearful field will live in history by his martial deeds, but he will be cherished in our hearts for the rounded symmetry of his humanity. In fiction we have all given this high degree. Where can we find more perfect examples than Col. Newcome or Henry Esmond? Is it not worth reflection to see *why* it is that these stand for us as types of what a man can become?

I think we can conceive of what our ideal of a human being should be by seeking to find the common quality of men so removed from each other in character and circumstance as King David, Peter the Apostle, Socrates, Alfred, Burns, Lincoln, Lee. The great Marcus has even defined such a man for us in formal words: he is "a man who delays not to be among the best, like a priest and minister of the gods; who uses the deity planted within him, which makes him uncontaminated by pleasure, unharmed by pain, untouched by insult, a fighter in the noblest fight, not overpowered by any passion, deep-dyed with justice, and accepting with his soul all that happens and is his portion."

It must be our aim and end to fix clearly in the mind of every pupil that the whole object of his college course should be one and the same as the whole object of his entire life, namely, to be a real human being. Not to strive for partial knowledge, for partial facts as an end, and finally to be graduated a Bachelor of Arts, but to strive for complete and utter manhood and to add to its magnificent qualities all the learning which our schools afford simply as a help towards carrying out his inmost and his highest aspirations. Each one of us should be ever striving to deserve among our fellows and in our most secret life this chief of all titles. The one that expresses the sum of all achievement possible to us; since when it is attained it fixes us as wholly human, and thus made in the image of divinity. The best title of our Master was the Son of Man, and He descended to this to show the term to which we might attain.

*A Word to the Graduates.*—And now, members of the graduating class, I wish to say one parting word especially to you, who are soon to see the formal signs of the approval of your professors and of our governors—the Regents.

In the name of the University I welcome you to your new estate. If we have done our duty by you, you are equipped for the beginning of your maturer life. If you do your duty by yourselves and by society there is nothing which you need fear to undertake. Here, on the very borders of the most western sea, in a golden land of promise, let me repeat to you the noble words which were first written down eighteen hundred years ago, in the midst of a savage wilderness, in the presence of hostile barbarians, by the hand of the greatest and most virtuous of the rulers of imperial Rome, sitting alone and silent in his soldier's tent. Let these great sentences be at once our farewell and our God-speed to each one of you:—

"If thou workest at that which is before thee, following right, reason calmly, vigorously, allowing nothing to distract thee, but keeping thy divine part pure, although bound to give it back immediately—if thou holdest to this, expecting nothing and fearing nothing, with heroic truth in every word and sound which thou utterest, then thou wilt live happy—and there is no man able to prevent thee."

## *ANTARCTIC EXPLORATION*[1]

THE author began by referring to the results established by Gauss in 1839. Gauss proved: "(1) That the knowledge of Y (the west component of the horizontal component of terrestrial magnetism, called usually X) over the whole earth, along with the knowledge of H (the north component of H) at all points on a line running from one pole to the other, is sufficient for the foundation of a *complete* theory of the magnetism of the earth. (2) That a finally complete theory was also deducible from the simple knowledge of Z (the component of the earth's magnetism, that is directed to the earth's centre) on the whole earth's surface." There existed, for a large part of the earth's surface, data for large charts of the normal values of the declination of H and of Z, at the epoch 1880, from which X, Y, and Z could readily be deduced. These charts were accurate for the zone lying between 60° N. and 50° S. lat. (except for some parts of North Asia and of Central Africa); they were less accurate for 60° to 70° N. lat., and 50° to 60° S. Beyond these limits in the south, lay regions almost unvisited since Ross's Expedition in 1840-43; so that the charts were correspondingly weak in those latitudes. The charts show that the *Challenger* crossed the Antarctic Circle about the meridian 79° E. These and other somewhat recent observations made between 50° and 60° S. lat., show that considerable changes in the magnetic elements have occurred since Ross's time, and therefore the charts for 1880 cannot be com-

[1] "On the Advantages to the Science of Terrestrial Magnetism to be obtained from an Expedition to the Region within the Antarctic Circle." Abstract of a paper read at the Birmingham meeting of the British Association by Capt. Ettrick W. Creak, R.N., F.R.S.

pleted, especially as our knowledge of the changes is too limited to permit of the use of Ross's observations. Further it is desirable to have actual verification of Gauss's extension by theory of the magnetic elements at places where they are known to places where they are unknown. The position of the south magnetic pole is still undetermined, and magnetic observations are wanted from 40° S. to the geographical pole. For the carrying out of these views, Melbourne Observatory, being furnished with the necessary instruments, would serve admirably as a base station, with subsidiary bases at the Cape, and at Sandy Point, Magellan Strait, for the use of portable absolute instruments. Much of the survey could be done on board ship at sea, observations having now become so trustworthy by the process of "swinging ship." Portable instruments could also be used on *ice*, where their readings would be specially free from sources of error. The great effect of the ship's iron in high latitudes can be got rid of by experience, as proved in the voyage of the *Challenger*, an important matter being a proper position on board far the instruments. This position could be chosen immediately after the selection of the ship. The error in the vertical component varies with the "heel" of the ship; the horizontal error can be eliminated by the process of "swinging."

## *NOTES FROM THE OTAGO UNIVERSITY MUSEUM*

### VIII.—*On the Claspers of Callorhynchus*

IN my friend Mr. Patrick Geddes' able article, "Reproduction," published in the recently issued twentieth volume of the "Encyclopædia Britannica" (ninth edition), the following note occurs (p. 410):—

"In the curious Holocephalous fish, *Callorhynchus*, Jeffery Parker has recently adduced arguments for regarding the claspers as the surviving rudiments of a third pair of limbs."

As this passage was written under the mistaken impression that a somewhat wild theory, hither only communicated privately to one or two friends, had been published, I think it will be advisable to state exactly the grounds on which I am disposed, provisionally, to consider the Holocephali as the only existing hexapodous vertebrates.

In the Elasmobranchii (Plagiostomi) the male is well known to possess a single pair of so-called claspers, each having the form of a plate rolled longitudinally upon itself so as to produce an incomplete tube, and supported by a more or less complicated cartilaginous skeleton continuous with the basipterygial cartilages of the pelvic fin.

In *Callorhynchus*, on the other hand—and I believe the same applies to *Chimæra*, of which I have no specimen—the male has two pairs of organs, which may be called respectively the anterior and the posterior claspers. The posterior claspers are evidently homologous with the claspers of the Elasmobranchs: they occur in the same position, have the form of a plate rolled longitudinally into a tube, and are supported by a prolongation of the basipterygium. No doubt, like the corresponding organs in sharks and rays, they have an intromittent function.

The structures I call anterior claspers are situated a short distance cephalad of the vent, inclosed, in the position of repose, in a pouch of skin having a somewhat contracted slit-like aperture, so that the clasper is ordinarily hidden from view. The aperture of the sac is erroneously marked "peritoneal aperture" in Günther's figure of *Chimæra colliei* ("Study of Fishes," p. 184). In connection with the sac is a gland secreting a lubricating fluid, and closely resembling the well-known gland of the Elasmobranch clasper.

In the female, although the clasper itself is absent, a small glandular sac occurs in the corresponding position.

The anterior clasper itself is a somewhat complicated organ, consisting of three chief parts supported by cartilage. The largest of these, which forms the main support of the whole structure, is a strong irregular cartilaginous plate, articulated by an elongated surface with the anterior border of the pubic portion of the pelvic girdle in such a way that when in its ordinary position of retraction, the whole apparatus is folded back in the hollow furnished by the outer surface of the pubic cartilage. To this principal cartilage of the anterior clasper are attached two others: one a thin delicate plate, shaped like the human external ear, the use of which is not obvious; the other a somewhat thicker plate, rolled upon itself to form a tube, in much the same way as the posterior clasper, and evidently serving as a duct for the passage of the above-mentioned secretion. The whole apparatus is covered with soft mucous membrane, except the free portion of the principal cartilage which is studded with minute sharp denticles

The clasper is exserted by the action of a strong muscle arising from the inner face of the pubic cartilage and passing over its anterior border to be inserted into the principal cartilage of the clasper. The plane of movement of the organ is nearly horizontal.

That a serial homology (homoplasy) exists between the anterior and the posterior claspers is suggested by the following facts:—(*a*) The general similarity of their structure; (*b*) they both articulate, mediately or immediately, with the pelvic cartilage; (*c*) they both lie in the line of Balfour's lateral ridge, *i.e.* of the hypothetical lateral fin; (*d*) the blood from both appears to be poured into a vein which is clearly the representative of the lateral vein of Elasmobranchii, which latter I have adduced reasons for considering as the vein of the proto-vertebrate lateral fin (*Trans. N.Z.Inst.*, vol. xiii. p. 413, and vol. xv. p. 222; *Proc. Roy. Soc.*, June 1886).

I regret that all my efforts to obtain earlier embryos of *Callorhynchus* than those I described three years ago in NATURE (vol. xxix. p. 46) have failed. It must therefore remain for future investigations to decide whether the anterior clasper of Holocephali is developed from a portion of the lateral ridge which usually atrophies, and whether its skeleton is formed by the concrescence of pterygiophores (radial fin-cartilages).

At present, therefore, the hypothesis that the anterior claspers of the Holocephali represent a middle pair of limbs is nothing more than a deduction from an unproved theory. I should not have ventured to publish it without further evidence if my friend had not, quite inadvertently, forced my hand.

Dunedin, N.Z., August 16 T. JEFFERY PARKER

## *SOCIETIES AND ACADEMIES*

### SYDNEY

**Linnean Society of New South Wales**, July 28.—Prof. W. J. Stephens, M.A., F.G.S., President, in the chair.—The following papers were read:—On some new or rare fishes from the Australian region, by E. P. Ramsay, F.R.S.E., and J. Douglas-Ogilby. A few notes are given on the curious Blennoid genus *Xiphasia* of Swainson, and a description is given of a species—*Xiphasia setifer*, Swainson—now for the first time taken in Australian waters. *Arrhamphus sclerolepis* and *Gastrotokeus biaculeatus* are recorded as fishes not previously seen on the New South Wales coast.—Catalogue of the Australian Coleoptera, part 5, by George Masters. The present part contains the large family of the Curculionidæ, numbering over 1200 species, and bringing the total number now catalogued up to 5625. It was stated that probably two more parts would complete the order Coleoptera.—Miscellanea Entomologica, No. 2: the genus *Liparetrus*, by William Macleay, F.L.S. This is a complete monograph of the genus *Liparetrus*. All the old species are redescribed, many new ones added, and the genus is subdivided into several sections and sub-sections. Altogether about 100 species are characterised.—Revision of the Australian Lepidoptera, No. 1, by E. Meyrick, B.A., F.E.S. Five families of the Macro-Lepidoptera, or Lesiadæ, Arctiadæ, Hypsidæ, Syntomididæ, and Zygænidæ, are monographed, numbering about 150 species, about half that number being new to science.—Notes on synonymy of Australian Micro-Lepidoptera, by E. Meyrick, B.A., F.E.S. The synonymy of fifteen species of Micro-Lepidoptera is corrected, from an examination of specimens in the British Museum.

### PARIS

**Academy of Sciences**, October 18.—M. Jurien de la Gravière, President, in the chair.—A theory of the unequal flow of gases, by M. Haton de la Goupillière. Although geometricians have already solved a few questions relating to the unequal movement of fluids, no general theory appears to have yet been applied to the subject so far as regards the gases. The object of the present paper is to make good this want, and to present a complete solution of the problem in connection with the receptacles of compressed air for locomotives or tramways filled from reservoirs maintained by the compressing engines at a constant tension.—Researches on the tension of the dry bicarbonate of ammonia, by MM. Berthelot and André. The authors here discuss the important and complex problem, whether the tension of ammonia in the air, the ground, and natural waters, and its movements between these various mediums, is to be assimilated to the tension of this free alkali dissolved in pure water and to its diffusion between an inert atmosphere and purely aqueous solutions. Numerous experiments here described show that the function of the three constituents of sal ammoniac is not the same in its dissociation, the carbonic and ammoniac gases, even in great excess, possessing no perceptible influence on the tension of the bicarbonate at the ordinary temperature, while liquid water determines its decomposition independently of the laws of dissociation of the salt.—On the origin of the motor nerves in the palate of the dog, by M. Vulpian. His experiments on the origin of the secreting nerves of the salivary glands and of the chord of the tympanum have led the author to the study of this subject, his conclusions mainly confirming the results already obtained by M. Chauveau, who operated on the horse and the ass.—Experimental researches on the cause of *rigor mortis*, by M. Brown-Séquard. In continuation of his previous paper (see last week's NATURE, p. 612), the author describes certain experiments, which seem to show that this phenomenon mainly depends on a contraction, that is, a muscular vital act beginning or continuing after the general extinction of life. At the same time it is not denied that a coagulation of the albuminous substances may also to some extent contribute to the rigidity which sets in immediately after death.—The mountain plants of the Parisian flora, by M. Chatin. It is shown that associated with the ordinary vegetation of the Paris district are found numerous highland and even Alpine specimens, such as *Swertia perennis*, *Atropa Belladonna*, *Euphrasia lutea*, *Digitalis lutea*, *Veronica montana*, &c., most of which are largely represented in the Alps and Scandinavia, and some few in the south of France. They generally flourish in localities where the conditions of life approach nearest to those presented by the Alps; but whether they are due to migration from those regions or are indigenous is a question reserved for future discussion.—Analysis of some cosmic dust which fell on the Cordilleras near San Fernando, Chili, by M. A. E. Nordenskjöld. This specimen, received last February from M. Stolp, of San Fernando, and weighing about 2 grammes, yielded on analysis: oxide of iron 74·59, oxide of nickel 6·01, silicic acid 7·57, magnesia 3·88, alumina 2·90, and minute quantities of lime, phosphoric and sulphuric acid, with traces of oxide of copper. This analysis shows that it is not a product of the Krakatão eruption, but comes for the most part from the inter-planetary spaces.—On surfaces inclosing cones of the second degree, by M. E. Blutel. The case is considered in which each cone touches its inclosure following a moving circle.—On the determination of the coefficients of expansion by means of the pendulum, by M. Ch. Ed. Guillaume. It is shown that this method, recently proposed by M. Robert Weber, cannot possibly yield the accurate determinations anticipated by him. All the apparatus needed for its application render the process extremely complicated, while under the most favourable conditions its precision will never exceed 1/300.—Theoretical value of the local attraction at Nice, by M. Hatt. Theoretic researches undertaken for the purpose of determining this value have led to the results here communicated, including some data tending to correct the geodetic latitude of Nice.—On some pyridic bases, by M. A. Ladenburg. Having two years ago determined the methods of synthesis for the pyridic and piperidic bases, the author has since succeeded, with the aid of MM. Roth, Lange, and Hesekiel, in preparing a whole series of these bases, which are here described.—Researches on the evolution of the embryo of the fowl, when the eggs are submitted to incubation in the vertical position, by M. M. Dareste. Of sixteen eggs treated in this way, only one was successfully hatched, all the other embryos perishing at various dates and under diverse conditions.—On the relations of the Leptocephalidæ to the conger-eel, by M. Yves Delage. Observations recently made at the Laboratory of Roscoff show that the Leptocephals, contrary to the opinion of Günther, are normal larvæ capable of transformation.—Contribution to the study of the Tertiary flora of the west of France and of Dalmatia, by M. Louis Crié. It results from this comparative study that five identical species and seven or eight closely-related types connect in a common palæophytic epoch the Tertiary districts of Mans and Angers in France with that of Monte Promina in Dalmatia.—On the discovery of a grave dating from the polished Stone Age, recently discovered near Crécy-sur-Morin, by M. A. Thieullen. The excavations carried out at this spot revealed two contiguous chambers built under a rock, and containing the skeletons of about thirty human beings of all ages and sexes, besides stone hatchets, knives, scrapers, and other relics of the Neolithic period, but no traces of pottery or the metals. The human remains are remarkably well preserved, five or six of the skulls being almost intact, and by their form apparently indicating the presence of two distinct prehistoric races.—On a meteorite found in a block of Tertiary lignite from Wolfsegg, by M. Gurlt, with remarks by M. Daubrée. This rare specimen of a meteorite, traced to Tertiary times, forms a mass of cosmic iron combined with some carbon and nickel, weighing altogether 785 grammes.—On the constant presence of micro organisms in the thermal waters of Luchon (64° C.), and on their action on the production of baregine, by MM. A. Certes and Garrigou. The object of this paper is to determine the presence of living organisms in thermal waters of the highest temperatures, to ascertain their nature and the part played by them in the production of the baregine or glairine commonly found in sulphurous waters.—On melanosis, a disease of the vine, by MM. Pierre Viala and L. Ravaz. This is described as a malady of American origin, not very injurious to French vineyards, and due probably to a parasitic fungus identical with the *Septoria ampelina* described by Berkeley and Curtis.

## BOOKS AND PAMPHLETS RECEIVED

"The Functions of the Brain," new edition, by Dr. D. Ferrier (Smith, Elder, and Co.)—"Journal of Royal Microscopical Society," October (Williams and Norgate).—"Experimental Chemistry," new edition, by C. W. Heaton (Bell and Sons).—"Origin of Languages," by H. Hale (Cambridge, Mass.).—"Concerning Force, Impulsion, and Energy," by J. O'Toole (Hodges, Dublin).—"On the Temperature and the Rainfall of the Croydon District, 1881-85," by H. S. Eaton.—"The Mechanism of Nature," by A. M. Stapley (Cornish, Manchester).—"Bibliotheca Historico-Naturalis et Mathematica: Lager Catalog" (Friedländer, Berlin).—"Notes from the Leyden Museum," vol. viii., No. 4, October, by Dr. F. A. Jentink (Brill, Leyden).—"Natural History," by Dr. H. A. Nicholson (Chambers).—"Diseases of Tropical Climates," by Dr. W. C. Maclean (Macmillan).—"Proceedings of the Royal Society of Edinburgh," Session 1885-86, No. 121.—"Carte Géologique Générale de la Russie d'Europe," Feuille 139.—"Bulletins du Comité Géologique St. Pétersbourg," Nos. 7 and 8, 1886.

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