THURSDAY, OCTOBER 24, 1907.

## WAY-SIDE FRUITS.

*Wild Fruits of the Country-side.* By F. Edward Hulme. Pp. x+221; illustrated. (London: Hutchinson and Co., 1907.) Price 5*s.* net.

THE subject of this book is one that may be most conveniently studied in the autumn season, when so many trees are in a fruiting condition. Mr. Hulme has written 212 pages, which are illustrated with thirty-six full-page coloured drawings, prepared by the author, and twenty-five half-tone pictures, which are reproductions from photographs. There are three chapters, and the species of plants are grouped into these chapters as follows:—Chapter i., plants of the hedgerows; chapter ii., trees of the forest; and chapter iii., plants of the moorland, the meadow and the stream.

The notes vary in length according to the estimated importance and interest of the species, and the text is largely composed of quotations from the old writers on the folk-lore of the species, and medicinal uses to which parts of the plants have been applied. The author attempts to trace in most cases the derivation of the names, and, in addition, supplies brief descriptions of the structure of the flowers and fruits. We have nothing but praise for the coloured plates, which in all instances appear sufficiently faithful to nature to enable the novice to identify the fruits, notwithstanding the drawings lack such botanical details as can only be shown after dissection of the fruits, and illustration of the sections. Those representing the common spindle tree (*Euonymus europaeus*), hawthorn (*Crataegus oxyacantha*), sweet briar (*Rosa rubiginosa*), and oak (*Quercus Robur*) are especially commendable.

Having said so much as to the merits of the book, we cannot be silent in respect to its defects. The text has evidently been written hurriedly, and the composition needed more careful revision than has been exercised. The following sentence, for instance, is not more ambiguous than many others that might be selected from each chapter. On p. 13, in respect to the privet (*Ligustrum vulgare*) the author writes:—

"After these somewhat offensive or altogether delightful flowers succeed the berries, and these, if unmolested by the blackbirds, thrushes, bullfinches, and other birds to whom they are acceptable, remain on the plant throughout the winter."

The punctuation is reproduced faithfully. Or, as on p. 203:—

"Large tracts have, however, of late years been ploughed up, a proceeding little to the benefit of anyone, and, so far as it goes, destructive of a wild beauty that might well have been suffered to remain, and which we, Staffordshire-born, can only regret the loss"!

On p. 14, in a sentence which refers to the privet, the word *generic* has been made to read *genuine*. On p. 52 the yew (*Taxus baccata*) is referred to as "a genuine ancient Briton," but on p. 57 it is also described as "a welcome and sturdy guest," which is surely suggestive of an exotic species rather than "an ancient Briton."

The use that is made of capital letters is altogether inconsistent. In the headings all the specific names commence with capitals, a practice which is indefensible when applied to botanical nomenclature, yet on p. 181 *Viscum cruciatum*, when printed in the text, has no capitals, not even one for the generic name.

We can see no reason for the author adopting the out-of-date name *Sarothamnus* for the common broom, the correct name for which is Cytisus. The plant should be invariably described as *Cytisus scoparius*. The list of illustrations at the commencement of the book has probably escaped the author's revision after the type was set. This would explain the generic word Rubus being misspelt Robus in three instances, and scoparius misspelt scaparius.

The subject of this work is an extremely interesting one, and notwithstanding the imperfections we have mentioned, the book may be recommended to those who are about to spend a holiday in a country district, or to students in schools, but especially to those who desire to acquire some knowledge of the folk-lore connected with some of the commonest fruiting plants in our native flora.

## COSMOLOGICAL SPECULATION.

*Two New Worlds.* (1) The Infra-World; (2) The Supra-World. By E. E. Fournier d'Albe. Pp. ix+157. (London: Longmans and Co., 1907.) Price 3*s.* 6*d.* net.

THE first part of this book is an elaboration of an analogy already familiar to the scientific public. The Infra-world is a universe in which an earthly atom is a solar system: the positive atom is its sun, the electrons are its planets. The author points out that the scale of distances in our own and the infra-world is approximately in the ratio $10^{22}:1$, this being the ratio of the average diameters of our solar system and an atom. Further, the infra-year, measured by the period of revolution of an electron about its positive atom, is, for a particular case, reduced by the same factor. In this coincidence Mr. Fournier finds justification for regarding the world of atoms as a veritable universe on a smaller scale.

The detailed account of the Infra-world which is presented in the first six chapters, though interesting in itself, is perhaps to be regarded mainly as preparing the way for the conception of a Supra-world, in which our solar system functions as an atom. It is not possible here to discuss the reasoning by which the author seeks to establish the existence of ultra-galactic universes; the arguments he employs are simple and reasonable, and will appeal strongly to the reader who is willing to be guided by probability in a region where logical certainty is at present unattainable. It is sufficient here to remark that the author's presentation of the Supra-world is based on the assumptions:—

"(1) That the material universe is infinite in three-dimensional space, and eternal both in the past and the future.

"(2) That the law of gravitation holds good throughout infinite space and time.

"(3) That the luminiferous ether has the same properties throughout space."

The Infra-world, our own universe, and the Supra-world are represented as three links in a chain of indefinite extent.

We learn from the preface that this book contains "an attempt to penetrate the mystery of space and time with the help of the most modern resources of scientific research." Mr. Fournier's success in achieving this object must depend upon what is required of one who penetrates a mystery. Certainly, the relativity of space and time could scarcely be more clearly and forcibly brought home than is done in these pages.

The limits of this notice do not permit a discussion of the author's speculations regarding the interrelation of "personality" in universes of different orders. The chief value of this work undoubtedly consists in the point of view which is here presented—a point of view which is valid for anyone who accepts the author's proof of the existence of universes of the next lower and higher orders to our own, whether he prefer to interpret conscious or subconscious activity in terms of motion, or matter in terms of consciousness.

Though necessarily incapable of verification, these speculations, which are well and clearly expressed, will hardly fail to evoke something more than a passing interest.

F. L. USHER.

## CHEMICAL METHODS IN MEDICINE.

*The Chemical Investigation of Gastric and Intestinal Diseases by the Aid of Test Meals.* By Dr. Vaughan Harley and Dr. Francis W. Goodbody. Pp. viii+261. (London: Edward Arnold, 1906.) Price 8*s.* 6*d.* net.

THE continual increase in our knowledge of the physical mechanisms of the body necessitates a corresponding increase in the complexity of the methods which the physician has to employ in his endeavour to locate the seat of disease and to determine its character. Every year the medical man has therefore to start his career with expert knowledge of instruments and methods that were not dreamed of by his predecessors, and every year the extent of his armamentarium is added to by the growth of our knowledge of diseases. Many of these methods which the present-day practitioner has to acquire are physical, such as the use of the thermometer, of the stethoscope, the ophthalmoscope, and the various other instruments which have been devised for throwing light into the cavities of the body.

Until recently his chemical methods were practically limited to the testing of the urine for sugar and for coagulable protein. Disorders of digestion were, and in many cases still are, treated purely empirically. Yet it cannot be a matter of indifference whether any given derangement of digestion has its primary seat in the stomach, the bowel, or the nervous system, whether it is accompanied with increase or diminution of the acid secretion of the stomach, or whether it is attended by an absolute failure on the part of the alimentary canal to assimilate in proper proportion to the food which is presented to it. It is of no use to label a series of drugs as good for indigestion, to administer them one after another, in default of knowledge on such important points as these. It is to aid the practitioner in his investigation of gastric and intestinal diseases by the latest methods that this book has been written.

Prof. Harley and Dr. Goodbody confine themselves entirely to the chemical methods, and even here are eclectic in treatment, mentioning only the methods which they have found during twelve years' trial of practical value.

It is to be hoped that the publication of this book may help to render more general the application of science to practice in the treatment of this important class of disease, since the book contains records of a number of analyses made by the authors on different patients, which furnish a useful guide to the results which may be expected in practice.

It is impossible to avoid the impression that the increased technical knowledge required for the diagnosis and treatment of disease must tend more and more to specialism along certain lines, and must handicap the private patient as compared with his poorer brother who is treated in a hospital. Without the resources of skilled assistance and a well-equipped laboratory, it is impossible for a busy practitioner to make all the investigations which are necessary to determine the diagnosis and to control the treatment of a number of cases of diseases. It is possible that in future years every consulting physician will regard a hospital for observation, and a private laboratory with skilled assistants, as necessary adjuncts to his consulting-room. At the present time, if the disease be one of doubt or difficulty, the pauper in the hospital has a better chance of enjoying the benefit of the latest discoveries than has the private patient.

We have no doubt that practitioners, whose time is not already entirely absorbed by the round of visits, will find this book of considerable value. It will not have failed of its object if it teaches such men to carry out a proper investigation of the gastric contents in cases of disordered digestion instead of simply guessing at the causation of the disorder. In one or two places the authors are hardly explicit enough for the purposes of those men who are working out the methods by themselves. Thus, on p. 31, no idea is given of what the colour-changes on titration of the gastric juice consist when dimethyl-amido-azo-benzol is used as an indicator, nor is the rationale of Töpfer's method for determining the acidity of gastric juice made sufficiently clear. These and a few other slight drawbacks can easily be amended in a subsequent edition.

## WILD LIFE AND ADVENTURE.

*Wild Life in Australia.* By W. H. D. le Souëf. Pp. xv+439; illustrated. (Christchurch: Whitcombe and Tombs, Ltd.) Price 7*s.* 6*d.* net.

*The Life-Story of a Squirrel.* By T. C. Bridges. Pp. vii+230; illustrated. (London: A. and C. Black, 1907.) Price 6*s.*

*Adventures in the Great Forests.* By H. W. G. Hyrst. Pp. 330; illustrated. (London: Seeley and Co., Ltd., 1908.) Price 5*s.*

*Heroes of Pioneering.* By E. Sanderson. Pp. 352; illustrated. (London: Seeley and Co., Ltd., 1908.) Price 5*s.*

IN re-publishing, with considerable additions, the series of natural history articles which originally appeared in the *Victorian Naturalist* and the *Emu*, the author of "Wild Life in Australia" has assuredly been well advised; for within this unassuming little volume is to be found a valuable store of information concerning the animals and plants of various districts in Australia. The province of Victoria, the Riverina district of New South Wales, the islands of Bass Strait, Queensland, and Western Australia are in turn discussed; and in each case the treatment of the subject is full of interest, although the amount of space devoted to each district is by no means large. The most important observations in the book are those relating to the life-history of the duckbill or platypus. Many of our readers will recall that in 1901 Mr. G. Metcalfe, at a meeting of the Zoological Society, denied that the platypus lays eggs. Mr. le Souëf, on the other hand, definitely states that at the end of October the creature lays one or two eggs, which are of elongated form and furnished with a leathery shell. The egg is believed to be soon hatched, and the newly-hatched young is naked, and about one inch in length. A nest and broken eggshell were, according to the author, forwarded to Dr. P. L. Sclater. The point in dispute may now be regarded as settled. Mr. le Souëf adds that the platypus is a good climber, and that when on land it folds inwards the portion of the web projecting beyond the toes, so that the latter may be enabled to obtain a grip of the surface.

So far as the naturalist is concerned, "The Life-Story of a Squirrel" is effectually condemned by the illustrations, which (although of passable excellence from the conventional standard) represent the squirrel as being wholly red above, with long ear-tufts, at all seasons. In the winter scene facing p. 142 the characteristic grey flanks are not shown; while in the plate facing p. 32, which is stated in the text to represent a larch, and must therefore, as the tree is in leaf, indicate summer, the squirrel is likewise shown with ear-tufts and the chestnut tail of winter. The text is not of a nature that commends itself to our taste, or, it may be added, to that of certain young people to whom we have shown the volume. For our own part, we like either a sound book on natural history or a good novel; the attempt to combine the two does not appeal to us.

Of the two remaining volumes mentioned above, a brief notice must suffice, seeing that both are based on more or less well-known stories of travel and adventure or on striking historical events, and appear to be mainly intended for boys. In both instances the authors are to be congratulated on their selections and on the interesting style in which these are placed before the public. In his preface Mr. Hyrst records a protest against the destruction of forests which is proceeding only too rapidly in many parts of the world, quoting a statement to the effect that seven acres of primeval forest are felled to meet the requirements of the paper-maker for a single day's issue of a New York journal. Adventures in the great forests of the world, ranging from Major Stedman's expedition in Surinam in 1772 to the journeys of Speke and Grant, Winwood Reade, and other comparatively modern African explorers, are recorded in a style which should attract all juvenile readers. Mr. Sanderson carries his readers further backwards in time, commencing with Sir Walter Raleigh in Virginia, and continuing his narrative down to the establishment of British supremacy in Rhodesia and Nigeria.

## OUR BOOK SHELF.

*The Collected Mathematical Works of George William Hill.* Vol. iv. Pp. vi+460. (Washington: The Carnegie Institution, 1907.)

THE fourth volume of Hill's mathematical works brings the re-publication of these papers up to date, and a little beyond it; for it includes four memoirs that have not appeared elsewhere, and are of very considerable interest. It is, indeed, difficult to overstate the interest of the whole volume—at least, to those occupied in the subjects treated of. Newcomb, in his "Reminiscences," permitted himself a good-natured grumble at Hill's "lack of the teaching faculty." It seems to us that for true instruction as to what the problems of celestial dynamics actually require, and what are the most hopeful ways of approaching them, nothing has appeared since Laplace's "Mécanique Celeste" that so well deserved study as these four volumes. One cannot do them justice in a brief notice. Generally we should say their unique force is a force of character, a serious purpose to adhere only to real problems, to which great analytical facility, with clearness and fastidious elegance, and immeasurable patience are subservient.

Passing over the minor papers, and one of much interest not hitherto published—No. 84, "On Dynamic Geodesy"—the chief part of the volume is engaged in the attempt to find integrals of the planetary equations of motion which shall be valid for an indefinite lapse of time, and so supply some conclusive information as to the permanent future stability, and equally as to the past history of our system. This may be said to be the problem of vital interest at the present time in this branch of astronomy. Construction of tables of the actual motions of the planets is so far perfected that their remaining interest is almost wholly technical. On the other side, if we may take the opinions expressed by Hill in No. 60, "Remarks on the Progress of Celestial Mechanics since the Middle of the Century," the efforts of even very brilliant analysts have not succeeded in throwing much light upon the problem of representing the motions by more general integrals.

Without claiming too much for what Hill himself here contributes, his memoirs are instructive as giving almost a history of the efforts, extending over

many years, of his patient and trenchant mind to effect some real advance. The ideas to which he most recurs are those of Delaunay and Gyldén, to both of which it is evident that he attaches high value.

The paper No. 79, "Integrals of Planetary Motion Suitable for an Indefinite Length of Time," supplies a solution of the problem in outline, but in complete and not in unfinished outline, so far as it is illustrated by the system of Jupiter and Saturn.

The volumes are published by the Carnegie Institution of Washington. Vol. iv. contains an index, but it is of the perfunctory character that makes it little more than a list of names; Delaunay's name is followed by a list of no fewer than eighty-three reference numbers, without other clue; it would be shorter and equally useful to write DELAUNAY—*passim*.

R. A. S.

*Stray Leaves and Some Fruit on Cancer, based upon Physiologic Chemical Principles.* By Henry D. McCulloch. Pp. 49+3. (London: John Bale, Sons and Danielsson, Ltd., 1907.)

THE title of Dr. McCulloch's book is original, and there is no doubt as to the "stray leaves," but in our opinion there is very little "fruit," and we find very little of either "physiologic" or "chemical" principles in the foundation of the heterogeneous collection of quotations which form the bulk of the book—if, indeed, it can be said to have any foundation whatever.

In the present state of the cancer question, such undigested material can only be another obstacle to the real study of this most difficult of problems. A particular form of protozoal infection is assumed without any proof, or mention of work on this theory, as the cause of cancer; and the author thinks that "by proper culture, and introduction to the leucocyte, a vaccine or perfect remedial agent, vicariously prepared in a living animal, will be possible."

Dr. McCulloch makes an attempt to explain the *rôle* of the leucocyte in the natural production of specific vaccines in cancer. Certain leucocytes being phagocytes eat up the opsonised microorganisms under certain conditions, and return to the lymphatic glands and there degenerate; their remains are propelled to the "gland reservoir," where a chemical dissociation and rearrangement of their constituents is brought about, and are finally converted into the immunising agent. This occurs in the early stages of cancer, which are not recognisable. When these conditions fail, the leucocytes perform segregation, and hence the metastasis in the cancer growth.

The dissociation and rearrangement which occur, according to the author, are said to be brought about by enzymes. No doubt these play a part in the process, and it might have been thought that the author would have made an attempt to try to isolate them, or, at any rate, determine what enzymes were present. The assumption of an enzyme is not sufficient proof for its presence, since enzymes are specific in their actions, by which means they are identified. A "nascent enzyme" has not yet been described. The author has also introduced "hormone" in the hope that the word may help to explain the unknown.

The presence of so many quotations might have included the following, by a distinguished physiological chemist:—"The less a physiologist knows about chemistry, the greater is his inclination to work at the most difficult chemical subjects—the proteins and ferments. If even this subject be not sufficiently obscure to him, he can study the phenomena of coagulation. He feels most at home in the still more obscure subject of the pathology of coagulation and of the ferments; it is good to fish in the dark! *These authors have built up a literature which no one can become master of, and which is only a drag and a brake to science.*"

In this book of quotations, Dr. McCulloch finishes up with one in Sanskrit, of which he gives a voluminous interpretation, which appears to have even less to do with cancer than many of the many others of which the book is made up. R. H. A. P.

*Helianthemum Canum (L.) Baumg. und seine nächsten Verwandten.* By Dr. E. Janchen. Pp. 68. (Jena: Gustav Fischer, 1907.) Price 2.50 marks.

*Helianthemum canum* is a highly variable species, and therefore one for which it is difficult to define the limits. In the volume of Engler's "Pflanzenreich," dealing with the Cistaceæ, Dr. W. Grosser differentiates two varieties that are each again subdivided into several forms. The herbarium worker may follow such a splitting of interrelated forms, but it is extremely unlikely that he could separate them in the field where intermediate forms would probably be found. Dr. Janchen puts forward an alternative limitation of *Helianthemum canum*, and one or two nearly related species. Broadly, he merges in *canum* part of the species recognised by Grosser as *marifolium*, and maintains *italicum* and *rupifragum* as independent species. There appears to be considerable support for Janchen's arrangement, and the adoption by Grosser of two varieties under different species as *H. canum v. marifolium* and *H. marifolium v. canum* is decidedly confusing, but the determinations of Dr. Janchen are also based solely on herbarium material, although a crucial test could be obtained either by a study of the plants as they grow or by cultivating them from seed. Undoubtedly, such methods are arduous but not impossible, as all the plants under discussion are European. It is only right to add that Dr. Janchen himself recognises the necessity for determining the systematic limits in such variable species by the methods indicated.

*Limnologia: Studio Scientifico dei Laghi.* By Dr. G. P. Magrini. Pp. xv+242; illustrated. (Milan: U. Hoepli, 1907.) Price 3 lire.

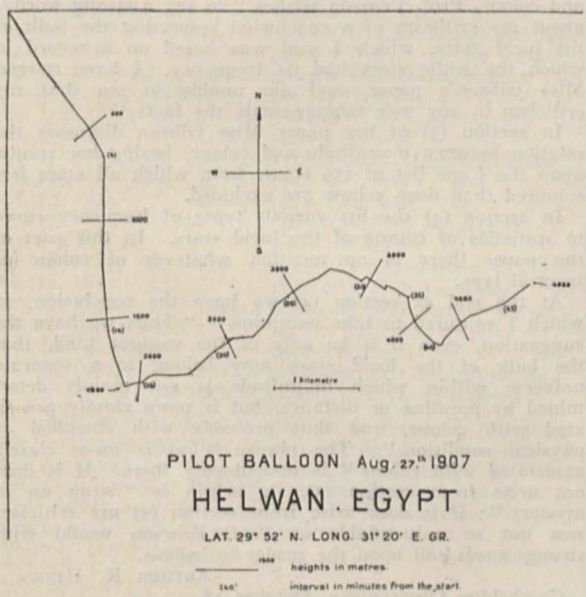
THIS valuable little work forms Nos. 372–373 of Hoepli's well-known scientific series of manuals. As the title implies, it deals entirely with the phenomena of lakes, and is intended to be preliminary to a somewhat similar work on the much larger subject of oceanography. Limnology owes its name to Prof. F. A. Forel, whose standard monograph on the Lake of Geneva is recognised as a model in this branch of inquiry. The present volume deals more particularly with the geographical and physical sides of the question, touching but very lightly on the more difficult subject of biology; it summarises the methods of observation which experience has shown to be the best, including descriptions of the instruments used, the improvements recently introduced in them, and the principal results hitherto obtained. The occurrences of *seiches* are attributed partly to the sudden cessation of wind which had been previously blowing over the lake, and partly to small differences of pressure at various points of the lake (acting on the water as on the mercury of a barometer); it is, however, pointed out that although it may be possible to indicate some of the causes that produce *seiches*, it is very rare that the particular cause of any individual *seiche* can be precisely determined. An appendix contains a list of the positions and areas of the principal Italian lakes. The author admits his especial indebtedness to Profs. Forel and Delebecque, to whose works, and to those of Prof. Chrystal and others, frequent references are made in the compilation of this useful manual.

## LETTERS TO THE EDITOR.

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

### Upper Air Research in Egypt.

THE Helwan Observatory (under the Survey Department of Egypt) has recently acquired apparatus to enable it to join in the study of the upper regions of the atmosphere. As a commencement, some fifteen ascents of small "pilot" balloons were made during the month of August. On three occasions the balloons were watched to a height of 5000 metres, but rather a large percentage of the balloons used burst at much lower altitudes. A better type of balloon has been ordered, and it is hoped that observations may be regularly made with them up to 5000 metres or 6000 metres. The balloons are of 2 feet nominal diameter, and are filled with dry hydrogen made from zinc and sulphuric acid. They are observed as they ascend by two observers at the ends of a base line 1 kilometre in length. The theodolites are of the very convenient type made by S. and A. Bosch, of Strassburg, specially for this work. The result of a month's work shows that at this season the surface wind (N. to N.W. as a rule) is from




1000 metres to 2000 metres thick. Above this there is a layer of varying thickness of winds from W. to W.S.W., whilst above 4000 metres other winds are reached, but the number of observations is at present too few to generalise about this region. An interesting ascent is shown in the figure, which represents the horizontal projection of the flight of a balloon on August 27, with contours showing the position of the balloon at intervals of 500 metres. In this case, above the stratum of S.W. wind there was a layer of N.W. winds, whilst above this a S.W. current was again entered.

Besides this study of the winds, kite ascents will very shortly be commenced. The apparatus acquired for these consists of a winch of the pattern designed by Mr. W. H. Dines, F.R.S., driven by a Crossley petrol engine of 4 horse-power. The observatory is indebted to Mr. Dines and also to Mr. J. E. Petavel, F.R.S., who watched the manufacture of the winch and introduced many minor alterations which use of a similar machine at Glossop had suggested. The machines are housed in an iron building on the flat desert plateau behind the observatory.

During the September international days (September 4, 5, and 6) five ascents of pilot balloons were made. The height to which they were followed varied between 2500 metres and 3300 metres.

Helwan. B. F. E. KEELING.

### Newton's Rings in Polarised Light.

AN erroneous statement regarding the above-mentioned subject is made in Preston's "Theory of Light" (p. 363, 1901 edition) and also in Edser's "Light" (p. 519, 1902 edition). As the error is a rather serious one, it seems worth while to point it out.

When the rings are seen between two lenses of the same substance, by light polarised perpendicularly to the plane of incidence, reflected at an angle greater than the polarising angle of the substance, it is stated that the centre of the rings is bright. That this is wrong can be seen. For:—

(1) Stokes has shown from the principle of reversibility that, whatever be the nature of light, the centre of the rings seen between lenses of identical refractive indices is black at all incidences of the light.

(2) Since the centre of the rings is black *at all incidences* for common light and for light polarised in the plane of incidence, it follows by resolution that it is also black when the light is polarised in a perpendicular plane.

(3) When the angle of incidence is less than the polarising angle, the coefficients of reflection *in glass* and *in air* at the bounding surfaces of the two media are opposite in sign. It is argued that, on increasing the incidence, the coefficient of reflection *in air* changes sign as the polarising angle is passed, and therefore at such incidences the two coefficients agree in sign, and destructive interference no longer takes place. Really, however, it appears from Fresnel's formula (coefficient $= -\tan(i-r)/\tan(i+r)$ that both the coefficients change sign as the incidence passes through the polarising angle, and therefore continue to differ in sign, as can be directly shown from the principle of reversibility. Destructive interference does, therefore, take place.

(4) I have shown by experiment that the statement is not true.

(5) Airy has shown (Lloyd's "Wave Theory," p. 178, and Jamin's "Optique Physique," p. 503) that when the two lenses differ in refractive index, the centre of the rings seen in light polarised perpendicularly to the plane of incidence is white only when the incidence lies between the angles of polarisation of the two media. Outside these limits the centre is dark.

C. V. RAMAN.

Science Association Laboratory, Calcutta,
September 12.

MR. RAMAN'S criticism of the statement made on p. 519 of my "Light for Students" is quite justified. Some time ago I noticed the error myself, and devised the following experiment, to which the same objections cannot be raised, while at the same time it is more easily performed than that in which two lenses of different refractive indices are used.

An ordinary black tea-tray is filled with tap water, and the surface is then touched by the end of a glass rod which has been dipped in oil (I find that the heavy paraffin oil used for engine lubrication answers well). The oil spreads over a fairly large area, Newton's rings being exhibited round the edge of this. On viewing the colours through a Nicol at an angle slightly greater than 45° no change is produced when the light transmitted is polarised in the plane of incidence, but on turning the Nicol through a right angle the colours change to their complementaries. In this case the light is reflected from the lower surface of the film at an angle slightly greater than the angle of polarisation for that surface, while it is reflected from the upper surface of the film at an angle less than the polarising angle. I presume that if Lloyd's single mirror fringes were observed through a Nicol, a similar change would occur on rotating the Nicol; I should be obliged if anyone who has tried this experiment would let me know whether this actually occurs. EDWIN EDSER.

### Thermodynamics of Diffusion.

IN his review of "Thermodynamics" (NATURE, July 25) and again in the *Philosophical Magazine* for July, Mr. Burbury directs attention to a result stated by me regarding the gain of entropy resulting from slow diffusion of gases at constant pressure and temperature.

May I direct attention to the context in connection with

which this result is stated in "Thermodynamics" (§§ 124, 126, 156)?

It cannot be deduced from the laws of thermodynamics or the definitions of a perfect gas (§ 124). These leave the change of entropy in the form of an undetermined constant.

It must necessarily be based entirely on experimental evidence (§§ 126, 156). It is in all probability *approximately* true for actual gases, but of this the experimental physicist is the only competent judge. As applied to "perfect gases" it should be regarded, in common with Boyle's law, as one of the "definitions of a perfect gas," a definition selected partly on account of its simplicity and partly on account of its approximate agreement with the properties of actual gases (§ 156).

An irreversible transformation does not, *ipso facto*, imply a gain of entropy. Unless a compensating transformation exists (§§ 50, 51), and unless the final result involves nothing more than a loss of available energy, we have no justification for applying the methods of thermodynamic analysis. If diffused gases could never be separated, we should have an instance in point; but do such exceptions exist?

Mr. Burbury asks why should different gases behave differently from different portions of the same gas? This question must be decided by the experimental physicist, subject to some further condition, *e.g.* that the gases are in the presence of a liquid which dissolves one of them or of a membrane which is permeable to one of them only. In other words, the matter resolves itself into the question, Why should the conditions of equilibrium of a gas in such circumstances depend on its *partial* pressure instead of on the total pressure of the mixture?

If the experimental physicist had told me that the total pressure, and not the partial pressure, was the determining factor, I should have asserted that no entropy was gained by diffusion, and should have written zero as the value of my constant C.

But then we should have no vapour of water in our atmosphere unless the temperature rose above the boiling point of water. These, generally speaking, are the views which the book was intended to convey; but may I direct attention to the large number of open questions in thermodynamics that have hitherto only received scanty attention in the hands of mathematical physicists?

G. H. BRYAN.

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IN the passage in my review to which Prof. Bryan takes exception I had in my mind his definition of available energy at p. 35 and p. 43:—"The available energy of a system *under given conditions* is the quantity of energy which *under these conditions* can be converted into work"; and in the same passage the conditions are also spoken of as "external" conditions. Let the system consist of two gases occupying equal halves of a cylinder, both at the same temperature and at pressure $p$, separated by a piston impervious to either, and the whole surrounded by air at the same pressure $p$. It seems to me to be impossible under those conditions to convert any of the energy of the system into work; but if it can be done, it must be possible to explain how. The context of p. 125 does not seem to me to explain it.

S. H. BURBURY.

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### The Nomenclature of Radio-activity.

THE name "ionium" which Dr. Boltwood proposes for the new radio-active element, of which he announces the discovery in NATURE of October 10, is open to serious objections. I do not mean merely linguistic objections—it is too late to consider them; beside such a hybrid as "ionisation" the philological barbarity suggested by Dr. Boltwood is insignificant; but it is a first principle of scientific nomenclature that a name should connote some of the distinctive properties of the thing named. A thoroughly satisfactory system for naming radio-active elements has not been put forward, but that adopted by Prof. Rutherford in designating the members of the series descended from radium is at least better than none.

According to this system, the products arising successively from the disintegration of a radio-active element are denoted by the name of that element followed by the letters X, A, B, C, &c. The principle of this plan has been adopted by universal consent in the nomenclature of the products of radium, thorium, and actinium, but for historical reasons slight divergences from the simplest form of the system have been permitted. Only one disintegration product of uranium (other than the radium series) has been known hitherto; its name, uranium X, is in accordance with Prof. Rutherford's nomenclature. Dr. Boltwood now announces the discovery of a descendant of uranium subsequent to uranium X; it appears to me desirable that this product should be known as uranium A, and should not be given any purely fanciful and meaningless name such as its discoverer suggests.

NORMAN R. CAMPBELL.

Trinity College, Cambridge, October 12.

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### On Correlation and the Methods of Modern Statistics.

IN my last letter (October 3, p. 566) I ventured to express the modest hope that "an astronomer may be permitted to dissent from these applications of modern statistical methods." Prof. Pearson refuses the desired permission with such warmth of language and wealth of argument that I find it difficult to make a suitable renewal of the request. Perhaps I may be allowed to confine my reply to the point of most general interest.

With regard to the supposed relation between magnitude and colour, Prof. Pearson wishes "to say a strong word" about my criticism of a conclusion respecting the bulk of the lucid stars, which I said was based on a record in which the white stars had no frequency. I have re-read Miss Gibson's paper, and am unable to see that my criticism in any way misrepresents the facts.

In section (3) of her paper Miss Gibson discusses the relation between magnitude and colour, basing her results upon the Cape list of 159 stars, from which all stars less coloured than deep yellow are excluded.

In section (4) she fits various types of frequency curve to statistics of counts of the lucid stars. In this part of the paper there is no mention whatever of colour or spectral type.

At the end of section (4) we have the conclusion, to which I ventured to take exception:—"Thus we have the suggestion, even if it be only of the vaguest kind, that the bulk of the lucid stars may belong to a separate universe within which magnitude is not mainly determined by parallax or distance, but is more closely associated with colour, and thus probably with chemical or physical condition." The phrase "*but is more closely associated with colour*" is undoubtedly there. If it does not arise from section (3), its origin is "wrop up in mystery"; if it does arise from section (3) my criticism was not so unjustifiable as Prof. Pearson would with strong words call upon the reader to believe.

ARTHUR R. HINKS.

Cambridge Observatory, October 18.

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### New Zealand Birds.

DURING the past twenty-five or thirty years many reports have been published in regard to the extinction of New Zealand birds, and an impression has gone abroad that our avifauna, with its striking peculiarities and its wealth of interest to ornithologists, will soon be lost. Some time ago, when I was inquiring into the results of the acclimatisation of English birds, I had thousands of circulars distributed in all parts of the colony, and on those circulars I placed questions dealing with the position of the native birds. When the circulars were returned to me I found that every native bird was accounted for, in some cases in many different districts.

I feel, therefore, that I am able to sound a brighter note than has been sounded by most writers on New Zealand ornithology. From personal observations, I can say that several species the extinction of which was announced twenty years ago are fairly plentiful, and are increasing. I may mention specially the stitch-bird (*Pogonornis cincta*), the bell-bird (*Anthornis melanura*), the North Island robin (*Miro australis*), and the tui (*Prosthemadera novae zealandiae*).

I do not know of a single New Zealand bird which we can say with any degree of certainty has become extinct since European occupation of the country, except perhaps

the quail (*Coturnix novae zealandiae*), and it is reasonable to suppose that it may still be represented on some flats that settlement has not reached. My inquiries extended only to the mainland; I did not deal with the islands included in the colony's boundaries.

JAS. DRUMMOND.

Christchurch, New Zealand, September 8.

### Showers from near β and γ Piscium.

ON October 12, at 9h. 50m., I saw a second-magnitude meteor at 346°+3°, and it appeared to be nearly stationary at that point, but I recorded the object imperfectly, as I was looking toward the western sky at the time.

On October 2, 1902, I noticed a small meteor almost stationary at 345°+3°, and several others directed from the same point. This shower in Pisces is rather a prominent one in the months of August and September, and it has frequently been observed. The following are some of the determinations of the radiant:—

| | | | |
|---|---|---|---|
| July 25 to Aug. 12, 1879 | 343°+3° | Weiss | 6 meteors |
| Aug. 10, 1897 | 345+3 | Libert | 6 ,, |
| Aug. 13–16, 1893 | 347+0 | W.F.D. | 6 ,, |
| Aug., 1893 | 347+0 | Corder | 6 ,, |
| Aug. 16–20, 1885 | 345+0 | W.F.D. | 7 ,, |
| Aug. 15–21, 1901 | 345+0 | W.F.D. | 7 ,, |
| Aug. 19, 1900 | 346+1 | W.F.D. | fireball radiant |
| Aug. 21, 1901 | 341+5 | W.F.D. | meteor radiant |
| Aug. 21–23, 1879 | 350+0 | W.F.D. | 10 meteors |
| Aug. 24–Sept. 7, 1886 | 346+1 | W.F.D. | 5 ,, |
| Sept. 1–4, 1885 | 346+0 | W.F.D. | 9 ,, |
| Sept. 3–14 | 346+3 | Schmidt | |
| Sept. 8, 1899 | 347+3 | W.F.D. | fireball radiant |
| Sept. 14, 1901 | 345+1 | W.F.D. | ,, ,, |
| Sept. 14, 1875 | 348+0 | Tupman | ,, ,, |
| Sept. 15–20, 1876-1879 | 346+0 | W.F.D. | 10 meteors |
| Sept. | 344−3 | Schmidt | |
| Sept. 1858–63 | 346−3 | Heis-Neumayer | |
| Sept. 17, 1885 | 345+0 | W.F.D. | 4 meteors |
| Sept. 17, 1898 | 343+0 | W.F.D. | meteor radiant |
| Sept. 20–Oct. 4, 1886 | 347+0 | W.F.D. | 5 meteors |
| Sept.–Oct. 1, 1891 | 345+0 | Milligan | |
| Sept. 27, 1906 | 347+2 | W.F.D. | fireball radiant |
| Sept. 29–Oct. 2, 1877–1902 | 347+3 | W.F.D. | 13 meteors |

Possibly several showers may be involved in producing these radiants. As they nearly agree with the radiant point computed for Daniel's comet on September 12, they possess an interest of rather special character, and it is to be hoped that observations will be augmented, particularly at the middle of September.

Bristol, October 14. W. F. DENNING.

### The "Quaternary" Period.

IN Dr. Wright's interesting review of "Les Grottes de Grimaldi," by M. L. de Villeneuve (NATURE, October 10, p. 590), I find the following:—"M. Rivière attributed them [the deposits] to the Quaternary period, M. Mortillet, on the other hand, regarded them as Neolithic." Now it is impossible to conceive any defensible use of the word "Quaternary" that does not include the Neolithic. Many authors have condemned the expression on the ground that the Pleistocene and Recent are nothing more than the latest and very subordinate portions of the Tertiary period. For my own part I believe that the great influence which man has already exerted on the character and distribution of the forms of life upon the earth, as well as on the purely physical conditions of its surface and the still greater changes that his activity must occasion even in the near future, are ample justification for marking his effective appearance on the scene by the commencement of a new period in the earth's history, a period the threshold of which we have scarcely passed. If, however, the Quaternary "period" is to be considered to close at the end of the Pleistocene, it becomes so insignificant in comparison with the long ages of its predecessors that it would be better to dispense with it altogether. JOHN W. EVANS.

Imperial Institute, London, October 11.

THE separation of the Quaternary period from the Recent period, which begins with the Neolithic, is attributable to the fact that an interruption was supposed to have occurred in Man's occupation of Europe. According to this view, the Recent period begins with his reappearance. Of late years it has been shown that such a view is untenable, and that no such interruption occurred. There is therefore much reason in Dr. Evans's contention that the Quaternary period should be extended to include the Recent period. The term "Quaternary" has, however, a recognised meaning which could not be changed without entering into a discussion of the reasons for the step—a discussion which would be quite outside the province of the writer of a short review.

WILLIAM WRIGHT.

### To Deduce the Polar from the Intrinsic Equation.

I SHALL be grateful if one of your mathematical readers can give me the polar equation of the spiral which satisfies the condition $\rho s = c$, *i.e.* the spiral the curvature of which is a linear function of the arc. A. B. PORTER.

324 Dearborn Street, Chicago, September 19.

THE curve in which the *radius* of curvature is proportional to the arc is easily seen to be an equiangular spiral. If, as your correspondent assumes, the radius of curvature is *inversely* proportional to the arc, the problem is more complicated, and it is best in the first instance to express the Cartesian coordinates in terms of a third variable before attempting to form the polar equation. If instead of $\rho s = c$ we write $\rho s = \frac{1}{2}k^2$, we get with the usual notation

$$\tfrac{1}{2}k^2 \frac{d\phi}{ds} = s, \text{ whence } \phi = \frac{s^2}{k^2}$$

(choosing axis so that $s = 0$ when $\phi = 0$).

Put

$$u = \sqrt{\phi} = \frac{s}{k}$$

and we have

$$x = \int ds \cos\phi = k\int \cos u^2 du = \frac{k}{2}\int \frac{\cos\phi\, d\phi}{\sqrt{\phi}}$$

$$y = \int ds \sin\phi = k\int \sin u^2 du = \frac{k}{2}\int \frac{\sin\phi\, d\phi}{\sqrt{\phi}}.$$

By a suitable choice of origin, the lower limit of integration can be made to be zero in each case.

The integrals are known functions closely allied to the well-known error function. In fact, we have

$$x + iy = k\int_0^u e^{iu^2} du = \frac{k}{\sqrt{i}}\, erf\, u\sqrt{i}$$

To find the polar equation, we first transform the coordinates to new axes of X and Y, making an angle $\alpha$ with the old axes. Thus

$$X = x\cos\alpha + y\sin\alpha = k\int_0^u \cos(u^2 - \alpha)\, du$$

$$Y = y\cos\alpha - x\sin\alpha = k\int_0^u \sin(u^2 - \alpha)\, du$$

If now $r$, $\theta$ are the polar coordinates, we may adapt the last results to polar coordinates by taking $X = r$, $Y = 0$, $\alpha = \theta$. The polar equation is thus the eliminant of the two simultaneous equations

$$r = k\int_0^u \cos(u^2 - \theta) du$$

$$0 = k\int_0^u \sin(u^2 - \theta) au.$$

In terms of $\phi$ we have

$$r = \frac{k}{2}\int_0^\phi \frac{\cos(\phi - \theta)}{\sqrt{\phi}} d\phi,\quad 0 = \int_0^\phi \frac{\sin(\phi - \theta)}{\sqrt{\phi}} d\phi$$

while the inclination $\psi$ of the tangent to the radius vector is given by $\psi = \phi - \theta$.

This method can be applied to find the polar equation of a curve the radius of curvature of which is any function of the arc, but, as in the present example, the integrations cannot always be evaluated in terms of the functions discussed in elementary text-books. G. H. B.

## SOME SCIENTIFIC CENTRES.

### XI.—THE PHYSICAL LABORATORIES OF MANCHESTER UNIVERSITY.

SIXTY years ago John Owens, fine-spinner of Manchester, left 97,000*l.* "for providing or aiding the means of instructing and improving young persons of the male sex in such branches of learning and science as are usually taught in the English universities, but subject, nevertheless, to the two following fundamental rules and conditions, that the students, professors and teachers . . . shall not be required to make any declaration as to or submit to the test of any of their religious opinions. . . ."

The trustees rented for the purpose of the college a large private house in Quay Street in the city, formerly inhabited by Richard Cobden. The college was opened in 1851, with a staff of five professors, among whom appears the name of Edward Frankland as first professor of chemistry.

Though the chemical laboratory became almost at once very successful, a special fund of 10,000*l.* being raised for its development, it was not until much later that the chair of physics, or, as it was then called, "natural philosophy," was founded, Prof. A. Sandeman being its first occupant. He was succeeded by Prof. R. B. Clifton, F.R.S., now of Oxford, who was again succeeded in 1866 by Prof. William Jack.

On Prof. Jack's removal to Glasgow, Dr. Balfour Stewart, F.R.S., was called from Kew Observatory, where he was then superintendent. A small physical laboratory was opened by him at Quay Street in 1871, when eight students attended for instruction.

In 1873 the college was removed from the city to its present site in Oxford Street, to the fine new building erected from the designs of Mr. Alfred Waterhouse, R.A. The accommodation assigned to the physical laboratory consisted of three small rooms in the basement, quite at the back of the college. With the addition of a private laboratory for the professor, and a workshop, these constituted Prof. Stewart's quarters for experimental work up to his death, which occurred in 1887. Though much of Prof. Stewart's work while at Kew, such as his classic research on the air-thermometer, was of an experimental character, after he came to Manchester he seems to have devoted his attention more particularly to the theories of terrestrial magnetism and of the sun, rather than to laboratory research. The writer, who attended his classes in 1887, remembers how Prof. Stewart displayed an almost affectionate interest in demonstrating the use of certain instruments, such as, for example, the magnetometer, in which he always showed an especial delight.

*Photo.*] [*Warwick Brookes, Manchester.*

FIG. 1.—Prof. A. Schuster, F.R.S., in his laboratory.

On Prof. Stewart's death, after an illness brought on by an extremely rough sea voyage from Ireland, Prof. Arthur Schuster, F.R.S., who then occupied the chair of applied mathematics in the college, was called to succeed as Langworthy professor of physics and director of the physical laboratories.

Although from time to time the quarters assigned to physics had been considerably enlarged, the demand for a larger laboratory soon became very urgent, and, a generous donor having promised a large sum for the purpose, the council decided to build a new physical institute on a plot of ground close to the main buildings.

An interesting volume[1] has recently been published giving a description of the new physical laboratories and of the work done at the college during the occupation of the chair of physics by Prof. Schuster. It was compiled in commemoration of the twenty-fifth anniversary of his professorship, which was celebrated last summer by a large gathering of his old students and assistants, a specially bound copy being presented to Dr. Schuster by them on the occasion. Its compilation was largely the work of Dr. Hutton, head of the electrochemical department, who recently succeeded Dr. Lees, F.R.S., as assistant director of the laboratory. This book contains plans of the building and some excellent illustrations of the various departments, together with biographical notes and a bibliography of the scientific achievements of the professor, his staff, and pupils during the period named. The frontispiece of the work is a fine portrait of Prof. Schuster, by Lafayette.

As an account of the new laboratory appeared in these columns previous to its opening by Lord Rayleigh in June, 1900,[2] attention will only be directed here to a few of the more important features, and more particularly those connected with the research work.

From his earliest associations with physical science Prof. Schuster had always been specially interested in spectroscopy, having received his inspiration from contact with the foremost pioneers in this branch, Bunsen, Kirchhoff, and Roscoe. Hence it was only to be expected that the facilities for spectroscopic research in the new laboratory should be of a unique character. Probably one of the most important pieces of special apparatus is the large concave grating of 21½ feet radius, of very high quality, specially ruled by the late Prof. Rowland for Dr. Schuster. The mounting, the details of which have been improved by Prof. Schuster, and subsequently by Mr. Duffield, is arranged so that the grating and camera are fixed to carriages, sliding on specially stout iron beams, so connected that as the camera moves away from the plate the grating moves towards it. With this arrangement, as Rowland showed, the different portions of the spectrum are always in focus, whatever the position of the camera on its beam. Mr. Duffield communicated last year to the British Association a preliminary account of a research in which he has been engaged using this equipment, for the study of the effect of pressure on the arc-spectrum of iron, the pressures being varied up to 100 atmospheres.

Other spectroscopic apparatus are a 33-plate echelon-spectroscope by Hilger; a printing comparator for the measuring of spectrum photographs, from the designs of Prof. Kayser; a quartz spectrograph; and a smaller specially mounted concave Rowland grating of one-metre radius.

A very important development of the special work of the laboratory is the department of electrochemistry, which, owing to the efforts of Dr. Hutton and Dr. Petavel, F.R.S., has now established a wide reputation. The details of the equipment have been previously described,[3] but mention must be made of the special electric furnace in which reactions can be studied in gaseous pressures ranging up to 200 atmospheres, and also of the various modifications of the carbon-resistance furnace, designed by Dr. Hutton for different purposes. Accounts of more than one important research undertaken in the department are now in the press.

No record of the physical work at Manchester would be complete without a reference to the long series of painstaking researches by Dr. Lees on thermal conductivity. Alone, and in conjunction with students as collaborators, he has published during the past fifteen years ten papers, many of them of great importance on the subject. He was the first to work with sufficient accuracy to determine with certainty the sign of the temperature coefficient of thermal conductivity in a number of materials, and the value of his work was recognised by his election as a Fellow of the Royal Society last year.

The physical department at Manchester was one of the first to recognise the importance of electrical engineering, and in the old buildings a considerable sub-department was the "dynamo house," where, under Dr. Lees's tuition, many now occupying high positions in the world of electrotechnics received their training. When the department was reorganised on a larger scale, the Hopkinson Memorial Wing was built and equipped by the friends and relatives of the late Dr. John Hopkinson for the purpose. This was placed under the supervision of Dr. R. Beattie. In this house and its annexes are installed a representative collection of all the more important types of modern machines, including specially designed generators for experimental work of all kinds, as well as some machines of historic interest, such as the pair of early alternators presented by Dr. Henry Wilde, F.R.S., to illustrate the property of synchronous running originally discovered by him.

A meteorological station in Whitworth Park, erected by the generosity of the Whitworth trustees, has been splendidly equipped under the care of Dr. C. G. Simpson, and quite recently a kite station at Glossop Moor on the Derbyshire hills has been fitted up under the superintendence of Dr. Petavel with improved Dines apparatus, for winding in and paying out the steel kite-wires, worked by a small engine. This is the most westerly station in Europe for kite-flying, and may therefore acquire considerable importance in the international scheme for the investigation of the upper atmosphere.

Dr. Petavel's researches on radiation and on high-pressure explosions led to his recently being elected to the Fellowship of the Royal Society, and have caused him to be regarded as an authority on both these branches.

After mention of these particular developments of the work of the laboratory, we may note that in the volume referred to, the mere bibliography of the scientific publications of Prof. Schuster and his pupils occupies no less than eighty pages, covering an extremely wide range. Students have been attracted to the laboratory, not only from all parts of England, but from abroad, especially of late years. This is due in some measure to the splendid provision made for research, but undoubtedly in a greater degree to the eminence Prof. Schuster has attained as an original investigator, and pioneer in many important branches of physics. His early work on the discharge of electricity through gases, carried out in the old building with the help of his extremely able private assistant, the late Mr. Arthur Stanton, contributed largely to laying the foundations of the modern theory of the charged atom, which has seen such marvellous developments at the hands of the Cambridge school of physics. His work as an astrophysicist has taken him almost all over the world on eclipse expeditions, and, as a representative either of the British Government or of the Royal Society, to many scientific con-

[1] "The Physical Laboratories of the University of Manchester." A record of twenty-five years' work. Prepared in commemoration of the twenty-fifth anniversary of the election of Dr. A. Schuster, F.R.S., to a Professorship in the Owens College, by his students and assistants. Pp. 142. (Manchester: The University Press.) Price 5s. net.

[2] NATURE, vol. lviii., pp. 621–2.

[3] Hutton and Petavel, Journ. Inst. Elec. Eng., 1903, vol. xxxii. pp. 222–247.

ferences. His influence on the research done by his pupils at Manchester is easily traced, and all of them would acknowledge the inspiration and encouragement of many a half-hour's chat with the professor, perambulating the corridor to and fro in a thoroughly characteristic manner.

Some months ago Prof. Schuster announced his intention of vacating the chair of physics to allow more leisure for the literary work and theoretical research to which he has recently devoted himself more particularly. To the satisfaction of his colleagues at Manchester, it has been decided, however, that his connection with the college shall not cease, but that he will continue to direct some of the research, and the council has therefore appointed him "honorary professor." His place as Langworthy professor and director of the laboratory has been filled by the appointment of Prof. E. Rutherford, F.R.S., of Montreal, who arrived in Manchester a short time ago and organised some researches, though not nominally in charge of the laboratories until the commencement of the October session. Prof. Schuster at present is engaged in the study of the permeability of iron at high temperatures under high pressures, especially with a view to discover the effect of high pressures in changing the temperature, between 800° and 900° C., when the metal suddenly loses most of its magnetism. Pressures up to 1000 atmospheres are contemplated. A second problem under investigation is the effect on the rate of decomposition of radio-active substances of extremely high pressures, such as are met with deep down in the earth's crust. In both these problems the design of the high-pressure portion of the apparatus has been due to Dr. Petavel, and for the latter purpose Mr. Cook, the university mechanician, has succeeded in constructing a combined pump and ram, in which pressures up to 37,000 pounds per square inch can be maintained without perceptible leak over long periods. The effect on radium of pressures up to 2000 atmospheres has been studied, and an account of the experiments will be ready shortly.

The accompanying photograph of Prof. Schuster in the laboratory was taken specially by Mr. Warwick Brookes. J. A. HARKER.

## *A NEW METHOD OF COLOUR PHOTOGRAPHY.*

THE latest method of colour photography is distinguished as the "Warner-Powrie" process, and is well illustrated at the first exhibition of the Society of Colour Photographers, which will close on October 26. It will presumably be some little time before the plates are generally obtainable, but so far as can be judged from the examples shown and the details of their preparation, it is a process that will offer special advantages. Mr. Powrie has been working at the subject for many years, and has succeeded in producing a triple-coloured lined screen with better and finer lines than has been possible by previous methods, and without either gap or overlap. He discards ruling in favour of a very ingenious method of printing that does away with all need for the troublesome registration that becomes almost impossible with fine lines. The glass is coated with a bichromated colloid, exposed under a black-lined screen that has spaces half the width of the lines, and developed in warm water. This leaves the colloid in lines with spaces of bare glass twice as wide as the lines. By immersion in a solution of a green dye the lines are stained, and by the application of formalin or chrome alum the colloid is made quite insoluble and the dye fixed. The plate is coated again, exposed under the same black-lined screen, the only precaution being that the green lines already made shall be covered with the black lines of the overlying screen. After exposure and development the plate is immersed in a solution of a red dye to stain the second set of lines, and again treated with a hardening agent. The plate is coated once more, and this time exposed alone with its back to the light, so that the red and green lines already made serve to protect the coating from light action. So after development all the remaining spaces are exactly filled with colloid, and this is then dyed blue. The prepared plate is coated with a suitable photographic emulsion, and can be used in a similar way to the "autochrome" plates of Messrs. Lumière, which we have already described. The chief difference between the two apparent by mere inspection is that the colours are in lines instead of as a random grain. But the lines can be made so fine that they are invisible to a normal eye without assistance.

It is obvious that the "autochrome" and the "Warner-Powrie" plates, and any plates in which the surface is apportioned to three colours for colour reproduction, must absorb about two-thirds of the light that would pass through them if the colours were not there. A simple colour, such as red, is produced by a silver deposit that covers the green and blue colours that are in the area that is required to be red, and this area is therefore one-third red and two-thirds black. A print on a "bleaching-out" paper (as the "Uto") would give its colours mixed with a double area of black, and therefore be uselessly dark. It is difficult, if possible, to obviate this with a random distribution of the colours, but Mr. Powrie, with his plates, overcomes the difficulty by separating the plate and the paper with a thin sheet of celluloid or glass, and by two mirrors on opposite sides of the printing frame gets oblique light in two directions, as well as direct light at right angles to the surface, and so causes each coloured line in the plate to give a line on the printing paper three times its width. In this way, each colour—red, green and blue—produces its effect over the whole surface of the paper, the colour patches are continuous (free from black), and what should be white parts are completely bleached instead of being coloured like the original. In the same way, but using ordinary plates, and red, green and blue light separately for the exposures, a separate negative can be obtained of each of the three colours, with a continuous image on each, and these can be used for any method of three-colour printing. A single exposure on a single plate will thus give all that is necessary for the preparation of the three colour records which hitherto have been obtained by separate and generally consecutive exposures on the original. C. J.

## *MR. HOWARD SAUNDERS.*

IT is with unfeigned regret that we record the death of Mr. Howard Saunders, after a long and painful illness. Mr. Saunders was born in London in 1835, and was therefore seventy-two at the time of his death. He was educated privately—to a great extent at Dr. Gavin Smith's school at Rottingdean, near Brighton, where he is said to have developed that taste for ornithology by means of which he attained eminence in later years. Immediately after leaving school he entered on a business career, and at the age of twenty joined a mercantile house at Callao. Five years were spent by him in Chili and Peru, where archæological studies appear to have

chiefly occupied his leisure. In 1860 he crossed the Andes, reaching the headwaters of the Amazons, and descending that river to Pará, in Brazil, where he made his first long halt. Few Englishmen had at that time made a similar journey, which appears to have been fraught with difficulty.

After this journey Mr. Saunders returned to England, and devoted himself to the study of ornithology in real earnest. In South America he had acquired an intimate acquaintance with the Spanish language, so that in the numerous visits he paid to Spain between the years 1863 and 1870 he found himself thoroughly at home. Owing to these frequent visits he became a recognised authority on the ornithology of the Spanish peninsula, and in the year 1869 he published in the *Ibis* the first of a series of important papers on that subject.

To those members of the British public interested in birds, Mr. Saunders is, however, much better known as the editor of the third and fourth volumes of the fourth (and last) edition of "Yarrell's British Birds," the late Prof. Newton, who had edited the two earlier volumes, having found himself unequal to the task of continuing the work, at the rate of issue deemed necessary by the publishers. This work is alone a monument to the extensive knowledge and unflagging industry of Mr. Saunders. In addition to the conciseness and yet fulness of his descriptions, the text of these two volumes is noteworthy on account of the minuteness of detail with regard to the geographical distribution of the various species. The first part of vol. iii. appeared in 1883, and the last volume was completed in 1885.

This, however, was by no means the only work on British birds by Mr. Saunders. In 1887 he published a list of the birds of our islands; and in 1888–9 "An Illustrated Manual of British Birds," which originally appeared in parts, and of which a second edition was issued during the years 1897–9. Terns, gulls, and skuas were a group of birds in which Mr. Saunders was specially interested, and he was engaged by the Trustees of the British Museum to write the volume on this group (Gaviæ) for the famous series of "Catalogues," of which this volume is the twenty-fifth. It was published in 1896. He was one of the contributors to the "bird volume" of the scientific results of the cruise of the *Challenger*, which appeared in 1881, and likewise wrote the article Birds in the "Antarctic Manual." He was also joint-author of the "Birds of Lancashire," and had, indeed, an almost unrivalled knowledge of the county distribution of British birds. His papers in the *Ibis*, in addition to those on the birds of Spain, are numerous, and, needless to say, valuable.

At an early stage in his career Mr. Saunders became a member of the British Ornithologists' Union, at the meetings of which he was a regular attendant, while he also took a large share in the management of that body. He was a Fellow of the Linnean, the Zoological, and the Royal Geographical Societies, and served on the council of each, as well as contributing largely to the publications of the second named. The Society for the Protection of Birds also claimed his interest. For several years (1880–5) Mr. Saunders was secretary of Section D of the British Association; he was also a member of the American Ornithologists' Union, and on the foreign list of the Société Zoologique de France and of several other Continental scientific bodies. In addition to ornithology, Mr. Saunders also took an active interest in geographical research, especially that connected with the exploration of both polar regions. His death will be felt as a personal loss by a large circle of scientific friends, both in this country and abroad. R. L.

## NOTES.

THE first Press messages by wireless telegraphy were transmitted by the Marconi system across the Atlantic Ocean, between Ireland and Cape Breton, on October 17. Several congratulatory messages were exchanged between the two continents. The Governor-General of Canada dispatched a message from Ottawa congratulating the King "on the establishment of a fresh link between Canada and the Motherland," to which His Majesty replied on the following day by the same method of communication:—"His Majesty the King to Earl Grey, London, October 18.—I thank you for your telegram. I am delighted that wireless Transatlantic telegraphy should unite the bonds between Canada and the Mother Country so closely.—EDWARD R." The Irish station is situated on a headland facing the Atlantic, about four miles from Clifden, in Galway, and is the largest wireless installation in the United Kingdom. A number of tall masts, arranged in a line facing seawards, contain a network of wires on which messages are received and dispatched. The operators have a telephonic apparatus with a sensitive sounder attached to their ears, and it is their trained sense of hearing and distinguishing the Morse signals transmitted that enables them to detect the signals. It is stated that signals are sent and received simultaneously, and that a speed of about thirty words per minute has already been attained. Full particulars of the modifications in the apparatus and plant which have made the success of last week possible will doubtless be forthcoming in due course. Mr. Marconi and those at work with him are to be congratulated upon their triumph over practical difficulties, and men of science have reason for satisfaction in this remarkable development of means of communication by means of ether waves. The Marconi Company state that any delays in the transmission of messages by their system between North America and the United Kingdom are attributable entirely to delays on the land lines. The company claims that with a private wire from its station at Glace Bay to Montreal, and from the Irish station to London, the service between London and Montreal will immediately compare favourably with the cable service in point of speed.

THE Faraday lecture was delivered by Prof. Emil Fischer, professor of chemistry in the University of Berlin, at a meeting of the Chemical Society held on October 18 at the Royal Institution. Sir William Ramsay, K.C.B., president of the society, was in the chair. An abridgment of the lecture appears in another part of the present issue. At the conclusion of his discourse a medal was handed to Prof. Fischer by Sir William Ramsay as a mark of appreciation by the Chemical Society of his scientific work. Sir Henry Roscoe proposed a vote of thanks to the lecturer, and remarked that the great interest of the lecture is due, not only to the fact that Prof. Fischer is a master of his subject, but also because the application of synthetic chemistry to biology is a subject that at the present time exceeds in interest and importance any other branch of the science. In seconding the vote, Sir James Dewar mentioned that the centenary of the isolation of potassium and sodium by Davy fell on the day following that of the lecture.

THE death is announced of Prof. A. Fürtwangler, professor of classical archæology in the University of Munich, and a prolific writer on archæological subjects.

THE council of the Royal Meteorological Society has awarded the Symons gold medal for 1908 to M. L.

Teisserenc de Bort, of Paris, in recognition of the services which he has rendered to the science of meteorology. The medal was established in memory of the late George James Symons, F.R.S., the founder of the British Rainfall Organisation, and is awarded biennially. The presentation will take place at the annual general meeting of the society on January 15, 1908.

At the sixth annual meeting of the Northern Scientific Club, held at Newcastle on October 17, Sir W. H. White was elected president, and gave an address upon the application of the gyroscope for steadying ships. He showed a working model of Dr. Schlick's apparatus, which, he said, when applied to cross-Channel boats and coasting passenger steamers, would so prevent the rolling of these vessels as to allow persons troubled with sea-sickness to travel on the sea in comfort.

A message was received in New York on October 9 from Dr. Frederick A. Cook, the explorer. It was dated August 26, from Etah, and ran as follows:—"I have hit upon a new route to the North Pole, and will stay to try it. By way of Buchanan Bay and Ellesmere Land, and northward through Nansen Strait over the Polar Sea, seems to me to be a very good route. There will be game to the eighty-second degree, and here are natives and dogs for the task." Dr. Cook's expedition is provisioned for two years, and is wintering thirty miles further north than Commander Peary did two years ago.

The experts of the U.S. Forestry Service, after a fortnight's work on the ground principally affected, are still in the dark as to the origin of the blight that has attacked the white pine of New England during the summer. At Brunswick, Maine, it is feared that the beautiful Bowdoin pines, of which Hawthorne and Longfellow wrote, will soon be a thing of the past. The blighted trees are recognised by the fact that the tips of the needles of this year's growth have turned a peculiar reddish-brown colour, so that the trees look as though they had been scorched. The national Government has established several sample plots, not only at Brunswick, but also at Peterboro, New Hampshire, where a scientific study of the problem is to be carried on.

The Philosophical Institute of Canterbury, New Zealand, is making arrangements for an expedition to some southern islands included in the colony's boundaries. The expedition will be under the leadership of the Hon. R. McNab, Minister of Lands and Minister for Agriculture, who is interested in the history of the islands, and has written an interesting work dealing with the old sealing and whaling days in the islands and the southern part of the mainland. The expedition will be under the auspices of the Government, and will be taken to the islands in one of the Government's steamers. It will leave New Zealand about the end of November or the beginning of December, and will visit the Auckland Islands and Campbell Islands. About twenty New Zealand men of science will take part in the undertaking. They will be divided into two parties, one going to each group. Work will be done in regard to terrestrial magnetism, zoology, geology, and botany, and reports will be prepared dealing with the results of the investigations.

The jubilee of the East Kent Scientific Society was celebrated on October 16 by a conversazione held at the Simon Langton School, Canterbury. Biological, chemical, and physical exhibits were on view, and several interesting demonstrations were provided. The society numbers eighty-six members.

Reuter's correspondent at St. Petersburg states that reports have reached there of an earthquake in Central Asia. On October 21, between 9 a.m. and 10 a.m., a strong but gradually diminishing shock of earthquake was recorded at Katta-kurgan. Other advices state that an undulatory earthquake occurred on October 21 at Samarkand, lasting from 8.45 to 10.30, and causing cracks in many buildings. The dome of one mosque and the minaret of another collapsed.

We learn from the *Agricultural News* of the West Indies that Mr. W. R. Buttenshaw died suddenly in Calcutta on September 9, at thirty years of age. Mr. Buttenshaw, who was a graduate of the University of Aberdeen, entered the service of the Imperial Department of Agriculture for the West Indies as lecturer in agricultural science at Jamaica in 1899, and was appointed scientific assistant in charge of publications at the head office at Barbados in 1903. He left Barbados in May last to take up an appointment as botanist in the Indian Agricultural Service.

Cardiff is now to have a seismograph. Mainly through the instrumentality of Principal E. H. Griffiths, F.R.S., the local Naturalists' Society took the matter up, and approached the City Council with the offer of a seismograph and several other instruments to complete the set belonging to the corporation if only the latter would suitably house and maintain the same. The city fathers, after some demur on the score of economy, have now unanimously agreed to the proposal. An excellent site has been found for the seismograph on Penylan Hill alongside the public observatory, where will also be installed all the instruments necessary for a complete meteorological outfit. This announcement was made amidst applause at the annual meeting of the naturalists on Thursday evening, October 17, by the retiring president, Prof. Haycraft.

The Harveian oration was delivered by Dr. F. Taylor at the Royal College of Physicians on October 18. In the course of his address, Dr. Taylor remarked that Harvey's injunction to search and study out the secrets of nature by way of experiment should be addressed to the lay public, not, indeed, that they may experiment themselves, but that they may promote and forward such experimentation, or at least not hinder and obstruct it. Consideration of the value of experiment and research leads to the reflection how enormous has been the progress, on the one hand, made in medicine in the last few years, and how large, on the other, is our ignorance of natural phenomena in relation to disease and its treatment or control. Dr. Taylor referred to the work of Prof. E. Starling, to whom the Baly medal for the present year has been awarded, on the chemical relations of the functions of the body, as being particularly in accordance with the spirit of Harvey. Two advances which have had important results are the improvements in surgical practice which, initiated by Lord Lister, have led to the present theory and practice of asepsis in surgery, and the advances on the therapeutical side which are intimately connected with the subject of prevention and immunity, and the treatment of disease by antitoxins and the later opsonic methods. The field for research is enormous, the necessity for research patent, and even if the number of workers who can conduct research on the highest lines is limited, whether on social, financial, or moral considerations, there can be no doubt that the medical profession as a body will continue actively to support the maxim contained in Harvey's injunction to search out the secrets of nature by experiment.

FROM Tuesday to Saturday of this week boys of all ages have a delightful opportunity of seeing well-made models of engines, boats, electrical and other devices, and tools used in making them, at the Royal Horticultural Hall. Besides seeing the models at rest or at work, they are able to attend lectures on some of those attractive features in mechanics, physics, or chemistry that made the Polytechnic such a favourite resort in the old days. The *Model Engineer* is to be congratulated on the success of its first exhibition, or at any rate on what ought to be a success, the only misfortune being that, as the younger boys are at school now and the older boys are at work, many who would have attended with delight are perforce out of reach. Our interest in an exhibition such as this is more with its educational aspect than in general with the exhibits themselves. A boy with a mechanical or scientific turn obtains exactly the kind of encouragement which is wanted; his vague ideas as to making something, however fantastic (before the days of bicycles he generally hankered after making a velocipede), are corrected by seeing pleasing things that will really work of every kind of difficulty, from the simplest to the most elaborate, and, what is more important, he learns precision and how to read a drawing, for the instructions given at the exhibition and in the *Model Engineer* are accompanied by proper scale elevations and sections that would do credit to an engineer's office. The boy of the present day has a great advantage over his predecessor owing to the great development and moderate price of small precision tools. These are to be seen in their usual variety; but it is a little sad to notice under the same roof beautiful small precision lathes, with hollow mandrels and draw-in chucks, hailing often from Germany, and old-fashioned designs of cheap lathes with short and solid mandrels. Of course money is the difficulty, and the boy is tempted by the greater capacity of the gap lathe. Perhaps as an educational instrument it has its value. Among the pleasing subjects of lectures is the gyroscope, but, judging from the syllabus, the lecturer has missed the opportunity which the now popular "diabolo" would have given him if his dexterity is equal to his knowledge of demonstrating the laws of precession. We can only repeat our regret that such a treat should not have been arranged for the holidays.

THE *Times* of October 15 contains a further communication from Dr. Stein announcing the results of his work in north-western China during the last few months. Leaving the Lop-nor region, where, at Miran, he had made discoveries proving that in the second century A.D. the Indian kingdom in Turkestan, of which he had previously found such important remains at Niya, between Khotan and Cherchen, extended eastwards almost to the borders of China, Dr. Stein proceeded along the ancient trade-route across the desert of Gobi towards the oasis of Sha-chau, still, as of old, the westernmost outpost of Chinese population and speech. This route has been avoided in modern times until now, on account of its difficulties. Dr. Sven Hedin did not essay it, and it had not been crossed for many years until, not long ago, two British officers from India performed the journey. Their feat was chronicled in the Journal of the Royal Geographical Society, but is not mentioned by Dr. Stein in his letter. The discoverer has found a very interesting relic of ancient Chinese authority in this region in the shape of a previously unknown "great wall" of defence, erected in the early days of Chinese conquest by the Han emperor Wu-ti, at the close of the second century B.C. Dr. Stein traced its course for 140 miles, and found many interesting remains of its original builders and later garrisons in the shape of Chinese records on wood, chiefly referring to matters of military administration, besides numberless miscellaneous antiques, which had been perfectly preserved by the dry climate and soil. Buddhist antiquities of a thousand years later have also been found on sites to the south of this wall, and with these researches Dr. Stein is still occupied.

AN informal conference of representatives of museums, with members of the Museums' Association and other persons interested, was held at Salford, on October 18, by the invitation of the Museums and Libraries Committee of the Salford Corporation, who entertained the visitors. The meeting was well attended, the museums of Liverpool, Manchester, Leeds, Hull, Leicester, Bolton, Chester, and Warrington being represented among others. The afternoon was spent in the inspection of the Peel Park Museum and the recently opened natural history branch at Buile Hill Park, and Mr. B. H. Mullen, curator, afterwards gave a brief account of the recent extensive changes and developments carried out in the Salford museums. Mr. G. A. Dunlop, Warrington Museum, in a paper on the preparation of botanical specimens for exhibition, described in detail processes of drying flowering plants in silver-sand and boxwood sawdust, exhibiting samples of successful results with the latter medium, in which leaves and delicate floral structures were perfectly preserved. The forms were practically permanent; the colour of specimens exposed to the light might be expected to last about two years. An effective dry method of preserving succulent plants was, however, still a desideratum. Mr. H. Murray, Manchester Museum, followed with notes on wet methods of preserving plants for exhibition. Mr. E. E. Lowe, Leicester Museum, read a paper entitled "What should be the Curator's Ideal?" in which he offered evidence of the need for an all-embracing scheme or classification, as of an ideal museum, which should cover the whole field of museum work, and from which curators might select, and by which they might verify and co-ordinate their work in such sections of the whole as they might severally find it practicable to include in their programmes. Mr. Lowe submitted an outline of some portions of such a scheme, and was encouraged to proceed with the project.

THE first meeting of the new session of the Royal Geographical Society will be held on November 11, when Mr. Mackintosh Bell, director-general of the New Zealand Survey, will give a paper on the Great Dougias Glacier and its neighbourhood. Arrangements have also been made for papers by Dr. Hunter Workman, on the exploration of the Nun-Kun mountain group, in the Himalayas, and its glaciers; Dr. Vaughan Cornish, on the Jamaica earthquake; Mr. A. H. Harrison, on his search for an Arctic continent; and Dr. Tempest Anderson, on his visit to the volcanoes of Guatemala and St. Vincent. Among other papers provisionally arranged are the following:—the Duc d'Orléans, on his exploration in and around Novaya Zemlya; the Count de Lesdain, on his journey from Peking to Darjiling through Central Asia and Tibet; Mr. Laurence Gomme, on the story of London maps; Dr. T. G. Longstaff, on the Trisul district of the Himalayas; Mr. A. W. Paul, on Bhutan; Dr. W. S. Bruce, on his recent expedition to Prince Charles Foreland, Spitsbergen; and Dr. Johnston Lavis, on the influence of volcanic action on some features of the earth's crust. A series of lectures on the geographical conditions which affect the development of the British Empire is being

arranged for, one or two of the lectures to be given each session; the lectures at present decided upon are:—on the British Islands, by Mr. H. J. Mackinder, and on Australia, by Prof. J. W. Gregory, F.R.S. Beginning on Thursday, January 23, and continued weekly, a course of six lectures will be given by Dr. H. R. Mill on the geographical distribution of rainfall in the British Islands.

FROM Mr. John Wheldon we have received a copy of a catalogue of ornithological literature, comprising nearly 1000 books and papers.

A PAPER by Messrs. W. K. Brook and S. Rittenhouse on the life-history and development of the hydroid *Turritopsis nutricula*, in which both the hydroid-stock and the free-swimming medusas are described, is published in the Proceedings of the Boston (U.S.A.) Natural History Society, vol. xxxiii., No. 8.

IN the list of additions to the Zoological Society's menagerie in the Regent's Park, attention may be directed to a specimen of Phillips's dik-dik antelope from Somaliland, the first of its kind ever exhibited in the gardens. A true zebra from Cape Colony is likewise an important addition to the collection.

THE council of the Ealing Scientific and Microscopical Society deplores, in its report for the past year, the lack of interest displayed by local residents in matters scientific, and the consequent want of expansion in the membership roll of the society. Unless at least twenty new members are enrolled during the coming year, the society's expenses must be cut down. Among the reports of addresses delivered during the year, attention may be directed to one on the continuity of the germ-plasm, in which an abstruse subject is explained in a remarkably clear manner.

IT has long been known that the North American cat-fishes of the genera Noturus and Schilbeodes can inflict painful wounds with the spines of their pectoral fins, but some difference of opinion has hitherto prevailed whether a sac opening by a pore in the axillary region of these fishes is a true poison-gland. In the September number of the *American Naturalist* Mr. H. D. Reed, after careful examination of several species of these cat-fishes, states that the pore, which is the aperture of a gland, is present in all, and that in at least one species the secretions of the gland are poisonous. It has also been found that in species in which the spines are not strongly serrated, glands of the same type are developed on the pectoral and dorsal fin-spines. In these species, in which they attain their highest development, the glands are structurally similar to those of the weaver-fishes.

AMONG a number of interesting articles in the October issue of *Science Progress*, special reference may be made to one by Mr. F. V. Theobald on the economic relations of birds to agriculture, horticulture, and forestry. Despite the enormous amount of literature on British ornithology, the author is of opinion that our present information concerning the majority of the species is insufficient to admit of a definite pronouncement as to their utility or harmfulness, and that it is consequently necessary to study their food in a much more systematic manner than has hitherto been attempted. Some birds Mr. Theobald does not hesitate to condemn to destruction, among these being the black-cap, blackbird, and sparrow-hawk. Attention may also be directed to an article by Dr. A. Dendy on the pineal gland. Although its wonderful developmental history is fairly well known, we are still ignorant of the function of this organ. To remedy this we require a series of investigations into the physiology of the pineal organs, both in those animals in which they still exist as a sense-organ, and in those in which the epiphysis cerebri has assumed the character of a ductless gland.

THE Bulletin of the Johns Hopkins Hospital for September (xviii., No. 198) is longer than usual, and contains a number of important papers on pathological subjects. Prof. W. G. MacCallum gives a short outline of an experimental course in pathological physiology which the students of the Johns Hopkins Hospital have the privilege of attending.

FROM Messrs. G. W. Bacon and Co. we have received a set of the first part of their "Photographic Nature Drawing Cards," reproducing illustrations of leaves. The size of the prints averages about 5 inches by 3 inches, and on each a single leaf is figured. They are nicely printed, and serve to indicate general shape, outline, and veining, but obviously the advantage lies with natural specimens.

A CATALOGUE recently received of Leitz microscopes contains several new designs and fittings. A novel and improved form of fine adjustment, providing endless movement by means of a cam, is supplied with the better stands; being fitted to the connecting piece between the frame and the tube-holder, it is possible to curve the frame so as to give accommodation for large objects on the stage. In the so-called museum microscope there is a circular drum on which a dozen preparations can be fixed that rotates under the objective. Special features are combined in the mineralogical microscopes, and an opaque illuminator for fitting on the end of the tube has been designed. A pamphlet describing Edinger's drawing and projection apparatus has also been published.

THE July number of the *Philippine Journal of Science*, vol. ii., No. 4 of the botanical series, is assigned to the identification of specimens collected by Mr. E. D. Merrill and others on Mt. Halcon, Mindoro. With regard to new plants described by Mr. Merrill, the most notable is a species of Centrolepis providing the first record for the order Centrolepidæ in the Philippines. The order is typically Australian, as four out of six genera are entirely confined to Australasia, and out of twenty species of Centrolepis this and one other only occur outside Australia. Several other plants of the collection bear out the same affinity; *Dianella caerulea*, *Halorrhagis halconensis*, and *Cladium latifolium* afford good examples. Two new genera are proposed, Halconia under the order Tiliaceæ, and Mearnsia under the order Myrtaceæ. A small parcel of mosses collected on the same expedition was referred to Dr. V. F. Brotherus. His determinations and those of the orchids consigned to Mr. O. Ames are also published.

DR. VIRGINIA RIDSDALE has published a thesis (Lord Baltimore Press, 1906) dealing with the arrangement of the real branches of plane algebraic curves. The Harnack and Hilbert processes of small variation from specially degenerate curves are applied to curves with the maximum number of branches, and the various possible arrangements of internal and external ovals are discussed. The author concludes that the theorem with which the paper professes to deal can be stated in several alternative forms. This theorem relates to the greatest and least numbers of ovals for a curve of given degree.

THE Weekly Weather Report of the Meteorological Office for the week ending Saturday, October 19, states

that the rainfall was more than the mean in all districts except Ireland N. In nearly all parts of the kingdom, except Scotland N. and Ireland S., the excess was very large. Several parts of the country recorded falls of much more than an inch within twenty-four hours, and some places more than 2 inches. Most of the heavy falls occurred either on October 15 or 16. At Lincoln (about 1½ miles from the centre of the city) as much as 3·50 inches were recorded on October 16, and at Leith 2·61 inches on October 15, while over a large area of Great Britain measurements of between 1 inch and 2 inches were registered. The largest aggregates for the week were 4·92 inches at Bournemouth and 4·62 inches at Portland Bill.

THE report of the Government Meteorological Department on rainfall registration in Mysore for 1906 shows very clearly, both statistically and graphically, that the district average for the year was somewhat above the mean of the past thirty-seven years in all parts except in Shimoga and Kadur, but was, on the whole, not sufficient to make up for the deficiency of the two previous years. The greatest rain in twenty-four hours was, as usual, at Augumbe (Shimoga), where 15 inches fell on July 21 and 11¼ inches the following day. The director, Mr. J. Cook, states that though the interest of the observers in their work has greatly increased in recent years, many of the gauges are still badly exposed.

AN interesting pamphlet by Mr. D. W. Horner, entitled "Observing and Forecasting the Weather: Meteorology without Instruments," has recently been published by Messrs. Witherby and Co., 326 High Holborn (post free, 7*d*.). On reading this booklet we were impressed by the fact that much useful work can be done by the public generally without expense, and with advantage to themselves, by recording their observations as recommended. The greater part of the pamphlet deals with the importance of cloud observations, and the author points out how anyone possessing an ordinary photographic camera may obtain useful pictures of clouds and lightning flashes. To make the chapter on wind more complete, a table of the velocities corresponding to estimated force by Beaufort's scale is given; the equivalents were in general use until very recently, but have been slightly modified by a publication of the Meteorological Office (No. 180, 1906) bearing upon the subject. With reference to the supposed influence of the moon on the weather, the author states that there is "grave reason for doubt" that Sir W. Herschel compiled a table until recently published in almanacs; any doubt on the question was removed by Sir J. Herschel's denial in *Good Words*, 1864.

MESSRS. SANDERS AND CROWHURST have issued a new series of lantern slides from Mr. W. Farren's photographs illustrating wild bird life, taken from nature. The slides include many instructive pictures of birds and their habits. Enlargements of the photographs are also issued.

A SECOND edition, being the third impression, of Dr. R. Wallace Stewart's "Higher Text-book of Magnetism and Electricity" has been published by Mr. W. B. Clive. This edition contains an additional chapter on the electron theory of matter and radio-activity, written by Mr. J. Satterly.

A SECOND edition, which has been revised and enlarged, of Dr. Ernst Cohen's "Vorträge für Arzte über physikalische Chemie" has been published by Mr. W. Engelmann, of Leipzig. An authorised translation of the first edition, by Mr. M. H. Fischer, was published by Messrs. Henry Holt and Co., of New York, in 1903, and the English version was reviewed in NATURE of July 16, 1903 (vol. lxviii., p. 245).

FROM Messrs. Philip Harris and Co., Ltd., of Birmingham, we have received a specimen of their recently introduced students' clinometer and compass. It consists of a silvered dial of some 2½ inches diameter divided into degrees in the two uppermost quadrants, and provided with a pair of sights of the usual folding pattern. About this dial revolves a metal collar carrying a spirit level, to which is affixed an index point indicating the angular elevation of the object under measurement. No fine degree of accuracy can be expected, of course, from a dial of so small a radius, but, with the accompanying compass, the instrument should be found extremely useful in educational work, such as is involved in the practical study of physical geography, inasmuch as it will familiarise the student with the principles of the angular measurements of elevation and azimuth. The clinometer would be simpler to use, it appears to us, and would give greater accuracy, if some method were devised of attaching the collar carrying the level and index to the stand, thereby leaving the sights and dial to move independently of the latter, which could then be accurately levelled at the commencement of the observation and afterwards left undisturbed.

## *OUR ASTRONOMICAL COLUMN.*

MELLISH'S COMET, 1907*e*.—A second telegram from the Kiel Centralstelle informs us that the comet discovered by Mr. Mellish at Madison on October 13 was observed by Prof. Hartwig at Bamberg on October 15. Its position at 17h. 0·4m. (Bamberg M.T.) was R.A.=8h. 26m. 13s., dec.=8° 45′ 16″ S., and its magnitude 9·5.

The following are a set of elements and an ephemeris calculated by Miss Lamson from places observed on October 15, 16, and 17, and communicated by Prof. Pickering to the Kiel Centralstelle (Circular No. 100):—

*Elements.*

$T = 1907$ September 12·47 (M.T. Greenwich).
$\omega = 291° 42'$
$\Omega = 55° 32'$ } 1907·0
$i = 118° 53'$
$q = 0{\cdot}973$

*Ephemeris 12h. (G.M.T.).*

| 1907 | α | δ | Brightness |
|---|---|---|---|
| | | ° ′ | |
| October 19 ... ... | 8 14·1 ... .. | −7 0 ... ... | 1·15 |
| ,, 23 ... ... | 7 57·7 ... ... | −4 38 ... ... | — |
| ,, 27 ... ... | 7 36·0 ... ... | −1 30 ... ... | — |
| ,, 31 ... ... | 7 6·8 ... ... | +2 39 ... ... | 2·06 |

The brightness at time of discovery (mag.=9·0) is taken as unity. On October 27 the comet will be about halfway between γ (26) Monocerotis and Procyon, and on October 31 it will be some 2° north of δ (22) Monocerotis. On the latter date the comet will rise a little to the north of east at about 10.30 p.m.

A BRIGHT METEOR.—Mr. W. F. Denning informs us that a fine meteor = ♀ was seen by Miss Irene Warner of Horfield Common, near Bristol, on October 19 8h. 50m. It disappeared close to the star δ Aquarii, near the planet Saturn, and was directed from the north-east region of Cygnus, near α and ε. It was of a fiery yellow colour and formed quite a conspicuous object even in the presence of the nearly full moon.

THE SPECTRA OF SUN-SPOTS AND MIRA CETI.—In the September *Astrophysical Journal* (vol. xxvi., No. 2, p. 123) Father Cortie compares the spectra of Mira Ceti, taken at Stonyhurst during the maxima of 1897 and 1906, with the sun-spot spectrum, and infers therefrom that the temperature of the spot vapours is lower than that of the photo-

sphere, thus confirming the results previously obtained by Sir Norman Lockyer, Profs. Hale and Adams, and others. There are strong reasons for believing that the spectrum-producing vapours of Mira were at a higher temperature during the 1906 than during the 1897 maximum. In the first place the star was brighter, and therefore presumably hotter. Again, the changed intensity of the hydrogen lines and of the characteristic absorption bands also indicates, according to our present knowledge, an increased temperature in 1906. Concurrently, the titanium-oxide bands in the spectrum of Mira were weaker in 1906 than in 1897, and, as these bands are *stronger* in the spot spectrum than in that of the photosphere, it seems reasonable to conclude that the spot vapours are therefore cooler than those of the general photosphere.

The evidence thus afforded by the temperature, and the accompanying spectral, changes of Mira from one maximum to a higher one agrees with Sir Norman Lockyer's temperature classification of the stars wherein similar changes, from type to type, are held to determine the relative positions of the Antarian and Aldebarian groups.

RECENTLY DISCOVERED MINOR PLANETS.—In No. 4205 (October 10) of the *Astronomische Nachrichten*, Prof. Bauschinger gives a list of thirty-four recently discovered minor planets showing the permanent designatory number that has been allotted to each. The last date of discovery given is June 9, 1907, and up to that time six hundred and thirty-five of these objects had been allotted permanent numbers. The present list also gives the provisional designation, the name of the discoverer, the date of discovery, and, where it has been allotted, the proper name by which each asteroid is to be known. A second list gives the elements for the orbit of each minor planet where they have been determined. Fifteen of these objects, which were allotted provisional numbers in 1906–7, have been found to be identical with previous discoveries.

ELEMENTS OF COMETS 1907*a* AND 1907*d*.—A set of parabolic elements for the orbit of comet 1907*a* is published by Signor E. Tringali in No. 4205 of the *Astronomische Nachrichten* (October 10).

The same journal also contains a set of parabolic elements for comet 1907*d*, calculated by Prof. E. Millosevich from observations made on June 16, July 18, and August 22. The results of a number of observations of the latter comet made at the Kremsmünster Observatory during the period July 4 to August 28 are given by Prof. F. Schwab in the same issue. On August 18 the comet was of 2·5 magnitude, and its tail was seen to extend 16° in the direction from λ to γ Geminorum.

THE LIVERPOOL ASTRONOMICAL SOCIETY.—We have received the annual report of this very active society giving a brief *résumé* of the work done and papers read during the session 1906–7. Among the latter, reference may be made to the president's address delivered at the opening meeting by Mr. W. E. Plummer, who, in a most interesting paper, directed attention to a few of the more urgent problems at present facing the practical and the theoretical astronomer.

An excellent photograph of Mr. George Higgs is reproduced as a frontispiece, and that observer contributes a short paper dealing with recent advances in the absolute wave-length measurements of solar radiation. Some curious phenomena were described by Mr. C. T. Whitmell, who supposed the observer to be located on the sun, and from that standpoint surveyed the solar system. Of more practical interest were the papers by the Rev. R. Killip, on the planet Jupiter; Mr. H. Waters, who presented a few notes to beginners in stellar photography; and Mr. F. W. Longbottom, on work with a 12¼-inch reflecting telescope of 24-inch focus. The two last-named papers are illustrated by reproductions of photographs, that of the vicinity of γ Cassiopeiæ having been taken by Mr. Waters with a 3¼-inch Voigtlander portrait lens of 8 inches focal length mounted on a rough equatorial stand and driven by hand.

A MODERN SUN-DIAL.—The August number of the *Bulletin de la Société astronomique de France* (p. 360) contains an interesting illustrated description of a sun-dial which the author, Vicomte d'Aurelle Montmorin, thinks may suit the modern requirements of the general public. The usual gnomon is replaced by a wire stretched across a rectangular frame, its shadow being cast on to a semicircular dial at the back. The frame is adjustable on pivots to any latitude, and curves engraved on the instrument give the equation of time for every fifth day. Setting screws are provided to adjust for longitude, once for all, and for the equation of time, so that no calculation is necessary, the time being read off directly from the dial, which is divided into divisions of five minutes each. The instrument is very portable, and the author suggests an ingenious arrangement of selenium cells whereby the hours and quarters might be struck on one or two gongs.

## *FLEAS AND PLAGUE.*

SIR LAUDER BRUNTON, F.R.S., delivered the inaugural address at the opening of the twenty-fifth session of the London School of Tropical Medicine on Monday, October 25, Mr. R. L. Antrobus, C.B., Assistant Under Secretary of State for the Colonies, presiding. He described the campaign against mosquitoes in relation to malaria and yellow fever; sleeping sickness, its spread along the lines of commerce in Africa and its transmission by a tsetse-fly; and then proceeded to discuss plague. The ravages of this disease in Europe in the fourteenth century under the name of the "Black Death" were described, and quotations from contemporary writers were given illustrating the terrible condition to which the countries attacked were reduced by the pestilence.

In India at the present moment the ravages of plague, though not so great as those of the Black Death or of the Great Plague in London, are nevertheless dreadful. During the first six months of this year no less than 1,060,000 deaths from plague occurred in India, and out of these 632,000 occurred in the Punjaub, which has a population of only twenty-five millions, that is to say, one in every forty inhabitants in this district has died of plague between January and June.

It has long been observed that great mortality in rats is apt to precede pestilence, and Mr. Hankin suggests that the story of the Pied Piper of Hamelin is a legendary account of a plague epidemic. Simond first suggested that fleas transmitted the virus, and the most convincing experiments have been made by Captain W. Liston, I.M.S., who found that 61 per cent. of white rats and 52 per cent. of Bombay rats contracted plague from fleas which had fed upon infected rats. He then found that fleas would infect guinea-pigs. He further showed that guinea-pigs did not catch plague if they were protected from fleas in various ways, *e.g.* by wire gauze, adhesive fly-paper, &c. His experiments have been confirmed and extended by the Advisory Committee appointed by the Secretary of State for India, the Royal Society, and the Lister Institute, who concluded from their experiments that:—

(1) Close contact with infected animals does not give rise to plague epidemic among guinea-pigs when fleas are excluded.

(2) If fleas are present, epidemic starts at once.

(3) An epidemic may be started when no contact with a plague-infected animal is allowed, when fleas from infected animals are introduced.

(4) Infection can take place without the animal being in contact with the ground. Thus a guinea-pig put in a wire cage and suspended 2 inches from the ground contracted disease.

(5) Aërial infection did not take place if the cage was 2 feet (that is, more than fleas jump) from the ground.

(6) In all the animals thus naturally infected the large proportion, 90 per cent. (nearly), of the buboes were in the neck; 179 animals were examined, and in obtaining fleas from animals 65·3 per cent. were obtained from head and neck.

The great difficulties in the way of preventive measures are ignorance and apathy, to which superstition is often superadded. In some parts of India there is great prejudice against taking life of any kind, but this is not universal, because in some parts goats are offered to Kalee, the Goddess of Destruction. If the Brahmins could per-

suade the natives that the sacrifice of a dead rat as often as possible to Kalee would avert pestilence, rats would very soon be destroyed, and plague would be at an end.

Cases of plague from time to time arrive at the Port of London, and rats might therefore become infected and start a pestilence in our midst. We are pursuing a foolish policy in allowing rat- and flea-infected districts to exist in the East End of London and other similar places.

## THE THIRD "PREHISTORIC" CONGRESS OF FRANCE.

THE third Congrès préhistorique de France was held at Autun (Saône and Loire) from August 12 to August 18, and attracted some 350 adherents, about fifty more than did the congress held at Vannes in 1906. More than 150 archæologists attended the scientific meetings and excursions held at Autun.

The congress was opened in the town theatre, where an address of welcome was delivered by the Mayor of Autun. Then Dr. A. Guébhard and Dr. Marcel Baudouin, the president and general secretary respectively of the congress, made the usual statements, and were followed by the official delegate of the Minister of Public Instruction, Prof. Matruchot, of the Faculty of Paris and director of *Pro Alesia*. Prof. Matruchot congratulated the Société préhistorique de France on the success it has attained, and conveyed to it the compliments of the Government.

On Monday evening, August 12, the congressists attended a reception at the Town Hall at the invitation of the learned societies of Autun, a group of bodies held in high respect in France. The brilliancy of this gathering was enhanced by the presence of numerous professors and men of science from other lands, the list of those present including the names of M. Rutot (Brussels), Prof. Cossina (Berlin), MM. O. Montelius (Stockholm), Valdemar Schmidt (Copenhagen), Count Zeppelin d'Arlehausen (prefect of Lorraine), M. Wassre (Switzerland), MM. Lewis and Dickins (England), M. Peabody (U.S.A.), &c. In addition to several German professors who assisted in the meetings of the congress, there were also present Profs. Adrien de Mortillet (Paris), P. Girod (Clermont-Ferrand), Dr. Henri Martin, M. Edmond Hue, M. Gustave Chauvet (Ruffec), Dr. Baudon, deputy of Beauvais, &c.

Among the subjects discussed should be mentioned that which treated of the prehistoric features of the Eduen country, in which the congress was held, and which was celebrated in the Roman history of Gaul. In the environs of Autun itself is situated the "Champ de la Justice," a Neolithic station which has furnished a number of "finds," and formerly included a fine megalithic alignment, which to-day is totally destroyed. This was visited by those who attended the congress, and there is indubitable evidence that it was formerly an ancient fortified camp, of which only the eastern side of the vallum, which has been investigated by M. Déchellette, remains.

Part of another evening was devoted to each of the walls of the town, and groups of the congressists also visited the Roman remains of Autun, which is surrounded on all sides by primitive ramparts dating from the time of Augustus; the temple of Janus, the sepulchral pyramid of Couhard, and the principal gates, such as La Porte St. André and La Porte d'Arroux, were amongst the sites visited. Then another place of great interest was found in the Roman theatre, at one time an important structure, now a mass of ruins, which, however, forms one of the chief attractions to tourists in Autun.

The principal question on the agenda of the congress was that of prehistoric camps and fortifications, which have been thoroughly examined by the learned president of the meeting, M. Guébhard. These were clearly described and discussed by the president before a large meeting of the whole congress held in the theatre on the evening of August 13. The exposition was rendered more enjoyable by the lantern-projection of more than 130 slides, and was so enthusiastically received by the large audience present that another afternoon was devoted to this complex subject.

Another lantern lecture was delivered, on the afternoon of August 14, by Mr. Lewis (England), his subject being the principal megaliths of England, whilst Mr. F. V. Dickins (England) exhibited a number of photographs of Japanese megaliths taken by M. Goodhan. These photographs were greatly appreciated by the audience, and, in the subsequent discussion, Dr. Marcel Baudouin, the great French authority on the study of megaliths, insisted upon the great interest of the English cromlechs and of the Japanese *allées couvertes*, which belong to a more recent epoch, and of which the funeral ornaments singularly recall those of the Gaulish sepultures.

This meeting concluded with a lantern demonstration given by Dr. Henri Martin, who dealt with the remains, showing traces of utilisation, found at stations of the *Moustérienne* epoch in Charente and Dordogne.

It is not advisable to describe here all the communications discussed at the congress, but it should be recorded that, concerning the megaliths, it seems to be generally admitted in France that the monuments were unquestionably oriented for a set purpose. Dr. Baudouin, who, following Gaillard (of Plouharnel) and many others, scientifically defends this theory in France, stated that the orientation varies from N.E. to S.S.E. in Brittany and Vendée, and clearly refers to the rising sun if one takes into account the latitude of the place and, an important factor, the momentous seasons.

The variation of the orientations indicates that in erecting these monuments all the seasons were considered, although the alignments to the winter sun predominate, as in Brittany, where the most frequent direction is S.S.E. This is in good accordance with the results of the work recently prosecuted in England concerning this important problem. The author also insisted upon the relations between menhirs and dolmens, and showed by an example, *apropos* and indisputable, that the menhirs were really indicators of megalithic sepultures, or of the limits of the necropolis of this epoch. By using two certain holed stones as indicators, he was enabled to discover an *allée couverte* which was buried under the soil, and had until then remained undiscovered. This "find," made with remarkable scientific precision, was received by numerous foreign congressists as a striking example of the value of a theory which many of them still ignore.

The question of the place the Aurignacien stratum should occupy in the classification of Palæolithic industries was also discussed at length, first at Autun by Prof. Girod, then at Solutré itself by Dr. Arcelin, jun., and M. Adrien de Mortillet. One sees that the excavations of Solutré should afford the much-desired solution of this problem, but it is not there, for the stratigraphy of that classical station is very intricate owing to serious landslides, and the consequent over-running, which detracts all meaning from the disposition of the layers laid bare by the recent work of M. Arcelin, jun. This worker believes, however, the *sous-solutréenne* layer to be re-mounted; but M. de Mortillet holds the opposite opinion, and believes that the over-running is real.

The question of forgeries was also discussed, and it was decided that it is necessary to warn prehistorians concerning "finds" in the Charollais country, near Autun. Possibly some of the Neolithic arrows of bizarre shapes are genuine, but it is certain that others are the work of clever forgers.

"Eoliths," the fruitful source of much debate, also came up for discussion. The subject seems threadbare in spite of the frequent writings of M. Rutot. He apparently admits that there are "eoliths" of every epoch of the "Stone age," but the true "eoliths" are those which correspond to the Tertiary deposits and suddenly appear in the Lower Quaternary. This is what may be called, with Dr. Baudouin, the *Préchelléen*, without entering into the detail of the layers.

Four days, instead of three, were this year devoted to the final stages of the congress, the session being augmented by one day for this purpose. In this time all the camps were visited, special attention being paid to the stations of the Iron age. Thus, in the days devoted to the more extensive excursions, the congressists visited Mont Beuvray, near Autun, which, under the name of *Bibracte*, was formerly the central Oppidum of the Aedui. Here are carefully preserved the precious remains of brave Gaulois, of which other specimens were also seen in the

Musée de l'Hotel Rolin. The toilsome journey to an altitude of 810 metres was amply repaid by a good lunch, and, in spite of the rain, by the more artistic pleasure of the grand panorama of surrounding plains and hills which is to be seen from the summit.

This visit to Mont Beuvray, a hill well known to the whole world, since it has justly given its name to an important epoch—the Iron age—recalled the fact that Cæsar once visited this Oppidum, and shortly after protected the Aedui from the Helvetian attack, and also from that of Ariovistus. It was here, too, that the Gauls held the famous general assembly, after the Aedui abandoned the Roman cause, and proclaimed Vercingetorix, the proclamation no doubt taking place near the *Pierre de Vibre*.

The ancient importance of this fortified Eduen camp is also attested by the fact that Cæsar, after the triumph at Alesia, established himself there. After this, Gaul was completely submitted to the Eastern civilisation, and *Bibracte* (with its *Beuvraysien, i.e.* its *industrie du Fer*), some years after the commencement of the Christian era, was completely obliterated by a forest fire. Vestiges of the town have been found by a modern Eduen, Bulliot, and a room in the Musée de l'Hotel Rolin is devoted to the results of the gigantic excavations. These were shown to the congressists by his worthy successor, M. Déchelette, who also exposed, for the congress, several Gaulish habitations, and prepared an exposure laying bare part of the old ramparts of the Oppidum, thus affording the visitors a view of a good example of the constructions of that epoch.

On August 16 an excursion to the boundary of the Côte d'Or and Saône and Loire occupied the attention of the congress, and a number of dolmens in the neighbourhood of Nolay and Decize were examined, but these do not recall anything of those well-known monuments on the borders of the Gulf of Morbihan. This visit showed what becomes of monuments in the centre of France, as those of the Field of Justice, in Saint Pantaléon, near Autun, had already appeared as an ultramicroscopic reduction of those of Menec and of Kerlescant at Carnac.

The evening was devoted to an enjoyable visit to the camp of Chassey, a typical Neolithic fortification occupied later by the Gallo-Romans. In the hands of the late director of the Musée Rolin, Dr. Loydreau, this camp furnished a valuable collection to the museum, and, thanks to the enthusiasm of M. R. Gadant, the room devoted to the collection was solemnly declared open during the visit of the congress. The subject of this second excursion was restricted entirely to the two principal periods of the polished stone epoch.

Looking south from Chassey, the far-away plateau of Aluze may be seen, considered by the Eduens as being the only Alesia possible. This supposition has not, however, prevented M. Etienne Bonneau from preparing his modest work, in spite of many difficulties, on the Siège d'Aluze par J. César.

At the camp of Chassey, of which the northern and southern parts of the vallum remain intact, excavations had been specially preserved, and furnished the visitors numerous fragments of Neolithic pottery and remains of Bovides, &c.

The third day was devoted to the Palæolithic age, to the period of the *pierre taillée*, and to this end the congressists visited the very fine collection made by Arcelin *père* from the classical beds of Solutré, and now to be found in the Musée de Mâcon. The son of the inventor of Solutré, Dr. Arcelin *fils*, was the guide, and had prepared a new cutting of the *Clos du Charnier*, which showed *in situ* the exact stratification of the beginning of *Solutréen*. As has already been mentioned, this visit did not give the key to the thorny question of *Présolutréen* or *Aurignacien*, on which sides are taken by the leaders of the Belgian and French brigades.

But the old school of prehistoric France showed that the Solutré bed has been greatly modified by the earth displacements, and so rendered little assistance to the solution of the Aurignacien problem. Against this the few facts have shown that the layers, as known, of horses, which form the base of the station, appear to be contemporaneous with the *Mousterien*. In fact, it appears, *a priori*, that one such place which had been frequented by the Palæolithic workmen had also been inhabited by the Solutréens. Certain flints, and remains of horses, apparently prepared on the Mousterienne model, have been found by Drs. Arcelin and Baudouin.

On the last day of the excursions a visit was made to the Oppidum d'Alesia, where there are rare traces of the Gaulois (huts, &c.). The epoch appears to be completely the Gallo-Roman, *i.e.* at the end of the Iron age. Here is to be seen the result of two years' assiduous labour, and one sees that if Faith is not able to raise mountains, Science of to-day is able to dig out from their foundations the majestic ruins of several successive Roman civilisations. In face of these works, the question which suggested itself was, "If by some unlikely chance this was not the true Alesia, how is it that a town, having presented such elaborate monuments, has left no trace of itself in the primitive history of France?"

This visit, with that to the two special walls which were seen at *Alise Sainte Reine*, worthily brought the congress of Autun to a close.

As a proof of the enthusiasm aroused, it may be stated that the last excursion attracted more than 100 participants. In spite of the complexity of the excursion programme, and in spite of the large number of adherents, the congress programme was carried out punctiliously.

The splendid organisation of this Congrès préhistorique de France may henceforward remain a model for others. It is to be hoped that its success will be repeated upon the occasion of the fourth congress in 1908, and that a still greater number of foreign workers, more especially the specialists of Great Britain, will be present.

## *ECONOMIC BIOLOGY AND AGRICULTURE.*

A CONFERENCE to mark the inception of a new department of economic biology at University College, Bristol, was held on Thursday, October 17, in the Bristol Museum, the Right Hon. Henry Hobhouse, P.C., taking the chair.

Mr. A. D. Hall, director of the Rothamsted Experimental Station, speaking upon the experimental work at Rothamsted, directed attention to the part played by bacteria in the fixation of nitrogen in the soil. Mr. E. S. Salmon (Agricultural College, Wye) referred to the destructive character and prevalence of fungus pests, and the beneficial results following the use of various spray solutions. Mr. F. V. Theobald (vice-principal Wye College), in dealing with the investigations upon insect pests, urged the importance of each worker making his own observations upon their life-history and habits within the district in which he worked, otherwise much mischief would result from the repetition of misstatements. It has been found, for example, that the winter moth, the wingless females of which are supposed to emerge in the middle of October and ascend tree trunks to lay their eggs, does under certain conditions and in some districts appear earlier, so that grease banding of the trees is in such cases carried out too late, and much damage results.

Prof. J. R. Ainsworth Davis (Aberystwyth), speaking upon economic biology in relation to fisheries, urged a much closer connection between educational work and trade. He also pointed out the need of a fuller knowledge of the movements of food fish, and the importance of organising systematic investigations upon the fisheries of the Bristol Channel and the rivers flowing into it. Mr. T. H. Middleton (Board of Agriculture and Fisheries), speaking upon the public and departmental aspects of economic biology, stated that it is the policy of the Board to subsidise institutions establishing departments of agriculture, recognising that the work of economic biologists is of public benefit, in that all are consumers. The result of disease and unscientific management leads to dearer foodstuffs. The Board has a special interest in the work of biologists, and can be made an effective intermediary between the scientific man and the grower. It is possible that a time will arrive when the Board will be able to do more in support of applied science, and when that time comes consideration will be given to those institutions

which have actively worked for the benefit of agriculture, forestry, and fisheries.

Mr. W. R. Barker, chairman of the Museum and Art Gallery Committee, said the committee of that institution recognises the beneficial effect of active cooperation with the University College of Bristol, and to that end is rapidly developing a special section of economic biology for the exhibition of insect and plant pests, and of material damaged by them. Prof. A. F. Stanley Kent explained that the new department has been called into existence by the needs of the west of England, and that applications for help and inquiry have come in rapidly. Valuable research work has already been carried on at the college in matters relating to economic biology, and important results have been obtained in connection with ciders, black-currant disease, and the development of lobsters on the coast of Devon and Cornwall. It was announced that Mr. Richardson Cross has offered land for an experimental station, where investigations upon various crops, manures, &c., can be carried on; additional land has also been offered by Mr. James Sinnott at St. Anne's Park. It is intended that the teaching side of the work shall be kept subsidiary to the advisory, and that the real function shall be to supply information and render help wherever required. Prof. Lloyd Morgan pointed out that academic and national interests in these matters are one, and that the department will directly benefit the community. Mr. W. E. Collinge (Birmingham) described the work of his department in the University of Birmingham, instancing as an example of the work done the yield from two orchards of the same acreage, and only separated by a road. One left unsprayed produced fruit worth 122*l.*; the other, that had been sprayed, produced fruit worth 497*l.*

## *SYNTHETICAL CHEMISTRY IN ITS RELATION TO BIOLOGY*

IT is easy to understand why in its early youth organic chemistry was so closely connected with biology; the materials which the chemist was called upon to investigate were mostly products of animal or vegetable origin. Indeed, carbohydrates, proteins, and vegetable acids served Lavoisier, Gay-Lussac, Berzelius, and Liebig as materials in elaborating the methods of elementary analysis.

The isolation of urea from animal urine by Rouelle, the recognition of uric acid, lactic acid, malic acid, and glycerine by Scheele, the isolation of asparagine by Vauquelin and Robiquet, of morphine by Serturnier, together with many other similar discoveries accomplished during the first ten years of the nineteenth century, are admirable examples of the manner in which the living world was drawn upon and made to yield up its treasure of chemical compounds. The many hundreds of natural organic compounds enumerated in the text-books of animal and vegetable chemistry are proof of the rich harvest since gathered in this field of investigation; but how small is their number when compared with the 130,000 carbon compounds which organic chemistry can boast of to-day. All these, it is known, are either products of the artificial transformation of organic matters occurring naturally or have been completely synthesised from their elements. The accumulation of this huge material, including the elaboration of the necessary methods, has been the main occupation of organic chemists during the past sixty years; and as their discoveries gave rise to much happy speculation, for the time being they took the lead in developing chemical theory.

It is not to be denied that, in the latter half of the last century, owing to the growth of the subject in importance, organic chemistry became separated from biology. It cannot be mere chance that the most famous of Liebig's pupils, A. W. Hofmann, A. Kekulé, and A. Wurtz, did not follow the example of their great teacher, whose chief triumphs were won by the use he made of chemical methods in solving biological problems. Perhaps they were restrained by the feeling that, mainly through his influence, physiological chemistry had been developed into a separate discipline, which should be cared for by men who could devote themselves entirely to its service. Such subdivision of labour undoubtedly has many advantages; the disadvantages would have outweighed these had it precluded interchange of experiences and friendly co-operation of workers in the two fields; the history of both sciences, however, affords ample proof that such has not been the case.

Physiologists have ever been ready to avail themselves of the latest developments of chemical analysis and synthesis, whilst organic chemists have not only been stimulated in many ways by biologists, but their studies have derived much practical aid from biological science. I may instance the modern development of the chemistry of fermentation, which began with the pioneer work of Pasteur, and was greatly favoured by the introduction of Koch's refined bacteriological methods; also the flourishing industry to which the manufacture of medical remedies prepared by synthetic methods has given rise.

But organic chemistry will certainly never be content to act as the mere handmaid of biology. This is impossible, as the theoretical and technical problems which she is already called upon to consider are too numerous, and they cannot fail to increase in number and importance in the future; but I do consider it not only possible, but desirable, that the close connection of chemistry with biology which prevailed in the days of Liebig and Dumas should be re-established, as the great chemical secrets of life are only to be unveiled by cooperative work. I will therefore attempt to indicate the part chemistry can play by reference to cases of which I can claim to have personal experience.

We know that in nature the construction of organic matter begins in the leaves of plants with the conversion of carbon dioxide into sugar, from which many physiologists suppose the complex substances contained in the living cell are formed by further changes in which nitrogen, sulphur, and phosphorus take part.

These transformations are for the most part enveloped in mystery. We know nothing definitely even of the assimilation of carbon dioxide. Of the various hypotheses advanced to explain the change, that advocated by A. von Baeyer has gained most support, namely, the view that the initial product is formaldehyde, glucose being formed from this by a process of polymerisation. Actually both changes have been effected artificially. After it had been shown by Butleroff that on heating formaldehyde with lime water a sugar-like, syrupy product is formed, and O. Loew had improved the method of effecting the condensation, I was able to adduce proof that the complex mixture contains a small quantity of an α-acrose which can be transformed into glucose. As it was known that carbon dioxide could be converted into formaldehyde by more or less drastic means, the preparation of glucose from carbon dioxide thus became a possibility. Recently, Fenton has succeeded in carrying out the reduction of carbon dioxide to formaldehyde at a low temperature in aqueous solution, so that it is now possible to effect the complete synthesis of sugar at temperatures such as prevail in the living plant. But how thorough is the work of the plant in comparison with our laboratory practice; usually when such questions are discussed, the poor yields which our methods give rise to are forgotten!

I need only allude here to recent apparently successful attempts, on the one hand, to effect the reduction of carbonic acid to formaldehyde by means of light, and, on the other, to detect formaldehyde in green leaves, as Prof. Meldola dealt exhaustively and critically with these questions in his presidential address eighteen months ago. I may be allowed, however, to dwell somewhat on one peculiar feature of the natural change, namely, the asymmetric character of the synthesis; according to present experience, and especially the brilliant investigations of H. Brown and Morris, the optically active hexoses of the *d*-series, glucose and fructose, are alone formed.

But from the experience gained in effecting syntheses in the sugar group, as I showed some time ago, it is possible to give a fairly satisfactory explanation of this change. It is only necessary to assume that the condensation is preceded by the formation of an additive compound of

[1] Abridged from the Faraday lecture delivered by Prof. Emil Fischer, F.R.S., at a meeting of the Chemical Society held at the Royal Institution on Friday, October 18.

formaldehyde with some optically active constituent of the chlorophyll granules. I shall give a more precise form to this hypothesis if I say that I consider it probable that the carbon dioxide itself enters into combination in this manner, as there is reason to suppose that the proteins offer sufficient opportunity for its fixation; according to Siegfried, even the simple amino-acids are capable of combining with carbon dioxide. I am inclined to think that this compound with carbon dioxide undergoes decomposition into oxygen and a reduction product, probably a derivative of formaldehyde; the condensation to sugar takes place either in the original asymmetric complex or in one produced from it by a secondary change involving the separation of the formaldehyde and its re-association in some other manner. It may be that the condensation takes place directly or that intermediate compounds, biose or glycerose, are formed. Thanks to the researches of Marckwald, and especially those of Mackenzie, we are acquainted with a whole series of asymmetric syntheses; no one of these, however, is half so complete as that involved in the formation of sugar under natural conditions. Indeed, it is obvious that if the natural process is to be imitated *in vitro*, it will be necessary to alter the methods hitherto adopted in every single detail; difficult as this may appear, it is not altogether impossible.

But even if this be done successfully, the precise nature of the assimilation process will not be finally elucidated. It is to be expected that this will only be accomplished when biological research, aided by improved analytical methods, has succeeded in following the changes which take place in the actual chlorophyll granules.

The carbohydrates elaborated by the plant undergo combustion to carbon dioxide and water in the animal body. The change is easily effected by means of powerful oxidising agents at the ordinary temperature; the natural process, however, must be a very different one, as in the organism oxygen is conveyed to the carbohydrate by oxidising enzymes, and doubtless many intermediate products are formed of which we know little at present.

It would be easy to multiply examples; but these two are sufficient to demonstrate the incompleteness of the explanation of biochemical processes deduced from the data of organic chemistry. The service rendered to biology by chemical analysis and synthesis, which will be rendered by it in even greater measure in the future, is to be sought in other directions.

The ultimate aim of biochemistry is to gain complete insight into the unending series of changes which attend plant and animal metabolism. To accomplish a task of such magnitude, complete knowledge is required of each individual chemical substance occurring in the cycle of changes and of analytical methods which will permit of its recognition under conditions such as exist in the living organism. As a matter of course, it is the office of organic chemistry, especially of synthetic chemistry, to accumulate this absolutely essential material. The chemical constitution of hundreds of carbon compounds which occur naturally has already been determined, and their more important properties have been established; but far more remains to be done. In proof of this, let me briefly direct your attention to the three great classes of substances which predominate in the living world: the fats, the carbohydrates, and the proteins.

It was established at least ninety years ago by Chevreul, in the course of his celebrated investigations into the process of soap-making, that the fats can be decomposed into the glycerine discovered by Scheele and into fatty acids; but the relationship of these latter to one another could not be understood until the conception of homologous series had been evolved in organic chemistry. The classical researches of Berthelot and the discovery of glycol by Wurtz were necessary preliminaries to the establishment of the constitution of glycerine; the final proof that the fats are neutral glyceric salts of the fatty acids was first provided by Berthelot's synthesis. Synthetic methods have made us acquainted with the mono- and di-glycerides and also with mixed triglycerides such as have frequently been met with of late in nature. Nevertheless, the group in which the natural fats are ranged is one in which there are still many lacunæ and many misstatements to be corrected.

The problems afforded by the fats are simple, however, in comparison with those connected with the carbohydrates. The original subdivision of the group into mono-, di-, tri-, and poly-saccharides has been justified in practice. Up to the present time only the monosaccharides have been studied satisfactorily from the point of view of their spatial structure. The growth of our knowledge of the monosaccharides has proved in many ways to be of importance in connection with biological inquiry, especially in enabling us to penetrate the mystery of enzyme action somewhat further.

On contrasting the effects which emulsin and the enzymes in yeast produce on the various glucosides prepared by synthetic methods, I was led to conclude, not only that there was a difference between the two series of optical antipodes similar to that discovered by Pasteur in the course of his studies of moulds, but that very slight changes in configuration were sufficient to inhibit the action of enzymes entirely. I was led by these observations to apply the simile of *lock* and *key* as an expression of the close inter-relationship in configuration which obtains between the enzyme and the substance which it attacks. Similar results were obtained on investigating the behaviour of the stereoisomeric hexoses with yeast, the fermentative power of which we now attribute to an enzyme—E. Buchner's zymase.

The experience gained with the glucosides became of service in studying the polysaccharides. Another outcome of the investigation has been the discovery of distinct enzymes capable of attacking di- and tri-saccharides. As the result of these inquiries, I was able to formulate a rule of general biological significance, namely, that the alcoholic fermentation of a polysaccharide is necessarily preceded by its hydrolysis by some particular enzyme. It was shown, especially in the case of the invertase of *Monilia Candida*, that it is not essential that the enzyme should even be soluble in water.

Unfortunately, but few successful syntheses of polysaccharides have been effected. It is most desirable, therefore, that better methods should be devised, as it is probable that the attack on the dextrins, gums, and similar undeciphered substances is most likely to be successful if made from the synthetic side. It is to be expected that biology would gain much by the discovery and utilisation of such materials; more, perhaps, than it has from the study of the monosaccharides and of the glucosides prepared by artificial means.

The carbohydrate group is that in which use was first made of enzymes as synthetic agents. Such syntheses fascinate the imagination, as they approximate closely to natural processes; but I may point out that they cannot take the place of purely chemical methods, as these latter are so much more under our control and can be varied in so many ways that we are in the position to produce materials which it is quite impossible for the organised world to furnish. Laboratory synthetic methods will be indispensable for a long time to come, not only for preparative purposes, but also as the means of elucidating the structure of complex substances of natural origin.

This contention is applicable to the proteins even more than it is to the carbohydrates; as they are among the most complex substances produced in the living world and are concerned in all the vital activities of the cell, a complete comprehension of their nature must obviously precede the full development of biological chemistry. We distinguish to-day some forty to fifty natural proteins, discovered by the joint labours of chemists and physiologists; but it is to be expected that as the methods of differentiating and separating them are improved, their number will be largely increased.

At present the majority are known only in an amorphous form; some important terms of the group, however, such as oxyhæmoglobin, egg albumin and the albumin of horse serum, excelsin from the Brazil nut, and the edestins from other plant seeds, have been obtained in definite crystals; but, unfortunately, it cannot be decided from their crystalline appearance whether these products are definite substances, as the tendency to form mixed crystals is the greater the more complicated the molecule. Examples in point are afforded by the aniline dyes, the higher fatty acids, and the purine compounds;

and those who have studied the chemistry of the natural silicates will be aware of the extension which mineralogists have been compelled to give to the conception of isomorphism. It would therefore be altogether surprising if the crystallised natural proteins should turn out to be single substances.

Of the numerous attempts to unravel the constitution of the proteins by analytical means, the only method which has given useful results hitherto is that of hydrolysis. Hydrolysis can be effected by acids or by alkalis, and also by digestive enzymes; the products, it is well known, besides ammonia, are albumoses, peptones, and ultimately amino-acids. The wide range of variation in composition of these amino-acids is shown by examining a list of all the substances hitherto prepared from the proteins.

The proportions in which the various amino-acids are obtained from the different proteins vary very considerably. In some cases they are altogether lacking, as may be proved by application of the definite tests for tyrosine, tryptophane, or glycine; but it is worthy of note that, as a rule, the amino-acids isolated from the mixtures produced by subjecting albuminous substances to hydrolysis all occur almost without exception, especially is this true of the important proteins which play the chief part in animal or vegetable metabolism, so that the conclusion must be drawn that none of them can be dispensed with in organic life. With the exception of diaminotrihydroxydodecanoic acid, they have all been so thoroughly investigated that their structure is well established. The majority also have been synthesised, proof of their structure having, in fact, been given in this way. Only oxyproline, histidine, and diaminotrihydroxydodecanoic acid remain still to be synthesised.

With the exception of glycine, all the amino-acids derived from natural sources are optically active; but when prepared by ordinary synthetic methods, as is well known, they are obtained in the first instance in the racemic form. The resolution of the racemoids into their optically active components has been effected quite recently in most cases. Asparagine, however, which is closely related to aspartic acid, had been resolved into the two active forms by recrystallising the inactive synthetic product from water and separating the two constituents mechanically. Moreover, in the case of some other amino-acids, for example, leucine, the antipode of the natural form had been obtained by partially fermenting the synthetic product with moulds. The complete synthesis of the active amino-acids which are obtained from natural sources was first accomplished by the method I introduced based upon the use of the acyl derivatives. The method has been applied with success to the majority of the synthetic products; its extension to the remaining cases, proline, lysine, tryptophane, and cystine, is not likely to be attended with any difficulties.

As the amino-acids are formed from the proteins, not only when these are subjected to the action of hot acids and alkalis, but also at moderate temperatures by the agency of the digestive enzymes, they are to be regarded as the true foundation stones of protein molecules. Opinions adverse to this hypothesis are only occasionally met with; they centre round the arbitrary supposition that complicated atomic re-arrangements may take place during hydrolysis.

Were one inclined to regard such objections as of moment, all the experiments on the determination of the constitution of organic compounds by degradation methods would be useless; moreover, the conclusions which have been drawn in other cases from the results obtained by the dissection of compounds have been too frequently confirmed by their synthesis. It is now possible to make this claim on behalf of the proteins, as it has been found to be possible, by a process the reverse of hydrolysis, to associate amino-acids in such a manner that substances are produced which, in the case of the simpler terms, closely resemble peptones, whilst the more complex resemble proteins.

I have termed these synthetic products *polypeptides*, in view of their relationship to the peptones and to facilitate systematic treatment of the group on the lines of the carbohydrates.

No useful purpose will be served by my giving an account of the synthetical methods on the present occasion, especially as I had the honour, six months ago, of describing to you the preparation of an octadecapeptide derived from fifteen molecules of glycine and three molecules of *l*-leucine, a substance which in its external properties closely resembles many natural proteins. I may say that more than one hundred of these artificial polypeptides have already been synthesised.

Many of them, it is true, belong to the lower stages, but all the amino-acids previously mentioned, with the exception of diaminotrihydroxydodecanoic acid, have been made use of in their preparation. The synthesis of the higher terms has been restricted hitherto to the combinations of glycine, alanine, and leucine; there is not a shadow of doubt, however, that all the remaining amino-acids could be associated in complicated systems with the aid of our present methods. The knowledge of the artificial polypeptides thus acquired has opened up new ways of investigating the peptones and albumoses analytically. During more than fifty years, physiological chemists have endeavoured without much success to isolate homogeneous substances from these ill-defined materials; all the products described by them, however, bear indubitable evidence of being mixtures. By making use of new methods based on the study of the polypeptides, it has been possible during the last two years to isolate and detect with certainty quite a number of dipeptides among the decomposition products of the proteins.

In spite of encouraging successes, I am fully aware of the difficulty of discovering the nature of all the components of the various peptones and albumoses; but in preparing the way for the synthesis of the natural proteins this is not even necessary. Probably the work can be restricted to the reconstruction of the original system from the major products of cleavage formed in the process of hydrolytic dissection. I am indeed venturesome enough to cherish the hope that I may be able to solve this problem in the case of silk fibroin, one of the simplest proteins. To deal with the whole of the proteins will be a gigantic task; so large a number of separate investigations will be necessary that nothing less than the life-work of a whole army of inventive and diligent chemists will suffice to complete it. Probably, too, the unpleasant discovery will be made that the natural proteins as we know them to-day are only to be obtained by mixing the homogeneous artificial products.

I have sketched this prospect merely to indicate the manner in which synthesis must play the leading part in this field of work. The nature of the more complicated carbohydrates, as I have already pointed out, will also have to be determined in the future, I imagine, mainly by the application of synthetic methods. Obviously the conditions are very similar in the case of the dextrins and gums to those met with in the case of the proteins, and starch, which has hitherto been regarded as a homogeneous substance, appears also to come into the same category, according to Maquenne's observations.

Not only do the proteins constitute the major part of living protoplasm, but they appear also to be the material from which the organism prepares its most wonderful agents—the ferments or enzymes. In many of the more thoroughly investigated biological processes their cooperation has been demonstrated, and there is good reason to suppose that they take part in all changes occurring within the living cell. So much is certain, the physiological chemistry of the future will be largely concerned with the study of fermentative changes; many indications that this must be the case are to be met with in tracing its latest developments.

The number of the enzymes has been increased to an extraordinary extent during the last ten years. I may allude to the newly discovered enzymes correlated with the carbohydrates: maltase, lactase, mellibase, trehalase, amygdalase, inulase; to the various oxidases: laccase, tyrosinase; to the lipases, erepsin, enterokinase, arginase, the sucroclastic and glucosidoclastic enzymes, and finally to the zymase of alcoholic fermentation. Much valuable information has been accumulated as to the manner in which they act, as to their formation from zymogens, and as to their assistance by co-ferments and their retardation by chemical agents or by anti-ferments. The specific character of their action, in other words, their dependence on the structure and configuration of the object they

attack, has been proved beyond doubt, and favours very definitely the assumption that enzyme and hydrolyte enter temporarily into combination, a conclusion to which H. E. Armstrong and E. F. Armstrong have quite recently again very properly directed special attention; but, unfortunately, we know practically nothing of the composition of the enzymes, as the complete isolation of an enzyme has never been accomplished.

From observations hitherto made, it appears in a measure probable that they are derived from proteins and possess a protein-like character. If this be so, it may be hoped that the experience gained with the proteins will be of service in the investigation of enzymes.

In the meantime, there are other directions in which synthetic chemistry can be of service in elucidating the chemistry of fermentation. In the same way that the artificial glucosides have been of use in establishing the dependence of the action of enzymes on configuration, the synthesised polypeptides are now being used by Abderhalden, Euler, and others to define and measure the activity of the proteoclasts. In a like manner, the synthetic exploration of the purine group has served to direct the recent observations on the fermentative de-amination and oxidation of adenine, guanine, and xanthine. Finally, attention may be directed to the use that has been made of stereochemical considerations in the course of Bertrand's interesting studies of the oxidation of polyhydric alcohols by the sorbose bacterium.

Not only have the methods of organic chemistry proved to be fruitful of results in the case of the proteins, but also when applied to complex derivatives of the latter, such as the nucleo-proteins, for example. Thus we are indebted to the brilliant researches of A. Kossel and his school for our knowledge of no less than four bases of the pyrimidine and purine group obtained by breaking down nucleic acids, and the analytical investigation of the latter has already been carried so far that, in the opinion of H. Steudel, it is to be expected that their synthesis will be effected at no distant date. Similar success may be hoped for even sooner in the case of the lecithins. Structural chemistry, moreover, is slowly acquiring the mastery over cholesterin by making use of the experience afforded by the synthetic study of the hydroaromatic substances.

Besides the old well-known constituents of the animal body, new substances having quite unexpected properties have been added from time to time. Such are iodothyrin from the thyroid gland—discovered by Baumann—and crystalline adrenaline—isolated by Takamine from the supra-renal capsule—minute doses of which increase the blood-pressure. Judging from analytical results and the synthesis effected by F. Stolz, adrenaline possesses a relatively simple structure. In the opinion of the discoverers, this is probably true of the "pancreatic secretin" made known by Bayliss and Starling's researches, which has the remarkable property of liberating enzymes from the pancreas. May it not also be true of the toxins of many infectious diseases and of the antitoxins used in serum therapeutics, the discovery and systematic investigation of which by Behring, Roux, P. Ehrlich and others, are to be reckoned among the greatest achievements of modern biology and medicine?

The methods of organic synthesis will certainly serve to throw light on the nature of all such substances of animal origin. Equally numerous problems await solution in the plant world.

The great success with which the alkaloids and terpenes have been studied during the past ten years is known to all, but it is only too obvious that much still remains to be done when such substances as quinine, morphine, and caoutchouc remain to be synthesised.

Alizarin and indigo are prepared artificially in huge quantities, and we are well informed as to the structure of hæmatoxylin and kindred substances; but our ignorance is correspondingly great of most of the blood colouring matters, as well as of many coloured constituents of our own bodies—of the hair, the skin, and the eye.

The fullest recognition must be accorded, however, to recent investigations on the complex colouring matters of the blood and of chlorophyll, which is distantly related to the former, associated with the names of Schunck, Nencki, Marchlewski, Küster, and Willstätter.

In fine, the aid of synthetical chemistry is required in every direction in arriving at a clear understanding of structure and of change. The methods at our disposal in the laboratory are doubtless altogether different from those which come into operation in the living world, but chemists are already trying to effect changes in carbon compounds by means of so-called mild interactions, under conditions comparable with those which prevail in the living organism. It may suffice to refer to the development of a number of catalytic processes and to the comprehensive studies on the action of light on organic substances undertaken by Ciamician. In fact, the effort is already being made to cooperate with biology; it is clear that a section of the forces of organic chemistry is being directed once more towards the goal from which it set out. The separation from biology was necessary during the past century while experimental methods and theories were being elaborated; now that our science is provided with a powerful armoury of analytical and synthetical weapons, chemists can once more renew the alliance both to its own honour and to the advantage of biology. Indeed, the prospect of obtaining a clearer insight into the wondrous series of processes which constitute animal and vegetable life may well lead the two sciences to work with definite purpose to a common end.

In order, as far as possible, to avoid mistakes in this difficult task and to shield ourselves from the disappointment which is the inevitable consequence of exaggerated hopes, we cannot do better than strive to imitate the great example of Faraday, who always, with rare acumen, directed his attention to actual phenomena without allowing himself to be influenced by preconceived opinion, and who in his theoretical conceptions gave expression only to observed facts.

## UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The Public Orator, Dr. Sandys, spoke as follows on Thursday, October 17, in presenting for the degree of Doctor in Science *honoris causa* Geheimrath Emil Fischer, F.R.S., professor of chemistry in the University of Berlin:—

Scientiae chemicae professor Berolinensis, purpura nostra (ut videtis) vestitus, ex insperato nobis hodie paulisper affulsit. Novimus tamen quam subtiliter materiam illam investigaverit, quae cum aqua commixta lanam colore roseo pulcherrimo tingit; novimus, via quam admirabili pedetemptim progressus, sacchari genera multa, aut olim nota aut ab ipso patefacta, in elementa sua prima resolverit, atque atomorum de ordine et positura leges novas illustraverit. Peritis saltem nota sunt plurima alia viri huius inventa, quae scientiae intimae ad ipsa penetralia pertinent. Duo vero laboris eius monumenta multorum oculis sunt manifesta atque aperta. Berolinensibus praesertim patet Institutum illud magnum consiliis eius conditum; talium rerum studiosis ubique terrarum patet opus eius eximium sexies saltem in lucem editum. Virum igitur tam insignem et salvere et valere hodie libenter iubemus, qui Faradaii in memoriam orationem inter Londinienses propediem habiturus est, quique, studiorum communium consuetudine nobiscum consociatus, eo artiore nobiscum vinculo coniunctus est, quod filium suum natu maximum Universitati nostrae in scientia chemica erudiendum haud ita pridem commendavit.

Duco ad vos virum in scientia chemica per orbem terrarum totum illustrem, AEMILIUM FISCHER.

On Tuesday, October 15, Mr. A. Henry, the reader in forestry, gave his inaugural lecture before a large audience. The Vice-Chancellor presided. Mr. Henry dwelt upon the causes which had retarded the scientific development of forestry in Great Britain. He then described the various types of forest and their origin, and the several methods of the management of forests. He also described the rapidly approaching depletion of the forests in the United States and northern Europe, and pointed out the necessity of re-afforesting the waste lands of our country. He dwelt at length on the possible introduction of exotic trees, such as the western larch and the Corsican pine. In conclusion, Mr. Henry described the course he purposed to

pursue in developing the teaching and research in forestry in the University.

The number of students who have just matriculated is 1099, as compared with 1021 who matriculated in October, 1906. Of these, fifteen are advanced students.

The number of first-year students studying medicine is 130, as compared with 122 last year and 117 in 1905.

Mr. R. P. Gregory has been appointed university lecturer in botany in succession to Mr. Hill, as from Michaelmas, 1907, until Michaelmas, 1912, and Mr. A. M. Smith has been appointed demonstrator in the same subject for the five years ending September 30, 1912.

The general board of studies will shortly proceed to appoint a university lecturer in advanced human anatomy in succession to Dr. Hill. The annual stipend is 50*l*. Candidates are requested to send their applications, with such testimonials as they think fit, to the Vice-Chancellor on or before November 5.

OXFORD.—In a Convocation held on October 22, the honorary degree of D.Litt. was conferred upon Prof. E. Meyer, professor of ancient history in the University of Berlin, in recognition of his work on Egyptian hieroglyphs and researches in Egyptian history and chronology, and his general study of history.

The offer of a sum of about 1000*l*. for the foundation of a prize as a memorial of the late Prof. Weldon, and for the encouragement of biometric science, has been accepted by Convocation. The prize is to be awarded every three years for the most noteworthy contribution during the previous six years to biometric science without regard to nationality or sex, biology being interpreted to include zoology, botany, anthropology, sociology, psychology, and medical science.

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MR. A. A. READ has been appointed professor of metallurgy at the University College of South Wales and Monmouthshire.

AT University College (University of London) on October 16, the Chadwick medals for municipal hygiene and engineering were presented to Mr. N. G. Dunbar, Mr. W. D. Reynolds, and Mr. J. R. Wade.

THE Lord Lieutenant of Ireland will open the new Municipal Technical Institute at Belfast on Wednesday next, October 30. In connection with the opening, a conversazione will be held in the institute on Friday, November 1.

THE third annual general meeting of the Association of Teachers in Technical Institutions will be held on November 9, at 3 p.m., in the South-Western Polytechnic, Chelsea, S.W. The annual report of the council will be presented, and other business transacted.

AT Bedford College for Women (University of London), Reid fellowships for research have been awarded to Miss Tchaykovsky and to Miss C. Saunders. Dr. W. H. Willcox has resigned the appointment as lecturer in hygiene, and Mr. J. A. H. Brincker has been appointed temporarily to take his place.

THE President of the Board of Education, Mr. McKenna, on October 18 laid the memorial stone of a new girls' high school at Gloucester. The cost of the school buildings alone is to be 13,615*l*. Subsequently, Mr. McKenna delivered an address to a large meeting of persons interested in education, and directed attention to a modern tendency in educational administration by which is being realised the American conception of a single type of public school for all classes of the community.

THE report read by the principal, Mr. H. B. Knowles, at the distribution of prizes to the students of the Salford Royal Technical Institute on October 18, referred to several points of interest to administrators of technical institutions. Mr. Knowles directed attention to the fact that the Board of Trade requires that a candidate who seeks to qualify as an engineer in the mercantile marine must have served as an apprentice for at least four years. Time spent in a suitable technical school may, however, be accepted as equivalent to artisan service in the ratio of three years in the technical school to two years' artisan service. The Board of Trade has recognised the day mechanical engineering courses at Salford as giving suitable training for this purpose. During last session all applicants for admission to the Salford institute under sixteen years of age were required to give evidence that they possessed a satisfactory preliminary knowledge of English and mathematics, and, failing this, were advised first to attend special courses preparatory to the work of the institute. Sixty per cent. of the applicants for admission were thus rejected. Courses of study are now arranged suitable for persons engaged in the chief industries of the district, based upon attendance at the institute on three evenings per week.

SPEAKING at Wakefield on October 17 at a public meeting held in connection with the Wakefield Education Guild, Mr. Haldane said that higher education is of great value to those engaged in industrial pursuits, in fact it is of value to the whole nation. Learning for learning's sake is a great text, and it does not shut out the utilitarian side. The profits of industrial enterprise go to the man of brains, to the man with the power of direction. This shows that it is vital to those engaged in industrial enterprises that they should have command of science and as much knowledge as they can get. Unless knowledge is spread among the people there cannot be equality of opportunity. There is only one leveller, only one man who does anything substantial to make people equal, and that is the schoolmaster. Education in this country will never be right until the elementary school, the secondary school, and the university are linked together. The British people perhaps need education more than any other nation. We are very prosperous; we are very self-reliant; we have magnificent energy; if we had not, we should have been distanced in the race. But we are competing against science and the increasing science which science gives. We are being more and more handicapped in the race, and it is our own individual powers that have enabled us still to get to the goal in front of our competitors. Let us learn before science makes still further advances, and before they are appropriated by foreign nations, to bring ourselves at least up to their level.

## SOCIETIES AND ACADEMIES.

### LONDON.

**Entomological Society**, March 2.—Mr. C. O. Waterhouse president, in the chair.—*Exhibits.*—Commander J. J. **Walker**: Living specimens of the heteromerous beetle *Sitaris muralis*, first re-discovered at Oxford in 1903 by Mr. A. H. Hamm on old stone walls in the vicinity of Oxford inhabited by the mason bee, *Podalirius* (*Anthophora*) *pilipes*, on which it is parasitic in its early stages.—G. T. **Porritt**: Black specimens of both sexes of *Fidonia atomaria* from the Harden Moss Moors, Huddersfield, illustrating the melanic tendency of Lepidoptera in the district.—H. St. J. **Donisthorpe**: *Apion semivittatum*, taken at Deal; *Magdalis duplicata* from Nethy Bridge, the first record of the species for Scotland; *Formica sanguinea* from Aviemore and Nethy Bridge, the first record for Scotland; and *Piezostethus formicetorum*, taken with *Formica rufa* at Rannoch, a species not recorded since 1874.—A. H. **Jones**: A case of butterflies taken this year from Herculesbad, South Hungary, including specimens of *Erebia melas* from the Domogled, which bore a remarkable resemblance to *Erebia alecto*, var. *nicholli*, Oberth., from Campiglio, and *Erebia lefebvrei*, Oberth., also shown for comparison by Mr. H. Rowland-Brown. Mr. Jones also exhibited examples of *Chrosophanus dispar*, var. *rutilus*, and *C. alciphron*, from the neighbourhood of Budapest, both species of great size and brilliant colouring.—Dr. F. A. **Dixey**: Specimens from Uganda of the African Pierine genus Mylothris, showing an almost complete gradation between *Mylothris chloris*, Fabr., and *M. agathina*, Cram.—M. **Jacoby**: Several fine forms of the ab. *ceronus* of *L. bellargus* taken this autumn at Folkestone, and one example of the ab. *cinnides*, Stgr.—Norman **Joy**: A specimen of the rare beetle, *Cryptophagus subdepressus*, Gyll., taken near Garva, Ross, on August 4 last.—W. J. **Lucas**: Two specimens of *Deilephila euphorbiae* bred by Mr. Nicholson and Mr. Summers from larvæ found in Kew Gardens. Mr. Lucas also exhibited several examples of predaceous insects with

their prey *in situ*.—H. M. **Edelsten**: Specimens of *Sesia andraeniformis*, bred from pupæ taken in Bedfordshire and Kent, and ova of *Nonagria cannae*, giving an account of its remarkable methods of oviposition.—A. **Harrison** and H. **Main**: Four broods from females of *Pieris napi*, var. *bryoniae*, captured on the Kleine Scheidegg Pass, Switzerland, in July, 1906, showing a wide range of variation.—Prof. T. Hudson **Beare**: A specimen of the rare bug *Lygaeus equestris*, Linn., from St. Margaret's Bay, also specimens of *Hypera tigrina*, Boh., taken in some numbers on the wild carrot at the same locality, and *Apion semivittatum*, Gyll., off plants of *Mercurialis annua*, all taken during the same period at St. Margaret's Bay.—*Papers*.—The species of Hesperidæ from the Indo-Malayan and African regions, described by Herr Plotz, with some new species: Colonel Charles **Swinhoe**.—The butterflies of Mauritius and Bourbon: Lieut.-Colonel Neville **Manders**.—The hibernating habit of the lepidopterous genus Marasmarcha: Dr. T. A. **Chapman**.

PARIS.

**Academy of Sciences**, October 14.—M. A. Chauveau in the chair.—The transits of Mercury across the sun, and, in particular, on that of November 14 next: G. **Bigourdan**. A review of the various phenomena regarding which further information is desirable, including the visibility of the planet outside the sun, the external and internal contacts, the appearance of the horns and the measurement of their distance.—The summation of Laurent's series: A. **Buhl**.—The invariants of differential systems: Étienne **Delassus**.—A theorem on integral equations: Tommaso **Boggio**.—The analysis of mixtures of air and gas or combustible vapours: Jean **Meunier**.—A new improvement allowing of the rapid detection and estimation of methane: Nestor **Gréhant**.—The reactions in the nickel-plating bath: A. **Brochet**. The causes of the favourable effect of the addition of boric acid to the bath are discussed, and also some peculiarities of the way the anode is attacked.—A vinyl alcohol of the type ArR : C : CH.OH: MM. **Tiffeneau** and **Daufresne**. The substance described in a previous note as anisylcyclopropanol has been found to be methylanisylethenol, $(CH_3O).C_6H_4—C(CH_3) : CH.OH$, the first alcohol of this type to be isolated.—A caoutchouc tree at Tonkin: MM. **Dubard** and **Eberhardt**. The principal characters of the tree are given in detail, and prove that it is a new species of the genus Bleekrodea, and is named *Bleekrodea tonkinensis*. This tree is of great economic interest, as it is the first caoutchouc-bearing tree found in Indo-China. It is abundant, and the rubber produced from it is of the highest quality.—The reception of the light stimulus in the compound eyes of insects, particularly the Muscidæ: P. **Vigier**.—The evolution of the carbon, water, and ash as a function of the age in plants: J. **Tribot**.—The psychophysical law; applications to energetics and photometry: Charles **Henry**.

GÖTTINGEN.

**Royal Society of Sciences**.—The *Nachrichten* (physico-mathematical section), contains the following memoirs communicated to the society:—

March 9.—Determination of absolute values of magnetisation numbers, especially for crystals: W. **Voigt** and S. **Kinoshita**.—Determination of the elastic constants of aragonite: W. **Voigt**.—Interpolation by means of exponential functions: H. **Burkhardt**.—Some properties of the radium atom: E. **Riecke**.

May 11.—Peculiar cases of vibrating membranes: W. **Voigt**.—The influence of internal reflexions on the interference phenomena in doubly refracting crystal plates: H. **Joachim**.

June 8.—The most general concept of the plane continuous curve (second paper): A. **Schoenflies**.—Vibrations of non-uniformly stretched membranes: W. **Voigt**.

July 20.—The so-called general energy equations of the technical theory of rigidity: J. **Weingarten**.

July 27.—Four new letters of Gauss: P. **Stäckel**.

The business communications, part i. for 1907, of the same society include reports on the progress of the publication of Gauss's works and on the Samoa Observatory, together with a memorial discourse on Ludwig Boltzmann, by W. **Voigt**.

## DIARY OF SOCIETIES.

*THURSDAY*, OCTOBER 24.

CHEMICAL SOCIETY, at 8.30.—The Constitution of Phenol- and Quinol-phthalein Salts: a Contribution to the Quinonoid Theory of Colour: A. G Green and P. E. King.—Poly-ketides: J. N. Collie.—Production of Orcinol Compounds by the Action of Heat on the Sodium Salt of Ethylacetoacetate: J. N. Collie and E. R. Chrystall.—A Simple Gas Generator for Analytical Operations: J. M. Sanders.—Some Double Ferrocyanides of Calcium, Potassium and Ammonium: J. Campbel Brown.—Halogen Determination in Organic Substances: J. Moir.—Racemisation by Alkali as applied to the Resolution of *r*-Mandelic Acid into its Optically Active Isomerides: A. McKenzie and H. A. Müller.—The Optical Activity of Cyclic Ammonium Compounds: F. Buckney and H. O. Jones.—Keten. A New Anhydride of Acetic Acid: N. T. M. Wilsmore.—The Action of Phosphorus Pentachloride on Hydroxy-trimethyl Succinic Ester. 1 : 2-Dimethyl Trimethylene 1 : 2-Dicarboxylic Acid: H. Henstock and B. E. Woolley.

*FRIDAY*, OCTOBER 25.

PHYSICAL SOCIETY, at 5.—On the use of Variable Mutual Inductances: A. Campbell.—On Magnetic Oscillators as Radiators in Wireless Telegraphy: Dr. J. A. Fleming.

*TUESDAY*, OCTOBER 29.

FARADAY SOCIETY, at 8.—On the Electrolysis of Salt Solutions in Liquefied Sulphur Dioxide at Low Temperatures: Dr. B. D. Steele.—Note on the Action of Aluminium Powder on Silica and Boric Anhydride: F. E. Weston and H. R. Ellis.—Reduction of Metallic Oxides by Means of Calcium Hydride: Dr. F. Mollwo Perkin and Lionel Pratt.—A Series-Parallel Lamp Resistance Useful for Electrochemical Work: N. T. M. Wilsmore.

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