THURSDAY, SEPTEMBER 19, 1907.

IRRIGATION ENGINEERING.

Irrigation: its Principles and Practice as a Branch of Engineering. By Sir Hanbury Brown, K.C.M.G. Pp. xv+301. (London: Archibald Constable and Co., Ltd., 1907.) Price 16*s.* net.

IRRIGATION is of such paramount importance to extensive tracts in India, and to the whole of Egypt, that it is in these countries that irrigation works have been carried out on the largest scale, and therefore the author, who has gained his experience in this branch of engineering in both these countries, is particularly well qualified for dealing with this subject; and by drawing his examples of works in illustration from both sources, and especially from Egypt, he has been able to present the principles and practice of irrigation in their grandest and most modern aspects. The whole object of irrigation is to supply water for agriculture to lands which are either devoid of adequate rainfall or on which the rain does not fall at a suitable period for the crops; and owing to the very unequal and irregular distribution of the rainfall in certain warm, and especially tropical, countries, large and extensive engineering works are often required to store and convey the abundant rainfall to arid regions at a distance. The simplest sources of water for irrigation are rivers which overflow their banks in the flood season, and inundate the adjacent low-lying lands, such as the Nile in Egypt, the Tigris and Euphrates in Mesopotamia, and the Indus in Sind. As, however, the land near the river bank is higher than the plains at the back, owing to the chief deposit of silt from the muddy flood-waters occurring when the overflow from the river loses its velocity on overtopping the banks, inundations would only occur with high floods, and would spread irregularly over the land according to variations in level.

To provide against these natural defects, and to obtain a uniform distribution of the fertilising silt as well as of the water, the basin system of irrigation was introduced, in which the land is divided by banks into a series of basins, and the water is admitted into the large low-lying basins at the back through sluices at the side of an embanked canal drawing its supply from the river above the highest up-stream basin of the set; whilst the smaller basins at a higher level adjoining the river are fed from a high-level canal deriving its water from the river further up-stream. By these arrangements the filling of the several basins in each set can be regulated with uniformity, and advantage is taken of a high flood to secure a large deposit of mud serving as manure. The mud is gradually deposited from the still water in the basins, and when the river falls the clear water is discharged, and the seed is laid in the damp mud. The basin system has been very extensively developed in Egypt; whereas in India canals draw the water from the rivers in flood-time, and irrigate the land by means of branch canals leading the water into field channels. Irrigation by inundation, however, only provides for winter crops; whilst the more valuable summer crops, such as sugar-cane, cotton, and rice, need water at definite intervals when the rivers are low, and protection from inundation during the flood season. This perennial irrigation enables two crops to be raised in the year, and more than doubles the value of the land; and the water stored by the Assuan dam has provided for the conversion of 450,000 acres from basin irrigation into perennially irrigated land. Besides rivers, wells, lakes, and artificial reservoirs afford sources for the supply of water for irrigation.

In India, wells irrigating 13 million acres are second only in importance to canals from rivers, which irrigate 17 million acres; whilst tanks enclosed by embankments, serving as primitive storage reservoirs collecting the rainfall and local drainage, irrigate 8 million acres; and the high concrete reservoir dam across the River Periyar, in the very rainy district of Travancore, stores up water which is discharged by a tunnel through the Ghats for irrigating the arid district of Madura, on the eastern side of the mountain range. Wells are used for irrigation in Egypt, but do not occupy at all the same important position as in India; though in olden times Lake Mœris provided a natural reservoir filled with water in flood-time, and supplementing the discharge of the Nile at its low stage, for which also the equatorial lakes act as regulators at the present time; whilst the reservoir formed by the Assuan dam supplies water for summer irrigation when the flow of the Nile is deficient. In the chapter on sources of supply it is stated that the storage required to secure the volume of water needed for the irrigation of summer crops for the whole of Egypt, during the hundred days in the year during which the flow of the Nile is at its minimum, is six thousand million cubic metres, of which one-sixth has been provided by the existing Assuan reservoir. The author enumerates five methods of increasing the storage, the first of which, namely, the raising of the Assuan dam, has been decided upon, since the book was written, for doubling the present supply; whilst the second proposal of building a second dam higher up the Nile has been rejected as impracticable. Little attention has been bestowed on the third project of forming a reservoir in the Wadi Rayan depression near the site of Lake Mœris; and a reservoir of this kind at the side of the river, when periodically filled up with muddy Nile water, would appear destined to be filled up before long with deposit.

The two last schemes for increasing the supply, advocated by Sir William Garstin, consist in effecting a great reduction in the loss from evaporation of the flow of the White Nile in passing through the swamps of the Sudd region, by diverting the discharge from the swamps into a straight cut, not less than 210 miles long, from Bor to the confluence of the River Sobat at Taufikia below the Sudd region, and combining this increased discharge with the utilisation of the Albert Nyanza for storage, during the four months of flood discharge, by regulating its outflow, so as to make up the deficiency during the remaining eight months. The new cut would have the great value of permanently increasing the flow of the Nile throughout the year below the confluence of the Sobat, but

its construction would involve a very great expenditure, and occupy a long time; and it is very unfortunate that the fact of Lake Tsana, near the headwaters of the Blue Nile, being in Abyssinia is considered as precluding its utilisation as a storage reservoir for the irrigation of the Sudan and Egypt, with its great natural advantages of extensive area and commanding position. Several sections of reservoir dams are given in a chapter on dams and reservoirs, which, being drawn to various scales, are not readily compared, though forming an interesting series; but the foundations of the new Croton dam have had to be carried down more than forty feet deeper than shown on the section; and the Salt River dam, constructed for the irrigation of an arid district in Arizona, only about seventeen feet less in maximum height than the Croton dam, has the crest of its waste weirs raised the unprecedented height of 225 feet above the deepest part of the river-bed at the dam.

Interesting descriptions are given of the diversion weirs across rivers in India to raise their water-level for supplying inundation canals, and of the Zifta, Delta, and Assiout barrages for regulating the supply of irrigation water from the Nile, worked by Stoney's sluice-gates sliding on free rollers. The important function, however, performed by the Assiout barrage in raising the water-level of the river in August, 1902, during so low a flood of the Nile that the water could not flow into the great canals, until, by the prompt action of Mr. Webb in closing the gates, a sufficient head was obtained, for which the barrage had not been designed, should not be overlooked, as it preserved a large tract from a loss in non-irrigated crops of more than 600,000*l*. Moreover, the Esna barrage, in course of construction across the Nile between Assuan and Assiout, has been designed of sufficient strength to perform a similar duty when needed in perfect safety. Standard books, indeed, have been previously issued dealing with irrigation works on their grandest scale, in "The Irrigation Works of India," by Mr. Buckley, and "Egyptian Irrigation," by Sir William Willcocks; but the book under review will be very valuable for all persons interested in irrigation, by dealing in a single volume with and contrasting the principal works and systems of irrigation in these two great countries, and thus presenting a very comprehensive view of that most important subject of irrigation for the development of arid regions.

GEOLOGICAL EXPLORATIONS IN SINAI.

The Topography and Geology of the Peninsula of Sinai (South-eastern Portion). By W. F. Hume. Pp. 280+plates. (Cairo: National Printing Department, 1906.)

THE interesting region described in this memoir by the superintendent of the Geological Survey of Egypt extends from near Dahab along the western borders of the Gulf of Akaba to the promontory of Ras Mohammed. It lies east of Mount Sinai proper, or Gebel Musa, which is not, however, the highest of the Sinai mountains.

Attractive as the region is from an historical point of view, and interesting as it is to the naturalist, it offers few temptations for the ordinary tourist; and this not merely because it is an arid country. The Arab inhabitants are honest and obliging, but their dwellings consist simply of cloth stretched on a few poles, and placed under the protection of a rocky ridge. Keen as sportsmen, they use flint-lock guns, often of great length, serviceable for small game, as well as for the leopard, hyæna and ibex, which are the more abundant of the larger mammals. The country itself has been spoken of as "one of the most mountainous and intricate regions on the face of the earth," and Dr. Hume admits that much of it is a veritable wilderness with a bewildering complex of topographical structure. To the mountaineer it will hardly appeal, as there are no inaccessible peaks, but to the botanist and zoologist, who will find chapters specially devoted to them, and to the geologist, there are many attractions, not the least of which may be the absence of any extensive literature on their subjects.

The main portions of the area are composed of igneous and metamorphic rocks of ancient date—pre-Carboniferous at any rate. They rise in a mountain system trending north-east and south-west with a transverse chain that parts the region into two districts. The rocks include gneiss and sundry schists, granites, andesites, felsites, &c. The earliest sedimentary and volcanic rocks were penetrated by masses of granite, and some of the later intrusions have been arranged in strikingly symmetrical lines. The northern portion of this region is largely plateau, an old plain of marine denudation that appears only recently to have lost its capping of Nubian Sandstone. It has an average level of 1220 metres, except where cut by narrow gorges. In the southern portion, which comprises a multitude of ranges and peaks, the valleys are more deeply excavated, and in consequence the mountains, though lower, appear relatively higher than those in the north.

Still further north there is an area composed of barren Nubian Sandstone with overlying fossiliferous limestones of Cenomanian age, where the succession is greatly disturbed by trough-faults that have led to the production of rift valleys.

The structure, in a broad sense, is comparatively simple, as Dr. Hume observes, the main features having been produced by upheaval and dislocation rather than by erosion. Thus the principal mountain chain is due to a fault with a westerly downthrow of more than 5000 metres. Nevertheless, the influence of the rocks on the configuration of the land is well marked. The summits of many peaks are formed by felsite dykes; elsewhere parallel dykes of felsite and dolerite form the remarkable "dyke country," while the granite, which wears away in shells, presents curious rounded knobs and pillars. The coastal plain exhibits many features of interest in the presence of Miocene strata, and also of raised coral-reefs of Pleistocene age. Moreover, there are terraces of roughly stratified gravel in the principal valleys, as well as countless loose boulders. These were probably of torrential origin, distributed during the Glacial period, when, as Dr. Hume remarks, a small amount of *névé* might have accumulated on the Sinai mountains. Of still later date are some curious calcareous sandstones

that contain oolitic grains, and are perhaps of marine origin. No economic products of great importance are known, though ores of copper, iron, and manganese have been found, and it is suggested that gold should be sought for.

It only remains to add that the work is well printed and illustrated. If the geological maps are exceptionally ruddy in tint, this arises from the extent of igneous rocks. For the topographical details the author expresses his indebtedness to Mr. H. G. Skill, who contributes also an appendix on meteorology. The photographic views enable the reader to gain a good idea of the scenery and rock-features, as well as of a hyæna-den, of certain stone-circles, and of the Sinai convent. H. B. W.

ELECTROCHEMISTRY.

A Text-book of Electro-chemistry. By M. Le Blanc; translated by W. R. Whitney and J. W. Brown. Pp. xiv+338. (London: Macmillan and Co., Ltd., 1907.) Price 10*s.* 6*d.* net.

THE new English edition of Le Blanc's "Electrochemistry" has followed very closely upon the publication of the fourth German edition. One is at once struck by the great increase in size of the book and by the large increase in the number of diagrams. From the translators' preface we notice that twenty-five of the diagrams have been added by themselves, and the book has certainly been improved by the additions.

Although the scheme of the book is much the same as it originally was, the additions are so numerous that it is almost a new work. By studying this edition and the first edition, which appeared in 1895, one is struck by the large amount of work which has been done in the domain of electrochemistry, albeit the fundamental laws have undergone very little change, the chief being one of degree rather than of principle. The ionic theory has been assailed from all sides, but although certain modifications have been made, such, for example, as the conception of the hydration of the ions, it must be conceded that it has rather gained strength than lost by the attacks. If those who assail the theory would give an alternative hypothesis which would as satisfactorily explain the phenomena of solution as does the ionic hypothesis, then the arguments would assume a more tangible form, and the ionic theory might be consigned to the limbo of history.

Prof. Le Blanc deals almost entirely with the theoretical aspects of electrochemistry, but at certain points he indicates the bearing of theory on practice. For example, on p. 18, when referring to the conversion of heat into electrical energy and of electrical energy into heat, a digression upon the "Electrical Furnace and its Industrial Importance" is made, the application of Ohm's law being given. Brief reference is here made to calcium carbide, cyanamide, carborundum, phosphorus, and the preparation of nitrates from atmospheric nitrogen, but the book, as already mentioned, does not deal with technical processes.

Chapter ii. deals with the development of electrochemistry up to the present time, and treats in the main with the development of the ionic theory.

More notice might have been taken of the difficult subject of the electrolysis of fused salts, the author having contented himself with a footnote on p. 316 referring the reader to Lorenz's "Die Elektrolyse geschmolzener Salze," and a remark that the phenomena are entirely analogous to those of aqueous solutions. The interesting phenomenon of electrolysis without electrodes is referred to on p. 317, and it is pointed out that in this case, as in electrolysis where both electrodes dip into the solution, Faraday's law is obeyed.

The translators, Drs. Whitney and Brown, have paid particular attention to nomenclature, and have endeavoured to be consistent throughout. The method adopted is set out in full in an appendix. The adoption of F instead of E for electromotive force is hardly happy; according to this rendering we get Ohm's law

$$C=\frac{F}{R},$$

F is more generally used to denote a Faraday, or 96,540 coulombs of electricity. The translators employ the symbol Q for quantity of electricity. These are, of course, minor points, but they are inclined to muddle the student. It would perhaps be a good thing to convene an international committee so that electrical and electrochemical nomenclature might be standardised; at present it must be admitted that it is more or less chaotic.

From a theoretical standpoint we do not think it possible to meet with a better book than the one before us, and there is little doubt that it will be highly appreciated and widely studied. F. M. P.

AUSTRALIAN INSECTS.

Australian Insects. By Walter W. Froggatt, Government Entomologist, New South Wales. Pp. xiv+449; with 37 plates, containing 270 figures, also 180 text-blocks. (Sydney: William Brooks and Co., Ltd., 1907.) Price 12*s.* 6*d.*

THIS is the first general introductory work published on the insects of Australia, and it will be very useful to residents commencing the study of entomology, as well as to any European or American entomologists who wish for a general view of the Australian insect fauna, which contains a large number of highly interesting forms not met with in other parts of the world, though some species found in the extreme north appear to be only an offshoot from the rich tropical fauna of New Guinea.

The classification adopted is mainly that employed by Dr. D. Sharp in the "Cambridge Natural History." Mr. Froggatt commences his work with an introduction, tables of contents, and chapters on classification, distribution, structure, and fossil insects; after a detailed account of the principal groups of insects represented in Australia, including much interesting information about habits, &c., he concludes the book with chapters on the collection and preservation of insects, museum collections and types, publications dealing with Australian entomology, and an alphabetical index of Latin and English names.

We have, fortunately, no representative of the termites, or white ants, in Britain, though one species is found as far north as Bordeaux; but the author figures the huge nests of several Australian species, one of which, *Termes meridionalis*, Froggatt, builds what is called a "magnetic nest," like a brick wall, about 10 feet high and long (judging from the figure of the man standing in front), always pointing north and south, with the wall facing east and west. Another species, *Eutermes pyriformis*, builds a towering pillar-shaped nest, often 18 feet high.

Among the more remarkable specially Australian insects of various orders figured in this book, we may mention the curious apterous desert cockroaches (genus Polyzosteria, p. 19); the great Phasmidæ (of which *Podacanthus wilkinsoni*, Macleay, is figured as an example on plate v.); various strange grasshoppers, &c. (on plates vi. and vii.), and neuropterous insects (pp. 60, 61, plate ix.); the curious sawflies belonging to the genus Perga, &c. (pp. 71–73, plates x. and xi.); various handsome Buprestidæ (plate xviii.); the gaudy day-flying moths of the family Agaristidæ (p. 233) and the "whistling (stridulating) moths" of the genus Hecatesia, which emit sounds like the call of a Cicada (pp. 234, 235), of which latter group there are also many large and remarkable Australian species. We may also note that while the butterflies of Australia are not specially numerous or remarkable, the moths are extremely numerous and interesting, many being very remarkable either for their size, their structure, or their beauty. Of course, we do not meet with many British species, but among them we may mention forms of the painted lady butterfly and the convolvulus hawkmoth, hardly distinct from the ordinary European insects, and the well-known meal moth or flour moth (*Asopia farinalis*, L.) figured on p. 269.

Occasionally we note a trifling error; thus, on p. 41, the names *Locusta danica* and *Œdaleus senegalensis* appear to have been transposed by some accident.

We congratulate Mr. Froggatt on the publication of this useful and interesting book. W. F. K.

OUR BOOK SHELF.

Nature's Craftsmen: Popular Studies of Ants and other Insects. By Henry Christopher McCook. Illustrated from Nature. Pp. xi+317. (London and New York: Harper and Brothers, 1907.) Price 7*s.* 6*d.* net.

Dr. McCook has long been known as one of the most painstaking and successful of the investigators of insect life in America, and the publication of a selection of his researches in a more popular form will, we hope, bring them under the notice of a far wider public than his former works have appealed to. There is no want of variety in the volume before us, and, in addition to ants and spiders, which are perhaps the author's favourites, he discusses bees, wasps, ant-lions, cicadas, caddises, &c. Still, nearly one-third of the book is taken up with the most interesting subject of the whole insect world, ants; probably the most highly organised of all known animals, born, not only in complete armour, like some of the ancient gods and heroes, but provided with all the tools and requisites necessary for their busy and industrious lives, even to brushes and combs, &c. Their wonderfully organised communities, where each works for all, and all for each, make our most advanced civilisations appear almost as barbarism in comparison, and our grandest architectural and engineering triumphs little better than mud-pies.

Among the most curious developments of ant-life are the so-called "honey-ants," where the nests contain a certain class of ants in which the abdomen becomes enormously distended with a sweet substance derived from a kind of oak-gall. When they have attained this condition, they pass their lives in the nests, hanging to the uneven roofs of the vaulted chambers, and they dispense food to the workers, by whom they are tended like the other dependent classes of the community, such as the queens and larvæ. An excellent illustration of one of these internal chambers is given on p. 99. This was taken from a nest eight feet long, three feet high, and a foot and a half wide, formed of galleries and chambers honeycombed in the solid rock.

The book is written in a very pleasing style throughout, with the exception of the last few pages, which bear signs of haste. The illustrations are also numerous and spirited, and many readers will be pleased to see the frontispiece, which gives us a portrait of the amiable author sitting on a lawn in a garden chair.

In conclusion, we may perhaps venture to express a regret that the word "instinct" is still used, as it appears to us to be an obsolete expression which is philosophically untenable at the present day, and which it would be just as well to avoid.

Concrete Steel Buildings. By W. Noble Twelvetrees. Pp. xii+408. (London: Whittaker and Co., 1907.) Price 10*s.* net.

This is a companion volume to the author's work on concrete steel, in which the distinctive characteristics of reinforced concrete were dealt with, and the theory underlying the design of structures in this material was discussed fully and in detail. In the present volume the author gives particulars of a number of typical pieces of constructional work in ferro-concrete which have been carried out in this country and abroad during the past few years. Mr. Twelvetrees has selected with great care the various examples of this method of building construction which he describes, and architects and engineers who consult this book will have little trouble in finding full descriptions of buildings similar to any they may be called upon to design. Examples of transit sheds for docks, railway goods stations, warehouses, factory buildings, business premises, villas, flour mills, hotels, theatres, &c., are all in turn fully described, and excellent illustrations are given of all important details, with copious notes as to the methods of making the concrete, the nature and disposition of the reinforcing steel, and of the results of proof tests of the structures. In the illustrations, which form a very important feature of a book of this nature, the author has wisely contented himself with giving the chief overall dimensions. When a radical departure from ordinary practice, such as the use of ferro-concrete, is made in constructional works, much can be learnt from the inevitable failures, and the last chapter of the book is devoted to a brief account of a few noteworthy collapses and of the probable causes of these failures, whether due to faulty design, or to bad workmanship, or to both causes. In the appendix a list is given of concrete-steel buildings and other structures in the United Kingdom, which will be found useful by those who are anxious to have the chance of inspecting such works before

deciding to adopt this type of construction in any given case. An excellent index adds much to the value of this book for reference purposes, which will prove a welcome addition to the library of every architect and civil engineer. T. H. B.

Waterworks Management and Maintenance. By W. D. Hubbard and Wynkoop Kiersted. Pp. vi+429. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd., 1907.) Price 17*s.* net.

THIS book is divided into three parts, the first dealing with the methods and principles of developing, improving, and storing water supplies; the second with the maintenance and operation of waterworks; and the third with water rates, and depreciation and valuation of waterworks property.

Although this book treats of American practice, and cannot be regarded as a text-book for experts, yet it contains a great deal of information useful to those having the designing and management of waterworks for urban districts.

The authors point out that in selecting a source from which a supply can be obtained a knowledge of the physical characteristics of the territory from which the water is to be obtained is the first consideration; a chemical analysis is necessary to detect impurities; and as drinking water is a medium through which the bacilli of certain diseases may be imbibed, and infection thus widely disseminated, a rigid bacterial examination has now become a recognised necessity.

Chapter i. treats of ground water supply and wells, the percolating capacity of soils, rate of filtration through sand, and purification works. The second chapter deals with water supply from rivers, and the means of fitting it for domestic use. The third chapter describes the class of engines in use for pumping, the other chapters treating of plans and records, service connections, meters and fittings, fire protection, financial management and accounts, water rates, and depreciation.

Attention is directed to the subject of electrolysis, or the effect that the introduction of street railways worked by electricity has had on the water mains; and illustrations are given showing the effect of electrolysis on the cast-iron mains. As a result of electrolytic action the metal of the pipes becomes in some cases so softened that it can be cut with a knife. Cast-iron is affected the least, wrought-iron next, mild steel the next, then high carbon steel, and lead the most. The salts in the ground also have a varying effect, the order of activity being chlorides, nitrates, and sulphates. The drier the soil the more resistance it offers to the passage of the current. Wasting of the lead in the joints also leads to leakage and eventual failure of the pipe by the blowing out of the lead.

Pictures from Nature's Garden; Stories from Life in Wood and Field. By H. W. Shepheard Walwyn. Pp. 311; illustrated. (London: John Long.) Price 6*s.*

To the naturalist the chief point of interest in this little volume is undoubtedly centred on the illustrations, which are reproductions from photographs by the author. Among these we may specially refer to one of a dormouse asleep (p. 34), which, so far as we know, is unique, and certainly of great interest. The photograph of a sleeping bat, apparently a pipistrelle (p. 27), is likewise excellent, as is also one of a Japanese or Manchurian sika-deer, with the white "chrysanthemums" on the buttocks fully expanded (p. 306). In both these instances it is a pity that the names of the species depicted are not given. As to the text, we venture to think even the author himself would admit that it is scarcely of a nature demanding detailed notice in the columns of this journal.

R. L.

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.]*

On Correlation and the Methods of Modern Statistics.

IN NATURE of August 29 (p. 461) appeared some account of a discussion at the British Association on modern methods of treating statistics. The following paragraph occurs:—

"Mr. A. R. Hinks, who was somewhat sceptical as to the general applicability of the new methods, inquired what meaning could be attached to the value 0·3 of the correlation coefficient in such cases as $y=\log x$. He also gave an example in which questionable conclusions had been arrived at by the method, the reason being that certain groups of stars had been studied for special purposes, while others had been neglected."

The obvious answer to the first part of Mr. Hinks's inquiry is that no meaning could be attached to the particular value 0·3 unless we were told what part of the relation $y=\log x$ it referred to, and then it would have a quite definite but limited meaning. Every statistician trained in modern methods in the case of statistics belonging to new material plots his regression lines and tests the approach to linearity in his material. When he finds any orderly system, but no approach to linearity, he naturally tests the dependence of his characters by the correlation ratio. That test applied to Mr. Hinks's case of two absolutely correlated variables $y=\log x$ gives unity or perfect correlation, as we might anticipate.

Writing to Mr. Hinks for further information as to the bearing of the second part of his criticism, he tells me that the report is too brief to be intelligible, and owing to his courtesy I have been provided with a fuller report of his speech, in proof, for the Journal of the Royal Statistical Society. The "questionable conclusions" reached by the method of correlation to which he refers occur in "a recent paper published under the auspices of Prof. Karl Pearson" (Winifred Gibson, Monthly Notices R.A.S., vol. lxvi., p. 445), and the special point to which Mr. Hinks refers is the result reached by Miss Gibson for the relationship between parallax and photometric magnitude. The point is an extremely interesting one, and that must be my excuse for ventilating the matter in the pages of NATURE. Mr. Hinks makes two criticisms, the first as to method and the second as to matter.

First, as to Method.—Mr. Hinks says that if the stars were uniform in size and brilliancy, the parallax and magnitude relation would be logarithmic, and consequently the coefficient of correlation would not be unity. "He understood that in such a case it was proper to use correlation ratios, but not correlation coefficients. If this was so, he would ask the exponents of modern methods to erect a very large and conspicuous danger signal to keep astronomical statisticians from falling into such a trap."

Now Miss Gibson's paper was, I believe, the first to place modern statistical methods before astronomers, and the statistician may well make slips in a new field. But as to *method*; what does she actually do? She calculates (1) the correlation coefficient between magnitude and parallax, (2) the correlation coefficient between parallax and amount of light, and finding both small, she plots (3) the regression line, and calculates the correlation ratio, and as this takes a value of 0·4, she points out that the correlation coefficient is not the suitable measure in this case. In other words, she puts up the very danger signal which Mr. Hinks requires! I fail entirely to see how Mr. Hinks's remarks as to the logarithmic relation apply to Miss Gibson's work. She has treated the matter correctly from the statistical standpoint, and her paper shows that she was fully aware of the possibilities attached to a logarithmic relationship, which she more than once cites.

Secondly, as to Matter.—Here Mr. Hinks is on safer ground, but one in which I fancy astronomers have been guilty of a considerable amount of circular reasoning.

They start from the hypothesis that magnitude is very closely related to parallax, and when the statistician shows that the best determined parallaxes show no continuous relationship between parallax and magnitude, they turn

round and say: "Yes, but our stars were selected because they had big proper motions." They thereby screen entirely the fact that the fundamental hypothesis that the brighter stars are much the nearer as yet awaits statistical demonstration. Miss Gibson worked on the seventy-two stars given by Newcomb, as of fairly well-ascertained parallax. Mr. Hinks says that the peaks in Miss Gibson's parallax-magnitude curve are in two out of three cases due to selection of certain stars because of their exceptional proper motion. Now this naturally leads us to inquire why the stars with magnitudes about 2 and again about 6 were not selected by their proper motions, but those about 4 and 5 and again those about 7 to 9 were. Further, there is a fundamental point which Mr. Hinks has to meet. Statistically to produce large effect on the correlation of two quantities by selection, the character used for selection must have high correlation with both. In other words, if the selection of stars by proper motion is to pull down the assumed high relationship between magnitude and parallax to a low value, not only must magnitude and proper motion be highly correlated, but proper motion and parallax. Now these correlations have been carefully investigated, and we know what they are—they are such as to influence, but not very much influence, any relation between parallax and magnitude. Now I think the circular process of the reasoning I have referred to will be visible. It runs as follows:—

There is a high relationship between parallax and magnitude; it is not statistically evident, because the parallax stars have been chosen on account of proper motion; this involves a very high correlation between proper motion and magnitude; a very moderate correlation, but not a high correlation, does exist. Shall we say that these stars have been selected by reason of something else?

Surely the hypotheses of high relationships between magnitude and parallax and proper motion are of sufficient importance to deserve *proof*, rather than to be taken as axiomatic? If the reader will examine Table III. of vol. ii. of the Yale Observatory Memoirs (p. 202), which has reached me since Miss Gibson's memoir appeared, he will find the parallaxes of 163 stars, differing widely from Newcomb's series, dealt with, but the correlation ratio (0·28) is even less than that (0·40) found for Newcomb's material. The specious appearance of descending magnitude with the parallax groups is almost wholly due to the first group of large negative parallaxes, which seems merely to signify that large errors of parallax are more common with faint stars. I take it that 0·35 is an excessive value for the relationship between proper motion and magnitude.[1] Against these merely moderate relationships I would place those connecting spectral class and magnitude, which can be as high as 0·69, and, again, the fact that colour and magnitude are related at least as closely as parallax or proper motion and magnitude; and I would venture to ask whether it may not be that the mass, the chemical constitution, and the life-history of a star, as evidenced in its spectroscopic character, have sensibly more to do with the magnitude than its mere distance? After all, almost any theory of distribution of stellar mass, position, and motion would lead us to expect a relatively small correlation between proper motion and distance, sensible, indeed, on the average of great numbers, but as ineffectual for the purpose of selecting an individual as choosing an able assistant by a preliminary measurement of his head.

KARL PEARSON.

Biometric Laboratory, University College, London.

[1] Dr. A. Lee has worked out for me the correlation ratio for more than 300 northern and 300 southern stars in Boss's catalogue. For the southern stars the correlation of magnitude and proper motion is insignificant, for the northern stars it is much less than in the above cases, and would be insignificant but for a group of four stars with magnitude less than 1·5. These points will be brought out in a forthcoming memoir.

Plague Prevention in India.

HIS MAJESTY'S recent letter on this subject to the Government of India was well designed to stimulate the Government to more active efforts against the disease, but has been followed by pronouncements from it which do not suggest any strong hope that that object will be attained. In these pronouncements the Government of India issues advice to the heads of local administrations regarding the methods of dealing with plague—a familiar matter; but, as the *Pioneer Mail* of August 23 remarks:—"Nothing is said about finding the money for the proper carrying out of these recommendations." There is, moreover, another defect which suggests further doubts. The whole of the edict is filled with injunctions to avoid "any action which excites the opposition of the people." Now as almost every sanitary action, from cleansing the backyard upwards, does excite the opposition of a large percentage of the people, this policy means, I fear, not the advancement, but the abandonment of any large-scale operations against plague in India.

Obviously, in epidemics as in war, the superstitions, fancies, and trifling objections of the individual must give way to the public interest. The only alternative is widespread death. To use compulsion may be unpleasant to a Government, but it is a duty to use it. If a Government does not use compulsion it must be held responsible for the fatal results. In my experience, popular opposition to sanitary measures is not really a serious matter. The strength of it is in inverse proportion to the capacity and resolution of the authorities. What opposition has occurred in this case has, I think, been created largely by the original weakness which gave in to it. It is useful to compare the despotic and successful sanitary methods of the Americans with the feeble and futile system adopted in India.

It is difficult to see the object of this pronouncement of the Government of India, which will apparently tend only to hamper executive officers in the performance of their duties. We must infer that the recommendations were made chiefly with a view to please the numerous pseudo-philanthropists who exert so much evil influence in the councils of the great empire of Letspretendia.

Those who wish to ascertain what is really being done against plague in India, compared with statements in Parliament, should consult Prof. Simpson's recent lecture in the *Lancet*, especially that of July 27. According to him, the Government has spent only about 1,500,000*l.* on plague prevention, against 17,000,000*l.* on famine relief, and this in spite of the fact that 20,000,000*l.* surplus revenue has been collected during the same period (since 1896).

I have not seen any complete discussion of the actual measures which should now be taken against plague in India, but think that the following will be approved of by most hygienists who have considered the matter:—

(1) The whole of the plague administration should be centralised, removed from the hands of the civilians who have hitherto obtained such poor results, and put in those of experts, on the American system. This administration should allot the expenditure, indicate the researches, direct the practical measures, publish monthly reports showing exactly what it is doing, and be held responsible for the results of its work.

(2) The expenditure on plague research should be increased ten-fold. The present commission is doing excellent work, but the investigations can be obviously enlarged so as to include many new fields, such, for instance, as the search for a specific therapeutic agent, on the lines of work now being done in connection with sleeping sickness.

In the message of the Government of India there is no sufficient statement on either of these important points. We may rest assured that if they are not included the plague measures will remain as ineffective as before.

RONALD ROSS.

The University, Liverpool, September 16.

Root-action and Bacteria.

IN NATURE of July 18 (p. 270) I mentioned that I had proved the excretion from plant roots of a toxic substance. This substance proves to be alkaloidal in nature, and is precipitated, in addition to the usual alkaloidal reagents, by most of the substances in use as artificial manure. Potassium sulphate and chloride appear to be the most complete precipitants of all the reagents so far tried. They appear to precipitate the substance in the form of a base—a white amorphous powder. The amount excreted is by no means negligible, and *Sesamum indicum*, indeed, in its early stages at least, appears to excrete more solid matter than it builds up in its own substance.

Details are given in a Memoir of the Agricultural Department of India.

F. FLETCHER.

Ghizeh, Egypt, August 22.

SOME SCIENTIFIC CENTRES.

X.—THE LIVERPOOL SCHOOL OF TROPICAL MEDICINE.

ON July 9, 1898, Major Ronald Ross completed the proof that the malaria of birds was transferred by the bite of mosquitoes from infected to healthy birds. In December, 1898, a commission was dispatched by the Colonial Office to British Central Africa to study blackwater fever, to inquire into the truth of Ross's discoveries, and to study the whole question further.

About this time, Sir Patrick Manson had been urging the formation of schools of tropical medicine, and the subject had received energetic support from Mr. Chamberlain. In Liverpool, also, the subject was warmly taken up, and with such practical result that the first tropical school was founded by Sir Alfred Jones, K.C.M.G., in November, 1898. Major Ross was appointed the first lecturer of the Liverpool School of Tropical Medicine, and the school was formally opened by Lord Lister on April 21, 1899, and on July 1 Major Ross delivered his inaugural lecture, directing attention to his scheme for extirpating malaria by attacking the pool-breeding mosquitoes. The further result of this was that at the end of July, 1899, the first (malarial) expedition of the school was dispatched to Sierra Leone, West Africa. This was the first of those expeditions to the tropics which have made the school famous. Since 1899 there has not been a year in which some expedition has not been carrying out research in the tropics, and at the present moment there are at work one in Brazil at yellow fever, another in Africa on trypanosomiasis; and a third is on the point of starting to study blackwater fever in Central Africa.

The educative effect of these expeditions has been immense, and we hardly think it can be doubted that every person interested, not only in West Africa, but in the tropics generally, owes a deep debt to the school. Not only has the direct practical outcome in the saving of life been great, but indirectly also a powerful effect is exercised on the young generation, so that now those going to the tropics do so with a knowledge of what risks they run in respect of malaria, and how to avoid them.

But, further, the influence of these expeditions and of the reports furnished by them has given an immense impetus to anti-mosquito measures all over the world. The most successful instance and the best known of these measures has been the extinction of malaria at Ismailia, and perhaps it is not too much to claim that the influence of the Liverpool School of Tropical Medicine has determined the magnificent success of anti-mosquito measures under Col. Gorgas against yellow fever at Havana.

In this connection it is of interest to point out that Major Ross will read a paper at Berlin this autumn summing up the progress of anti-malarial measures in British Possessions all over the world. The gain to the public is, then, we believe, a great one. That the scientific results have been not inconsiderable is evident from the publications of the well-known memoirs of the school. Since 1899, when the first memoir was published, twenty-one memoirs had been published up to 1906, together with a text-book, "The Practical Study of Malaria and Other Blood Parasites."

Perhaps the two most striking discoveries recorded in these memoirs were, firstly, that of Dutton, of a human trypanosome in man, *T. gambiense*, the finding of which was the forerunner of that of the same trypanosome as the causative agent of sleeping sickness; and, secondly, Dutton and Todd discovered, independently of Milne and Ross, the spirochæte, *S. duttoni*, of African tick fever, and they showed that it was transmitted by the tick *Ornithodorus moubata*.

Thus the school can claim a worthy, if not exclusive, share in the elucidation of three of the great diseases of Africa, viz. malaria, sleeping sickness (trypanosomiasis, and African tick fever. Thomas's successful experiment in Manaos in infecting chimpanzees with yellow fever by means of mosquitoes is also worthy of mention.

These expeditions have cost the school large sums of money, and have also involved the loss of two valuable lives, viz. those of Dr. Walter Myers and Dr. J. E. Dutton. Myers, who gave promise at Cambridge of a distinguished career, died of yellow fever at Para shortly after the commencement of his work. Dutton's brilliant career was cut short by death while working in the Congo. Two recent developments show that the school is still in vigorous youth, and is not content with its past achievements. We have above alluded to the publication of the memoirs. These memoirs were exclusively devoted to the publications of the results of the various expeditions of the school, and from this cause and from their somewhat expensive price it was thought advisable to change their form and to enlarge their scope. A journal of high standard devoted to tropical medicine and parasitology has long been needed, and it was resolved to admit publications from others than those who were connected with the school. The result has been to establish the "Annals of Tropical Medicine and Parasitology," which promises to have a successful and useful career before it.

Prof. Ronald Ross, F.R.S.

The expeditions, as we have already stated, have become a marked feature of the school's activity. They have necessitated the establishment of special research laboratories. For although underlying these expeditions is the idea that research into tropical disease is best carried out in the area where the disease is

endemic, yet much material is accumulated during these expeditions which can only be worked out subsequently. As the laboratory accommodation is insufficient to accommodate all this material, a research department under a special director has been established at Runcorn, where ample room for animals and laboratory experiments exists. These laboratories also supply parasites in a living condition for the purposes of study in the teaching laboratories. Here numerous experiments have been and are being carried out in the treatment of sleeping sickness (trypanosomiasis). It was Thomas who first suggested atoxyl in the treatment of trypanosomiasis. This, followed by mercury, is probably the most hopeful treatment now in existence.

We may finally briefly refer to the laboratories, where the public, no less than by the expeditions, benefits by the training of medical men, already stationed in or about to proceed to the tropics. In fact, it is stated in its prospectus that the first of the objects of the school is to give a practical training to medical men proceeding to the tropics. In connection with this training, which is as thorough as the too-brief period of three months will allow, about thirty medical men pass through the school in the year, a number which is not too great for the staff successfully to cope with.

THE YEAR'S PHOTOGRAPHY.

THE annual exhibition of the Royal Photographic Society is now open at the New Gallery in Regent Street, and will remain open until September 26. Artistic, professional, and commercial photography are well represented, but we are concerned chiefly with the scientific and technical sections. The exhibition aims at showing the year's progress, and as the item that has aroused the most interest since last October is the commercial introduction of the Lumière "autochrome" plate, which serves for the copying of coloured objects in colour on a single plate, photographs by this method form the most conspicuous group in the exhibition. The results are transparencies on glass, and are conveniently arranged for viewing them in a darkened portion of the balcony. The character of the new plates has already been described in these columns, therefore it is sufficient to say here that they depend upon the usual principles of three-colour work, and that their novelty consists in having each plate complete in itself, and needing no instrument, taking or viewing screen, or other special accessory for their use or examination. Messrs. Lumière are to be congratulated on their success, and well deserve the medal that has been awarded them. As to the results, some appear to be excellent, while others must be faulty from the predominance of one of the three colours; but, as we have so often said before in connection with colour work, it is impossible to judge of the results as one would like to be able to unless the original is side by side with the copy. No exhibitor seems to have cared to submit any of his pictures to this test. This remark also applies to the other colour photographs, which demonstrate that the multiple-plate methods still hold their own, and that the standard of perfection has, perhaps, a tendency to rise. Photomicrographs of the grain of the "autochrome" plates and spectra taken on them are on view, and serve to show the limitations of three-colour processes when dealing with the comparatively unmixed colours of the spectrum.

Some of the photographs of Mars, taken two months ago at the Lowell Observatory, are shown by Profs. Lowell and Lampland. Several canals are visible, and one has been photographed double. Drawings of the planet made under high magnification are added for the sake of comparison. The Greenwich Observatory send four frames of work done during the year, which include the recent comet, Saturn and its satellite Phœbe, and Jupiter and its satellites VI. and VII. These astronomical exhibits will prove of great interest, not only to those who are students of the subject, but also to those whose chief source of information is their daily paper.

Of the considerable collection of photographs of living creatures it is possible to refer to only a few. Mr. Douglas English contributes a series of photographs illustrating the life and history of the British mud-wasp, but his most striking exhibits are those in which he has obtained a very close imitation of the colour of the original by locally modifying the image with reagents, and in one case backing it with "metallic powders." He is bold enough to send the actual skin in one case to show how very nearly he has reproduced the colour. Notwithstanding Mr. English's success, we are inclined to discourage work of this kind, because by such manipulation the examples lose much of their value as photographs, and it is very doubtful as to how long the colours produced in this way will remain without change; but it must be admitted that at present they convey an excellent idea of the originals. Among the other exhibits of special interest may perhaps be mentioned Mrs. Veley's "Lemur Studies," Mr. W. Bickerton's three photographs of the common tern alighting at its nest after flight, and Mr. Alfred Taylor's ten photographs of the "Long-eared Owl from the Egg to Maturity." Mr. Daniel Finlayson's three frames are of a kind that must be exceedingly useful for teaching purposes. He shows the leaves of four common plants "awake and asleep," five photographs illustrating "Red Clover strangled by Dodder," and ten distinct examples of "Seed Dispersal by Hooks, Parachutes, and Wings."

Pathological work is not much in evidence, but the majority of visitors will doubtless find a personal interest in Dr. G. H. Rodman's radiograph of the two hands of a young lady, one of which was severely affected by rheumatism. The small bones of the diseased wrist are apparently matted together. Mr. Martin Duncan's photomicrographs of living bacteria are noteworthy, though for practical purposes of identification microscopists will probably continue to prefer to deal with dead "preparations." Mr. Duncan gives no hint of his method which he "has now perfected."

There are numerous other exhibits of many various subjects, for the collection of this year surpasses that of any previous year that we recollect in interest, variety, and general technical excellence; but we must refer to Mr. Frederick E. Ives's diffraction gratings, though they are not strictly photographic. These replicas are made with fish-glue instead of gelatin, and, by the means described in the catalogue, he has obtained, in addition to normal results, "freak gratings" of many different kinds. Not only can most of the light be thrown into the first-order spectrum on one side, but vigorous copies can be made from weak originals. A considerable variation of colour effects is shown in the "freaks," and may serve to indicate some of the possibilities of variations that may occur to a greater or less extent in gratings intended to give normal results. These gratings can be seen on application to the attendant by anyone interested in the subject.

Those who wish to see the results of the practical application of photographic methods to pictorial purposes will find a collection of excellent examples in the west room which is devoted to this section, and a

choice selection at the Gallery of the Royal Society of Painters in Water Colours, 5a Pall Mall East, this latter being the fifteenth annual exhibition of the Photographic Salon. In neither case is the method of production stated, so that it is not possible to know how much is pure photography nor whether any given example is likely to be reasonably permanent. It is, however, a noteworthy fact that, besides the platinum and carbon processes in their numerous variations, this year there are many "oil prints," that is, prints in which the image is produced in pigments prepared in oil, by the process introduced by Mr. G. C. H. Rawlins a year or two ago. It is satisfactory to note that as these processes that yield results of undoubted trustworthiness increase in number, there is a tendency for them to oust those that are less desirable.

C. J.

INTERNATIONAL SEISMOLOGICAL CONGRESS.

THE second conference of the International Seismological Association will be held at the Hague on September 21–25. The first two days will be occupied by the permanent commission, which will discuss the financial reports from the secretary and the director, election of officers, and other matters relating to general administration. The meetings of the general assembly will take place on September 24 and 25. Amongst matters of immediate seismological interest to be discussed we notice the question of establishing a station at Kashgar, seismological bibliography, the annual publication of a catalogue of earthquakes for the entire world, and the geographical distribution of sound phenomena which have had hypogenic origin. Other scientific questions which will receive consideration relate to the rapid publication of data relating to large earthquakes, the reduction of seismic elements to absolute values, and the reproduction of seismograms. Discourses and conferences relate to a catalogue of microseisms for the year 1904, and the earthquakes in that year which have been recorded throughout the world, together with the analysis of seismograms, the publication of seismograms obtained on August 16 and 17, 1906, and the new work now in progress at Strassburg Observatory. To carry out the above programme evidently means a full four days' continuous work.

From what we read in daily papers and magazines, it is clear that much haziness exists in the public mind as to how earthquakes came to have an international importance. The first successful attempt to treat earthquake phenomena in a scientific manner was undoubtedly due to the late Robert Mallett. Strange as it may sound, his work practically remained in abeyance until Japan, desiring to acquire some of the material civilisation of the west, invited to her shores people from all quarters of the globe. Although none of these was asked to give instruction relating to earthquake phenomena, none of them could refrain from giving serious attention to movements which were frequently, and we may even say rudely, brought to their notice. In 1880 a seismological society was established. The first important work accomplished by this society was to devise instruments which would measure earthquakes, the result of which was that constructors for the first time learned that earthquake forces could be expressed in definite mechanical units. This led to new types of structures, and these experience has shown will stand severe shakings whilst ordinary European structures seriously suffer. This issue of seismological investigation, inasmuch as it bears upon the safety of life and property, indicates that the study of earthquake phenomena is of more practical importance than is generally supposed. Among other outcomes of the study we may mention the determination of suboceanic sites where it would be fatal to lay a cable, the indication where certain cables have failed, and the collection of materials which enable those who insure to adjust rates to risks.

Whether the information bearing upon what may be called the "by-products" of seismological investigation will attract the attention of the International Association remains to be seen. Should it do so, then the British Government and the British investor may be compelled to go abroad to supply their wants. At present the work of the association is chiefly directed to that which is purely scientific, teleseismic records and their interpretation receiving the most attention. Since 1755 it has been recognised that a very large earthquake occurring in one country might give evidence of its existence in very distant regions by causing water in lakes or ponds to oscillate. In 1877 the oscillations of a bubble in a level at Pulkova were traced to an earthquake which destroyed Iquique. In 1884 cryptoseismic movement was frequently recorded in Japan. The late Dr. E. von Rebeur-Paschwitz also recorded these unfelt movements, which he traced to definite seismic centres.

In connection with the history of international seismological cooperation, it may be here mentioned that one of the first attempts to obtain the same was made in 1883 through his Excellency the late Sir Harry Parks and the Foreign Office of Japan. In 1895 attempts to repeat the same came from Japan and from Germany; the first successful attempt was that undertaken by the British Association in 1897, which now enjoys the cooperation of about fifty similarly equipped stations fairly evenly distributed over the land surfaces of the globe. This is an asset of considerable importance which we hope may continue to exist, and at the same time be able to assist the congress now sitting at The Hague.

THE IMMIGRATION OF SUMMER BIRDS.[1]

THIS second report is very similar to that first issued, which was noticed in NATURE for September 6, 1906. It has been prepared on the same lines, and is open, to a large extent, to the same criticism, though we are glad to observe that the various immigratory movements are now associated with the weather conditions prevailing in countries south of the shores of the Channel.

In the best interests of the inquiry, and at the risk of again being considered "somewhat hostile," the writer would once more urge the committee to confine its labours for several years to come to the publication of the observations received, and to refrain from drawing conclusions of any kind from its present limited knowledge. It serves no useful purpose to mention that particular species arrived on certain sections of the coast only, for in all but a few cases their supposed absence merely indicates that they escaped the notice of the observers, and nothing more; they have long been known as immigrants on the sections of the coast from which the committee has not, as yet, received information concerning them. The publication of observations of this nature has already misled some who have but little knowledge on the subject; and so also has the statement that the few species which arrived on the south-east coast held a north-westerly course and so reached Wales! No proof is offered in support of this very remarkable speculation, nor is any worthy the name

[1] Report on the Immigrations of Summer Residents in the Spring of 1906. By a Committee appointed by the British Ornithologists' Club. (London: Witherby and Co., 1907.) Price 6s.

afforded by the published data. In fact, the report generally bears evidence of having been drawn up on the supposition that the data are practically complete, whereas such perfection, or anything like it, is an absolute impossibility. The committee, and others interested in bird migration, would do well to remember that not one bird in a thousand that arrives on our shores, or which proceeds inland or coastwise, comes under the notice of competent observers, numerous though they be. This important consideration makes it imperative that some years must be devoted to the amassing and testing of materials ere the foundations of a trustworthy report can be laid.

The records collected by the committee are numerous, and, as interim reports seem to be desired, may be considered of sufficient interest and value to render them worthy of publication. There are a number of unfortunate slips in the report, some of which are so palpable that it seems strange that Mr. Bonhote's—the preparer's—colleagues on the committee did not detect them. W. E. C.

PRESERVATION OF MEMORIALS IN AMERICA.

AS an outcome of an article which appeared in these columns on June 6 (p. 130), entitled "Landscape Protection in Germany," the American Scenic and Historic Preservation Society has sent us some of its literature. This society was incorporated in 1895 by a special act of the Legislature of the State of New York, and holds, therefore, a semi-official position in that State. It has to report annually to the Legislature, and has a right to make recommendations regarding improvements to any of the municipalities.

The society's aims are summed up to a large extent in its name. It endeavours "to protect beautiful features of the natural landscape from disfigurement, either by physical alterations or by the erection of unsightly signs and structures, and to preserve from destruction remarkable geological formations or organic growths possessing an artistic or scientific value"; and it also endeavours "to save from obliteration names, places, and objects identified with local, State and national history; to erect suitable historical memorials where none exist."

In towns and villages it aims at procuring parks and open spaces, where necessary for the health and comfort of the inhabitants; it makes every effort to prevent the destruction of trees, and stimulates as much as possible a desire for local beautification in the minds of the public.

The funds depend on the members' subscriptions and voluntary contributions. The Government gives no financial support, but public money is occasionally placed at its disposal for acquiring or keeping in order properties for the public benefit. It is also empowered, according to its charter, "to receive real or personal property, in fee, or trust . . . and to administer it as a public trustee."

By means of meetings, free lectures, circulating historical pamphlets, and various educational means, the society endeavours to engrain in the people an appreciation of the beauties of nature, and also a patriotic interest in historical localities. Its efforts are becoming fully appreciated all over America, for its services are requisitioned in many different parts and in many different ways, the verifying of historical sites and putting up of tablets to commemorate noteworthy events being the most usual. America is much to be congratulated on having such a society, and especially one that is so active.

NOTES.

PROF. J. B. FARMER, F.R.S., has accepted the editorship of the *Gardeners' Chronicle* in succession to the late Dr. M. T. Masters, F.R.S.

THE inaugural address of the coming session of the Royal Scottish Geographical Society will be delivered by Lord Milner in the Synod Hall, Edinburgh, on Wednesday, November 13.

WE regret to see the announcement that Prof. L. F. Vernon Harcourt, emeritus professor of civil engineering at University College, London, died on Saturday, September 14, at sixty-eight years of age.

THE managers of the Metropolitan Asylums Board have approved of the erection at Belmont, Surrey, of new laboratories for the preparation of diphtheria anti-toxin and for bacteriological work. The total expenditure on the laboratories is not to exceed 6500*l*.

Symons's Monthly Magazine, the present issue of which is the five hundredth number of that interesting organ of meteorological opinion, announces that Dr. G. Hellmann has been appointed professor of meteorology in the University of Berlin and director of the Prussian Meteorological Service, in succession to the late Prof. von Bezold.

A TELEGRAM from Seattle states that a volcano in the Aleutian Islands became active on September 1 and 2, and that ash ejected from it fell upon twenty villages. A disturbance recorded by a seismograph at Washington on September 2 appears to have been due to this eruption.

THE Royal Geographical Society has received the following telegram referring to the Anglo-American Polar Expedition, signed by Captain Mikkelsen and Mr. Leffingwell:—"Sledge trip covering 500 miles crossed edge continental shelf twice soundings 50 miles off coast and beyond 630 metres no bottom ship lost next year continuation geology ethnography surveying and exploration Beaufort Sea."

THE Royal Commission on Mines has appointed Dr. A. E. Boycott to make an investigation with a view to determine whether there are any indications of the disease known as ankylostomiasis (miner's worm) in coal mines in Great Britain. Mr. John Cadman has also been appointed to make a series of observations and tests of mine air in connection with the question referred to the commission whether any steps should be taken to lay down a standard of ventilation in mines.

PROF. E. HECKEL, director of the Colonial Institute at Marseilles, has been awarded the gold medal founded by Dr. F. A. Flückiger, of Strassburg, in 1893, and awarded every five years, in recognition of steps taken to promote the advancement of scientific pharmacy, irrespective of nationality. Mr. E. M. Holmes, the curator of the museums of the Pharmaceutical Society of Great Britain, received the first medal, and the second was presented to Dr. C. Schmidt, of Marburg.

THE discovery of an interesting dene-hole on the south side of Windmill Hill, Gravesend, was described in the *Times* of September 14. It appears that a workman engaged in making excavations for building purposes discovered a shaft, rather less than 3 feet wide, which descended vertically to a depth of 55 feet from the surface, when it entered the chalk, and after piercing 3 feet of this rock opened out into a large artificial cavern. This cave was divided into two chambers by a roughly hewn

wall of solid chalk, a western chamber measuring about 30 feet by 24 feet, and an eastern one about 24 feet by 20 feet. The excavation consequently presented the exceptional character of a twin chamber. The roof showed numerous holes, apparently made by picks of horn used in excavating the chalk, whilst the walls had been smoothed, perhaps by means of flints. A curious smoothness on part of the roof of the eastern chamber, clearly due to long-continued but gentle friction, led to the suggestion that some substance like corn in the ear had been pitched into the chambers from the top of the wall, which formed a platform under the shaft, thus apparently lending some support to the view that the dene-hole may have been used as a subterranean store-house for grain.

OWING to the development of wireless telegraphy in the Navy, the Admiralty has decided to establish a separate branch of the Service for this work, and this branch will be kept quite distinct from the ordinary signalling branch. In order to place the new section on a proper basis, about three hundred men will be turned over to it as volunteers, taken from the leading signalmen as well as able seamen and marines. Ultimately the telegraphists will be recruited from boys entered in the training ships in the usual way. The Admiralty has also decided to erect a wireless telegraph station for the use of the Royal Naval Service at Corkbeg, near the mouth of Cork Harbour. This station is to supersede Roche Point station, the situation of which is not considered safe.

THE President of the Local Government Board has authorised the following researches under the grant voted by Parliament in aid of scientific investigation concerning the causes and processes of disease:—(1) Further study by Dr. Sidney Martin, F.R.S., of the chemical products of pathogenic bacteria. (2) Bacteriological investigation by Dr. F. W. Andrewes of the air of sewers and drains. (3) Observation by Dr. W. G. Savage of the bacteriology of "garget" and maladies of the udder or teats of milch cows, and of possible relation of sore throat in the human subject to pathological conditions of the udder and teats of these animals; also investigation by him of paratyphoid fever and its microbic cause. (4) Joint investigation by Drs. M. H. Gordon and T. J. Horder of the life-processes of the Meningococcus, with a view to means of combating cerebro-spinal fever.

THE Permanent International Commission of Aëronauts and the International Federation of Aëronauts held conferences at Brussels last week, under the presidency of Prince Roland Bonaparte. An address on the advantages of the universal adoption of the metric system in aëronautics was read by Dr. Guillaume, and a resolution in favour of its adoption by all affiliated aëro clubs was carried unanimously. Papers were also read on air currents, dynamics of the atmosphere, wind velocity, temperatures at high altitudes, aëronautic observatories for practical meteorology, the history of dirigible balloons, progress of the problem of flying and aërial navigation, and the economical manufacture of hydrogen for balloons. On Sunday, thirty-four balloons started from the Parc Cinquantenaire in competition for the valuable cup to be presented to the aëro club of the country the balloon of which covers the greatest distance. The contest was won by a German balloon, which descended at Bayonne, having covered a distance of 1000 kilometres. The second place is shared by a Swiss balloon, which covered 900 kilometres, and a British balloon, which travelled 890 kilometres. The international conference will be held next year in London.

THE *Frithjof*, with the Wellman expedition on board, arrived at Tromsö on September 13, the attempt to reach the North Pole by airship having been abandoned for this year. On September 2 Mr. Wellman's balloon, the *America*, was towed about two miles in a northerly direction to Vogel Bay Island. Off this island the airship was set free, but the wind, coupled with a driving snowstorm, finally beat it back over the mainland of Spitsbergen. The gas being allowed to escape, the airship descended and landed on a glacier about half a mile inland. No damage was sustained, except that a few tubes and wires were broken and bent. The scientific instruments on board were uninjured. The *America* was in the air three hours. In the one hour and a quarter during which she was travelling by her own power she made about fifteen miles, including some beats to windward, demonstrating the power of the motor and the dirigibility of the airship. In three days the entire ship, including even part of the gasoline, was conveyed back to camp in good order. The balloon-house and the entire plant were put into condition for the winter. Three men were left to guard it until next summer.

ON September 13 the *Lusitania*, the world's greatest and fastest ship, reached New York, having covered the distance between Queenstown and Sandy Hook, 2782 miles, in five days fifty-four minutes, at an average speed of 23·01 knots. Although the *Lusitania* has not lowered the Atlantic record, she has crossed at a greater pace than any boat on a maiden voyage ever did before her. The slight difference existing between the *Lusitania's* average and the *Deutschland's* record of 23·15 knots in 1903 is attributed to fog. The progress marked in steamship construction since the advent of the *Umbria* twenty-three years ago is instructive. The length has been increased 50 per cent., and the displacement is more than three times what it was. The power of the machinery has been multiplied by five, but so great is the difficulty of increasing the speed that the *Lusitania*, notwithstanding its enormous advance in size and power, has not added more than 25 per cent. to the speed. The *Lusitania* has a length of 760 feet, a breadth of 88 feet, and a depth of 60 feet 4½ inches. Its draught is 33 feet 6 inches, its displacement 38,000 tons, and its gross tonnage 32,500. It requires about 5000 tons of coal to steam to New York, and carries a cargo of 1500 tons and 2198 passengers. The indicated horse-power of the steam turbines is 68,000, and the steam pressure 200 lb. The full complement of the ship is 827 persons, the navigating staff numbering sixty-nine, the engineering staff 369, and the personal 389.

TWO papers read at a conference of the Catholic Truth Society on September 11 dealt with the question of the bearing of scientific progress upon religious belief. The Rev. J. Gerard, S.J., in a paper entitled "Science and her Counterfeit," pointed out that the true man of science, that is, the investigator actively engaged in scientific research, must be distinguished from purely popular writers and lecturers on scientific subjects. "It is the first principle of science," he remarked, "that nothing should be taken on faith, that we should prove all things, and take no step forward until we have made quite sure of our ground." Many writers, however, who undertake to supply the demand for popular scientific instruction, contradict in their practice the principles which men of science insist upon as necessary for the attainment of real knowledge, and encourage the habit of hasty conclusion instead of the spirit of scientific caution. Hypothesis is an essential part of scientific progress, but, as Dr. B. C. A. Windle explained in a subsequent paper on scientific facts

and scientific hypotheses, it is necessary to distinguish clearly between hypothesis or theory and scientific observation. Let facts be accumulated in as great a measure as possible, and theories too, in reasonable number, but let us be quite clear as to what are facts and what are theories, and quite definite in our ideas as to the relative value of the two categories. Father Gerard and Dr. Windle are justified in their remarks as to the unscientific character of much that is put forward in the name of science, but without the authority of careful and accurate observation. One reason for this is the attempt made to instruct people in scientific progress who will not take the trouble to understand the alphabet of nature. To the general public a sensational assertion is much more interesting than a plain statement of fact, and a personal opinion is confused with the established truth to which it refers. It is, however, a sign of progress that the road to the present position of science is strewn with the wreck of hypotheses and theories. No true philosopher regards a hypothesis or theory as a Procrustean bed upon which all new knowledge must be placed, but only as a working or suggestive explanation of observed facts. In this respect the scientific type of mind differs from that which is content to accept mediæval scholastic philosophy as a final court of appeal for new learning.

Biologisches Centralblatt for August 15 and September 1 contains an article by Mr. A. Mordwilko, of St. Petersburg University, on the biology of the Aphididæ, being a summary of a larger work on the same subject. The reproduction of these insects is discussed in the first portion of the article.

In *British Birds*, No. 4, Messrs. Witherby and Ticehurst continue their account of important additions to the list of species recorded from our islands since 1899. Attention may also be directed to a note by the first-named writer on the nesting of a pair of herons in a pool on Dungeness beach.

The greater portion of the August issue of the *Museums Journal* is devoted to the conference held at Dundee in July last, where the presidential address was delivered by Mr. J. Maclauchlan. The majority of the papers read was devoted to subjects connected with art and manufactures rather than to natural science.

Two papers in part iii. of vol. li. of the Memoirs and Proceedings of the Manchester Literary and Philosophical Society are devoted to zoological collections made by Mr. S. A. Neave in N.E. Rhodesia. In the first, which is illustrated by a coloured plate of two new species, the collector discusses the birds, while in the second Mr. G. A. Boulenger, who describes one new fish, records the cold-blooded vertebrates obtained.

The habits of the North American short-tailed shrew-mouse (*Blarina brevicauda*) form the subject of an article by Mr. A. F. Shull in the August number of the *American Naturalist*. In winter, at any rate, the species feeds largely on snails of the genus Polygyra. These snails are hoarded by the shrews for future use, the emptied shells being either left on the surface of the ground or deposited in various parts of the nests or burrows. Short-tailed field-mice and vesper-mice are also attacked and killed for food, while numbers of insects and earthworms are likewise consumed. The shrews are therefore highly beneficial to the agriculturist.

To the August number of the *Zoologist* Mr. Graham Renshaw contributes some notes on the Californian condor (*Gymnogyps californianus*), a species in imminent danger of extermination. Although in former days ranging so far north as British Columbia, this condor—the largest bird-of-prey in the United States—is now represented only by a small remnant in south-west California. A flock of twenty-six was, however, seen so lately as 1894, and it is hoped that the species may still be holding its own in the more remote mountains. A specimen is now living in the Zoological Park, New York.

What amounts to little less than a revolution in the taxonomy of invertebrates is proposed by Mr. R. T. Günther in the August issue (vol. li., part iii.) of the *Quarterly Journal of Microscopical Science*. Although their molluscan affinities were suggested by d'Orbigny in 1834, the arrow-worms (Sagitta, &c.) have been definitely classed by nearly all modern zoologists among the annelids, in which they constitute the group Chætognatha. Mr. Günther is, however, convinced that they are in reality primitive molluscs. "No organ of importance," he remarks, "has been described in chætognath anatomy which is not paralleled by similar and, we believe, homologous organs among the Mollusca. Indeed, we believe, we can go further and demonstrate that the divergences of structure between the Chætognatha and the Mollusca are slighter than those known to exist between different orders belonging to the latter phylum." The Mollusca, according to the author, typically pass through a free-swimming ("veliger") stage, and while in creeping and sessile forms the foot and shell attain high development, in pelagic types the shell tends to disappear, and the foot may either likewise atrophy or become modified into a swimming organ. On this view the class may be divided into Nectomalacia and Herpetomalacia, the former including the shell-less Chætognatha and the shelled Cephalopoda, and the latter all the rest.

In *Nature Notes* for September, Mr. O. C. Silverlock records the results of experiments conducted by himself during the last two years with the view of testing the sensibility of ants to changes of temperature and to the ultra-violet rays of the spectrum. As regards the first point, the experiments indicate that very small changes of temperature are perceived by these insects, the sensations of heat in which must be much more delicate than in human beings. Many ants, for instance, perceive so small a rise of temperature as 0°·3 C., while a very large percentage take cognisance of a rise of 0°·5 C. In respect to the ultra-violet rays, it has been already shown by Lord Avebury that these affect ants like true light-rays, and this being so, the author is of opinion that these rays probably appear to them as a colour of which the human mind cannot form a conception. The ants do not appear to be chemically affected by these rays, but they change their positions when placed in the spectrum by reason of their dislike to the colour of these rays, and also on account of the smaller heating effect produced by this end of the spectrum.

In the report for the year 1906–7 of the industrial section of the Indian Museum, Calcutta, Mr. I. H. Burkill enumerates the additions to the collections received during the year; among the art specimens is a sword and silver scabbard presented by the Tashi Lama. Of the products examined by Mr. D. Hooper in the laboratory, the oleo-resin of *Hardwickia binata*, the gum-resin of *Mangifera indica*, and the oil of *Cochlospermum gossypium* are interesting; also the sample of Kashmir hops.

It was a happy inspiration to bring together in the Natural History Museum at South Kensington a collection of Linnean mementoes in commemoration of the bicen-

tenary of the great Swedish naturalist. The collection, consisting of portraits, autographs, manuscripts, specimens and books, is arranged in one of the bays of the great hall, and a small pamphlet, prepared by Dr. A. B. Rendle, explaining the different exhibits has been issued as the third of the special guides of the museum.

AN ingenious but difficult hypothesis, tracing the origin and evolution of angiosperms to aposporous developments from a type allied to the thallose liverworts, is offered by Mr. O. F. Cook in vol. ix. of the Proceedings of the Washington Academy of Sciences. It is suggested that as aposporous prothalli arise from the sporophyte in certain varieties of *Nephrodium pseudo-mas*, so the gametophyte of the primitive angiosperm may have had its origin; the proposition requires the elimination of the macrospore, and leads to the comparison of the nucellus with an aposporous prothallus, thus running counter to accepted homologies. It cannot be said that the arguments advanced are sufficiently weighty to warrant a reversal of existing opinion.

THE third part of the botanical series of the *Philippine Journal of Science* (vol. ii.) contains determinations of new or little-known indigenous ferns, and a collation of species of Dryopteris, both prepared by Dr. H. Christ, and the diagnoses of new Philippine palms, by Dr. O. Beccari; also Mr. E. D. Merrill contributes a first list of Philippine botanical literature. Dr. Christ notes that there is a tendency to the production of insular reduced types among the ferns, instancing the irregularity and reduction of fronds in *Dryopteris canescens*, and the peculiar stunted forms grouped under *Leptochilus heteroclitus* and *Pteris heteromorpha*. A new species of Christensenia, more recognisable under the generic name Kaulfassia, is described. Dr. Beccari's communication includes three species of Areca, one as robust as *Areca catechu*, also species of Pinanga, Arenga, Livistona, and Calamus.

MR. R. N. HALL, in his "Notes on the Traditions of South African Races, especially of the Makalanga of Mashonaland," reprinted from the *African Monthly*, and published by the African Book Co., Ltd., Grahamstown, has revived his controversy with Mr. R. MacIver regarding the date of the Zimbabwe temple. In his reply to the theory that the ruins cannot be dated earlier than the fourteenth or fifteenth century A.D., he lays special stress on the statement of De Barros that, on the arrival of the Portuguese at Sofala, about 1505, the Moors informed them that the temple was then ancient, and that the Makalanga possessed no tradition of its erection. It is obvious that on such a question the oral traditions of savages are of little value. But Mr. Hall discusses at length various lines of evidence, which, he believes, establish the permanence of such traditions among the Bantu races—their veneration of ancestors, their genealogies of royal families, their belief that their forefathers migrated from the north, their tales of the early Portuguese occupation, of cannibalism, the slave trade, and so on. He further asserts that the Makalanga have been less migratory than their Bantu kinsfolk, and hence their belief in the extreme antiquity of the Zimbabwe is deserving of credit. On the other hand, he admits that these traditions were not recorded at the time when Europeans first came in contact with them. On the whole, the Makalanga traditions in the versions now accessible do not command perfect confidence, and they do not furnish conclusive evidence in disproof of the archæological facts on which the conclusions of Mr. MacIver were based.

THE third part (the second in order of issue) of the Eugenics Laboratory Memoirs has just been issued by Messrs. Dulau and Co. It is entitled "The Promise of Youth and the Performance of Manhood," and contains the results of an inquiry, by Mr. Edgar Schuster, into the question how far success in the examination for the B.A. degree at Oxford is followed by success in after-life. Apart from the Oxford class lists, the investigation is based on "Crockford" and Foster's "Men at the Bar." The results show a striking relation between the earlier and later success. Thus among those who took their degree in 1859 or previously, and subsequently entered the Church, 68 per cent. of the first-class honours men obtained some clerical distinction or first-class scholastic appointment, whilst the percentage falls to 37 per cent. for the second-class men, 32 per cent. for the third class, 29 per cent. for the fourth, 21 per cent. for those who took pass degrees, and 9 per cent. only for those who took no degrees. The results in the case of those subsequently called to the Bar are similar. Taking a rougher division, 32 per cent. of those who obtained first to fourth-class honours subsequently obtained some form of office or appointment that was reckoned as distinction, whilst only 16 per cent. of those who obtained pass degrees or no degrees did so. It would seem from these figures that the degree examinations are a better test of general ability, and not of a merely special type of ability, than is generally believed. It seems a pity that these memoirs cannot be issued at a lower price, or, preferably, published in some recognised journal.

DR. GUSTAV VON ZAHN contributes to Nos. 5 and 6 of the current volume of the *Zeitschrift der Gesellschaft für Erdkunde* a paper on the physical and economic geography of the isthmus of Tehuantepec. The author visited the isthmus in October, 1906, and devoted special attention to existing and possible routes across it as means of inter-oceanic communication. His conclusions are strongly in favour of a new Transpacific route from Salina Cruz.

A LECTURE delivered before the Versammlung deutscher Naturforscher und Ärzte at Stuttgart by Prof. Dr. E. Hammer in September last is reprinted in *Petermann's Mitteilungen* (vol. liii., p. 97). Prof. Hammer discusses the scales of maps most useful for geological and general economic purposes, favouring 1 : 25,000 for ordinary publication. He lays great stress on the need for such maps bearing some indication of the degree of accuracy of the contour lines shown, as well as of the actual determinations of height upon which the contours depend.

THE *Mitteilungen* of the Vienna Geographical Society contains (vol. l., p. 139) an interesting paper on the "zonal" distribution of rainfall, by Dr. Fritz von Kerner. The author has repeated and extended the measurements of Loomis's rainfall maps made by Sir John Murray, using the more recent maps of Supan, and gives the rainfall in belts of latitude, first for all longitudes and also for the eastern and western old world and the new world separately. Detailed comparisons are given with Murray's results, and also with the measurements of Bezdek published in 1904. Supan's maps for the four seasons are treated in a similar way, the accuracy of the work being tested by comparing the sums of the four seasonal values with those obtained independently from the map for the whole year.

THE most noteworthy feature in the report of the Mauritius Observatory for 1906 is the shortage of rainfall; the annual amount for the island (mean of fifty-

seven stations) was 72·4 inches, as compared with the average, 79·5 inches. Notice is directed to an apparent connection between droughts in Natal and Mauritius, well-marked winter droughts at the coast stations of the former place being followed by summer droughts in Mauritius at intervals of from three to seven months.

We have received from the Deutsche Seewarte its monthly meteorological chart for the North Atlantic Ocean for September, which, like the corresponding chart published in this country, is replete both on face and back with information of value to seamen, and includes notes on ice, fog, &c., brought down to the latest possible date. A comparison of the face of the English and German charts naturally exhibits slight differences in the results; this is unavoidable when compilation is made from data received from different sources. The back of the German publication contains, *inter alia*, charts showing the weather conditions between Ushant and Gibraltar, and sudden changes observed in the sea-surface temperature south of the Newfoundland Bank, each chart being accompanied with useful explanatory text.

The Publications of the Japanese Earthquake Investigation Committee, Nos. 23 and 24, are devoted to an account and study of the seismograms of what is called the "Great Indian Earthquake of 1905." The preface states that these are issued as a systematised account of the instrumental observations of the earthquake, to be laid, for discussion, before the International Seismological Association at its next general conference. The data yielded by the seismograms are discussed with a wealth of elaboration and tabulation which tends to obscure the conclusions drawn; some of these are diametrically opposed to those generally held in this country, and the data on which they are based seem more consistent with the view that this earthquake was not so very "great," and that the distant records are imperfect. The value of the series of reproductions of forty-one seismograms taken at twenty-nine different stations would have been increased had the reproductions of Milne seismograms been less coarse in texture, but even with this drawback they form a collection which will be extremely useful to students of seismology, and we have only to regret that it should have been left to the Japanese Government to produce an adequate report of a British earthquake.

A new microphone for wireless telephony, the invention of Prof. Majorana, is described in the *Electrician* of August 30. The microphone consists of a jet of water falling on a collector made of two cylindrical pieces of platinum. The two pieces of platinum are connected to a battery, and a current passes depending on the thickness of the water film connecting the two surfaces; this thickness is varied by passing the stream of water before it falls on the collector through a receptacle, one side of which is formed by a membrane actuated in the ordinary manner of a telephone transmitter. It is stated that the vibrations produce corresponding fluctuations in the water jet, and the secondary current reproduces in consequence the sound waves. The collector circuit is connected to the spark-gap in the wireless transmitter, a Poulsen arc in nitrogen being the most suitable spark-gap to employ. No particulars are given of distances over which transmission has been accomplished.

The *Halbmonatliches Literaturverzeichnis* of the *Fortschritte der Physik* continues to fulfil its function of bringing the titles of papers published in the various departments of physics promptly before its readers. It is interesting to notice that nearly 40 per cent. of the papers published fall within the section cosmical physics.

The general characteristics of the treatment of elementary geometry adopted by Messrs. Barnard and Child in their "New Geometry for Schools" (Messrs. Macmillan and Co., Ltd.) and similar volumes have been described in these columns on more than one occasion (vol. lxix., pp. 97 and 391; vol. lxxi., p. 174). To meet the requirements of teachers and students who wish only to follow the subject up to particular standards, the course of work has been subdivided, and three new volumes containing various sections have recently been published. Part iii. of "A New Geometry" contains the equivalent Euclid, Books ii., iii. (35–7), and the harder parts of Book iv.; parts iii. and iv. (in one volume) include, in addition, Euclid, Book vi., and the algebraical treatment of ratio and proportion for commensurable quantities; and "A New Geometry for Middle Forms" contains the substance of Euclid, Books i.–iv., together with additional matter. The six volumes, which now form Messrs. Barnard and Child's series on practical and theoretical geometry for schools, provide students in any part of the Empire with courses of study which cover satisfactorily the revised syllabuses of examining bodies, and follow the reformed methods of geometrical teaching brought about by the reports of committees of the British Association and the Mathematical Association.

OUR ASTRONOMICAL COLUMN.

Daniel's Comet (1907*d*).—An excellent reproduction from a photograph, and a description of comet 1907*d*, are published in the September number (p. 385) of the *Bullétin de la Société astronomique de France* by M. F. Quénisset, of the Juvisy Observatory. With a clear sky, the comet appeared incomparably brighter than the Andromeda nebula, and gave the impression of being about the brightness of a second-magnitude star; the tail could be seen, by the naked eye, extending to a distance of 8° or 10°. Between July 12 and August 15 twenty-six photographs were obtained, three portrait lenses of 16·0, 13·5, and 3·8 cm. aperture, and 0·740, 0·565, and 0·130 metre focal length, respectively, being chiefly employed. On these photographs the structure of the tail is very sharply defined, and on one obtained with the last-named objective the tail can be traced for not less than 17°. From the photographs obtained with this instrument on August 7 and 8 there is evidence of a rotatory motion of the comet about a line joining the nucleus and the sun.

As seen in the 24-cm. (10-inch) equatorial and on the photographs taken with a Viennet objective, the structure of the tail near the head was fan-like, the colour being a fine green, and the brightest part was directed towards the sun. A visual examination of the comet with a spectroscope revealed the three strong hydrocarbon bands on a brilliant background of continuous spectrum. These bands were sharply defined on the red side, and faded away gently towards the violet, and, on replacing the spectroscope slit, they, with others, were seen resolved into lines; the order of their brightness was green, blue, orange.

From Mr. G. Gillman, of Aguilas (Spain), we have received a drawing showing the observed path of the comet from August 13 to 21. On the former date Mr. Gillman, as shown on his drawing, was able to trace the tail for a distance of 25° in a W.S.W. direction.

Owing to its decreasing brightness and to the fact that it does not rise until about 1½ hours before sunrise, the comet is becoming a difficult object, but we give below a further extract from the ephemeris published in No. 4196 (p. 337, August 23) of the *Astronomische Nachrichten*:—

Ephemeris 12h. (Berlin M.T.).

1907	α (true) h. m.	δ (true) ° ′	log *r*	log Δ	Brightness
Sept. 21	10 46·3	+7 5·1	9·8179	0·1879	6·4
23	10 55·7	+6 25·8			
25	11 4·8	+5 47·1	9·8550	0·2085	4·9

As mentioned last week (p. 503), Herr Kritzinger, of Berlin, recently pointed out (*Astronomische Nachrichten*, No. 4198) that the radiant point of this comet was in 346°+1° on September 12. Mr. W. F. Denning informs us that he watched the sky on September 10, 12, and 14, the weather being very clear, but did not notice any meteoric shower from the point mentioned. There was an active radiant at 355°+5°, however, about ten degrees E.N.E. from the position given by Herr Kritzinger. This display is often seen in September, and there is another at 346°+1° (exactly agreeing with the cometary radiant), often noticed both in August and September. The correspondence in the apparent places is probably accidental.

Mr. A. J. Hawkes writes from Bournemouth to suggest that the fine sunsets seen on Monday, and also at the end of last week, may be due to meteoritic dust in the track of the comet recently crossed by the earth.

THE LOWELL EXPEDITION TO THE ANDES.—In a recent communication to Dr. W. J. S. Lockyer, Prof. David Todd briefly describes the location and work of the Lowell expedition to the Andes for the purpose of observing Mars under the best conditions during the last opposition. Prof. Todd states that he selected Oficina Alianza, in northern Chili, for the location of the Amherst College 18-inch telescope, one of the instruments sent out by Prof. Lowell, and has found the atmospheric condition most favourable. Cloudless skies obtained day and night, and a windless and steady atmosphere produced an average "seeing" of 4 on a scale of 5. More than 5000 photographs, covering all regions of the planet, were obtained by Mr. E. C. Slipher, and many of them exhibit clearly the much discussed double canals. The telescope is the last one, of large size, erected by Messrs. Alvan Clark and Sons, and their chief mechanician, Mr. A. G. Ilse, is a member of the expedition. Photographs of the annular eclipse on July 10 were also secured, and the ringless phase of Saturn was much observed and photographed. Prof. Todd removed the station to a point in the higher Andes above Limas during the first week in August.

MARKINGS ON THE THIRD SATELLITE OF JUPITER.—In No. 4199 of the *Astronomische Nachrichten* (p. 381, September 6) Senor J. Comas Solá continues his description of the markings he has observed on Jupiter's third satellite, and gives position angles determining the positions of the same, at stated times, with regard to the direction of the axis of rotation of the planet. From the discussion of his results he concludes, provisionally, that (1) the visibility of the northern white cap is independent of the satellite's position in regard to the planet, and is incomparably greater than that of the other cap; its brightness is comparable to the snow-caps of Mars. (2) As on Mars, the northern cap of satellite III. is always bordered by a dark area, which appears darker nearer to the cap. (3) The northern cap appears to be turned towards us, and, if it is situated at the extremity of the axis of rotation of the satellite, the inclination of the equatorial plane to the orbit of the satellite must be considerable. (4) The dark spots and areas are difficult to observe, and appear to be variable in a very short time. (5) As yet nothing can be said of the rotation period of the satellite.

A plate of twelve drawings accompanies the paper, and shows very markedly the different features referred to, and their variations from time to time, as observed during the period November 24, 1906, to March 25, 1907.

ASTROPHYSICAL OBSERVATIONS AND ANOMALOUS DISPERSION.—In Nos. 4197–8 (p. 341, September 2) of the *Astronomische Nachrichten*, Prof. Hartmann discusses at length the possible explanation of several observed astrophysical phenomena by the theory of anomalous dispersion. He first discusses the general problem, and then its effect in the observed phenomena of the chromosphere, sun-spots, prominences, faculæ and flocculi, and the fixed stars. The results of the discussion are not universally conclusive, but Prof. Hartmann points out that, with stated conditions, the question may be decided by special observations. A bibliography of fifty-six papers on this subject is given at the end of the discussion.

FORTY YEARS OF CORNISH MINING.

MY connection with Cornish mining began in the year 1867, when I succeeded the late Sir Clement (then Dr.) Le Neve Foster as lecturer and assistant secretary to Mr. Robert Hunt's Miners' Association of Cornwall and Devon. It was a time of transition, for copper-mining after a brilliant career of a century or more was rapidly declining, and tin-mining, which though far more ancient had become second in importance, was once more in the ascendant. The man-engine, the employment of which had been greatly assisted a quarter of a century earlier by substantial prizes offered by the Royal Cornwall Polytechnic Society, was in use in a dozen of the principal mines, wire-rope and skip were gradually replacing chain and kibble, and rock-boring machines, thanks to the initiation of my predecessor, had already been practically tested in several parts of the county. These were real advances, but kibble-winding was still common even in the deepest mines; the cobbing hammer, the bucking iron, the hand-jigger, and the wooden shafted stamp were still at work to a large extent; while the stonebreaker, the California and pneumatic stamp, the various forms of pulveriser, the Frue and Luhrig vanners, the Wilfley and Buss tables, the self-acting and round slime frames, the air-compressor, and many other contrivances which are now looked upon as essentials in well-provided mines were only beginning to appear. When one compares the present condition of Cornish mining with its condition forty years ago, it is obvious that a sort of revolution has taken place.

In mining proper there has been no great advancement during the forty years. Somewhat greater depths have been attained in a few instances, and notably at Dolcoath, but Cornwall is still far behind several other mining regions in this respect. We are now more impressed than heretofore with the advantages afforded by good shafts, good underground roads, and good surface transport; the tramroad and tram-wagon have largely displaced the wheelbarrow; underground ore-bins, once so rare, are now becoming common; but in the main our system of underground mining was so good even a century ago that there was not very much room for improvement. Still, I will venture to predict that during the next forty years more vertical shafts will be sunk, that levels will be driven farther apart, that there will be a great deal more cross-cutting, and that our underground tramroads will be better constructed, so that "three men at a wagon" will be no more heard of.

As to the methods employed for breaking the ground, the chief changes have resulted from the use of boring machines and high explosives. In 1868 I first saw Doering's machine at work in Tincroft Mine. It was not a success, for, being operated by steam, the workings were rendered almost unbearable; in fact, while steam was the motive power, the use of the machine drill made very little progress either at home or abroad, and it is certain that if compressed air had not been introduced boring machines would to-day play a very small part in mining or tunnelling. Once introduced, however, the immense value of the system was at once recognised.

The difference between "to-day" and "yesterday" is seen in the fact that no rock-drill or air-compressor has ever been employed in the great mining parish of Gwennap, several of whose mines were still at work a generation ago, while at present all the great mines of the neighbouring parishes of Camborne and Illogan depend very largely upon these machines, not because they break the ground more cheaply, for it is well known that such is not the case (and, moreover, in narrow lodes they do not even break the ground more advantageously, for the "pay-streak" inevitably becomes much contaminated with barren "country"), but because they open the ground more speedily. One good effect of their employment has been the enlargement of the main drifts, and consequent improved ventilation, and this has been especially benefited by the large amount of cool exhaust air set free by the machines. The greater number of machine drills hitherto have been employed in sinking, rising, or drifting, but there is a constant and growing tendency to employ them in stoping also.

Forty years ago much gunpowder was still used in the

mines; to-day, after many experiments with compressed powder, cotton-powder, and other such compounds, and after nitro-glycerin had been tried and given up because of its danger, only such "high explosives" as dynamite, gelignite, and the like are used. These high explosives only came into use after much experimenting, by the Royal Cornwall Polytechnic Society in particular, but they have proved themselves very serviceable, especially in hard ground, and they are also found to be much safer in use than the old black powder.

Great improvements have been effected in the machines used for compressing the air employed in working the machine-drills; compound engines, compressing the air in successive stages, are now generally employed in the larger mines.

Compound engines, mostly of the tandem type, were introduced into several Cornish mines by Mr. Sims more than half a century ago, but with the low-pressure steam then employed did not recommend themselves, and so went out of use. A compound engine using high-pressure steam has been employed for years past in pumping at the Basset Mines for working the ordinary force pumps; of late many attempts have been made to introduce centrifugal pumps operated by electricity for draining the mines. A certain measure of success has attended these efforts, particularly at the Tywarnhaile Mines, and more recently at Wheal Vor; but it must be admitted that up to the present the Cornish system of pumping, the rods being operated by a simple vertical engine, single acting in the case of large installations, holds the field.

The use of electricity is spreading in the Cornish mines apart from pumping. At East Pool it has long been employed for surface traction, the mill being a mile or more away from the mine. At South Crofty it is employed for operating the new stamp mill; in several mines it supplies power to work pulverisers, buddles, and other dressing machines, and in this direction—as also in electric lighting—there is a large field for extension.

There have been great improvements in the engines used for winding during the past few years. It no longer takes thirty to forty minutes to raise a kibble of stuff from the bottom of the deeper mines, as it did at one time; skips running between guides are now common, cages bringing the ore-wagons direct to surface are employed in several mines, while the men are mostly brought up from below in shaft-gigs or special skips, so that the man-engine, once so great a boon and used in no fewer than twelve mines, can now only be seen in operation in the Levant Mine. For modern winding wire-ropes are universally used, and are practically indispensable. Accidents from its use are, indeed, exceedingly rare. Mr. Morgan's traversing engine, erected some years since for hoisting from Williams's Shaft at Dolcoath, will soon be at work again, but so far no proposals seem to have been made for using this remarkable engine anywhere else.

For signalling in shafts the old "knocker line" is still in use, and has its advantages. Indicators for the guidance of the engine-man are, of course, placed in the engine house in every case where men are raised, and in most other cases; overwinding is an extremely rare occurrence, such is the carefulness of the engine-man. The telephone was introduced in Wheal Eliza by Dr. Le Neve Foster many years ago for signalling from below, but it did not "catch on." It is, of course, used for ordinary business purposes in several of the mines.

The steam-boilers used in Cornwall are mostly of the Cornish or Lancashire type, and work at comparatively low pressures. The number of these boilers working above 60lb. is not very great, and those working at 100 or more could almost be counted on the fingers. Multitubular boilers, portable or semi-portable, are used in some instances where good water is obtainable, and particularly for winding, while the electrical pumping plant at Tywarnhaile is worked by engines which consume "suction gas."

Many improvements have been introduced in the treatment of ores; the ores treated in Cornwall now are almost exclusively of tin, copper ore being rare, while the working of iron, lead, and zinc ores has practically ceased.

The first crushing is generally done by stonebreakers of the Blake type, followed by stamps of the Cornish, California, or pneumatic type, the "rows" being finally reduced by some form of pulveriser. Self-feeders have not yet been used for the Cornish stamps, but they are always employed in connection with the California and pneumatic stamps. At Dolcoath powerful batteries of all three types can be seen regularly at work.

For dressing the crushed ore, while buddles are still very generally used at some stages, Wilfley, Buss, or other tables of the percussion type, or Frue vanners are employed in most of the larger mines. Hydraulic separators are mostly used to remove the slimes before feeding the pulp to the Wilfley and Buss tables, but in the case of the Frue vanner the slimes are generally removed for separate treatment at a later stage.

For slime treatment there is still nothing better known than the dead-frame, the ordinary round slime table, or the Acme table. The old-fashioned swinging rack for cleaning slime has practically disappeared, though it had some notable merits.

Most tin-ores need calcination before they can be cleaned for the market. In some of the smaller mines the old reverberatory oven is still in use, but in the larger mines the Brunton revolving calciner is always employed.

The calcination of tin-ores yields in some mines large quantities of "arsenic-soot," which is collected in long flues of masonry; this soot, at one time valueless or worse, is now an important by-product. It is handled by the ton as freely as sand, and apparently with equal impunity for cases of arsenic poisoning are far rarer in Cornwall than in London. Another important by-product in some mines is wolfram, which at one time was merely a deleterious component of the dressed tin, but is now profitably extracted at many of the mines, and in particular at Clitters United, East Pool, and South Crofty by means of the Wetherill magnetic separator. In this machine the powdered and thoroughly dried concentrates are carried slowly over electro-magnets on traversing belts. The magnets remove the slightly magnetic particles of wolfram, while the non-magnetic particles of cassiterite pass on and fall into a separate receptacle. The wolfram so separated in most cases still contains a considerable percentage of tin-oxide. At the mines mentioned this tin-wolfram product is "pickled" with dilute acid (aided by jets of steam at East Pool) in order to remove certain highly magnetic iron oxide components, which seriously interfere with the operation of the magnetic separator. A similar "pickling" was recommended by Dr. Richard Pearce forty years ago, and has occasionally been used for the removal of copper from calcined tin ores.

At Tynwarnhaile, and also at Dolcoath, the Elmore oil processes have been, or are being, introduced for the concentration of low-grade copper ores. The wet ore-pulp is mixed with oil and subjected to a partial vacuum, by which means the ore-particles are floated up from the waste as a sort of mineral scum, which is readily separated from the waste, and with much less loss than is the case by the methods hitherto employed.

Enough has been said in this hasty summary to show that the Cornish miner to-day, as in the past, is very ready to avail himself of such new methods and appliances as have a reasonable prospect of success, although it must be admitted that he is rather fond of letting other people experiment for his benefit. J. H. COLLINS.

THE IRISH PEAT INDUSTRIES.[1]

ACCORDING to reports published in 1814 by the Bog Commissioners, Ireland possesses 3,028,000 acres of "peat bog," of which 1,648,000 acres form "available" or so-called "red" bog, and about 1,380,000 acres form "mountain peat soil." The "red bog" is mainly confined to the great central plain of the island, and the "mountain bog" to the counties of Wicklow, Donegal, Mayo, Galway, and Kerry. As the accompanying outline bog map (Fig. 1) shows, there are few portions of the island destitute of bog.

The slow but continuous reclamation of Irish bogs which has been going on for the past three hundred years is referred to in a work written, in 1645, by Dr.

1 Abridged from the Economic Proceedings of the Royal Dublin Society, vol. i., part x. (July)

Gerard Boate. The method of reclamation practised in Ireland at the beginning of the seventeenth century, consisting as it did of draining the bogs and manuring the dried surface, was probably, owing to radical differences in detail between it and the Dutch fen reclamation process, of independent origin from the latter, which was introduced about the same time on the Continent at Groningen, in Holland, and at Emden, in East Frisia. At a later period—in the reign of William III.—the Dutch offered to introduce their system into Ireland upon condition of being allowed to establish a self-governing colony in the Queen's County.

The drainage and reclamation of the bogs have always been subjects of interest; the existence of so much unreclaimed land being a source of loss to the State, and its humidity being detrimental to the health of the community.

We find, for instance, a writer in 1660 recommending that "An Act of Parliament should be made that they who did not at such a time make some progress in draining their bogs should part with them to others that would," and about sixty-five years later an Act was passed

FIG. 1.—Outline bog map of Ireland.

by the Irish Parliament for the encouragement of the drainage of bogs.

Schemes for the drainage and reclamation by burning and manuring the surface of the bog, on the one hand, or by covering it with a layer of sand and manure after a due interval for subsidence, on the other, were published in 1814 in the reports of the Bog Commissioners. These reports described also the numerous successful plantations of trees in Irish bogs made during the eighteenth century. The engineers engaged in the work were of opinion that the bogs could be drained and converted into arable land without much expenditure of time or money.

It would be scarcely economic to attempt the reclamation of bogs the average depth of which is 25 feet, such as those in the central plain of Ireland, without first making a serious effort to utilise the "available" peat of the bogs. Apart from the large sum of 41,565*l.* expended in the years of the Bog Survey, there have been since that time smaller sums contributed by the State to the development of the peat industry. The Department of Agriculture, for example, has within the last few years spent upwards of 6317*l.* in experiments on the preparation of peat-moss litter and fuel. It employed the services of an expert to report upon the various Continental processes, and to select the machinery necessary for the carrying out of the experiments which were subsequently performed at Inny Junction, County Cavan, and at Castleconnell, County Limerick.

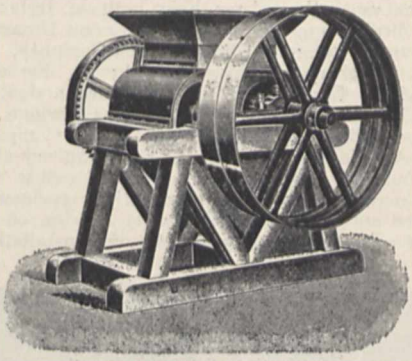

FIG. 2.—Dolberg's peat-moss litter dividing machine.

Within the past hundred years many attempts have been made in Ireland to utilise the peat supply. About the middle of the nineteenth century a turf-charcoal factory was established at Derrymullen by Rogers, but was, however, after a brief period of work, abandoned. A similar fate awaited the turf-distillation factory established in the year 1849 by Reece under the guidance of

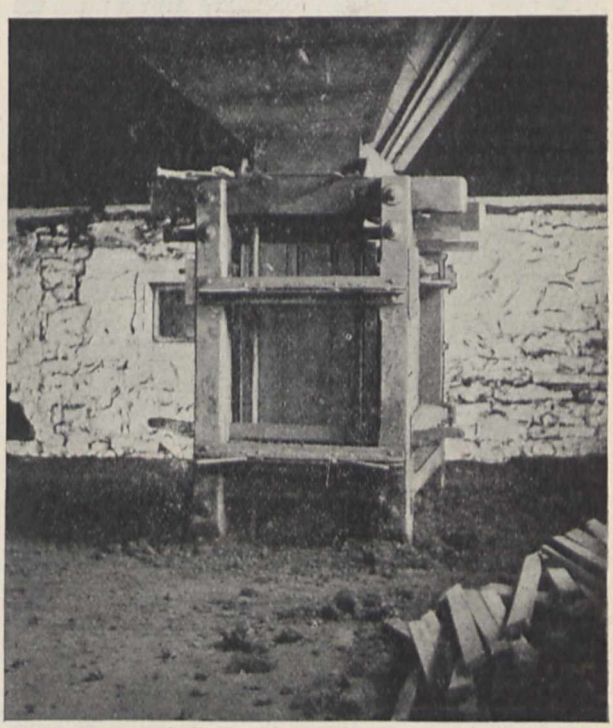

FIG. 3.—Peat-moss litter baler, Umaras, co. Kildare.

Sir Robert Kane at Kilberry, near Athy. Although a bright future seemed to lie before this factory, which was the first of its kind in Europe, it was, after a few years' active work, closed by its directors. In 1863 a process for the manufacture of "sieve turf" was worked on a large scale for a short time in connection with the Creevelea Iron Works near Sligo. At Derrylea, near

Portarlington, in 1866, several thousand tons of press turf were made by a modification of the oldest known "dry-press" process—that of Gwynne, which was itself tried on a small scale in 1855 at Kilberry. Of historical interest also is the fact that, of "wet-press" processes, one of the oldest found in the literature of peat is that which was employed by Williams in 1844 at Cappoge, in the Bog of Allen.

In recent years there have been built in Ireland many peat-moss litter factories, such as those at Umaras, near Monasterevan, County Kildare; at Coolaney, County Sligo; at Maghery, County Tyrone; at Ferbane and Rahan, King's County; and at Inchicore and Ringsend, in Dublin. The peat paper factory at Celbridge, County Kildare, belonging to the Callendar Paper Company, has recently been closed. At Umaras and Maghery there are peat-fuel factories, and at Kilberry a fuel called "electro-peat" is manufactured. Quite recently experiments have been carried out at Carnlough, County Antrim, on the production of ammonia from peat, and the installation of a

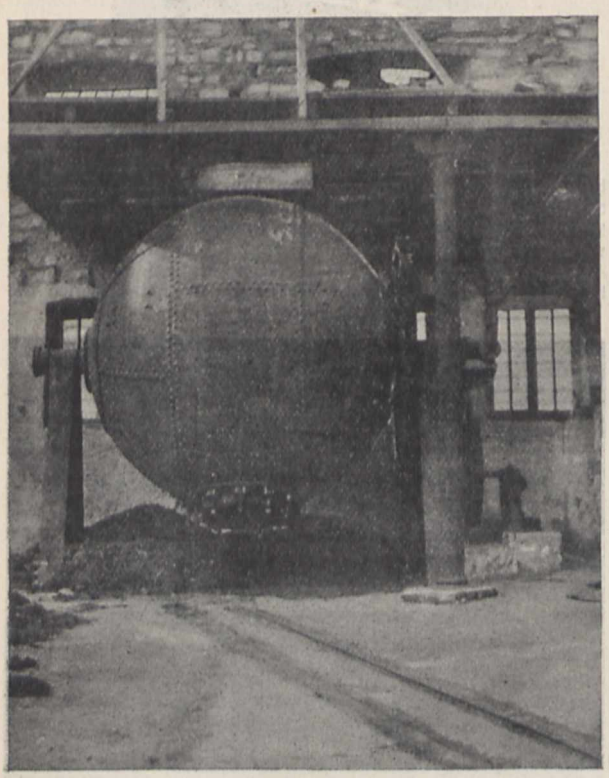

FIG. 4.—Peat digester, peat paper factory, Celbridge, co. Kildare.

plant capable of producing 5000 tons of ammonium sulphate per annum is now being completed at a cost of 85,000*l*.

It is convenient to divide the peat industries into three classes, namely, the fibre, the fuel, and the distillation industries. In this paper the first, and probably the most important, class will be considered more fully. In the peat-moss litter districts of Ireland the peat is dug out of the bog in large sods, which are dried in the air and stored under cover to prevent the re-absorption of water. The air-dried peat is next disintegrated by the rotating circular saws contained in the body of a dividing machine (so-called wolf, Fig. 2), sifted free from mould, and compressed into bales by vertical knee-lever presses, such as that used at Umaras (Fig. 3). From the "wolf," which is placed on the ground floor of the factory, the divided peat is carried by elevators to the upper floor, where, after passage through a cylindrical sieve, it is delivered into the funnel-shaped mouth of the baler. The mould can at the same time be collected apart. It is exported in large quantities by the owner of one of the factories to southern countries for the preservation and packing of fruit and vegetables grown there.

Where a suitable canal system exists the peat-litter industry is successful, but where canals are not available the industry is crippled by the high rates of carriage charged by the railway companies.

The purified peat moss can be used for the preparation of peat molassine meal and for the manufacture of alcohol, but as the latter process can scarcely at the present time be carried on remuneratively it is not practised in Ireland.

The peat paper factory which was established in 1903 at Celbridge, and turned out large quantities of wrapping paper yearly, was unsuccessful. It was finally closed in December, 1905. The peat, brought on cars from a bog situated at a distance of several miles from Celbridge, was subjected to a preliminary treatment in a large spherical revolving digester (Fig. 4), from which it was conveyed by cars running on a small iron railway to the scarifying and beating machine, where it was converted into pulp. After passing through sand-traps, the unbleached pulp was delivered on to an endless band, by which it was brought between the revolving rollers of a paper-pressing machine. The band of paper thus formed was glazed and polished by vertical rollers.

The motive power of the factory was electricity, which was generated in a dynamo driven by a 200 horse-power turbine worked by water from the adjacent Liffey.

The brown wrapping paper sold by the company was of a strong texture, excellent quality, and contained about 66 per cent. of peat fibre. Considering, however, the large amount of material present in crude turf which is useless for the manufacture of paper, it will be readily seen that the preliminary treatment of the peat should be carried out in the immediate neighbourhood of the bog.

The accompanying illustrations from the author's "Reports upon the Irish Peat Industries," part i., are reproduced by the courtesy of the Royal Dublin Society.

HUGH RYAN.

ZOOLOGY AT THE BRITISH ASSOCIATION.

The Physical Basis of Inheritance.

ONE of the most interesting features of the programme of Section D was a discussion, jointly with Section K, on the physical basis of inheritance. In opening the debate, Prof. S. J. Hickson, F.R.S., dissented from Montgomery's view that the inherited characters are transmitted *solely* by the chromosomes. The principal piece of evidence which is quoted in support of this hypothesis is Boveri's experiment (1889) in which an enucleate echinoderm ovum of one species, fertilised by a spermatozoon of another species, produced a larva with purely paternal characters; but similar subsequent experiments have not always resulted in a larva with purely paternal characters. Confirmatory evidence of the theory is held to be afforded by (1) the constancy in the number of chromosomes in the somatic cells; (2) the reduction to half the normal number of chromosomes in the sexual cells; and (3) the presence of similar heterogeneous chromosomes in the sexual cells of certain Arthropods and their mutual conjugation during fertilisation. If the theory be true, it appears necessary to hold that the chromosomes maintain their individuality, but there is convincing evidence that in some animals this is not the case, *e.g.* in certain Rhizopoda (*e.g.* Pelomyxa), Suctoria (*e.g.* Ephelota, Dendrosoma), and Cœlenterates. Moreover, if it be true that the cytoplasm of conjugating cells is not concerned in the transmission of hereditary characters, it is difficult to account for the long duration of the period of conjugation in Infusoria and the cases of fertilised enucleate eggs which produced larvæ with maternal characters. Prof. Hickson suggested a possible explanation, viz. that where the characters are comparatively rigid, as in mammals, insects, and some other groups, they are aggregated in definite masses, and may be associated with the chromosomes, but where it is advantageous for the characters to remain more variable they

are associated with the cytoplasm, as in the Protozoa and some Cœlenterates.

Prof. J. B. Farmer, F.R.S., said that although the chromosomes are probably not the actual bearers of the hereditary characters, they may produce their results by acting upon some specific substance in the protoplasm of the cell. He pointed out that the behaviour of the chromosomes in the heterotype division, preceding the formation of sexual cells, provides an arrangement for the sorting out of characters such as is shown to occur by breeding experiments. The chromosomes themselves consist of congeries of smaller entities—the chromomeres—which are probably very numerous; possibly it is these smaller entities which are associated with the hereditary characters. Such an assumption would answer the often raised objection that the characters exhibited by an organism are more numerous than the chromosomes. In any case, the heterotype division provides a mechanism for arranging these entities on a mathematical basis. The development of an organism on certain definite lines is the result of interaction of the nucleus and cytoplasm, and as there is no mechanism apparent in the cytoplasm for the sorting out of characters, while such is present in the nucleus, it seems reasonable to associate the latter with the carrying of the hereditary characters. Moreover, in many cases only the nucleus of the spermatozoon enters the egg during fertilisation, and yet the parental characters are conveyed.

Mr. R. C. Punnett pointed out that in the interpretation of the facts of heredity the student of genetics has been led to the conception of factors in the gametes upon which his unit characters are based. Between the postulated behaviour of these factors in segregation and the observed behaviour of the chromosomes in the divisions of the germ-cells there is a striking agreement. Nevertheless, certain cases of dihybridism offer phenomena pointing to the existence of gametic series in which the four types of gametes are produced, not in equal numbers, but in such ratios as 7 : 1 : 1 : 7 or 15 : 1 : 1 : 15. If the cytologist desires to regard the chromosomal elements as the physical basis of heredity, he must provide some scheme which will include these phenomena.

Prof. V. H. Blackman stated his belief in the chromatin as an active agent in the process of heredity. Boveri's work on the multiple fertilisation of echinoderm eggs seems to indicate that not only do the chromosomes carry the hereditary properties, but also that they are physiologically differentiated. The speaker suggested that in the protozoan nucleus there is a duplication or even a multiplication of the parts, and that it is not necessary for the whole nucleus to divide or for chromosomes to be evident; a portion of the nuclear substance pinched off may contain representatives of each of the characters.

Mr. R. P. Gregory pointed out that in all the somatic cells the division of the nucleus shows a certain form of symmetry, whereas just previous to the formation of gametes this symmetry is replaced by another—the heterotype division. From experiments in regeneration and vegetative propagation, it appears that all the characters are distributed throughout all the cells of the organism, whereas breeding experiments show that segregation takes place on the formation of gametes, one form of symmetry being replaced by another in precisely similar manner to that indicated by the study of the nucleus. It is impossible to believe that this is a mere coincidence.

Mr. A. D. Darbishire said he would only attempt to answer one question, viz., Are there any characters which depend for their manifestation on factors which exist in the cytoplasm? His observations on the starch grains in peas afford an affirmative answer. The difference between round and wrinkled peas depends largely on the nature of the starch grains. In round peas the grains are potato-shaped, in wrinkled peas they are round in contour and compound. In the hybrid the grain is intermediate between those of the parents in three respects:—(1) in contour; (2) in compoundness, about half the grains being simple and half compound; (3) in the number of pieces in the compound grains, which is usually three, rarely two (in non-hybrids it is six). As is well known, the formation of starch grains depends upon certain plastids produced, not by the nucleus, but from others previously existing in the cytoplasm.

Mr. L. Doncaster held that the maternal characters in the hybrid larvæ referred to by Prof. Hickson were only found in the very early stages, and could not properly be called hereditary characters. He suggested that the abnormal behaviour of the nucleus in the Protozoa might be associated with their great simplicity of organisation, no differentiation of chromosomes bearing hereditary characters having yet taken place.

Prof. M. M. Hartog said that the essential part of the chromosome in heredity appeared to be, not the chromatic elements, but the achromatic basis, a view advocated also by Boveri. He thought it was futile to attempt to exclude the cytoplasm from the genuine basis of heredity. With reference to the suggestion, made earlier in the discussion by Mr. C. C. Hurst, that cytologists should investigate the relations between the nucleus and the external characters of crosses, Prof. Hartog was inclined rather to request breeders to investigate certain forms exhibiting exceptional cell divisions. In at least two species of Tradescantia single chromosomes are often left out in the heterotype division of the pollen, and appear finally to be digested. In several species of Hemerocallis at the same stage the chromosomes are distributed into either three or four cells, and the pollen grains are consequently irregular in size, in number, and in the chromosomes they contain.

Prof. Hickson, in replying to the criticisms, regretted that there was not time to traverse them in detail. Referring to Wilson's work on the heterogeneous chromosome in the nucleus of the testis cells of *Anasa tristis*, he pointed out that Foote and Strobell deny the presence of such a chromosome. If, as was asserted during the discussion, specimens of this animal from some localities possess this chromosome while others from a different locality do not, that is a strong argument against the all-powerful influence of the chromosomes in regard to the hereditary characters.

The Experimental Study of Heredity.

Mr. R. C. Punnett illustrated his lecture on this subject by a series of actual examples, drawn chiefly from fowls and sweet-peas. He pointed out that the laws of heredity associated with the name of Mendel apply equally to plants and animals; the comb of the fowl, the stature of the sweet-pea, the colour of the stock, the hair of the rabbit, rust immunity in wheat, and some diseases in man, all conform to the same laws of heredity. Experimental work with animals may well lead to a solution of many problems in human disease; but, important as are the practical results, this study has a still greater importance in relation to our scientific conceptions, for it must radically affect our views of the process of evolution, the nature of mutation, and the physical basis of heredity.

Protozoa.

Mr. F. B. Rowley exhibited a series of models of Protozoa—Amœba, Vorticella, Paramœcium, Actinosphærium, and the parasite of human malaria in blood corpuscles—constructed chiefly of gelatin, which give an excellent idea of the appearance of these organisms in life.

Mr. H. B. Fantham discussed the classification of the Haplosporidia. He and Dr. Ridewood suggest the division of the group into two sections:—

(1) Polysporulea, in which the pansporoblast gives rise to nine or more spores, *e.g.* Rhinosporidium, Neurosporidium.

(2) Oligosporulea, in which the pansporoblast gives rise to a few (four) spores or to a single spore, *e.g.* Haplosporidium, Bertramia, Cœlosporidium.

The Movements of Spirochaetes.

Mr. Fantham pointed out that the nature of the movements of Spirochætes would serve as an aid in separating this genus from Spirillum. Knowledge of these movements would therefore be of value in connection with the vexed question of the nature of the organism of relapsing fever. Spirochætes, especially *S. anodontae*, with its pointed ends, usually move very rapidly, but in slowly moving specimens the organism can be seen to move forward while turning on its long axis. The motion can be

resolved into two components:—(1) a vibratory motion of flexion of the body mainly for progression; (2) a spiral motion of the body as a whole due to the undulating membrane—a spirally wound lateral extension of the ectoplastic periplast bearing striations (the contractile myonemes). The body of a Spirillum bears flagella, and is more rigid than that of a Spirochæte in motion. The so-called flagellate (ciliate) stages of Spirochætes are merely due to the splitting off of myoneme fibrils from the undulating membrane during its rupture, resulting from violent contortions or approaching death.

Some Points in the Structure of the Larva of Lanice conchilega.

The Rev. G. A. Elrington described, in the pelagic larva of *Lanice conchilega*, a gland situated on the dorsal side of the œsophagus, and composed of a cluster of large pear-shaped cells, the thin ends of which converge to the orifice of the gland, which lies in the mid-dorsal line of the "neck" region. From its staining reactions it is evident that the gland is concerned in secreting the mucin of the gelatinous tube in which the larva is found enclosed. The gland, which is not present in the adult or in a young worm which was just beginning to form its sandy tube, is evidently a transitory structure, which persists only so long as the larva retains its transparent tube. In the pelagic larva there are three separate nephridia, there being no trace of the fusion characteristic of the nephridial apparatus of the adult.

Mr. Arnold T. Watson expressed the opinion that the gelatinous tube, in which the larva floats, not only serves as a protection, but is also the means of collecting food particles, which on being brought into contact with the outside of the tube adhere to it. In order to secure this food the larva from time to time partially emerges from one end of the tube and applies to its surface the ciliated groove which runs from end to end of its growing tentacles. Development of the organism is thus carried on to a stage further than would have been possible in the absence of solid food. By the time the animal settles down on the sea-bottom and begins to construct the membranous sand-covered tube inhabited by the adult, the mucus-secreting gland, being no longer required, disappears, and owing to its dorsal position does so without disturbing the formation of the permanent ventral glandular structures which produce the membranous basis of the tube of the adult.

The Development of Ophiothrix fragilis.

Prof. E. W. MacBride, F.R.S., described the early stages of development of this common British Ophiurid. Two sets of cultures were studied, the first obtained by fertilising the eggs artificially, the second by allowing the ripe male and female naturally to shed their reproductive products. In the first series, segmentation resulted in the formation of a morula, an invagination followed, and it then transpired that the interior cells were precociously formed mesenchyme. The cœlom appeared as a single vesicle at the apex of the gut. In the second series segmentation resulted in the formation of a thick-walled blastula, followed by a regular invagination. At the pole of the larva opposite the blastopore a great crest of vacuolated cells—serving as a float—was formed. (This crest was not seen in the larvæ of the first series.) The larva then assumed a triangular form, the cœlom appeared at the apex of the archenteron as a bilobed vesicle, and the crest slowly diminished in size. The cœlomic vesicle divided into right and left halves; of these, first the left, then the right, divided into anterior and posterior parts. Somewhat later, from the anterior portion of the vesicle of both sides a sac was budded off; that of the left side became five-lobed, and gave rise to the water-vascular system; that of the right side generally remained small, but sometimes also assumed the five-lobed form, showing that it is a rudimentary fellow of the water-vascular system. The larva of *Ophiothrix fragilis* affords final and convincing proof that the echinoderm larva possesses three somites, the middle one of which becomes, on the left side, the water-vascular system.

The differences in the early phases of development of the two series above described are probably attributable to the fact that the eggs withdrawn from the female and artificially fertilised were not quite ripe, and therefore not quite of the same chemical composition as those naturally shed. In certain features the development of the artificially fertilised eggs resembles that of *Ophiothrix brevis*, a species with shortened development, a fact which leads the author to ask if mutations may not be due to slight chemical differences in ova at the moment of fertilisation.

Sex in Crustacea, and the Nature of Hermaphroditism.

Mr. Geoffrey Smith's studies upon parasitic castration show that animals belonging to widely different phyla, but especially Crustacea, when attacked by various parasites, undergo an alteration in their sexual nature. At first the gonad in both sexes degenerates to a greater or less extent; the males assume in varying degrees the secondary sexual characters proper to the female, while those of the male practically disappear; the females, without assuming any male characters, suffer a certain amount of degeneration of the secondary characters, *e.g.* the ovigerous appendages. Finally, either on recovery from the parasite or during the degenerative process, the male may develop ova of large size in the testis, alongside mature spermatozoa. The females never produce spermatozoa in their ovaries. These results, which apply especially to the effects of the parasitic Rhizocephala upon the crabs they infect, show that hermaphroditism can be called forth by an external cause acting upon a sexually differentiated animal, and that it can only be called forth in the male, not in the female. A partial temporary hermaphroditism is assumed by other Crustacea (*e.g.* the crayfish, spider-crab, and Orchestia) at particular seasons when a period of growth, as opposed to one of reproduction, is being initiated. The conclusion that hermaphroditism is a property of the male sex, developed in response to altered conditions of metabolism, can be applied to this state as found normally in Cirripedes and parasitic Isopods, both of which lead a sessile, inactive existence when adult, and have their vegetative functions developed to a high degree. In the parasitic Isopods all the individuals are at first free-swimming males, which, on settling down to their parasitic life, develop the hitherto latent female part of their organisation. The presence in some Cirripedes of males which may degenerate completely, even in the larval stage, and other facts, suggest that all the individuals are primarily males and subsequently females.

Mr. F. A. Potts confirmed Mr. Smith's results from his study of the effects of Peltogaster on the hermit-crab, in which also the assumption of the character of the opposite sex is confined to the male. Especially interesting is the appearance, in parasitised males, of the tufts of hair modified for egg-bearing, and the testes in many cases contain ova.

Experiments on Seasonally Dimorphic Forms of African Lepidoptera.

Dr. F. A. Dixey stated that it is often found that the successive broods of Lepidoptera produced in the course of a year differ widely in appearance according to the meteorological conditions prevailing during their immature stages, the contrast being especially marked where there is a sharp distinction between the periods of rain and dry weather. Mr. Guy Marshall, working at Salisbury, in Mashonaland, has succeeded in showing that, by artificially varying the conditions to which the butterflies are exposed during their immature stages, it is possible to bring about in the midst of one season the emergence of a form which under natural conditions would only have been produced in the other. The period during which the animal is susceptible to climatic influences varies in different species, the critical stage being in some cases confined to the larval, in others to the pupal, condition. In one instance (*Belenois severina*) the effect of moisture combined with heat differs entirely from the effect of the former alone.

The Function of the Spiracles in Sharks and Rays.

Mr. A. D. Darbishire concludes that in the dog-fish water is drawn into the pharynx by way of the spiracles, and to some extent by the mouth, and is expelled through

the gill clefts. In the skate the spiracles play a more important part, for when the animal is at rest all the water which enters the pharynx does so by way of the spiracles; none enters by the mouth. In *Rhina squatina* (the angel-fish) no movement of the spiracles is visible; there is a uniform current of water into the mouth and spiracles, and the water is driven out again through the gill slits by the undulations of the "gill covers."

The Systematic Position of Polypterus.

Mr. E. S. Goodrich pointed out that Polypterus and Calamoichthys, both from the rivers of tropical Africa, forming the order Polypterini, have no near relations among living fish. The presence of rhomboid ganoid scales, paired gular plates, a persistent spiracular gill cleft, true clavicles, a bilobed air-bladder, and a straight tail, form a combination unknown in any other order. Owing to their lobate pectoral fins, paired gulars, rhomboidal scales, outwardly diphycercal tail, and to a considerable resemblance in the disposition of the roofing cranial bones, Huxley (1861) placed the order Polypterini in the group Crossopterygii, in which it has been left by subsequent writers, associated with such extinct forms as Osteolepis and Holoptychius; but on comparing Polypterus with these fossils the resemblance is by no means close. The similarity in arrangement of the surface bones of the skull is only general, and such as may be found in most primitive Teleostomes. The scales of Polypterus and Osteolepis are of very different structure, those of the former being of the true ganoid type. The tail is not truly diphycercal, but of a modified heterocercal type, the notochord, in the young at any rate, being turned upwards (as shown by Budgett). In Actinopterygii there may occur a median ventral gular plate as well as two lateral series; two of the anterior plates of the lateral series may be more or less enlarged, as in Palæoniscidæ; the paired plates of Polypterus may be the homologues of these plates of the Actinopterygii, and not of the more median plates of the Crossopterygii. The skeleton of the pelvic fin and girdle of Polypterus is much more actinopterygian than crossopterygian in structure. The resemblance of the fins of Polypterus to the lobate fins of the Crossopterygii was shown by Budgett to be superficial only. The relationship of Polypterus to the Actinopterygii is supported by a comparison of the structure of the scales and of the fins, by the presence of large solid otoliths in the ear, and the double nostrils on each side of the snout, while the brain, the alimentary canal with its pyloric cæcum, the kidneys and testes, the separate anus and urinogenital apertures, are also consistent with this view.

Colour Variations in the Skin of the Hamster.

Prof. Simroth (Leipzig) exhibited a series of skins of the hamster (*Cricetus frumentarius*), which is common in the cornfields of some parts of Germany, and especially in Thuringia. The usual coloration of the skin is grey along the back and black ventrally, these two being separated by a lateral reddish area, and there are three white or pale yellow patches at the sides of the head and breast. The skins, however, show great variations in coloration. In one series the red areas and then the white patches disappear, the upper side becomes grey, greyish-brown, and finally black, so that the whole skin is now black. In another series the under side becomes lighter, followed by a similar change on the upper side, leading finally to an albino, the rarest variation. The black specimens were first noticed during the hot summers some years ago. It is not yet clear whether these colour variations are to be attributed to climatic conditions or are atavistic.

Photographs of a Young Living Okapi.

Sir E. Ray Lankester, K.C.B., F.R.S., exhibited photographs of a living okapi taken by Signor Ribotti at Bambili, on the Welle River, in the Congo Free State. The animal is a young colt showing the striping of the upper part of the fore and hind legs and hind quarters, and the dark body colour, apparently as in the adult. It is worthy of note that this is the first time that a European has seen a living specimen of the okapi. Some doubt having been recently expressed as to whether okapi is the native name of the animal, Sir E. Ray Lankester remarked that he had shown the photographs and a portion of a skin to some of the African pygmies, now in London, who recognised them, and at once spoke of them under the name okapi.

Plankton Investigations off the Isle of Man.

Prof. Herdman gave an account of his plankton investigations off Port Erin during April. These were undertaken with the object of testing different kinds of open and closing tow-nets, and of gaining information regarding the detailed distribution of the organisms according to locality, depth, and date. Examples were given of very different results, quantitative and qualitative, obtained from quite similar nets hauled not far apart as regards both distance and time. Sudden variations in the vertical and horizontal distribution of the plankton were discussed, and the seasonal changes were also considered; obviously great care and much observation of the gatherings of organisms are required before these can be considered as adequate samples. Prof. Herdman concluded that our methods must be investigated before the attempt to investigate nature on a large scale can be made, and also that an intensive study of small, well-chosen areas is necessary before conclusions can be drawn with regard to relatively large regions such as the North Sea or the Atlantic Ocean.

Mr. W. E. Collinge traced the rise, and pleaded for the due recognition, of economic biology; Prof. Simroth gave an account of his pendulation theory in relation to geographical distribution; Mr. J. W. Jenkinson described his further experiments on the development of the frog; Mr. T. V. Hodgson pointed out the principal features of interest in the collections of Pycnogonids from several Antarctic expeditions; and Prof. R. J. Anderson detailed his observations on the thickness of the skull in Mammalia; but these papers cannot be well summarised in the space here available. J. H. ASHWORTH.

PHYSIOLOGY AT THE BRITISH ASSOCIATION.

THE physiological section has for several years devoted one morning to some subject of general interest. This policy was inaugurated at Cape Town by the discussion on the effect of climate upon health; it was followed up at York by one on the physiological minimum of rest for children, opened by Dr. T. D. Acland; and this year at Leicester by one on the physiological and therapeutical value of alcohol. The interest which this subject has aroused of late made it a particularly appropriate one, more especially as the matter has not been recently discussed in at all a dispassionate way. From this point of view the meeting at Leicester was all that could be desired, and perhaps the most remarkable feature in connection with it was the very narrow margin which separated those who took different views as to the value of alcohol.

The discussion was opened by Prof. Cushny, F.R.S., who reviewed the effect of alcohol on the various systems of the body, alluding especially to its very doubtful effect as a stimulant to the alimentary system, its effects upon the circulation, especially the heart, as recently worked out by Prof. Dixon, and its action upon the muscular nervous system and on the power of the body to resist toxic agents. In doing so he introduced some of the subsequent speakers. Dr. Rivers gave an extremely interesting account of the use of the ergograph in obtaining records of the effect of alcohol. It was very remarkable to see how great was the psychical element in ergograph tracings; this, indeed, was so marked that much the same effect could be obtained by giving a dose of alcohol and one which the patient thought was alcohol, or even one which merely excited his curiosity. Dr. Rivers has been able, in conjunction with Prof. Dixon, to administer considerable doses of alcohol in forms which were not recognisable, and in doing so he has found no certain beneficial effect on the power of performing muscular work. Some curves shown by Dr. Waller, F.R.S., were quite in harmony with this view. These

results admittedly supported the contention put forward by Sir Victor Horsley, F.R.S., and Miss Sturge, that the ergograph gave results which were as yet too uncertain to yield a verdict which could be considered as final.

On one point there was unanimity, namely, that alcohol even in the smallest quantities was deleterious to the quality of mental work. This was insisted upon, not only by Sir Victor Horsley, but by Prof. Dixon, who took a much more optimistic view of the value of alcohol. Prof. Dixon especially considered it valuable in cases of cardiac collapse, on account of the readiness with which it appears to be absorbed and assimilated.

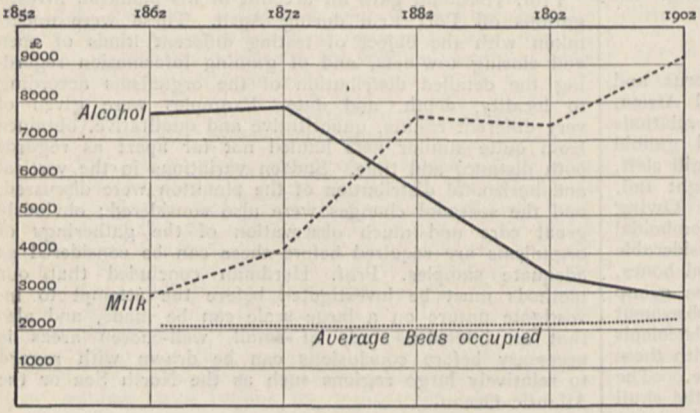

FIG. 1.—Diagram showing the gradual diminution during the past forty years in the administration of alcohol and the increase in the use of milk during the same period. The figures are summarised from the statistics of seven large London hospitals.

From the point of view of the use of alcohol in the treatment of disease, Sir Victor Horsley showed curves (Figs. 1 and 2) illustrating the departure from alcohol which has taken place in the last decade, not only in hospitals generally, but in hospitals for the treatment of fevers—a class of complaints in which alcohol was previously supposed to be especially beneficial.

Still dealing with the relation of alcohol to disease, Dr. Reid Hunt gave an account of the interesting experiments that he has been conducting which point conclusively to the fact that alcohol lowers the power of resistance of the body to a certain specific toxic body, acetonitryl.

Two points remain, the dose of alcohol which may be regarded as harmless, and the much-debated question of whether alcohol is a food. These points are closely connected. The impression left on the mind at the end of the discussion was that whether alcohol is or is not a food is largely a matter of definition. It seems certain, on the one hand, that it is oxidised in the body, yielding a corresponding amount of energy—in this sense it is a food. Such a definition includes many substances—morphia, for instance—which are clearly injurious. If alcohol is not only a "food" but "a useful food," it must be shown that it can be taken without injury to the organism in sufficient quantities to supply an appreciable proportion of the energy of the body. This has not yet been done.

Tuesday, August 6, was devoted to a discussion upon a much more technical subject, the value of perfusions. This was introduced by Prof. Schäfer, F.R.S., who gave an exact account of the best methods for perfusing the heart and the kidney. Others who took part in the discussion were Prof. Cushny, Dr. Alcock, Prof. Zuntz, and Mr. Barcroft. Perfusion has become so important a method in physiological and pharmacological research that some authoritative statement of its limitations would be useful. At present this may be approached in two ways: (1) by a discussion of the best fluids for the purpose, and here we may mention the work recently done at Oxford by Dr. Vernon, who advocated the addition of albumin to Ringer's solution; and (2) by an inquiry into the organs which seem to react most readily, when perfused, to the stimuli which normally produce functional activity. Along this line Mr. Barcroft tentatively put forward the thesis that those organs the coefficient of oxidation of which is lowest stand perfusion much better than others. Thus the heart and muscle react well when perfused, whilst the glandular structures appear incapable of full functional activity when irrigated with an artificial blood supply. Such a tissue as unstriated muscle, which probably has a lower coefficient of oxidation than any of the organs mentioned, will retain a considerable degree of functional activity if it be merely suspended in warm saline solution.

A very interesting discussion followed upon the presidential address. We need not further allude to the address itself, as it has already appeared in the columns of NATURE, than to say that the president's main thesis was that every practitioner should be trained in the quantitative administration of chloroform in surgical cases with an apparatus which delivered air containing a known percentage of the anæsthetic to the patient.

This view was very warmly supported by Sir Victor Horsley and Dr. Vernon Harcourt. Dr. Frederick Hewitt pointed out the difficulties which attended the administration of chloroform in this way, which consisted partly in the impracticability of having apparatus at hand in a great number of cases, and the difficulty in using them in cases where there was great personal idiosyncrasy in the patients. Prof. Waller made it clear, however, in a few words at the end that a person who had been instructed in quantitative ideas as to the administration of chloroform was in a better, not a worse, position to administer it without apparatus if need be, than the man who had only a rule-of-thumb knowledge. This view

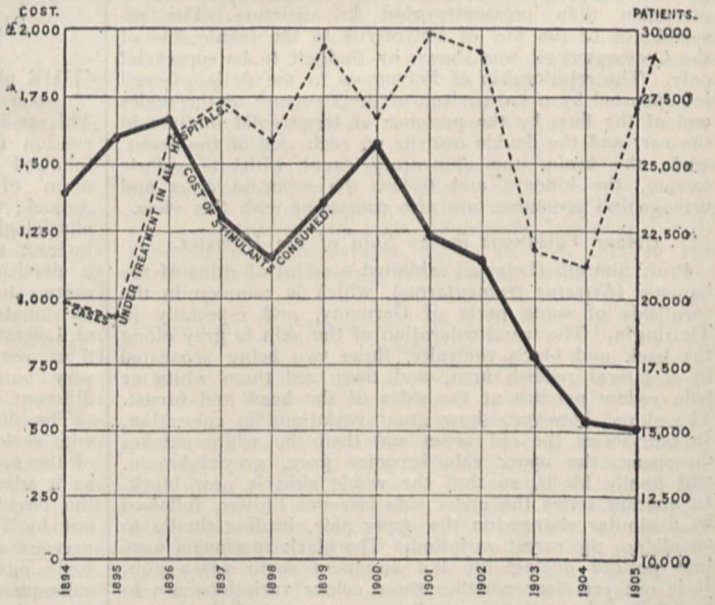

FIG. 2.—Metropolitan Asylum's Board Statistics. Diagram showing the fall in the administration of alcohol to fever patients during the years 1894 to 1905. The dotted line shows the number of patients beginning in 1894 with 20,000. The continuous black line shows the amount of money expended on alcohol beginning in 1894 with 1388*l.*, and falling to 515*l.* in 1905, although the number of patients in the hospitals that year was 27,162.

fairly represented that of the meeting, and it was supported by Prof. Schäfer, F.R.S., Prof. Gotch, F.R.S., and others.

The individual papers were perhaps fewer than is usually the case. Prof. Sherrington, F.R.S., added another to the series of communications on the coordination of reflex muscular movements in the spinal animal which has added so much to the interest of the British Association meetings in the last few years. Very beautiful examples were shown of graded reflex movements which took place in response to graded stimuli. His experiments throw a good deal of light upon the action of strychnine. This drug appears to cause an exaggeration of the rebound which takes place normally after reflex inhibition. The inhibition may be re-established by giving chloroform. Two practical points were brought out:—(1) that in many cases the physiological units of musculature do not correspond to the anatomical ones; and (2) that there is a portion of the gluteus maximus muscle which does not respond either to ordinary reflex stimulation or to strychnine.

Papers on the physiology of nerve were read by Dr. Alcock and Prof. Macdonald. Interesting in themselves, these communications were rendered doubly so by the fact that their writers take a diametrically opposite view of the nature of the nervous impulse.

Three reports were presented by committees; they dealt, respectively, with the metabolic balance sheet of the individual tissues, the ductless glands, and the effect of climate upon health. Their work evoked more interest than usual. The afternoon was spent in discussing the report of the committee of which Sir Lauder Brunton is chairman, and which is a very strong one. It has worked very hard in its efforts to produce a schedule for the collection of the necessary data for the comparison of the climatic conditions of various localities with the diseases which are prevalent in them. Along another line the committee has been greatly strengthened by the active interest of Prof. Zuntz, who came over to Leicester and gave an account of the work which is now being inaugurated in Berlin.

Prof. Zuntz is continuing the work which he and his collaborators carried on in the high Alps, and at the present time two travellers, Drs. Schilling and Jaffé, are making a corresponding set of observations upon themselves in Togo. It will be of great interest to compare the effects of hot climate with the positive results which were obtained upon the high Alps. J. BARCROFT.

THE KINGSTON EARTHQUAKE.

THE official report on the Kingston earthquake, of January 14 last, by Mr. Maxwell Hall, contains, in addition to the customary compilation of accounts of time, duration and violence of the shock, some interesting records of the peculiar behaviour of the sea on the north coast of the island. At Annotto Bay and Port Maria the sea receded, about three or four minutes before the shock at Port Maria, at about the same time after it according to the account from Annotto Bay, the amount of the recession being equivalent to a vertical fall of from 12 feet to 20 feet; after the shock the sea returned in a wave which swept up the shore to 6 feet or 8 feet above its normal level. This phenomenon was only recorded at the two localities mentioned, a fact which points to its being probably due to movement of the land rather than to a sea wave. At the Kempshot Observatory, St. James, the masonry pier of the transit instrument, resting on solid rock, was found to have been disturbed, so that the west end of the axis was 32″ higher than the east end. In Kingston Harbour subsidence of the land was noticed along the shore-line, of more than 24 feet in places, but this appears to have been due to the shaking down of loose accumulations of recent deposits, as there is no indication of a permanent change of level in the centre of the harbour or on land except near the shore-line.

Beside the official report, we have received from Prof. Carmody, of Trinidad, a series of photographs taken in Kingston on the second and third day after the earthquake. Two of these are reproduced, which show the character of the damage done; this was greatest in the case of walls facing east, those facing north or south being generally uninjured. A noteworthy peculiarity was the fact that arched openings seem to have withstood the shock while

FIG. 1.—Railway station wall facing south.

the rest of the wall was destroyed; as there is no form of construction less suited than the arch to withstand the strains set up by an earthquake shock, this can only be

FIG. 2.—Typical north and south narrow street.

ascribed to the badness of material used for building, the arches having stood owing to the necessity for using better material and more skilled workmanship in their construction.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BY the will of the late Mr. A. H. Blount, lord of the manor of Orleton, Hereford, who died in London on June 17, Yale University will receive a bequest the value of which, after payment of duties, &c., will amount to about 80,000*l*.

THE new session of Birkbeck College, London, will be opened on Monday, September 30, when an address will be given by Mr. G. G. Chisholm. The laboratories will afterwards be open to inspection, and demonstrations will be given. There will be an annual exhibition of students' works on Friday, Saturday, and Monday, September 27, 28, and 30.

THE Department of Agriculture and Technical Instruction for Ireland will, next month, award not more than three commercial scholarships to young men having a

sound general education and some commercial experience. The object of the scholarships is to afford facilities for the holders obtaining training in some higher institution, approved by the department, with a view to their employment as teachers of commercial subjects in Ireland. The scholarships are of the value of 100*l.* each, and are tenable for two years. Candidates must have been at least twenty-one years of age on September 1, and must fill in and return a certain form to the secretary of the department not later than September 25. The department also proposes to award three industrial scholarships to persons engaged in industries, such as the woollen, linen, leather, and tanning industries. The scholarships will be of the value of 80*l.* each, and may be renewed for a second or a third year at the discretion of the department.

THE new buildings in Queen's College, Belfast, which are to be formally opened by Lord Kelvin on September 20, are for the purpose of affording increased accommodation in the departments of chemistry, physics, engineering, natural history and geology, physiology, pathology, medicine, and surgery. The chemical buildings are now completed by the erection of a large lecture room, a lecture preparation room, and a museum for chemical specimens. In physics there are new elementary and advanced laboratories, and in engineering a laboratory, a lecture room, and a drawing office. The additions to the natural history and geological departments include a laboratory for elementary classes in biology, a laboratory for geology and mineralogy, and rooms for advanced classes and private research in zoology and botany. The physiological department has been provided with three new laboratories, viz. for histology, chemical physiology, and experimental work, and the pathological department with private research rooms for the professor and his assistant, and a laboratory for advanced classes in bacteriology. The medical buildings have been extended by the addition of a class room, &c., specially designed for operative surgery. The cost of these extensions has been defrayed by private donations, with the assistance of a Government grant.

A MEDICAL department of the Board of Education has been established to advise and assist in the discharge of the new duties imposed on the Board by the Education (Administrative Provisions) Act in regard to the medical inspection of school children which local education authorities are required by that Act to carry out in England and Wales. The chief duties of the Board in this direction will consist in advising and supervising local education authorities as to the manner and degree in which those authorities carry out this medical inspection; in giving such directions as may be necessary regarding the frequency and method of such inspection in particular areas; and in considering and sanctioning such arrangements as may be proposed under the Act by individual authorities for attending to the health and physical condition of the children. The organisation and *personnel* of the Board's medical department are not yet fully determined; as a first step Dr. George Newman has been appointed chief medical officer of the Board. Dr. Alfred Eichholz, who has for nine years been on the Board's staff as medical inspector of schools, will also be appointed to the medical department, and further appointments will be made in due course. The Board intends in the autumn to issue a circular to local education authorities regarding their new duties in the matter of medical inspection of school children.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, September 9.—M. Henri Becquerel in the chair.—The contact phenomena of phonolitic trachyte from Griounot, Cantal: A. **Lacroix.**—Bi-secondary butylene chlorohydrin: Louis **Henry.** The secondary butyl alcohol, $CH_3—CH_2—CH(OH)—CH_3$, was prepared synthetically from ethylmagnesium bromide and aldehyde; this was converted into the secondary iodide, and from this, by the action of alcoholic potash, symmetrical dimethylethylene was prepared. The chlorohydrin results from the interaction of this hydrocarbon and hypochlorous acid. Its physical properties are given.—The resistance of the air: M. **Jouguet.**—Contribution to the study of the alloys of cobalt and tin: F. **Ducelliez.** The present note deals with alloys containing between 57 per cent. and 66 per cent. of tin. The alloys are probably formed of a mixture of CoSn and Co_3Sn_2.—Celestite from Mokattam: M. **Couyat.**—Parasitic phanerogamic plants and nitrates: Marcel **Mirande.** Parasitic phanerogams without chlorophyll cannot absorb nitrates from their hosts. The green hemiparasites vary, some being capable of absorbing nitrates from the host, others not.—Variation in the ramification of umbels: H. **Ricôme.**—The causes of the death of the young hippopotamus of the museum menagerie: E. L. **Trouessart.** The animal died from injuries to the head caused by the mother in repelling the young hippopotamus from the breast.—The culture of the turbot: R. **Anthony.**—The subterranean waters of the Basque country: E. A. **Martel.**

NEW SOUTH WALES.

Linnean Society, July 31.—Mr. A. H. Lucas, president, in the chair.—The geology of Newbridge, near Bathurst, N.S.W.: W. Noel **Benson.**—Revision of the Australian species of the genus Anthobosca (Hymenoptera: fam. Scoliidæ), with descriptions of new species: R. E. **Turner.** By careful comparison with exotic species in the British Museum collection, the author has convinced himself that the insects classed in the genus Anthobosca are the male sex of the insects usually known in Australia as Dimorphoptera (Sm.).—The Mollusca of the Mast Head Reef, Capricorn Group, Queensland, part ii.: C. **Hedley.** This part enumerates the Gastropoda collected on and around Mast Head. Thirty-seven new species are described and figured. The geographical range of shells previously only noted on the one part from Torres Strait, on the other from the neighbourhood of Sydney, is greatly enlarged. Altogether, two hundred and two mollusca are added to the known fauna of Queensland.

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