THURSDAY, AUGUST 20, 1903.

## RIVER IMPROVEMENT.

*The Improvement of Rivers. A Treatise on the Methods Employed for Improving Streams for Open Navigation, and for Navigation by means of Locks and Dams.* By B. F. Thomas and D. A. Watt, U.S. Assistant Engineers, Members Am. Soc. C.E. Pp. xiv+356. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1903.) Price 25*s.* 6*d.* net.

IN their preface the authors state that they know of no recent book which treats of the improvement of rivers except in a general way, possibly because they seem not to be aware of the existence of a book, "Tidal Rivers," published in 1893, and have not apparently heard of the issue of a second edition in 1896, rewritten and enlarged, of "Rivers and Canals," from the first edition of which, published in 1882, they quote a long extract on the principles which should govern the improvement of tidal rivers. Undoubtedly, if the authors of these two books had confined their attention to the rivers of the United Kingdom, there would have been little matter in them properly applicable to American practice, owing to great differences in the physical conditions of the two countries; but both these books range over a very wide field, and deal with the improvement of rivers in various parts of the world, including, of course, rivers in the United States. Though, however, there is not such a complete dearth of books describing the methods of improvement of rivers with extensive basins, as the authors intimate in their preface, and on account of which they express the hope that their book will supply a much needed want, it is certain that the detailed descriptions of American methods and experience relating to the regulation and canalisation of large non-tidal rivers, will be of great service, not merely to those engaged in such works in the United States, but also to all engineers who have to deal with large problems of river improvement in countries containing vast drainage-areas, as met with in eastern Europe, Asia, Africa, and Australia, as well as in North and South America.

The largest river-basin of the United Kingdom, that of the Thames, with an area of only 5244 square miles, owing to the comparatively restricted extent of the British Isles, sinks into insignificance when compared with the Mississippi, having the largest drainage-area of the rivers of North America, amounting to 1,244,000 square miles, which, in its turn, is exceeded by two river-basins in South America, namely, the La Plata with a basin of 1,600,000 square miles, and the Amazon with a basin of about 2,250,000 square miles, the largest in the world. Accordingly, there is little scope in the United Kingdom for regulation works, and even for canalisation, which have enabled inland navigation to be considerably improved and extended along the large rivers of North America. On the other hand, there have not been the same opportunities in America for the great increase in depth of small tidal rivers, by dredging and training works, affording access to seaports, as has been effected in Great Britain in the Tyne, the Clyde, and the Tees, though access for sea-going vessels has been extended from Quebec to Montreal by dredging in the St. Lawrence; whilst the most important works carried out in the United States at the outlet of a river, are the parallel jetties which were constructed several years ago in extension of the South Pass of the tideless and deltaic Mississippi, across the bar encumbering its mouth, in order to concentrate the scour over the bar and thus deepen the outlet channel.

The authors deal very briefly with the improvement of river outlets in a single chapter of only ten pages, stating that this important subject would require a volume; and after quoting at full length the principles laid down by an English engineer for the improvement of tidal and non-tidal river outlets, and alluding to the experiments with working models, carried out by the same engineer, on the effects of training works in tidal estuaries, they refer to the method of improvement by jetties, and conclude with a short account of the jetty works completed at the outlet of the South Pass in 1879, and those authorised last year for obtaining a navigable depth of 35 feet at the outlet of the South-West Pass of the Mississippi. The book, accordingly, really relates to the improvement of the inland portions of large rivers for navigation by regulation works or canalisation, in which the authors, as assistant engineers in the Government Department of the United States, which has control of all the rivers, have wide practical experience, and for which the book furnishes a very valuable guide. This large quarto volume, with 349 pages of text, and illustrated by numerous pages of drawings, diagrams, and photographic reproductions dispersed throughout the book, and eighteen plates of detailed drawings at the end, together with a few blocks in the text, deals with the improvement of rivers in three distinct parts; the general characteristics of rivers and their surveys being considered in the first part, the improvement of open rivers in the second part, and the improvement of rivers by canalisation in the third part.

The first part is divided into five short chapters, occupying only forty pages altogether, treating respectively of introductory matters, the characteristics of rivers, preliminary examinations and surveys, topographical surveys and levelling, and hydrographic surveys. This part is mainly concerned with the preliminary data which require to be obtained before undertaking works of improvement, namely, the physical features of the river, consisting of the amount of the rainfall and the size of the river-basin, the fall and nature of the river-bed, the sediment brought down, shoals, bars, and changes in water-level; next, surveys of the course of the river; and, lastly, cross-sections of the channel, and measurements of the discharges over weirs and in the unimpeded channel.

The second part is divided into seven chapters, and covers ninety-one pages, dealing successively with the "Removal of Bars and other Obstructions," "Regularisation," "Dykes and their Effects," "Protection of Banks," "Levees," "Storage Reservoirs," and "Improvement of River Outlets." The first of these chapters relates to the various devices attempted

for stirring up the materials of bars and shoals so as to effect their removal by the current, the different types of dredgers and their capabilities, and the clearing away of trunks of trees, termed snags, and wrecks from the navigable channel. The most interesting work in this respect is the formation each year, during the low stage of the Mississippi, of a channel for navigation, about 250 feet wide and 9 feet deep, across sandy shoals in certain places by suction dredgers, the efficiency of which is increased by stirring up the sand with water-jets; and in 1899 five of these dredgers cut about 62 miles of channel at the average rate of 105 lineal feet per hour. The second chapter of this part lays down the general principles on which the regulation of river channels is based, with the object of obtaining greater uniformity of depth; whilst the following chapter describes the construction of spur and longitudinal dykes, which are sometimes submerged, by which the regulation is effected, a system which has been successfully applied to several of the larger rivers of Europe, as well as in America.

The protection of banks aims mainly at the prevention of prejudicial changes in the course of a river by the erosion of the concave banks in flood-time; and it is accomplished by pitching, rubble stone, fascines, brush mattresses, or occasionally submerged spurs. Levees, consisting of earthen embankments, formed along the banks of a river to prevent the river from inundating the riparian lands in flood-time, are rather works for the protection of property than for river improvement; but to effect their purpose they must be watertight, continuous, and have their tops above the highest floods, which necessarily have their water-level raised by being confined within the banks. Several rivers in Europe have been controlled by embankments, notably the Po, the Loire, and the Theiss; and levees have been extensively carried out on the Mississippi below Cairo and some of its tributaries, the total expenditure on these works in the United States being estimated at about 10,000,000*l*., up to the present time, for a length of 1436 miles; whilst considerable additions to the Mississippi levees are projected. These embankments, however, are liable to be occasionally overtopped and breached by an exceptional flood; and in alluvial plains, as in the case of the Mississippi, they are exposed to undermining by changes in the course of the river, in spite of regulating works; and the rush of water through the gap formed in the bank produces considerable devastation over the adjacent low-lying lands. Rivers bringing along large quantities of detritus in their torrential flow down steep mountain slopes, and abruptly emerging into flat plains, are liable to raise their beds by the deposit of sediment, owing to loss of velocity, when confined within embankments, a result which occurs in the Yellow River of China and some Japanese rivers; and under such conditions, when the embankments are successively raised to compensate for the rising of the river-bed, a terrible catastrophe is a mere question of time, due to the precipitation of the raised and imprisoned river through a weak place in the embankments, with irresistible force and rapidity, into the plains below.

The chapter on "Storage Reservoirs" consists almost entirely of extracts from a report by Captain Chittenden on "Reservoir Sites in Wyoming and Colorado," a method of compilation employed in several of the earlier chapters, though to a minor extent, and also in the following chapter on river outlets, already referred to. Reservoirs would be valuable in river valleys in serving, like lakes, for regulating the flow of rivers by reducing the flood discharge and augmenting the low-water flow. It is, however, only under exceptional conditions that reservoirs can be formed extensive enough, at a reasonable cost, to increase materially the flow of a river at its low stage; but this has been accomplished by damming the outlets of some lakes near the sources of the Volga and Msta in Russia, extending the navigable period of those rivers by nearly three months; whilst a similar improvement has been effected in the Upper Mississippi by raising the water-level of several lakes near the head-waters of the river, a system which might be considerably extended in this case, owing to the immense number of lakes existing near its sources. The formation of reservoirs at intervals along a river valley would greatly reduce the flood discharge by impounding the flood-waters, but the conditions are rarely favourable; and the cost of construction, and the extent of land submerged, present insuperable obstacles to the adoption of this system, merely for the mitigation of floods, in the great majority of cases. Several reservoirs, however, have been constructed in Europe for storing up water for water-power for industrial purposes, as well as for the mitigation of floods, with successful results, as, for instance, the Furens and Ternay reservoirs in France, and the Dahlhausen reservoir on the Wappen in Germany, the provision for floods being effected by keeping the reservoir drawn down to a definite extent below its full water-level for their reception.

The third part, relating to the canalisation of rivers, occupies one hundred and forty-one pages, or rather more than half the regular text of the book, and is divided into ten chapters, the three first dealing with locks and lock gates, the fourth with fixed dams on rivers, and the remainder with the various types of movable weirs, which constitute the more novel and most interesting portion of the subject. Though the first movable weir appears to have been the bear-trap weir erected in 1818 across the Lehigh River in the United States, consisting of two gates or shutters turning on horizontal axes on the sill, and one resting on the edge of the other, the principal types of movable weirs were gradually introduced in France between 1834 and 1885; and most of these French forms have been reproduced, on a larger scale, on some of the rivers of the United States; whilst the American bear-trap weir was adopted, with improvements, at Laneuville-au-Pont on the River Marne, in France, about the middle of the nineteenth century.

The object of these movable weirs is to leave the channel of a river quite unimpeded in flood-time for the passage of the flood discharge, and occasionally of vessels when the lock is submerged, whilst retaining the water-level of the river above it at a sufficient height for navigation in dry weather; and the three chief French types are the Needle Weir, the

Chanoine Shutter Weir, and the Drum Weir. The needle weir consists of a series of wooden spars resting against a bar at the top across the weir, carried on a row of iron frames providing a foot-bridge, and against a sill at the bottom, though of late years sliding panels or rolling-up curtains have been often substituted for the spars or needles; and this type of weir has been adopted for the first time in the United States for a weir across the Big Sandy River at Louisa, in Kentucky, with large inverted V-shaped frames placed 8 feet apart, and lying one inside the other when lowered on the apron in flood-time, and closed by needles having the exceptional dimensions of 12 inches width, 14 feet length, and 8½ inches thickness at the bottom and 4½ inches at the top, which are handled by a floating derrick. The frame weir suspended from an overhead bridge, so that all the movable parts can be raised out of the river in flood-time, as resorted to on the Lower Seine at Poses and Port-Mort, and the barriers substituted for needles, are described and illustrated in the book, but have not hitherto been adopted in the United States.

The Chanoine shutter weir is composed of a series of shutters supported centrally on a trestle, and turning on a horizontal axis, the trestle being maintained in an upright position by a prop, resting at its lower extremity in a cast-iron shoe fixed to the apron when the river is closed; and the weir is opened by withdrawing the props from their shoes, causing the trestles to fall flat on the apron, with the shutters on top of them in a horizontal position. Owing to the rapidity with which it can be opened, this type of weir is advantageous for rivers subject to sudden floods; and it has been adopted in the United States across the deep navigable passes on the Ohio and Kanawha Rivers, where shutters somewhat larger than the biggest in France have been erected.

The drum weir consists essentially of an upper and an under paddle revolving on a central horizontal axis, the row of upper paddles forming the weir; and the under paddles, revolving in the quadrant of a horizontal cylinder forming the drum, are made to close or open the weir by altering the water-pressure on their two sides in the drum, so that when the head of water from the upper pool presses on the upstream side of the under paddles, the upper paddles rise against the current of the river. In spite of the perfect control of this weir which the under paddles afford, the deep foundations required for these paddles below the sill, exceeding the height of the weir above it, have hindered its general adoption; and since the completion, in 1867, of a series of these weirs in the canalisation of the Marne, a tributary of the Seine, they have only been used in Europe for timber passes at the side of the weirs erected across the River Main for canalising it in 1883–6, and across the navigable pass, 9 feet in depth, of the Spree at Charlottenburg. A modified form of drum weir has been quite recently constructed in timber across the Osage River in Missouri, in which the paddles are replaced by a sector of a cylinder which fits exactly in the drum when lowered, and closes the weir when raised. The old bear-trap weir fell into oblivion for many years in America; but within the last few years some weirs of this type, of improved design, have been constructed; and two, placed alongside a new weir near Beaver on the Ohio River, each 120 feet long and 13 feet high, serve for the passage of drift and for regulating the discharge.

Another peculiar, novel type of weir, also forming part of the new weir across the Ohio, consists of a series of A-shaped frames, which, as in other frame weirs, can be lowered flat on the bed of the river in flood-time; but it differs from ordinary frame weirs in the frames themselves forming the barrier for closing the weir, by being constructed with a widened plated upstream leg touching the plates of the legs of the adjacent frames when standing upright, besides furnishing a support for the foot-bridge along the top of the weir.

The book concludes with three appendices, giving the dimensions of various locks and weirs in the United States, the standard specifications adopted for certain river works and materials, and laws for protecting the waterways in the United States. Altogether, the book affords a large amount of information about works carried out on rivers under Government in the United States; whilst in some of the chapters, such as those on levees, storage reservoirs, and more especially those on movable weirs, interesting particulars are also given of European works.

## THE FISHERMAN IN AMERICA.

*Bass, Pike, Perch, and Others.* By James A. Henshall. Pp. xix+410. (New York: the Macmillan Company; London: Macmillan and Co., Ltd., 1903.) Price 8*s.* 6*d.* net.

*Big Game Fishes of the United States.* By Chas. F. Holder. Pp. xiv+435. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1903.) Price 8*s.* 6*d.* net.

THESE two volumes of the "American Sportsman's Library" deal with the fishes of the United States, other than salmon, trout, and char, from the sportsman's point of view. Although the same ground is to a certain extent covered by both, Dr. Henshall has to deal with numerous species inhabiting both fresh and salt water, while Mr. Holder's volume confines itself to a comparatively small number of marine species, and this naturally results in the adoption of a different method of treating the subject by the two authors; this much they have in common, that both have produced books which give the angler information as to the tackle to be employed for each species and the places in which to employ it, and at the same time illustrate their remarks with excellent personal observations on the habits of the fish with which they deal.

The first book under notice combines in a greater degree than almost any other work of which we are aware, systematic ichthyology and directions to the fisherman; the author has adopted the classification of Jordan and Evermann's "Fishes of North and Middle America," and his specific descriptions and most of his nomenclature are taken from that standard work, with the addition of useful observations of his own upon the

specific differences between allied species. While welcoming the restoration of Esox as a generic name for the pike—in consonance with Jordan and Evermann's own most recent work—one rather regrets that the author has not reconsidered the reasons which have caused American writers to separate the graylings from the Salmonidæ as a separate family, and to substitute Stizostedium for the Lucioperca of European authors.

The reader of this book is immediately struck by the great difference between the American and European fish fauna as viewed by the fisherman; among fresh-water forms the only Cyprinoid fish considered in any other light than as prospective bait is the introduced *Cyprinus carpio,* while the place occupied in England by Cyprinoids is taken by numerous species of Percidæ and Centrarchidæ, the only representatives of which in our waters are the common perch and the ruff. From the angler's point of view this is no slight gain, especially as some of the Centrarchidæ, notably the two species of "Black Bass," attain a large size and rise freely to an artificial fly. Justice is also done to the merits of the grayling, but hardly, we think, to the views of either English anglers or poets respecting it. Among the marine fishes, again, our American friends have very many Serranoid and Sciænoid fishes to set against our bass, and numerous Sparoids where we have but one sea bream that can be considered an "angler's fish," but we find the grey mullets only mentioned as bait for other fish, and no species of Gadoid even mentioned. Mr. Holder is surely right, and the coalfish (the "pollack" of American writers) has not yet met with the recognition it deserves as a sporting fish.

It is, perhaps, hypercritical and unfair to complain of such a matter, but Dr. Henshall's language, especially in dealing with technical descriptions of tackle and gear, is not very intelligible to an Englishman, more especially when the great differences between English and American rods and lines are taken into account; it is a little startling to find an eight ounce rod recommended for pike fishing and puzzling to find no details as to the length and build of such a rod. A "chlorinated sea breeze" is apparently a special product of the western Atlantic, like the author's Bahama negro, for whose observations on fishes and their ways all Dr. Henshall's readers will be grateful.

We are reminded of a certain traveller's tale about a "mixed bag of wild fowl and hippopotami" when dealing with Mr. Holder's "Big Game Fishes," almost on the same line with Dr. Henshall's work; we pass from the grayling and the perch to the huge Serranoids of the Florida and California reefs, the tarpon, and the pelagic Scombridæ, the weights of which are reckoned by the hundredweight, and we pass, too, to descriptions of some of the most exciting fishing man can want. Unfortunately, the English sea fisherman must content himself with smaller game (unless he chooses to fish for the blue sharks, which are common enough off our western shores in the late summer), but a work like this should find readers outside the United States; the tunny and the albacore are within reach of British fishermen in the Mediterranean, the American tarpon has its counterpart in the Indian Ocean, and huge Serranoids are not confined to American waters. If English or colonial readers should feel encouraged to try their hands at "big game fishing," they will find in Mr. Holder's book all the information they can desire as to the necessary tackle and baits to use, and the kind of place in which to use them, and if Mr. Holder's descriptions of this exciting form of sport do not encourage them to try their hands at it, we really do not know what will.

In marked contrast to Dr. Henshall, Mr. Holder gives no specific descriptions of the fish he deals with, and his only attempt at systematic or anatomical detail in his introductory chapter is not very happy; no reason is given for terming the shark "not a true fish," and to dismiss so important a structure from a systematic point of view as a fish's pectoral arch by saying that "many of the corresponding bones among higher animals are seen, as a pectoral arch, scapula, clavicle, ulna, and radius," is neither useful nor accurate.

The printing and get up of both books is excellent, and both are well illustrated, the one in black and white, the other in colours; the only fault to be found is that the process blocks of fishes have lost in clearness by being printed on rather too rough a paper, and that the figure of Pseudopleuronectes in Dr. Henshall's book is printed upside down; there are also in Mr. Holder's book certain references to a non-existent Fig. 9, which are apparently due to an oversight. The index in each case is very good. L. W. B.

## TECHNICAL PHYSICS.

*Lehrbuch der technischen Physik.* By Prof. Dr. Hans Lorenz. Erster Band. Technische Mechanik Starrer Systeme. Pp. xxiv+625. (Munich: Oldenbourg, 1902.)

THIS book is interesting as the work of an engineer who is also a professor in one of the leading universities of Germany, where it is generally conceded that the science and practice of technical education are best understood, and have led in modern times to the most striking practical and commercial developments. The author rightly considers the fundamental principles of mechanics to be the groundwork of all physics, and has chosen mechanics as the subject of his first volume.

The most striking features of the book, as a whole, are the rigorous mathematical method of treatment adopted, the generality of the principles discussed, and the logical order of the arrangement. In an English "technical" text-book we should rather expect to find the practical applications in the foreground, and the general mathematical treatment of the principles either absent, or introduced only so far as was necessary for purposes of calculation, and not as the groundwork of the whole arrangement. Owing to the difficulty which many students find in appreciating general mathematical reasoning, we are inclined to make the mathematics as concrete and "practical" as possible, and to restrict it to the immediate applications required for illustrations. No doubt this may produce the best results, on the whole, in the case of

students whose abilities and opportunities are limited; but such students will probably not possess sufficient grasp of the mathematical principles to enable them to apply their knowledge to any new problem. Their training is "technical" in the English sense of the term. It may be questioned whether the German view of technical physics, as understood by the author of the present work, is not really the wiser and the more likely to lead to sound educational and commercial progress in the end.

The book begins with a general chapter on the geometry of motion. The idea of time is introduced in the next chapter on velocity and acceleration. This is followed by a chapter on relative motion, treating the usual examples, such as projectiles, planets, pendulum, oscillations, &c., in a very general manner. In chapter iv. we have mass and force introduced together with friction, damped oscillations, impact, work, and kinetic energy. In chapters v. and vi. we have a general discussion of the equations of motion in a plane, and in three dimensions, respectively, with a number of important applications, such as the theory of the precession of the earth's axis, the centrifugal governor, and the theory of models and dimensions.

The book concludes with a historical survey of the evolution of mechanical science divided into three sections:—(1) before Newton, (2) from Newton to Lagrange, (3) the later development of technical mechanics. This historical excursus would be unnecessary, from the teacher's point of view, for the mere inculcation of the principles of the subject, and would interfere with the logical order of ideas. But from the student's point of view such a historical survey is not only extremely interesting, but also most instructive. Correct ideas can only be appreciated in their true significance by contrast with incorrect conceptions, such as abound in the earlier history of the subject; and the methods and principles at which we have arrived at the present stage of progress are not in all probability the best expression of the science, but are the outcome of an intricate process of evolution along certain lines. To appreciate them fully it is necessary to know something of the manner in which they have been evolved.

It is probable that the English engineer would hesitate before devoting much time to the study of a foreign text-book which at first sight is of so "unpractical" a nature. But the mere existence of the book in its present form suggests a lesson which our technical educators may have yet, in some cases, to learn. H. L. C.

## OUR BOOK SHELF.

*An Introduction to Botany.* By W. C. Stevens. Pp. 428; with preface and index and key, 121 pp. and index. (New York and London: D. C. Heath and Co., 1903.) Price 6*s*.

AMONG the numerous works professing to guide the elementary student through the mazes of botanical science, this may claim several advantages, inasmuch as the greater part of the book is based on a sound conception of the method best suited for the purpose of training the beginner to observe and think for himself. It is the method which Huxley worked so hard to introduce into this country many years ago, namely, that of encouraging the student to investigate first, and then telling him more about the things he has seen, keeping the opinions and records of others in the background until he has acquired a stock of his own knowledge to work upon.

On the whole the purpose of the book is carried out, but the figures are often very poor, and the part dealing with systematic botany frankly returns to the old lines, and is, moreover, only suited to American students. Why this part should be separately paged is not clear; it necessitates a second index, and makes the book somewhat cumbrous. English students will find far better exercises in the use of analytical keys and floristic work generally in Hooker and Bentham's well-known "Flora."

*Kant's Lehre vom Glauben.* By Ernst Sänger. Pp. xvii+170. (Leipzig: Verlag der Durr'schen Buchhandlung, 1903.) Price 3 marks.

KANT'S philosophy has found, and continues to find, various application and still more various interpretation. The diversity of commentaries has led, in some quarters especially, to a feeling that Kant has received enough development, that in some cases the development has been too much controlled by the ideas of later systems, that, in fact, we must go back to Kant and define more clearly our ideas of what he really said. The present essay is obviously designed to assist that process. If we except the last section, which makes reference to the relation between Kant's doctrine and theology, the entire essay is confined to collecting Kant's statements and piecing together his doctrine of belief from the original sources. The author has clearly spared no pains to make his collection of passages complete, nor has he failed to point out the significance of Kant's distinctions or his variations in the use of terms. For the purpose indicated, it was necessary to follow the historical order; the result is a monograph not, perhaps, eminently readable, but deserving study. Though the author's reference seems to be especially to that scientific theology which ever finds it a primary duty to accept or answer Kant, his essay cannot fail to be of value to all interested in philosophy. His remarks on the various passages show clearly how the doctrine of belief runs through all Kant's work, and how its elucidation throws light on the structure and purpose of all his writings. An introduction by Prof. Dr. Hans Vaihinger will doubtless appear to many an adequate recommendation. G. S. B.

*Elementary Physics. Practical and Theoretical.* Second Year's Course. By John G. Kerr, M.A., LL.D., and John N. Brown, A.R.C.Sc. (Lond.). Pp. 169. (London: Blackie and Son, Ltd., 1903.) Price 2*s*.

THE practical exercises here brought together are intended for young students who have already had a year's work in experimental physics. Dynamics, heat and light are the only branches of the subject drawn upon, and presumably the learner is expected to wait until his third year before he may hope to become acquainted, from his own experiments, with the fundamental principles of sound, electricity, and magnetism. The exercises are well arranged and the instructions given are sensible and helpful, and show that the authors are teachers of experience. The student is more likely to obtain good results if a simple sighting apparatus is used in counting vibrations of the pendulum, but no instructions appear to be given as to the use of one. On p. 64 the student is told to hang a 50-gram weight to a thread for use in his experiment, which necessitates handling the weight, a bad habit which the teacher should discourage as much as possible. A want of uniformity in the spelling of gram should be corrected in the next edition. But, on the whole, the book is likely to prove useful.

*Among the Night People.* By Clara Dillingham Pierson. Pp. xi+221. (London: John Murray, 1903.) Price 5*s*.

THIS is an American book, for American children, and about American nocturnal animals; but, if we are not mistaken, it will interest English children too, and may be of no small value in letting them into some of the secrets of the life of "the Night People" of the world in general. It consists of a series of stories or sketches of the doings of raccoons, musk-rats, skunks, mice, weasels, foxes, moths, fireflies, &c., told without any affectation in simple language, and with an evidently real knowledge of the habits and characteristics of these creatures, and with a gentle humour which aptly conceals the instruction conveyed. The animals are, of course, humanised to some extent, and talk the language of human beings, but this is managed with such skill, that the animal characteristics are quite adequately retained. A good example is the story of the inquisitive weasel, where a phlegmatic black-tailed skunk is made to play with most amusing effect on the lively curiosity of these little animals, which are the same all the world over. The illustrations of scenes in the dark, by Mr. F. C. Gordon, are very happily conceived and executed.

*Qualitative Chemical Analysis.* By John B. Garvin, B.S. Pp. viii+241. (Boston: Heath and Co., 1902.) Price 3*s*. 6*d*.

IT is rare in these degenerate days to find an enthusiast for the teaching of qualitative analysis, who regards it as "a source of joy to the majority of normal minds," and as affording "the keenest delight and satisfaction." For analysis, as it is taught, is usually an arid tract, which the student is compelled to traverse on the way to earning a grant or receiving a degree, not a fertile country which he can cultivate with profit and pleasure. Yet one is bound to confess that these pages reflect the author's interest in his subject, and leave the impression that, in the hands of such a teacher, analysis might possess the attributes he describes. This is effected by making the student discover and tabulate the reactions for himself. Thus, the mere mechanical following of directions is, to a great extent, avoided, and the student is freed from the burden of making his own observations correspond with the printed information in his text-book. For an elementary book the subject is very fully treated. It is not intended to be used without some assistance from the demonstrator, and consequently many details of manipulation are suppressed.

J. B. C.

*British Rainfall*, 1902. Compiled by H. Sowerby Wallis and Dr. H. R. Mill. Pp. lxxvi + 250. (London: E. Stanford.) Price 10*s*.

THIS valuable work, which has appeared yearly since 1860, is perhaps better known to the scientific world than any other work on meteorological subjects; it has become a unique and indispensable epitome of reference on all questions relating to the distribution of rain over the British Islands. Each year adds to its importance, owing to the longer period over which the averages extend, and the nearly constant addition to the number of stations dealt with. These now amount to about 3500, and have increased 40 per cent. during the last fifteen years. It is highly creditable to the compilers that they have been able to issue the volume six months after the close of the year, within which time every record has been carefully revised prior to publication. In addition to the usual tables, the present volume contains an exhaustive discussion of the rainfall at Camden Square for the forty-five years 1858–1902, by Mr. H. Sowerby Wallis. Illustrations and notes upon the unusual occurrences of the year 1902 greatly enhance the usefulness of the volume.

## LETTERS TO THE EDITOR.

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

### The Amount of Emanation and Helium from Radium.

IN connection with the very striking experiments described by Sir William Ramsay and Mr. Soddy in NATURE of August 13, in which they have observed the presence of helium in the gases obtained from radium bromide and also the production of helium by the emanation of radium, it may be of interest to give some calculations of the probable amount of emanation and of helium produced by radium on the disintegration hypothesis, recently put forward by Mr. Soddy and myself to explain the phenomena of radio-activity.

A method of calculation has already been indicated by us (*Phil. Mag.*, May), but the data on which it was based are somewhat imperfect. A more accurate estimate can be made from the data of the amount of heat liberated by radium, recently measured by Curie and Laborde.

I have shown that the $\alpha$ or easily absorbed rays from radium consist of a stream of positively charged bodies, of mass about twice that of the hydrogen atom, projected with a velocity of about $2{\cdot}5\times10^{9}$ cm. per sec. These results have been recently confirmed by Des Coudres. These $\alpha$ bodies are expelled from every part of the mass of radium, but in consequence of the ease with which they are absorbed, only a small proportion of them escapes into the air. This self-bombardment of the radium probably gives rise to a large proportion of the heat which keeps the radium at a temperature above that of the surrounding atmosphere. Assuming for the moment that all of the heat is supplied by this continuous bombardment, an estimate can readily be made of the number of $\alpha$ bodies projected per second from one gramme of radium.

The kinetic energy of each projected body is $5\times10^{-6}$ ergs. Since this energy is transformed into heat in the mass of radium, the number of bodies projected to give an emission of heat of 100 gr. cals. per hour—the amount determined by Curie and Laborde—can be shown to be $2{\cdot}4\times10^{11}$ per second. Now Townsend has shown from experimental data that $Ne=1{\cdot}22\times10^{10}$, where N is the number of atoms in 1 c.c. of gas at standard pressure and temperature, and $e$ is the charge carried by an ion. The latest value of $e$, found by J. J. Thomson, is $3{\cdot}4\times10^{-10}$, so that $N=3{\cdot}6\times10^{19}$.

If the $\alpha$ bodies after expulsion can exist in the gaseous form, the volume of the gas produced (at standard pressure and temperature) is thus $\frac{2{\cdot}4\times10^{11}}{3{\cdot}6\times10^{19}}=6{\cdot}7\times10^{-9}$ c.c. per sec. or 0·21 c.c. per year. Allowing a wide margin for the possibility that only one-tenth of the heat emitted by radium is due to the kinetic energy of the projected bodies, the volume of the $\alpha$ particles should lie between 0·021 c.c. and 0·21 c.c. per year for each gramme of radium.

The determination of the mass of the $\alpha$ body, taken in conjunction with the experiments on the production of helium by the emanation, supports the view that the $\alpha$ particle is in reality helium. In addition, the remarkable experiment of Sir William and Lady Huggins in which they found that the spectrum of the phosphorescent light of radium consisted of bright lines, some of which within the limit of error were coincident with the lines of helium in the ultra-violet, strongly supports such a view. For as a consequence of the violent expulsion of the $\alpha$ particle, it

is to be expected that it would be set into powerful vibration and give its characteristic spectrum.

In the experiments of Sir William Ramsay and Mr. Soddy 30 milligrammes of radium bromide, probably about four months old, were used. If the α body is helium, the amount of helium liberated by solution of the radium in water must have been between 0·00017 and 0·0017 c.c., assuming that all of the helium produced was occluded in the mass of the substance.

There is evidence of at least five distinct changes occurring in radium, each of which is accompanied by the expulsion of an α particle. One of the products of these changes is the radium emanation. It is of interest to calculate the volume of the emanation occluded in radium when in a state of radio-active equilibrium. Taking as the simplest hypothesis that one α particle is projected at each change, the number of atoms of the emanation produced per second is 1/5 of the number of α particles, *i.e.* $1{\cdot}3\times10^{-9}$ c.c. When radio-active equilibrium is reached, it has been shown that 463,000 times the amount of emanation produced per second is stored up in the radium. This corresponds to $6\times10^{-4}$ c.c. The maximum amount of emanation to be obtained from one gramme of radium thus probably lies between $6\times10^{-5}$ c.c. and $6\times10^{-4}$ c.c.

The radium emanation is the active principle of radium, for about ¾ of the activity of radium is due to it. Thus a large proportion of the radiations from radium is a direct result of the changes occurring in the very minute amount of matter constituting the radium emanation. If ever 1 c.c. of the radium emanation can be collected at one spot, it will exhibit some remarkable properties. The powerful radiations from it would heat to a red heat, if they would not melt down, the glass tube which contains it. This very rapid emission of energy, in comparison with the amount of matter producing it, would continue for several days without much change, and would be appreciable after a month's interval. The very penetrating rays from it would light up an X-ray screen brilliantly through a foot of solid iron.

E. RUTHERFORD.

Bettws-y-Coed, August 15.

## Summer Lightning.

ALTHOUGH a good deal has been written on the subject of "summer lightning," it may not be superfluous to describe a display of the phenomenon which occurred here last evening on a scale far surpassing anything which it had been my good fortune to witness before. There had been several thunderstorms in the district during the previous five or six days, and a few peals were heard and heavy rain fell in the early afternoon of the day before (August 13). But the sky cleared rapidly thereafter, and the evening and night of that day were cloudless, every peak and crest standing out sharply defined in the clear air. Yesterday was still fine, but warmer and less bracing than visitors here expect. Late in the afternoon wisps of white mist began to gather round the summit of the Jungfrau, and streaks of thin cloud took shape in the higher air above the great mountain ridge that extends from the Silberhorn to the Breithorn. About 8 p.m. I noticed a faint quivering light overhead, supplemented by occasional flashes of greater brilliance and different colour. These manifestations rapidly increased in distinctness, and continued to play only along the opposite mountain-ridge, not extending into the regions beyond, so far as these could be seen from here, though I have since learnt that an independent series of flashes was seen around the Schilthorn on this side of the valley. Not a single peal of thunder was at any time audible. A long bank of cloud formed at a higher level than the summits of the mountain-ridge, and at some distance on the further side of it, so that the stars, elsewhere brilliant, were hidden along the strip of sky above the crest.

As one watched the display it was easy to distinguish more definitely the two kinds of discharge. One of them took the form of a faintly luminous reddish or pink light, which shot with a tremulous streamer-like motion in horizontal beams that proceeded apparently from left to right, as if their starting point lay somewhere about the back of the Jungfrau. These streamers so closely resembled the *aurora borealis* that, had they appeared alone, one would have been inclined to wonder whether the "northern lights" had not here made an incursion into more southern latitudes. So feeble were they when they sped across the clear sky that the stars were clearly visible through them. Sometimes they quivered on the far side of the cloud, lighting up its edges and shooting beyond it across the still unclouded blue. At other times they appeared on this side of the cloud, and showed the dark outline of the mountains in clear relief against the luminous background. They so rapidly succeeded each other that they might be said to be continuous, a faint pinkish luminosity seeming to remain always visible, though pulsating in rapid vibrations of horizontal streamers.

The brighter discharges were not only far more brilliant, but much more momentary. They had a pale bluish-white colour, and came and went with the rapidity of ordinary lightning. But they were clearly connected with the mountains, and not reflections from a series of distant flashes. Sometimes they arose on the other side of the great ridge, allowing its jagged crest to be seen against the illuminated surface of the cloud beyond, but leaving all the precipices and slopes on this side in shade. In other cases they clearly showed themselves on this side of the mountains, lighting up especially the snow-basins and glaciers with the dark crags around them. Nothing of the nature of forked lightning was observed among them. In one instance the flash or horizontal band of vivid light, a mile or two in length, seemed to shoot upward from the slope at the base of the precipices of the Silberhorn, as if it sprang out of the ground, having a sharply defined and brilliant base, rapidly diminishing in intensity upward, and vanishing before reaching half-way up to the crest.

But the most singular feature of the more brilliant white discharges was to be seen when one of the great couloirs of snow or a portion of a glacier remained for a minute or two continuously luminous with a faint bluish-white light. After an interval the same or another portion, perhaps several miles distant, would gleam out in the same way. My first impression was that this radiance could only be a reflection from some illuminated part of the cloud. But I could not satisfy myself of the existence of any continuously bright portions of the cloud. Moreover, the luminosity of the snow and ice remained local and sporadic, as if the beam of a search-light had been directed to one special part of the mountain declivity, and then after a while to another. While watching one of these patches of illumination, I noticed a bright point of light at the top of one of the basins of *nevé* on the slopes of the Mittaghorn. It quickly vanished, but soon reappeared, and then as rapidly was lost again. I thought that it was probably a star briefly exposed through rifts in the cloud, though its position seemed rather below that of the mountain-crest. Half an hour later, however, a similar bright light appeared about the same place, more diffused than the first, and having a somewhat elongated shape. Whether it was really a star seen through the distorting medium of a wreath of mist, or a form of St. Elmo's fire clinging to some peak on the precipice, could not be ascertained from its momentary visibility.

I learnt this morning that other observers who could watch at the same time the mountain ridges on each side of the Lauterbrunnen valley noticed that sheet-lightning was also playing about the Schilthorn, but quite independently of that on the Jungfrau range, the one mountain being dark, while the other was illuminated. The distance of the two electric centres from each other is between five and six miles. The whole display last evening afforded an admirably complete demonstration of the erroneousness of the notion formerly prevalent that summer lightning is only the reflection of distant ordinary lightning, and of the truth of the more recent views as to the nature of the phenomenon.

I may add that, as the lightning increased, the air, which

had previously been nearly calm, freshened into a strong breeze, which blew from the south-west down the valley, but died down after the illumination faded away. The cloud above the mountain began to assume irregular dark cumulus shapes, and the sky became generally overcast. Early this morning rain was falling heavily. The mountains have been all day shrouded in dripping cloud, and the deluge still continues. ARCH. GEIKIE.

Mürren, August 15.

### A Mirage at Putney.

PERHAPS the phenomenon of mirage is not sufficiently rare in England to make its occurrence noteworthy, but I should like to mention a singularly beautiful example that I noticed on Sunday last (August 16). I was riding on my bicycle along the Upper Richmond Road towards the west, and against a fairly steady breeze, and had arrived at that part of the road lying between the railway bridge and the Putney High Street—about opposite house No. 110—when I noticed that the road beyond, some fifty yards in front of me, was apparently flooded ankle deep in water. I was somewhat disconcerted at the prospect of riding through such a quantity of water, but I found to my astonishment that when I arrived at the supposed lake the road was perfectly dry. I thereupon turned and rode back to my previous station, and, dismounting, watched the phenomenon for some while. To assure myself that it was no personal illusion upon my part, I directed the attention of a passing stranger to the scene, and he was impressed as I had been. I should mention that the road sloped slightly downhill from me, and the sun was high (12.50 p.m.) above on my left. The line of sight must therefore have met the dividing surface between the layers of hot and cold air lying above the wooden paving almost at grazing incidence. The surface of the "water" was still, and the reflection of the gay dresses and sunshades of the ladies just from church was remarkably and beautifully clear. H. E. WIMPERIS.

London, S.W., August 17.

## *THE SOUTHPORT MEETING OF THE BRITISH ASSOCIATION.*

SECTIONAL ARRANGEMENTS.

THE arrangements of the various sections of the British Association for the forthcoming meeting at Southport have now been practically completed. The following summary shows the chief points of the programmes, so far as they are at present known :—

*Mathematical and Physical Sciences.*—The physical portion of Section A will be mainly occupied in discussing three questions of considerable interest to physicists at the present time. The nature of the emanations from radio-active substances will be introduced as one of the subjects for discussion by Prof. Rutherford, of Montreal, and it is expected that several visitors from the Continent will take part. Mr. Swinburne will introduce a discussion of the method of treatment of non-reversible processes in thermodynamics, in which Prof. Perry and others will have something to say, and Prof. Henrici will direct attention to the desirability of introducing vectorial methods into physics to a much larger extent than has been done hitherto. The fact that the International Meteorological Congress meets at Southport under the presidency of Prof. Mascart, of Paris, at the same time as the Association, will make the work in the department of Section A devoted to meteorology and astronomy of special importance this year. Contributions to the proceedings of the department have been promised by several of the members of the congress, including Hildebrandsson, Paulsen, and Pernter, and Sir Norman Lockyer will discuss the agreement in time between certain solar and terrestrial phenomena. Papers have been promised by Prof. Turner, Dr. W. J. S. Lockyer, the Rev. A. L. Cortie and Mr. Hinks, and there will be an exhibition of photographs from the Yerkes Observatory.

*Chemistry.*—In his opening address to the section, the president, Prof. W. N. Hartley, F.R.S., proposes to give a brief account of twenty-five years' work in spectroscopy applied to the investigation of the composition and constitution of terrestrial substances, both organic and inorganic, and to review the present position of spectroscopy chiefly in relation to chemical theories, indicating where it may be usefully and profitably extended. The following papers will be read :—"Dynamic Isomerism," by Dr. T. M. Lowry; "Hydroaromatic Compounds," by Dr. A. W. Crossley; "The Cause of the Lustre produced during the Mercerising of Cotton," by Mr. J. Hübner and Prof. W. J. Pope, F.R.S.; "Mutirotation, and the Glucoside Formula of Glucose," by Dr. E. F. Armstrong; "A Contribution to the Constitution of the Disaccharides," by Mr. T. Purdie, F.R.S., and Dr. J. C. Irvine; "Some Derivatives of Fluorine," by Miss Ida Smedley; "Fluorescence as Related to the Constitution of Organic Substances," by Dr. J. T. Hewitt; "The Cholesterol Group," by Dr. R. H. Pickard; "On Essential Oils," by Dr. O. Silberrad; "Freezing Point Curves of Binary Compounds," by Dr. J. C. Philip; "Action of Diastase on the Starch Granules of Raw and Malted Barley," by Mr. A. R. Ling; "Action of Malt Diastase on Potato Starch Paste," part i., by Mr. B. F. Davis and Mr. A. R. Ling; "Action of Malt Diastase on Potato Starch Paste," part ii., by Mr. A. R. Ling; "Some Properties of Sodium Hydride," by Mr. A. Holt; "On a Method of Separating Cobalt and Nickel and the Volumetric Determination of Cobalt," by Mr. R. L. Taylor; "The Influence of Small Quantities of Water in bringing about Chemical Reaction between Salts," by Dr. E. P. Perman; "Sur le Spectre du Silicium" and "Sur les Procédés de Photographie Spectrales applicables à la Pratique des Laboratoires de Chimie," by M. le Comte Arnaud de Gramont. Dr. W. A. Bone will open a discussion on the general subject of combustion by a paper on the combustion of methane and ethane.

*Geology.*—The following papers have been promised in this section :—"On the Disturbance of Junction-beds from Differential Shrinkage during Consolidation," by Mr. G. W. Lamplugh; "On the Igneous Rocks of Weston-super-Mare," by Mr. William Boulton; "On the Igneous Rocks of the Berwyn Mountain," by Mr. T. H. Cope and Mr. J. Lomas; "On the Recent Work of the Geological Survey," by Dr. J. J. H. Teall, F.R.S.; "Lower Ordovician Rocks in the Neighbourhood of Snowdon and Llanberis," by Mr. W. G. Fernsides; (1) "On the Origin of Certain Quartz Dykes at Foxdale, Isle of Man," (2) "On some Glacial Lakes in Switzerland," (3) "On the Geology of the Country Around Southport," by Mr. J. Lomas; "On the Porosity of Rocks," by Mr. C. C. Moore; "Notes on Sarsen Stones, with Special Reference to the Stones at Stonehenge," by Mr. H. W. Monckton; "On the Geology of Martin Mere," by Mr. H. Brodrick; (1) "On the Origin of Eruptive Rocks," (2) Observations on the Metalliferous Deposits of the South of Scotland," by Mr. J. G. Goodchild; (1) "On the Origin of the Drift Deposits of Lancashire and Cheshire," (2) "On the Striation of Boulders on Modern Beaches," (3) "Observations upon the Evidences for the Former Existence of Glacier-Lakes in N. England and S. Scotland," by Mr. P. F. Kendall. Dr. A. Smith Woodward, F.R.S., has promised a paper, but the title is not yet known. There will also be the first report of the committee appointed at Belfast to report upon the fauna and flora of the Trias of the British Isles. The greater part of this first report is furnished by Mr. Beasley, and deals with footprints.

*Zoology.*—There is promise of an interesting meeting in Section D. The most important event will be the open discussion on certain problems of fertilisation, in which it is anticipated that some prominent botanists will take part. Several papers dealing with the morphology of Cœlenterata have been promised, including one by Mr. Duerden on corals, and one on the physiology of digestion in Alcyonarians by Miss Edith Pratt. Mr. Crossland has promised an address on his dredging experiences in Zanzibar; Prof. McIntosh will read papers on a comparison of the terrestrial and marine fauna and on variation in Ophiocoma. Among other papers that will probably prove to be of considerable interest, there is one, by Mr. M. D. Hill, on the nuclear changes in the egg of Alcyonium. The president's address will deal partly with the question of the influence of the environment in the production of variations.

*Engineering.*—In this section, after the president's address on Thursday, September 10, a paper by Mr. T. Clarkson on steam driven motor-cars will be dealt with. Friday, September 11, will be mostly devoted to a discussion on the problem of modern street traffic, which will be opened by Colonel Crompton, R.E. If time permit, other papers will be taken on Friday. On Monday and Tuesday, September 14 and 15, the following papers will be discussed:—Refuse destructors, by Mr. W. F. Goodrich; natural gas in Sussex, by Mr. R. Pearson; water supply of south-west Lancashire, by Mr. T. Parry; balancing of Manchester engines, by Prof. Perry; balancing of alternators, by Mr. B. Hopkinson; gas engine explosions, by Mr. H. L. Wimperis; rainfall at Seathwaite, by Dr. Mill; and (1) cast iron used for springs; (2) alloys cast in water-cooled moulds; (3) effect of varying stresses on steel, by Captain H. R. Sankey. Several other papers will also be taken, but the final arrangements are not yet completed for these.

*Anthropology.*—The address of the president, Prof. J. Symington, F.R.S., will deal mainly with the significance of variations in cranial form, and will discuss the view recently revived by Prof. Schwalbe that the Neanderthal skull belongs to a distinct species of Homo, not *Homo sapiens*. It will also consider the relation between the external and internal form of the cranial wall. Among the papers accepted in physical anthropology are the following:—A study of the skulls from Round Barrows, in Yorkshire, by Dr. W. Wright; papers on skulls from the Malay Peninsula, by Mr. N. Annandale; and on the physical character of the Andamanese, by Dr. Garson; a note on Grattan's craniometrical methods, by Prof. Symington; a paper on the papillary ridges of the hand, by Dr. E. J. Evatt; another, by Mr. D. MacRitchie, on a Mongoloid type in N.W. Europe; and important reports on Dr. C. S. Myers's work on the rank and file of the Egyptian Army, on Dr. W. H. R. Rivers's researches among the Todas, and on Mr. Duckworth's investigations among the ancient and modern populations of Crete. The committee on anthropometric methods has a valuable report, and that on the teaching of anthropology will probably report *ad interim*. Archæology is unusually well represented. Mr. Arthur Evans, Mr. R. C. Bosanquet, and Mr. J. L. Myres offer reports on this year's excavations in Crete; Prof. Flinders Petrie and Mr. J. Garstang on recent work in Egypt; Mr. G. Clinch on a megalith at Coldrum, in Surrey, which illustrates certain points in Stonehenge; Mr. Annandale on stone implements from Iceland; Dr. C. S. Myers on the ruins of Kharga in the Great Oasis; Mr. T. Ashby on Roman work at Caerwent; and Mr. Garstang on Ribchester; while the usual report on Silchester excavation may be expected to lead to some discussion. Prof. R. S. Conway offers an analysis of ancient Italian place-names, as illustrating the early languages. Prof. Ridgeway has a paper on the origin of jewellery, and Mr. E. Lovett on the origin of the brooch. General ethnography (with the exception of Dr. Rivers's work on the Todas), and folklore and comparative religion (apart from Mr. W. Crooke's paper on Islam in modern India) are as yet poorly represented, but this defect will probably be made good before long.

*Botany.*—In the botanical section the address of the president will deal with the nature and geographical distribution of floras subsequent to the Coal period; the gradual progress of vegetation from the Lower Carboniferous period through the Coal age up to the Lower Cretaceous formations will be discussed, greater prominence being given to the Mesozoic floras. Miss Ethel Sargant will open a discussion on the evolution of the Monocotyledons, and Prof. J. B. Farmer will give a semi-popular lecture on Epiphytes. Mr. W. Bateson will give an account of the new discoveries in heredity, Miss E. R. Saunders will describe the results of some cross-breeding experiments with plants, and Mr. C. C. Hurst will describe some recent experiments on the hybridisation of orchids. Other papers will include an account of important recent advances in our knowledge of algæ, by Messrs. Tansley and Blackman; the sandhill and saltmarsh vegetation of Southport, by Dr. Otto V. Darbishire; on the seedlings of some grasses, by Miss Sargant and Miss Robertson; on willow canker, by Prof. T. Johnson; and on some experiments with the staminal hairs of Tradescantia, by Mr. Harold Wager. It is expected that a number of foreign botanists will be present at the meeting.

*Educational Science.*—The organising committee of this section has decided to continue the procedure adopted at previous meetings, namely, to confine the discussions to a few broad subjects. It is proposed to devote two days (September 10 and 11) to an organised discussion of school curricula, based on a series of short papers contributed by Prof. John Adams, Prof. H. E. Armstrong, F.R.S., Miss S. A. Burstall, Mr. G. F. Daniell, Mr. W. E. Fletcher, Mr. T. E. Page, Mr. J. L. Paton, and Prof. Michael E. Sadler. A joint meeting with the Geographical Section will be held to discuss the "Teaching of Geography." The discussion will be opened by Mr. H. J. Mackinder, and he will be followed by several gentlemen who have devoted special attention to this important branch of school work. In addition to these subjects, there will also be discussions on the reports of committees on:—(*a*) "The Conditions of Health Essential to the Carrying on of the Work of Instruction in Schools"; (*b*) "The Teaching of Natural Science in Elementary Schools"; (*c*) "The Influence Exercised by Universities and Examining Bodies on Secondary School Curricula, and also of the Schools on University Requirements"; (*d*) "The Teaching of Botany in Schools."

## *NATIVES AND CUSTOMS OF CHUTIA NAGPORE.*[1]

THIS bright and picturesque book, which should be widely read, gives in its text and illustrations a vivid picture of the eastern side of Chota, called by the natives Chutia Nagpore, the motherland (Chut) of the Nagas, who were Naga-Kushikas, sons of the Naga Cobra and the tortoise. But I hope that its interesting description of the country, its inhabitants and their festivals, and its glimpses into the traditional history of the past, especially those given in chap. v. of the Santal birth legends, are only a prelude to works

[1] "Chota Nagpore: a little known Province of the Empire." By F. B. Bradley Birt. Pp. xiv+310. (London: Smith, Elder and Co., 1903.) Price 12*s.* 6*d.* net.

of deeper research, in which the present author and others living in Chutia Nagpore may try to disentomb from below the present surface the ancient history of the country which was once the treasury of the Naga rulers of India, and will undoubtedly be in the future its richest manufacturing province. It contains about 5000 square miles of coal-fields, only worked on its eastern rim, inexhaustible supplies of iron ore, red and brown hæmatite, magnetite and limestone, immense wealth in other minerals, and in the remote past the gold of its gold-bearing river-sands and its diamonds filled the coffers of the Naga-Kushika kings. The central mountain of their realm was Parisnath, described in chap. vi., which was first the Marang Buru or Great Mother Hill of the Mundas and Santals. The Kushikas called it Mandara, the revolving mountain, and it was finally consecrated as the sacred mountain in the east of the trading Jains of the west, who gave it its present name of the Lord (nath) of Traders (Pañris).

The history of the country told in the legends, ritual and customs of its numerous tribes, takes us back through layer after layer of deposit beneath the surface of to-day to the first age of Indian village life surviving in Jushpore and Sirgoojya among the Korwas, who are nomad agriculturists living in rude huts of tree branches in forest encampments, vacated every two or three years. Their women add to the tribal food they collect in the woods and the animals killed by the men of the tribe, the produce of the crops they sow in their clearing until the soil is exhausted. Their successors were the Mundas and Marya or tree (marom) Gonds, living in permanent villages under the shade of the Sarna or village grove of old forest trees left standing in the ring of cleared rice land, the Gond tribal sacred snake. Beside the Sarna is the Akhra or dancing-ground, well depicted in the illustration here reproduced of Girls and Musicians at a Santal dance (p. 128). There the seasonal dances are held, a separate step and figure being set apart for each season, and thither in the primitive age the women of each village invited to these dances the men of one adjoining it in the same province or Parha, and there the children of each village were begotten as the offspring of the mother trees of the sacred grove. Their Spartan education, in separate establishments for each sex, by the women and men of each village to whom their mothers were sisters, still exists among the Ooraons of Chutia Nagpore, the Nagas of Assam, the islanders of Melanesia in the Indian Archipelago, and other races. They were taught to repeat the national educational and historical stories, and made thorough proficients in all their tribal duties.

We can trace in Chutia Nagpore the stages of advance from the simple primitive villages of the Mundas and Marvas to the elaborate Ooraon villages with allotments for village servants, in which the lands are divided into Manjhus or Lord's land, the Bhuinhiari land of privileged tenants eligible as Headman, Pahn or Village Priest, and Mahto or Accountant and the land of ordinary tenants, whose duty it is to till the landlord's Manjhus land. We can further study local history in the ritual customs and traditions of the laughter-loving and indomitably independent Mundas and Ho Kols, the Irish of India, of the silent and dogged Bhuyas, the musical Ooraons, forming a mixture of these two types, in the farming skill of the Kaurs and the feudal customs of the Chiroos and Kharwars, the ancestral rulers of Magadha, who attached Chutia Nagpore to their confederacy and ended the chain of aboriginal rulers, in which Mundas, Bhuyas, Gonds, Ooraons, and Kaurs were the successive links.

The three last, Ooraons, Kaurs, and Chiroo-Kharwars, were the sons of the barley as their predecessors were sons of the rice. Their national birthday is the

FIG. 1.—Girls and Musicians at a Santal Dance.

July-August festival of the Kurum, when they dance round the national mother, the kurum almond tree (*Nauclea Parvifolia*), wearing barley shoots in their hair, and the festival corresponds to the Hindu Nag Punchami, the five mother snakes held in the same month. The union of the rice-eating sons of the south with the northern eaters of barley is marked by the Magh festivals of January-February (p. 102) in Chutia Nagpore, and the Magh festival of Puryag at the junction of the Jumna and Ganges, where the union with the men of the south of the Kushika Gonds, who came down the Jumna, is celebrated by the offering as sacrifices of living victims brought in by the northern people as additions to the southern ritual, in which the only sacrifices had been the first fruits of the soil offered by the primitive villagers, and the fowls slain by the Munda sun worshippers.

It was the castes who form the northern stratum of the community who began the custom of wedding brides and bridegrooms to mahua and mango trees, while almost all castes still retain the leafy marriage bower in which weddings are celebrated as a reminiscence of their ancestors, who were sons of the tree before the northern growers of oil-seeds, barley, and other crops of Asia Minor substituted individual marriages for village unions.

The last stage in primitive national history is that of the race of the trading Jains of the Bronze age, and its length is marked by the vast excavations they have made in the copper hills of Lando in Seraikela and Baragunda, under Parisnath. They formed the port of Tamluk, called Tamra-lipti or Copper-port, and have left lasting memorials of their rule in the ruins of their capital at Dalmix on the Subanrikha, their temples at Telkupi (p. 177), and along the ancient road to Orissa, and in the establishment of the brass-ware industry of Manbhum, which supplied the brass vessels looked on as sacred in modern Hindu domestic ritual.

J. F. HEWITT.

## *THE SEISMOLOGICAL CONGRESS IN STRASSBURG.*

IN July of last year the British Government received an official invitation from Germany to take part in a conference the object of which was to establish an international inquiry about earthquakes. The meetings of this conference, which took place in Strassburg—July 23 to 28—usually commenced at 9 or 10 a.m., and concluded at about 5 or 6 in the afternoon. The proceedings were reported at length in the *Strassburger Korrespondenz* and other papers.

At the opening ceremony the chair was occupied by His Highness Prince Hohenlohe-Langenburg, his supporters being representatives of the Imperial Government and other officials. Twenty-five States or countries were represented, but the total number of delegates and guests who were at liberty to take part in the proceedings up to the time when final votes were demanded seems to have been exactly one hundred. As sixty-two of these were Germans, it can be easily imagined that German language and German influence preponderated in debates, and although ultimate results were arrived at by the single voices of separate countries, when Great Britain and her colonies, like the German Empire, had each one vote only, it is difficult to suppose that these results are entirely free from German bias.

France was not officially represented. When we consider the powerful influence exercised by this country upon the progress of science, the impetus given to seismology by Perrey, Montessus and other workers, together with the desirability of establishing stations in French colonies, a feeling of regret arises that so important a State was unable to assist the congress. Whether this would have been the case had the same been held in some other town than Strassburg is a matter for conjecture. The chief results arrived at were as follows:—

A central association is to be formed with its headquarters in Strassburg. Each contributing country will be represented by one member on a governing committee which elects a president, a chief for the central office, and a general secretary. The chief will reside in Strassburg, but it was decided that the president and secretary should be elected from outside Germany. Although it is desirable that these officers should represent different nationalities, it is also desirable that the chief of the central office and his secretary should reside at the central office.

It was suggested that the work of the association should be as follows:—

(1) To make observations after a common plan approved by the association. Inasmuch as there now exists in connection with the British Association, in Italy, in Japan, and in other countries established systems for seismic observations, which on account of the expenditure it would involve and for other reasons could not be reduced to a common plan, and further, that as direction from a centre would destroy incentive to investigation, this proposition was abandoned.

(2) To carry out experiments on important matters.

(3) To establish and support observatories.

(4) To collect, study, and publish reports or *résumés* of the same.

The detailed investigations referred to in the second suggestion are not unlike headings for chapters in a treatise on seismology. This work, and that embodied in the third and fourth proposals, are for the first twelve years to be carried out at a cost of 1000*l.* per annum, and this sum is to include a salary for the general secretary. The contributions to this inadequate sum are to be apportioned amongst the cooperating States according to population, the British contribution to be 160*l.* per year. Whether the British and other Governments will take part in the scheme remains to be seen. Assuming that they do, inasmuch as 1000*l.* per year is far too small an amount to meet expenses connected with the proposed programme, it seems likely that the central office at Strassburg, in its early days at least, will become a depôt from which reports are issued and a distributing centre for earthquake registers and other materials bearing upon recent seismological research. This in itself is a work of a magnitude not generally realised, a mere catalogue of earthquakes which have been recorded during ten years in Japan, for example, making in itself a volume of 1000 pages. To reduce publications of this description, written in Chinese characters, to a form in which European investigators might wish to see them would be a labour which but few would undertake. Yet Germany offers men who are willing to face such labours, whilst her Imperial Government asks the civilised world to cooperate in carrying out the gigantic task. Now at the eleventh hour, in the name of science and because other nations are apparently unprepared or indifferent to the advantages of centralisation, it seems likely that the seismological work of all countries is to be swept into one great net.

Germany has but few observing stations and no organised system for seismological investigations of her own, yet she is willing to take beneath her ægis the organisations of the world. Whether it be in the relief of a beleaguered city or in the study of an obscure science, Germany desires to take the lead. To turn the eyes of the world towards Berlin as the centre of

all learning turns the steps of students in the same direction, and a Government which fosters such a policy is deserving of its country. Germany has offered to take upon her shoulders a burden which others shirk, and if this can be achieved to the satisfaction of those concerned, she deserves great praise.

While this no doubt is one view of the situation, it must not be overlooked that Governments, particularly those that do not feel justified in giving support to seismological investigation within their own territory, may hesitate in offering support to such investigation in a foreign State. To suggest that a powerful empire needed 1000*l.* a year to carry on the proposed work would be wanting in good taste. Neither can it be suggested that delegates at the conference have carried away with them the impression that they are to receive something greater than a *quid pro quo*. Should the proposed convention be ratified, what they may possibly discover is that a birthright has been exchanged for a mess of pottage, and for a period of twelve long years a suzerainty has to be acknowledged. Truly enough the movement is called international, but at the same time it bears the character of absorption and crystallisation at a centre, and it is not every country that will care to add to its neighbour's prestige at the expense of its own, play second fiddle, and pay for the privilege. That seismology will benefit by cooperation there is but little doubt, but whether Germany can carry out what has been proposed, and whether the scheme has been presented in its best form are matters open to discussion.

## NOTES.

WE are informed that Mr. A. S. le Souef has been appointed director of the zoological garden at Sydney in succession to the late Mr. Catlett. Mr. Dudley le Souef, his elder brother, has been director of the gardens of the Zoological and Acclimatisation Society at Melbourne for several years, and a younger brother is director of the newly established garden at Perth, in Western Australia, so that the three brothers occupy three corresponding positions in the three Australian capitals.

FOR the study of bird migration, Mr. W. Eagle Clarke, assistant keeper in the Natural History Department of the Edinburgh Museum of Science and Art, has obtained permission from the Elder Brethren of Trinity House to spend a month upon the Kentish Knock Lightship, situated off the mouth of the Thames, and about twenty-one miles from the nearest point of land. The position of the vessel affords exceptional opportunities for observing the east to west autumnal movements of birds across the southern waters of the North Sea.

THE meeting this year of the French Association for the Advancement of Science was held at Angers under the presidency of M. Émile Levasseur, who, in his presidential address, dealt with one of those economic questions around which, at the present time, many controversies are being raised. "Wages," said M. Levasseur, "have furnished the material for hundreds of volumes and millions of fugitive leaflets which daily discuss the subject in all civilised countries," and he went on to devote his address to a consideration of three main questions affecting the wage-earner. These may be stated in the following words. "What causes determine the rate of wages?" "Have wages increased?" "Is the wage-earner a permanent factor in the organisation of labour?" In discussing the first question, the president recognised a number of causes for the variations in the rate of wages; among these factors are the productivity of the worker, the cost of living for the workman and his family, the general prosperity of the country, the special abundance of capital in each industry, the opposition between workers and employers, and political institutions and customs. After examining his second question, M. Levasseur concluded that wages have risen in France and in other civilised countries, and that the cause of it is the growth of riches, the progress of industry, the development of machinery, and the greater individual and collective value of the worker. The grants for scientific research made by the association amount this year to about 760*l.*, and this sum was divided among some fifty recipients, including certain scientific associations as well as men of science.

A REUTER telegram from Buenos Ayres states that severe shocks of earthquake were felt on August 12 at Mendoza. A number of houses and the tower of a church were destroyed.

VESUVIUS is in a state of active eruption. The Rome correspondent of the *Daily Chronicle* says a stream of boiling lava is flowing in a north-easterly direction towards San Giuseppe and the village of Ottajano, and has already reached a length of 800 metres.

A SEVERE hurricane passed over the island of Jamaica during the night of August 10–11, causing serious damage and loss of life. On August 8 the U.S. Weather Bureau notified its local agent at Kingston that a disturbance north-east of Barbados was moving to the north-west over the Windward Islands, and would probably develop a dangerous strength. Little notice, however, was taken of the warning. The storm was most severe in the early morning hours of August 11, and the whole of the eastern and north-eastern half of Jamaica has been desolated by it.

THE preliminary international conference on wireless telegraphy came to an end on August 13. The results of the conference have been embodied in draft regulations for the control of wireless telegraphy which it is proposed to submit to the various Governments concerned. A further conference may then be summoned to enter into an international convention based on these regulations; it is said that Germany intends before long to invite the European sea Powers and the United States to take part in a more general conference with this object. The conclusions at which the delegates at the preliminary conference arrived have not yet been made public.

AN instance of the practical advantages of wireless telegraphy at sea was given by the *Observer* last Sunday. A gentleman crossing to New York by the *Campania* discovered in the middle of the voyage that he had not sufficient money to pay his customs dues on arrival, nor did he know anyone on board from whom to borrow. He remembered, however, that his mother was crossing from New York by the *Lucania*, and the two vessels having got into communication by wireless telegraphy, he transmitted a request to her to pay the purser 10*l.*, asking him to advise the purser of the *Campania* to pay the sum to him. The transaction was successfully accomplished within an hour; it seems that with the spread of wireless telegraphy on ships, all the business that we are accustomed to transact on land will be able to be carried on with equal facility at sea.

AN account of some further experiments on the heat radiating power of radium, carried out by M. Curie in conjunction with Prof. Dewar at the Royal Institution at the time of M. Curie's lecture last June, is given in the *Times* of August 13. The facilities for accurate research at low

temperature which Prof. Dewar has developed at the Royal Institution laboratories enabled some careful experiments to be made. It was found that the heat radiating power of radium bromide is not diminished at the temperature of liquid air, and is actually greater at the temperature of liquid hydrogen. It is stated that the experiments leave no room for doubt that the rate of emission of heat by radium is greater at the temperature of liquid hydrogen than at any temperature from that of liquid air up to that of an ordinary room. The experiments also showed that the radiating power of a salt, or solution of a salt, of radium increases for about a month after its preparation to a maximum at which it then apparently remains stationary.

THE fire which occurred last week on the Paris Metropolitan Railway is probably the most disastrous which has taken place in connection with electric traction. In addition to the sympathy one feels for the unfortunate victims and their relatives, the accident is to be especially regretted as tending to discredit a system of transit which was becoming increasingly popular in this country. But although the fire was apparently started by the fusing of an electric wire, the terrible results which followed can in no way be charged to the account of electric traction, nor indeed to the system of underground railways. So far as one can judge by what is as yet known, there seem to have been serious mistakes made after the fire had been first noticed, and finally a panic resulted with its attendant dangers. But for this the accident might have been followed by little serious result; it is safe to say that in all accidents of this kind the best that any system can do is to safeguard, as far as possible, against the occurrence of a panic, for once this occurs the result is in no way commensurable with the original accident, and whatever precautions for safety may exist they are rendered inoperative.

THE Antarctic relief ship *Terra Nova* will leave Dundee on August 21. The vessel will proceed to Hobart, where she will be joined by the *Morning*. Captain McKay will command the *Terra Nova* and Captain Colbeck the *Morning*. Each vessel will carry instructions in duplicate for Captain Scott, upon whom the supreme command will devolve when communication has been established. A *Globe* correspondent states that the French Antarctic Expedition has sailed from Havre under the leadership of Dr. Charcot. The first task to be undertaken by the expedition will be that of finding the Swedish Antarctic Expedition under Nordenskjöld, which, it is supposed, is fast in the ice off Graham's Land. If Nordenskjöld should be found, then a voyage will be made into the Antarctic Ocean, mainly for purposes of scientific research, as the expedition will not try to establish an "Antarctic record." Dr. Charcot is taking out five men of science, and provisions for twenty-eight months, as the expedition will be absent nearly two years. A Reuter message from Stockholm reports that the Swedish expedition for the relief of Dr. Otto Nordenskjöld's South Polar Expedition sailed from there on August 17 on board the *Frithjof*.

THE recent serious floods in Silesia have raised an interesting point as to the relation between them and deforestation. The rivers which inundated Silesia have their origin in Austria, and it appears from a Berlin message in Monday's *Morning Post* that the Prussian authorities are informed by experts that the overflows are due principally to the deforestation of the Austrian highlands, which have become so barren of timber that the rivers no longer lose the large quantity of water which the trees formerly absorbed. Prussia has concluded, therefore, that until the Austrian highlands are retimbered the flood danger in Silesia cannot be eradicated, and heavy relief expenditure, such as the 500,000*l*. just granted, will be wasted.

WE learn from *Science* that it is proposed to celebrate the seventieth birthday of Prof. August Weismann, which will occur on January 17, 1904. The committee has decided to have prepared for that time a portrait bust of Prof. Weismann, which shall be deposited at the Zoological Institute of the University of Freiburg with appropriate festivities. It invites cooperation in this undertaking, not only from those who owe scientific stimulus to Prof. Weismann and have been guided by him into zoological activity, but also from all colleagues who desire to join in honouring Prof. Weismann for his work. Contributions may be sent to the Deutsche Bank, Leipzig, for the account of Prof. Zur Strassen, who is treasurer.

THE first International Exhibition of Industrial Art for Metal or Stone Products will be held at St. Petersburg in November next. The exhibition has the object of making the public acquainted with the progress attained by Russian and foreign industry in the artistic finish of metal and stone products.

THE Liverpool School of Tropical Medicine has decided, with the cooperation of the Government of the Congo Free State, to dispatch a trypanosoma expedition to the Congo Free State in September. The objects of the expedition will be to report on the sanitary conditions of Boma, Leopoldville, and other centres visited, and to recommend improvements of existing sanitary conditions; to continue the work of trypanosomiasis, human and animal, including the occurrence and distribution of trypanosoma in the Congo, the carriers of the parasite, and the relation of trypanosoma to sleeping sickness. Major Ross, of the Liverpool School, has received a letter from Major Penton, the principal medical officer of the Sudan, testifying to the success of the measures taken against mosquitoes for the prevention of malaria. Ismailia has been found by Major Penton to be practically free from mosquitoes, and to show a striking improvement as regards malarial fever.

THE committee of the National Physical Laboratory announces that it is prepared to test the accuracy of the pipettes, measuring glasses, and test-bottles used in the Lister-Gerber and other methods of testing milk. The fees charged are very moderate, and in view of the increasing attention that is being bestowed upon our milk supplies, these facilities should be largely made use of.

IN addition to the usual circulars respecting the close seasons for the salmon and other fisheries, the Fishmongers' Company has issued a notice with regard to the opening of the oyster season. It is pointed out that the various oyster beds, pits and layings round the coasts have been inspected, and all those proved to be polluted with sewage have been closed, and no oysters from these places will knowingly be allowed to be sold until they have been proved to be safe and wholesome. The cooperation of the medical and sanitary authorities in this matter is invited.

THE July number of the *Journal of Hygiene* (No. 3, vol. iii.) contains several papers of considerable interest. Drs. Newsholme and Stevenson describe the graphic method of constructing a "life table," and Mr. Hayward gives a new "life table" for England. Dr. Meredith Richards discusses the factors which determine the incidence of infantile diarrhœa, and concludes that artificial feeding and in-

sanitary milk supply are the most important. Dr. Fremlin describes the cultivation of the nitroso-bacterium, and Dr. Durham a new diluting pipette. Dr. Haldane finds that the presence of sulphur in coal-gas is the principal factor in vitiating the air, and Dr. Savage has investigated the relation between the pathogenicity of *bacillus coli* in drinking water and purity. Dr. Graham-Smith describes further researches upon factors which may modify the biological or precipitin test for blood.

DR. ROBERTO BOROLA, of Pavia, contributes to the Lombardy *Rendiconti*, xxxvi. 12, a note on the metric properties of quadric surfaces in non-Euclidean geometry, dealing with circular sections, foci, and confocal and concyclic systems of quadrics.

AN interesting extension of the use of Green's functions to the mathematical theory of conduction of heat is given by Prof. H. S. Carslaw, of Sydney, in the *Proceedings* of the Edinburgh Mathematical Society, xxi. The use of Green's functions has hitherto been mainly confined to the theory of the potential, although their use in connection with heat conduction has been mentioned by Minnigerode and Betti. Prof. Carslaw now shows how the functions in question can be obtained by means of contour integrals, and a general method applied to the solution of problems which are usually solved by independent methods.

"RED RAIN" forms the subject of a paper by Messrs. F. Chapman and H. J. Grayson in the *Victorian Naturalist* for June. The occurrence of dust-laden showers is not infrequent in Australia, but one of the most remarkable showers of this kind occurred on February 14 of this year. The writers describe analyses of samples of sediment collected from this shower at Camberwell and St. Kilda, and they compare the substances observed with the minerals contained in the dust commonly present on the roof of the National Museum, Melbourne. A sample collected in a second shower of "red rain" at St. Kilda on March 28 was also examined. The latter sediment was remarkable for the number of diatoms it contained, and the authors enumerate a list of the forms found, including about twenty-five species.

THE coefficient of thermal surface-conductivity across the surface of separation of a solid and a fluid is a quantity the determination of which is of considerable importance, especially in connection with the construction of boilers. In the *Zeitschrift* of the German Engineers' Association, Mr. L. Austin describes experiments made at Charlottenburg on this subject, giving the following results:—From metal to water at the boiling point the resistance is equivalent to a thickness of 1·2 to 2cm. of iron, but is reduced by stirring by an amount equivalent to about 0·75cm. of iron. The resistance increases as the temperature falls, reaching a maximum of 10cm. of iron, which is reduced by 1cm. by stirring. For flow of heat from water to metal, the resistance appears greater than for the reverse flow if the water is undisturbed, and about the same when the water is stirred.

THE *Atti dei Lincei*, xii. 10, contains a brief account of experiments in syntonic wireless telegraphy carried out at Spezia under the direction of the Minister of Marine. At San Vito two Marconi apparatus of frequencies "A" and "B" were connected with the same antenna, and communication was carried on simultaneously with Palmaria and Leghorn at distances of respectively 5 and 70 kilometres.

IN the *Atti dei Lincei*, xii. 11, Prof. G. Agamennone directs attention to an interesting contribution to our knowledge of terrestrial magnetism in the form of a discourse by Father Francesco Eschinardi, published in 1681, in which he makes mention of a sudden change in the magnetic declination at Rome from about 3° to 5° W., which occurred towards the end of October of the previous year. This the writer attributed to the effect of earthquakes in Spain and Malaga.

THE annual list of new garden plants of the year 1902, which is issued as an appendix to the Kew *Bulletin*, has been received.

A RECORD of plants collected in the northern region of Yucatan is commenced in the *Publications* of the Field Columbian Museum. The first fascicle, which treats of the ferns included in the Polypodiaceæ and Schizæaceæ, and the monocotyledonous orders Gramineæ and Cyperaceæ, is the joint work of Mr. C. F. Millspaugh and Miss Chase.

THE question of shade for coffee and cocoa plants is discussed in the Jamaica *Bulletin* of the Department of Agriculture, where it is pointed out that in many cases it is the bacteria working in the soil, and not the plants which require the shade. The choice of leguminous plants for the purpose is a wise one, as the nitrogenous contents of the soil are thereby increased. An article by Mr. Cousins, contrasting the constituents of four definite phosphatic fertilisers, serves to point the absurdity of an indiscriminate application of commercial fertilisers without taking into consideration the nature of the soil.

WHATEVER may be the outcome of the present political question of fiscal reciprocity towards our colonies, there can be no doubt about the advantages of a closer connection between them and the mother country. To further this object a scientific and technical department of the Imperial Institute was established, and a laboratory was provided wherein samples of raw material from the colonies can be analysed and reported upon by experts, as has long been done for vegetable products at Kew. In the second number of the *Bulletin* of the Imperial Institute, there appears an account of recent investigations undertaken by Dr. Dunstan and his assistants. These include the examination of rubbers from Africa, oil shale from Natal, iron ore from a district in the Bombay presidency, and other products. Also there are added special notices on various industries which are receiving attention in our dependencies and those of other European States.

IN vol. ii. of *Marine Investigations in South Africa* Mr. R. Kirkpatrick, of the Natural History Museum, continues his descriptions of the sponges, naming some new genera and species.

THE nature of the so-called terminal buds of fishes—organs scattered over the skin of the head in certain teleosts and ganoids, and at one time regarded as tactile in function—forms the subject of an article by Mr. C. J. Herrick, published in vol. xii. of the *Journal of Comparative Neurology*. It is inferred that these structures have no connection with the lateral line system, but are intimately related to the taste-buds of the mouth.

THE July issue of the *Emu* contains a number of interesting articles devoted wholly, or chiefly, to ornithology. In treating of New Zealand cormorants, Captain F. W. Hutton suggests that one group of these birds reached New Zealand from South America, and that, after considerable modification in the Antipodes, their descendants returned to their ancestral home, whence some found

their way to Kerguelen Island. This, it is argued, indicates that islands were formerly more numerous in the Antarctic than at present. Among the illustrations in the number before us, one plate shows a native high up in a gum-tree taking the nest of the white-tailed cockatoo, and a second the countless swarms of sooty terns which haunt the Great Barrier Reef in the breeding season.

IN an article entitled "The Genesis of the Kangaroo," a correspondent of the *Newcastle Daily Journal* of August 4 seeks to obtain credence for a view, current among Australian settlers, as to the early stages of development in these animals. Briefly stated, this view is to the effect that "after impregnation, the mingled germs find their way from the womb, or receptacle answering to such, through a duct or channel straight to the point of the teats," and that consequently the whole of the development takes place while the embryo is attached to the summit of the nipple. Nothing is said with regard to the position of the mysterious duct or channel alluded to in the quotation, while the commonly accepted view, namely, that the mother transfers the embryo from the vagina to the nipple, is dismissed with the statement that this is not supported by direct observation. Apparently the author is unacquainted with a note published some years ago in the *Zoologist* (and referred to in our columns at that time), in which Mr. D. le Souëf describes this transference in considerable detail, and states that it is effected solely by the maternal lips.

THE report of the British Museum for the year ending on March 31 last has been published as a Blue-book. In the natural history section the director records an increase in the number of visitors, and likewise in the list of donations. Attention is directed to the completion of the Nile Fish Survey, and to Dr. Andrews's geological explorations in Egypt, funds for which have been generously provided by Mr. W. E. de Winton. It is satisfactory to learn that the whole of the collections to be made by the National Antarctic Expedition are to come to the museum, and that the trustees have agreed to publish an account of the natural history results of the voyage. As regards the new section of economic zoology, a summary is given of work accomplished in advising the Board of Agriculture in regard to insect ravages and kindred subjects, and of visits paid in connection with the Board. A long list of correspondence in connection with mosquitoes and malaria indicates the energy with which these investigations are being pushed. Some progress has been made with the exhibition of economic zoology in the north hall, and collections of insects affecting economic products have been received from various parts of the world.

DR. HENRY HOEK, of Davos, has issued separate copies of a detailed paper on the geological structure of the central "Plessurgebirge" in the neighbourhood of Arosa (*Berichte der Naturforschenden Gesellschaft zu Freiburg-im-Breisgau*). Inspired by Prof. G. Steinmann, the author has sought to work out in detail the complex features of the district, which is well known in its general aspect to visitors to the Engadine. In so doing, he gives considerable credit to the observations of the English geologist, the late Mr. A. V. Jennings. The overfolding and repetition of strata by thrust-faults are well shown in numerous sketches and diagrams, and plate xiv. gives us a broad landscape, with the geology marked out on it in the clear and effective manner of Murchison and the early authors. Dr. Hoek concludes by supporting the views of Steinmann and Jennings in opposition to those of Rothpletz and Lugeons, and affirms that the main range, including the Brügger-horn and the Hörnli, is a mountain-mass of eastern Alpine type, pushed up from the south-east over a "Vorland" of Flysch. This Flysch, it is argued with reason, is entirely of Cainozoic age, and the mass of older rocks has been pushed across it for a distance of some 4 kilometres.

PROF. L. PLATE'S memoir "Über die Bedeutung des Darwin'schen Selectionsprincips," which was reviewed in NATURE of May 16, 1901 (vol. lxiv. p. 49), has reached a second edition. The new edition contains nearly one hundred pages more than were included in the original work, and the words "und Probleme der Artbildung" have been added to the title.

THE sixth edition of Prof. R. Hertwig's "Lehrbuch der Zoologie" has been published by Herr Gustav Fischer, Jena. The work originally appeared in 1891, and was favourably noticed in these columns (vol. xlviii. p. 173). The present edition has been enriched with many new illustrations, and the text has been revised in the light of recent theory and investigation in zoological science.

TWO useful volumes have been published by the Treasury Department of the United States Coast and Geodetic Survey. One is a list and catalogue of the publications issued by the survey from 1816–1902, and has been compiled by Mr. E. L. Burchard; the other is a second edition of a bibliography of geodesy, by Prof. J. H. Gore. This bibliography has been carefully revised to 1902, and deals with all books and papers on the subject in every language.

THE "List of Publications of the Smithsonian Institution, 1846–1903," by Mr. William J. Rhees, a copy of which has been received from the institution at Washington, will prove of great assistance to all readers who have access to the volumes indexed. The "list" consists of two parts; the first is a complete list of Smithsonian publications in numerical order, which is also approximately chronological; the second part contains a list of publications, available for distribution, arranged under subjects and authors. In this list are included the papers and addresses by eminent men of science which have appeared in the appendices to the annual reports of the Smithsonian Institution.

THE extension section of the Manchester Microscopical Society has issued a revised list of fifty-four lectures arranged for delivery by its members during the coming winter. The work of lecturing is voluntary and gratuitous on the part of the members, but hire of slides, travelling, and out-of-pocket expenses are charged. The purpose of the lectures is to bring scientific knowledge, in a popular form, before societies unable to pay large fees to professional lecturers, but in all cases where lectures are given before societies which are commercial undertakings, or are subsidised by grants, a fee is charged. The subjects of the lectures are varied and well chosen, and this pioneer work of the Manchester scientific workers deserves wide appreciation.

WE have received a reprint of an article, from vol. ix. of the decennial publications of the University of Chicago, on "New Instruments of Precision from the Ryerson Laboratory," by Mr. R. A. Millikau. The instruments described are a substitute for Atwood's machine, a Young's modulus apparatus, a "moment of inertia" machine, and a vapour-tension device. The pieces of apparatus are ingenious and likely to prove useful in the teaching of practical physics, but two at least can hardly be described as new. The substitute for Atwood's machine is merely a slightly modified form of the familiar smoked glass plate

falling in front of a vibrating tuning fork to which a suitable style is attached. It may interest Mr. Millikau to know that this device has been used by students at the London Royal College of Science for the last twenty years. Similarly the vapour-tension device is an improved form of the bent tube with the shorter limb closed and with mercury in the bend which has long been used in laboratories in this country for the determination of boiling points.

THE additions to the Zoological Society's Gardens during the past week include an Anubis Baboon (*Papio anubis*) from West Africa, presented by Mrs. J. B. Ward; a White-crowned Mangabey (*Cercocebus oethiops*) from West Africa, presented by Mrs. Stevenson; a Green Monkey (*Cercopithecus callitrichus*) from West Africa, presented by Mr. F. W. A. Jackson, R.A.; a Black Rat (*Mus rattus*), British, presented by Mr. Oswald M. Courage; six English Vipers (*Vipera berus*) from Dorset, presented by Mr. A. Old; two Slender Loris (*Loris gracilis*) from Ceylon, a Black Hornbill (*Sphagolobus atratus*) from West Africa, three Westerman's Eclectus (*Eclectus westermani*) from Moluccas, ten Common Skinks (*Scincus officinalis*) from North Africa, deposited; a New Zealand Parrakeet (*Cyanorhamphus novae-zealandiae*), a Golden-headed Parrakeet (*Cyanorhamphus auriceps*) from New Zealand, purchased; a Garnett's Galago (*Galago garnetti*) from East Africa, a Stanley Crane (*Anthropoides paradisea*) from South Africa, received in exchange.

## OUR ASTRONOMICAL COLUMN.

THE SPECTRUM OF COMET 1903 *c*.—On July 14 and 15 Dr. Curtis, of the Lick Observatory, found that the visual spectrum of this comet consisted of a strong continuous spectrum, and the three characteristic cometary bands, that at λ 4770 being by far the brightest. He tried to photograph the spectrum by giving a six hours' exposure with the 36-inch telescope, but obtained no result, the intrinsic brightness of the comet being too small.

Prof. Perrine, using a small slit spectroscope with the Crossley reflector, obtained a spectrum with four hours' exposure, and found that it contained the five bands obtained by Campbell in Comet *b* 1893 (Rordame) and in Comet *b* 1894 (Gale), viz. 388, 409, 421, 436 and 473. The bands obtained by Perrine also agree in brightness with those previously photographed, with the exception of that at λ 420, which was one of the brightest bands in the former comets, but is very weak in this one (Lick Observatory *Bulletin*, No. 47).

THE SPECTROSCOPIC BINARY β SCORPII.—Working with the new spectrograph of the Lowell Observatory, Mr. V. M. Slipher has determined that the spectroscopic binary β Scorpii has a very wide range of velocity, extending over 250km. from −109km. to +146; these variations are satisfied by a period of 6d. 21h.

The spectrum of each of the components is of the Orion type, and the velocity determinations were made from measurements of the lines Hγ, λ 4388, and λ 4472 (Lowell Observatory *Bulletin*, No. 1).

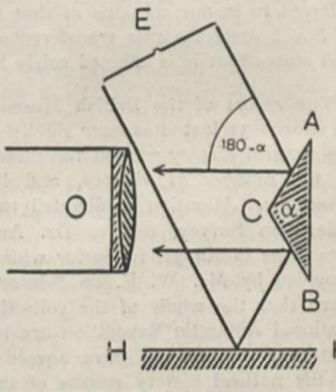
EFFECTS OF ABSORPTION ON THE RESOLVING POWER OF SPECTROSCOPES.—In a mathematical discussion of the manner in which the absorption of a train of prisms affects the resolving power of a spectroscope, Prof. Wadsworth, of the Allegheny Observatory, has found that for small absorption values the actual resolving power is practically identical with its theoretical value, but as the absorption increases a most important diminution of the resolving power takes place. So rapid is this diminution that in several actual instruments now in use, which were designed to give great resolution, this end has been defeated by the high absorptive power of the dense flint prisms used in their prism-trains. Thus in the Young spectroscope, the theoretical resolving power in the neighbourhood of the H and K lines is 300,000, whilst the practical power is only about 57,000, actually less than that which an instrument one-fourth the size would possess.

Prof. Wadsworth summarises the results of his discussion in the following statements. "It is at once evident from these results that if high-power prism spectroscopes are to be used in the investigation of the photographic region of the spectrum, the use of extra dense flint glass, so commonly employed in the past, must be avoided, not only on the score of light-efficiency, but, as now appears, on the score of photographic resolving power and purity as well. The use of lighter flint reduces the theoretical resolving power of any given prism train by decreasing the value of the dispersion coefficient, but this may be easily, and even advantageously, compensated by increasing the refracting angle of the prisms."

Many new spectroscopes have been designed on the principle enunciated above, amongst others those of the Allegheny, Lowell, and Philadelphia Observatories may be mentioned (Miscellaneous *Scientific Papers* of the Allegheny Observatory, No. 11).

A NEW CIRCUMZENITHAL APPARATUS.—A novel apparatus for determining zenith distances has been devised by Fr. Nušl and M. J. J. Frič, of Prague, and is described and illustrated in a *Bulletin International de l'Académie des Sciences de Bohême*.

The accompanying diagram shows the essential features of the apparatus. When the star E approaches the altitude 180-α it forms, at the focus of the telescope O, two images, one of which has been reflected directly from the face AC of the prism ACB, the other from the face CB after reflection from the surface of a bath of mercury HH; these two images coalesce at the moment that the star crosses the zenith circle at altitude 180-α, and that moment is chronographically recorded. Numerous improvements have been made on the original design, the chief of which consists in substituting two mirrors inclined to each other at the angle α in place of the prism shown here, and, by inserting small prisms, the star images are observed as sharply defined horizontal lines. Using a telescope of 350mm. focal length and 40mm. aperture, with a 50 eye-piece, a determination of time correct to ±0·05s.—0·06s. may be made, and by observations of three stars a determination of latitude correct to ±0″·22 is easily performed.




THE SECCHI COMMEMORATION.—The twenty-fifth anniversary of the death of Padre Angelo Secchi was commemorated at the Collegio Romano last spring, when an address was read by Prof. Elia Millosevich. This has since been published, with a portrait of Secchi, by the Press of the Lincei Academy.

## THE NEW YORK ZOOLOGICAL SOCIETY.[1]

ALTHOUGH the preservation of the native animals of the United States is one of the avowed objects of the New York Zoological Society, the establishment of small parks, where the larger species can live and multiply under conditions approximating as nearly as may be to their natural surroundings, has been specially undertaken by the sister society at Washington. And, so far as we gather from the report before us, the authorities at New York are directing their attention to the exhibition of animals from all parts of the world on an equal footing. Considering that the year (1902) to which the report relates is only the fourth

1 "Seventh Annual Report of the New York Zoological Society." Pp. 205; illustrated. (New York, 1903.)

in the development of the Zoological Park and of the serious work of the society, all concerned are to be heartily congratulated on the progress that has been made up to date, and the promise of rapid advance in the near future. A gratifying feature in the year's record was the transference of the New York Aquarium to the management of the society, since, as we are told in the report, this was made spontaneously by the municipality without any suggestion on the part of the governing body. The society has organised the administration of the aquarium on practically the same basis which has been found so effective in the case of the Zoological Park, with a director and council who secure the best expert advice obtainable. As regards the general progress of the park, the report records the completion of a lion house, and the issue of a contract for a building devoted to the exhibition of antelopes. The executive committee states, however, that if the menagerie is to equal the best European institutions of a like nature, even, greater efforts in the way of new buildings must be made in the future.

Judging from the excellent reproductions of photographs with which the report is illustrated, the larger mammals are allotted ample space, and enjoy, whenever practicable, surroundings suitable to their particular requirements. This is well exemplified in the annexed illustration of a group of Barbary wild sheep in the collection.

FIG. 1.—A group of Aoudad, or Barbary wild sheep. (From Report of the New York Zoological Society.)

Perhaps the most important part of the society's work, so far, at any rate, as menagerie administration is concerned, is the establishment of a medical department on what it is hoped may be a permanent basis. In the words of the report, "the object of this service is, by systematic observation and record, and by experimental treatment, to extend our knowledge of the care and health of wild animals in captivity, the causes of various diseases, and the means which should be taken for their prevention. This is both humane and part of an economic administration." The establishment includes a well-known medical pathologist, a trained veterinarian, and an expert in microscopic investigation and the preparation of pathological cultures. To the report before us the last-named official contributes two communications of prime importance in regard to menageries, namely, one on the modes of tubercular infection in wild animals in captivity, and a second on cysticerci in wild ruminants. The work of the department in question is therefore already in full swing, and its investigations will doubtless be found of the highest value to menagerie authorities throughout the world. None of us can fail to be pained at the large percentage of ailing animals to be seen in every menagerie, and all will therefore welcome anything that can be done to render such cases less common in the future.

In addition to the aforesaid special papers and the reports of various officials, the volume before us contains other articles of interest. In one of these, for instance, Mr. R. H. Beck gives a graphic account of hunting for giant tortoises in the Galapagos Islands, illustrated by a photograph of these reptiles coming to a pool to drink, and by a second of the mode in which their empty shells are carried on mule-back to the coast. The psychology of birds forms the subject of a communication by Mr. C. W. Beebe, while Mr. R. L. Ditmars discourses on the method of feeding reptiles in captivity, with especial reference to the somewhat forcible measures adopted in the case of a recalcitrant python.

To those who make the study of mammals a speciality, as well as to big game hunters and sportsmen generally, a paper by the secretary, Mr. M. Grant, on caribou, or reindeer, will be of special interest, not only from the excellent account of the various local forms, but from the numerous illustrations by which their distinctive features are displayed. One of these we herewith reproduce, on account of its being taken from an animal in the wild state. Mr.

FIG. 2.—Wild Newfoundland Caribou. (From Report of the New York Zoological Society.)

Grant considers that all the American caribou may be divided into two groups, the large and light antlered barren ground group, and the woodland group, distinguished by the short, heavy, and much-branched antlers. The distribution of the various members of these two groups is illustrated in a coloured map. R. L.

## THE ORIGIN OF SEED-BEARING PLANTS.[1]

WHEN Linnæus, in 1735, brought out his famous sexual system of classification, which for so long dominated systematic botany, twenty-three out of his twenty-four classes were occupied by flowering plants, and one only was left for the flowerless plants or Cryptogamia.

As the name "Cryptogamia" indicated, a thick veil of mystery still hung over the reproductive processes of these flowerless plants. When this obscurity became gradually dissipated, with the aid of improved microscopes, by the brilliant researches of Hedwig, Mirbel, Nägeli, Pringsheim, Cohn, Thuret, and above all Hofmeister, and the "Crypto-

[1] Discourse delivered at the Royal Institution on Friday, May 15, by Dr. D. H. Scott, F.R.S.

gamia," to quote a phrase of Prof. Sachs's, became the true "Phanerogamia," their relative importance received better recognition. In a recent classification—that of Prof. Warming—out of twenty-three classes no less than eighteen are assigned to Cryptogams.

In spite of our vastly increased knowledge of the Cryptogamia, the flowering plants are still in the majority as regards species. According to a recent census, out of about 175,000 known species of plants, about 100,000 or 4/7 are phanerogamic. For our present purpose we may speak of the flowering plants as the seed-bearing plants or Spermophyta, for at least in recent vegetation the two characters, the grouping of the reproductive leaves in a flower and the formation of a seed, go together, and the latter is the more definite and constant feature. The Cryptogams, such as ferns, mosses, seaweeds, and fungi, may, in contradistinction, be spoken of as the spore-bearing plants or Sporophyta. In the vegetation, then, of the present day, the seed-bearers are enormously predominant, not so much in mere number of species as in importance, including, with few exceptions, all plants of utility to man, and almost all of conspicuous stature, and occupying vastly the greater part of the earth's land surface.

To what do the now dominant seed-plants owe their success?

This is a difficult question, for all organisms are well adapted or they could not exist, and nothing requires more careful discrimination than the attempt to determine the exact factors which constitute the relative superiority of one group over another in the struggle for life. Everything depends on the conditions of the contest.

In the simpler of the higher Cryptogams, such as ordinary ferns, the spores are all of one kind, and on germination give rise to an independent plantlet, the prothallus, on which the sexual organs are borne. Fertilisation requires the presence of water for the actively moving male cells, the spermatozoids, to swim in. This condition may be something of a handicap to the plant, but if water is present, reproduction is fairly well ensured. In the more advanced spore-plants, such as the Selaginellas, so commonly grown in our greenhouses, the differentiation of the sexes begins earlier, for the spores themselves are of two kinds. There are numerous male spores of very small size (microspores) and comparatively few female spores of relatively large size (megaspores). In the group of the water-ferns (Hydropterideæ) only one of these large spores is produced in each spore-sac, which then, if provided with a special envelope, as in Azolla, may closely simulate a seed.

In the microspores, the prothallus is scarcely developed; the spore has practically nothing else to do but to produce the spermatozoids. On the female side, provision has to be made for the nutrition of the embryo, and here there is a comparatively bulky prothallus, though, as compared with that of the ferns, it tends to lose the character of an independent plant, and to become a mere storehouse of food-materials. There are certain obvious advantages in this heterosporous condition. The male spores are kept small for easy dispersal, and can be produced in correspondingly large numbers. The prothallial tissue is economised and only formed where it is wanted, *i.e.* in connection with the egg-cells from which the embryos arise.

The differentiation of microspores and megaspores is, in fact, comparable to that earlier differentiation of minute active spermatozoids, and large stationary ovum, which took place far back in the history of both animals and plants, and laid the foundation of sex.

At the same time the heterosporous arrangement, as we find it in Cryptogams, puts a new obstacle in the way of the successful accomplishment of the act of fertilisation. In order that this may happen it is necessary that the two kinds of spores should germinate together, as well as in the presence of an adequate water supply. The necessary association of the large and small spores is, as a rule, left to chance, the small spores being produced in enormous numbers, so that the chance may be a good one.

In the case of the great cryptogamic trees of the Palæozoic period the difficulty must have been a serious one. We know that their spores often differed in mass in the proportion of at least 100,000 to 1, and when bodies of such diverse weights were scattered by the wind from the tops of lofty trees, the chances must have been enormously against their coming to rest at the same spot. It was perhaps to this difficulty that the series of adaptations leading up to seed-formation owed their first inception.

If the microspores could be brought to the megaspores while the latter were still attached to the parent plant, much greater certainty of their union would be gained, for adaptations would now become possible for catching the small spores and retaining them in position. Some of the Cryptogams now living have got as far as this; the work of an American lady, Miss Lyon, has shown that in some species of Selaginella the microspores and megaspores meet and the spermatozoids are discharged within the sporangium; fertilisation is effected, and even an embryo may develop before the megaspore is shed. In this last respect these Selaginellas go beyond the seed-plants of the Palæozoic period, as we shall presently see. The first advantage, then, to be secured was the occurrence of fertilisation, or rather the bringing together of the two kinds of spore, on the parent plant. This is one of the constant characteristics of the seed-bearing plants; the process is spoken of as *pollination*, for what we call the pollen-grains are nothing but the microspores of the Spermophyta.

We will now see how the process actually goes on in some of the simpler seed-plants of the present day.

The seed-plants, as is well known, are divided into two great classes, the Angiosperms, in which the seeds are enclosed in a seed-vessel, and the Gymnosperms, in which they are exposed. In the former, fertilisation is effected by the growth of the pollen-tube through the tissues of the young seed-vessel; in the Gymnosperms the pollen falls directly upon the young seed or ovule, and the pollen-tube has only a short way to grow before reaching the egg-cell.

The Angiosperms (Monocotyledons and Dicotyledons) include practically all our familiar flowering plants, but with them we are not concerned at present. The question of the origin of Angiosperms is one of the great unsolved problems of botany, but it does not immediately touch our present subject. It is to the simpler seed-plants—the Gymnosperms—that we must turn for light on the origin of the seed-plants as a whole. The Gymnosperms are enormously the more ancient of the two classes, extending back through the whole of the Carboniferous period into the Devonian, while the Angiosperms, so far as we know, only appeared quite late in the Mesozoic period.

The most familiar of the Gymnosperms—the Coniferæ or cone-bearing trees—are themselves too far advanced on the seed-bearing line for our purpose. We will concentrate our attention on a family which, of all living flowering plants, stands nearest to the Cryptogams, namely, the Cycads. This group, not very well known to the non-botanist, but of which a splendid collection will be found in the palm-house at Kew, is now a small one, including nine genera and about seventy species, distributed through the tropical and sub-tropical regions of both the old and new worlds. In habit these plants, which may rise to the stature of small trees, bear some superficial resemblance to palms; the agreement with ferns is, however, much more striking.

In the genus Stangeria from tropical Africa, the leaves bear so close a resemblance to those of some ferns in form and veining that the plant, before its fructification was known, was described by competent botanists as a species of the fern-genus Lomaria.

In all Cycads the male fructifications are in the form of cones; the pollen-sacs are borne in great numbers on the under surface of the scales of the cone. In all the genera but one, the female fructifications are also cones, each scale bearing two large ovules. In the type genus Cycas, however, there is no specialised female cone at all. The fertile leaves are borne in rosettes on the main stem, alternating with zones of the ordinary vegetative leaves.

The fertile leaves are of large size and compound form, and usually each of them bears several ovules, which, whether fertilised or not, grow to a great size, sometimes as big as an egg-plum. They are in some species of a bright red colour, and contrasting with the yellow woolly leaves on which they are borne, are conspicuous and beautiful objects.

In thus bearing its seeds on leaves so little modified, and springing like the ordinary leaves from the main stem, Cycas is the most fern-like genus of flowering plants.

The ovule, at the time when pollination takes place, is

about the size of a small hazel nut. It consists of an outer envelope and a central body, the two being closely joined together, except towards the top, where the envelope leaves a narrow passage open, leading down to the central body. The apex of the latter becomes excavated into a hollow pit—the pollen chamber—a feature almost peculiar to Cycads amongst *living* plants, discovered by our countryman Griffith so long ago as 1854, though the credit is often wrongly given to later French or German investigators.

The pollen, blown by the wind or possibly conveyed by insects, is received in the opening of the envelope by a drop of gummy substance, and as this evaporates the pollen-grains are drawn down through the narrow passage into the pollen chamber below. There each grain anchors itself by sending out a tube into the neighbouring tissue of the ovule. Thus pollination is accomplished. Fertilisation, *i.e.* the actual union of the male and female cells, takes place some months later, when the ovule, now to all external appearance a seed, has reached its full size. In the meantime, the single megaspore or embryo-sac, embedded in the tissue of the central body of the seed, has grown to enormous dimensions—filled itself with prothallus and developed the egg-cells at its upper end, which are so large as to be easily seen with the naked eye.

The pollen-grain behaves like a cryptogamic microspore and produces two large spermatozoids, each with a spiral band bearing numerous cilia—the organs of motion. The pollen-tube becomes distended with water, bursts, and sets free the sluggishly moving spermatozoids, which by aid of the water discharged from the pollen-tubes are able to swim to the egg-cells and effect fertilisation.

This remarkable process, first discovered in 1896 by two Japanese botanists, Ikeno and Hirase, and independently in 1897 by the American Webber, occurs not only in the Cycads, but also in that strange plant the maiden-hair tree, Ginkgo, a form now completely isolated, certainly rare in a wild state, and said to have been only saved from extinction by cultivation around Buddhist temples in China and Japan, but which has a long geological history.

The cycadean method of fertilisation holds exactly the middle place between the purely cryptogamic process, where the active male cells accomplish the whole journey to the egg by their own exertions, and the method typical of seed-plants, where these cells are little more than mere passengers carried along by the growth of the pollen-tube.

The adaptations, which in the Cycads allow of pollination and fertilisation on the plant, are chiefly three :—

(1) The envelope of the seed with its narrow opening down which the pollen-grains are guided.

(2) The pollen-chamber below in which they are received.

(3) The pollen-tube which, however, plays a somewhat less important part here than in the higher flowering plants, and in the Palæozoic allies of the Cycads may perhaps have been dispensed with altogether.

There are, however, other points in which the ovule of a Cycad differs from the spore-sac of a Cryptogam. Not only is the megaspore solitary—that is a condition already reached among the water-ferns—but it is firmly embedded in the surrounding tissue. It is no longer a mere spore destined to be shed, but remains throughout an integral part of the ovule, while the ovule ripens into a seed and ultimately germinates. Thus the whole development of the prothallus takes place within the seed, and this requires special methods of food-supply, involving a complexity of structure far beyond that of any cryptogamic spore-sac. When the time for dispersal comes, the seed is shed as a whole.

There is, however, another character commonly regarded as essential to the definition of a seed; a seed should contain an embryo. This implies that, after the egg-cell has been fertilised, the young plant develops to a certain extent while still within the seed, and before it is shed. In the ripe seed the embryo passes into a resting stage, and only resumes its development when the seed begins to germinate and the embryo becomes a seedling. Usually, too, the ripening of the seed itself is dependent on the development of the embryo; if there is no fertilisation there is no true seed, only an abortive ovule.

In the Cycads this is not the case; the ovule ripens into a full-sized and apparently normal seed, even if fertilisation has failed. In our hot-houses Cycads are seldom fertilised; yet the conspicuous scarlet seeds of *Cycas revoluta*, or the crimson seeds of Encephalartos, are familiar objects to many Kew visitors. Further, the degree of development of the embryo at the time the seed is shed is very inconstant; sometimes, although fertilisation has taken place, the embryo is scarcely to be detected.

The definite resting stage of the young plant in the dry seed, so characteristic of the higher Phanerogams, is unknown to these primitive seed-bearers, the Cycads and the maidenhair-tree. The same appears to hold good for the seeds found in the Palæozoic rocks. Such seeds are common in certain localities, as in the Coal-measures of central France, and to a less degree in our own coal-beds. In petrified specimens the structure is often beautifully preserved, yet in no single case has a Palæozoic seed been found to contain an embryo. It is not merely a matter of preservation, for that is not unfrequently so good that the delicate egg-cells can still be recognised. Thus there is no known "seed" of Palæozoic age which, according to current definitions, strictly deserves the name. Technically, the term "ovule" would be more appropriate, but the obvious maturity of the integument makes the word "seed" seem more natural. So far the case is parallel to that of our recent Cycads or the maidenhair-tree.

It is, of course, possible that any day we may light on some Palæozoic seed with an embryo; it may be that the specimens hitherto found were all unfertilised, though the frequent presence of pollen-grains in the pollen-chamber makes this explanation unlikely. It seems not improbable that the development of an embryo in the ripening seed was a later device—that in the older seed-plants the period of rest came immediately after fertilisation, and that the growth of the embryo, when once started, went on rapidly and continuously to germination. In that case a seed with a recognisable embryo would rarely be preserved.

We are now in a position to see what are the chief advantages gained by a plant in adopting the seed-habit; they are :—

(1) Pollination on the parent plant, and consequently greater certainty in bringing together the two kinds of spore.

(2) Fertilisation either on the plant or at least within the sporangium, giving greater certainty of success, and protection at a critical moment.

(3) Protection of the young prothallus from external dangers.

(4) A secure water-supply during its growth.

(5) Similar protective and nutritive advantages for the young plant developed from the egg-cell.

This last end, however, was very probably not yet fully attained in the earlier seed-bearing plants.

We may now go on to consider our main subject—the historical question, from what group of spore-bearing plants were the seed-plants derived?

One thing is plain; the stage of heterospory was the immediate precursor of seed-formation, and it was from some group of Cryptogams producing spores of two kinds that the seed-plants sprang. Such heterosporous groups are, however, known in three of the main phyla of the higher Cryptogams.

In the Lycopod series we have, among their living representatives, pronounced heterospory in Selaginella and Isoetes; among the Palæozoic Lycopods it was commoner still. Within the class of the ferns we have the heterosporous water-ferns. In the third series, that of the horsetails, we have, it is true, only homosporous forms now living, but in Palæozoic times a well-marked differentiation of micro- and megaspores was attained, though less extreme than in the other two lines.

So far, therefore, there is no reason why the early seed-plants might not have had family relations with any of these great cryptogamic classes, and, as a matter of fact, all three lines have been championed by one botanist or another as the probable ancestors of the seed-plants.

The horsetail stock, though it attained an extraordinary development, shows no further sign of transition towards the higher plants.

The case for the Lycopods is stronger, and, indeed, they were long the "favourites," and were commonly regarded as lying nearest the true line of spermophytic descent. This idea was specially based on the mode of development

of the spore-sacs, which has much in common with that of the pollen-sacs and ovules of Phanerogams, and this, combined with the occurrence of well-marked heterospory in some genera, appeared to point to a relationship. But the former character (the development of the spore-sac from a group of cells instead of from a single one) is now known to be common to certain ferns, and to just those ferns (the Marattiaceæ, &c.) which prove to be the most ancient, so that this argument has lost its weight. It has lately been found, indeed, that some of the Carboniferous Lycopods produced seed-like organs, presenting the most striking analogies with true seeds, but the plants which bore them were in all other respects Lycopods pure and simple, and the case appears to have been one of homoplastic modification. There is no indication, as yet, of any forms really transitional between the Lycopods and the Spermophyta.

The one line which, so far, has yielded truly intermediate types is that of the ferns.

Among recent plants, the Cycads, as we have seen, offer some points of agreement with ferns, sufficient to have led certain distinguished botanists, for example Sachs and Warming, strongly to maintain their fern-ancestry. The chief points of agreement are :—

(1) The fern-like foliage in some Cycads, and in many the mode of folding of the leaflets in the bud.

(2) The arrangement of the pollen-sacs in groups on the underside of the cone-scales, like that of the spore-sacs of ferns on the underside of the leaves.

(3) The carpels or fertile leaves of Cycas, which, though bearing true seeds, are more like fertile fern-fronds than any other reproductive leaves.

By themselves, these characters, though suggestive, would be inconclusive; the anatomy is not directly comparable with that of any living ferns.

What, then, do we know of the history of this family in past times? The Cycads are now a small and isolated group; in the Mesozoic period, from the Trias to the Lower Cretaceous, they were one of the dominant types of vegetation, and spread all over the world. Of the fossil species recorded from the Oolite of the Yorkshire coast and from the Wealden of the south of England, one-third are referred to Cycads, and they were equally abundant in the Mesozoic floras of North America, India, and other countries. If they existed in the same proportion now as then, they would have about 35,000 species instead of 70! The Cycads of the Mesozoic, however, were not, as they are now, a single family, but a great class (the Cycadophyta of Nathorst) embracing very diverse types, often with organs of reproduction widely different from those of their surviving relatives, and showing a certain parallelism with angiospermous fructifications. But with all this there was on the whole a remarkable uniformity in habit, just as we find a general similarity in outward characters among so many dicotyledonous trees of the present day, though belonging to the most diverse families.

In the Mesozoic rocks we also find a certain number of plants (known only from their foliage) as to which it remains doubtful whether they belonged to Cycads or ferns, or to some intermediate group.

Besides the Cycadophyta, seed-plants were represented in Mesozoic days by a great number of Coniferæ, more or less allied to those still living, and by various forms akin to the maidenhair-tree, perhaps the more ancient type surviving in the recent flora.

When we go further back, to the Palæozoic rocks, it is only in their uppermost strata that we find forms clearly referable to Cycads or Conifers.

The best known seed-bearing plants of the older rocks are those of the family Cordaiteæ, which stretches back to the Devonian. They were tall, branched trees, bearing great simple leaves, sometimes a yard long. The anatomy of stem and root resembled that of an Araucarian Conifer, but the leaves had just the structure of the leaflets of a Cycad. Male and female flowers were borne in little spikes or catkins, and may best be compared with those of the maidenhair-tree. The seeds, of which the structure is known, closely resemble those of that plant, or of recent Cycads.

The Cordaiteæ, however, ancient as they are, were already pronounced gymnospermous seed-plants—by themselves they give no direct clue to the origin of Spermophyta. We must look elsewhere for the key to our main problem.

The vast number and variety of fern-like remains throughout the Palæozoic strata, wherever land-plants are known, is familiar to all. Almost every form of recent fern-frond can be matched from the impressions in the Carboniferous and Devonian rocks. A considerable number of these fossil fern-fronds are known to have really belonged to ferns, for typical fern-fructifications are found upon them. An experienced collector of Coal-measure plants, Mr. Hemingway, once told me that he reckoned on finding about 20 per cent. of the specimens of any true fossil fern in the fertile state. When, therefore, a common fossil fern-frond (so-called) is *never* found fertile, a strong suspicion is awakened that the plant must have had some kind of fructification other than that of an ordinary fern. This is the case with a surprisingly large proportion of the Palæozoic plants commonly described as ferns, and holds good of certain entire "genera"; the important genera Alethopteris, Neuropteris, Mariopteris, Callipteris, Tæniopteris, and others, have never yet been found, in any of their species, with fertile fronds, if we except one or two specimens so questionable and obscure that no conclusion can be drawn from them. It is probably under the mark to say that one-third of the so-called ferns of Palæozoic age afford no evidence from fructification that they were really ferns, as we now define them.

The absence of recognisable fertile fronds may, it is true, be partly accounted for by dimorphism. Many ferns, both recent and fossil, bear their reproductive organs on modified portions of the frond, or even on special fronds, very different from the vegetative foliage. Fossil remains are usually fragmentary, and when the sterile and fertile fronds are found isolated, there may be nothing to show that the one belonged to the other. But, allowing for this, there are very many "fern-fronds" which offer no evidence, even from association, of any fern-like fructification, while the fructifications actually associated with them are often anything but fern-like. There are, in fact, a number of unassigned seeds from the Coal-measures, some of which are commonly associated with certain of the quasi-ferns of which we are speaking.

On the whole, however, we have, up to this point, had before us merely negative evidence, indicating that many of the leaves, so familiar to palæobotanists, classed on account of their form and veining as fern-fronds may really have belonged to some group different from the true ferns. Negative evidence is notoriously weak; at most it only justifies us in taking up a position of philosophic doubt, though in this case it was enough to induce the distinguished Austrian palæobotanist Stur to suspect that the genera Alethopteris, Neuropteris, and others were not ferns, but Cycads.

During the last thirty years, however, positive evidence has been accumulating proving that certain of the fern-like Palæozoic plants were at any rate something distinct from true ferns, as we now know them. This evidence is derived from a study of the anatomical structure, which in Cycads and ferns, as they now exist, is sufficiently different to prevent any possible confusion between the two groups. A single section from the leaf-stalk of the fern-like Cycad Stangeria would be enough to show that it is a true Cycad and no fern, and conversely, a single section from the frond of Lomaria, with which Stangeria was once confused, would show it to be a true fern and not a Cycad.

A common Coal-measure plant, named *Lyginodendron Oldhamium*, was one of the first of the Palæozoic quasi-ferns to be examined anatomically. We owe this work, like so many other great advances in fossil botany, to the late Prof. Williamson, who thus led the way to the solution of the problem before us.

Externally, the plant is wholly fern-like; its characteristic highly compound foliage is that of a Sphenopteris (*S. Höninghausi*) with a Davallia-like habit. The large fronds were borne, at intervals, on a somewhat slender stem, which rooted freely. The slender proportions and the presence of spines everywhere, on leaf and stem, suggest that the plant may have been a scrambling climber like *Davallia aculeata*, for example, among recent ferns.

The structure of all the vegetative parts of the plant, stem, leaf, and root, is known as perfectly, perhaps, as in any plant now living. The leaves turn out to be

true "fern-fronds" in structure as well as in external aspect. The vascular bundle traversing the petiole, for example, is of the "concentric" type characteristic of ferns, and any differences there may be are in details only.

A section of the stem, however, bears at first sight no resemblance to that of a fern; outside the pith we find, in all mature specimens, a broad zone of wood and bast with its cells arranged regularly in radial series, like that of an ordinary "exogenous" tree, and in detail approaching especially the cycadean structure. At the border of the pith there are distinct strands of wood, and this region, which was laid down before the radially arranged zone, recalls the structure of an Osmunda. The bundles in the cortex of the stem, on their way out to the leaves, have, in this part of their course, exactly the structure of the strands in the leaf-stalk of a Cycad—a structure found, in this form, in no other living plants.

The roots, when young, resembled those of certain ferns (Marattiaceæ), but as they grew older they also formed radially arranged wood and bast like the roots of Gymnosperms.

On the ground of this remarkable combination of structural characters, it was inferred that Lyginodendron could not have been a true fern, but must have occupied a position intermediate between the ferns and the cycadean type of Gymnosperms.

A similar association of diverse anatomical characters has now been proved to exist in various other quasi-ferns of Palæozoic age. In Heterangium, for example, also investigated by Williamson, leaves and roots resemble those of the previous genus, but the stem is more obviously fern-like, agreeing in its earlier stages with that of a Gleichenia, but acquiring, with advancing age, a zone of secondary wood and bast of the cycadean type. This plant likewise bore foliage of the Sphenopteris form (*S. elegans*).

In Medullosa, on the other hand, to which the Alethopteris and Neuropteris foliage belonged, the original ground-plan of the tissues in the stem is like that of a complex fern, but the structure of leaves and roots, and the secondary structure of the stem itself, is almost purely cycadean. We might continue the list much further. Wherever one of these quasi-ferns has been examined anatomically, a similar combination of characters has been found. It may be pointed out in passing that, while many of these intermediate forms lead on towards the Cycadophyta themselves, others approach more nearly to the extinct family Cordaiteæ, and indicate that they also, though so different from ferns in habit, may yet have sprung from the same stock.

But so far the positive evidence has been wholly anatomical, and botanists are not yet altogether in agreement as to the value of anatomical characters. The anatomist very naturally thinks that there is nothing like anatomy, but the pure systematist will not be satisfied without the characters on which he has been accustomed to rely, and his faith in which has been so amply justified, those, namely, drawn from the reproductive organs. Darwin, however, who neglected nothing, was fully alive to the importance of anatomical evidence; he expresses his interest in an anatomical character in an amusing way in one of his lately published letters (1861), saying, "The destiny of the whole human race is as nothing compared to the course of vessels in Orchids!"

Until the present year, we had no satisfactory knowledge of the fructification in any one of the Cycadofilices, as we now call them, of the Palæozoic period. There is, it is true, some reason to believe that a form of fructification with long tufted spore-sacs belonged to Lyginodendron, but we know nothing as yet as to the details—it may prove to represent the male reproductive organs of the plant. Among the unidentified seeds of the Coal-measures, there are some—the great seeds known as Trigonocarpon—which are not only associated with Medullosa, but which show a certain structural resemblance to some of its tissues. But still the indications were slight—so slight that Prof. Zeiller, of Paris, than whom there is no higher authority, has recently expressed a doubt whether these Cycadofilices were, after all, anything more than a peculiar group of ferns.

Within the last few months, however, an altogether new light has fallen on our subject. Among the seeds discovered by Williamson in the English Coal-measures were three species which he placed in his genus Lagenostoma. These, as we shall see, are characteristic seeds of complex structure. One of them, named *L. Lomaxi* by Williamson, though not described by him, has lately been reinvestigated, in the first instance by my friend Prof. F. W. Oliver (see NATURE, June 4). The great peculiarity about it is that the seed itself was borne in a little calyx-like cup, fitting loosely round it, just as a hazel nut is borne in its husk. The cup, or cupule, which is deeply lobed, bears very peculiar glandular bodies, usually with a short thick stalk and a round head which is empty, as if the secretory tissue had broken down. These glands, on the cupule of the seed, have been found to agree exactly in dimensions, form, and structure with the glands borne on the leaves and stems of the particular form of *Lyginodendron Oldhamium* with which the seeds are associated.

Suppose that in some tropical forest where the trees were too lofty for their leaves and fruits to be reached, seeds and leaves and twigs were found scattered together on the ground, and that they all proved to bear exactly similar glandular outgrowths of a kind unknown elsewhere. Suppose, further, that the structure of the envelope of the seed turned out to agree in other respects with that of the vegetative fragments, should we hesitate to conclude that the seeds belonged to the same plants as the leaves and twigs, though we had never seen them actually in connection? Such is the argument with regard to the relation of the seed Lagenostoma to the plant Lyginodendron. Short of finding the vegetative and reproductive organs in continuity, the proof is as strong as it can be, and I think we need not hesitate to conclude that the one belonged to the other.

But, if this be so, the question as to the nature of the Palæozoic Cycadofilices is settled, at least as regards one member of the group. Lyginodendron was already a seed-bearing plant. The seeds are highly organised, and, broadly speaking, of the cycadean type. The integument and central body of the seed are closely joined to near the tip and along the line of junction run the strands which conveyed the water-supply. The upper part of the integument has a curious chambered structure—the central body terminates in a large pollen-chamber of peculiar bell-shaped form, in which the pollen-grains are sometimes found. The neck of the pollen-chamber fits into the opening of the integument and reaches the surface. The centre of the seed is occupied by the large megaspore or embryo-sac, in which remains of prothallial tissue can sometimes be detected. The seed, in fact, is as highly differentiated as any seed of its period, lacking only an embryo, as do all its contemporaries.

But if Lyginodendron, with all its fern-like characters, was thus a true seed-plant, we cannot doubt that other quasi-ferns of that period, exhibiting a similar combination of characters, had also entered the ranks of the Spermophyta, and we may confidently expect that, one by one, many of the as yet unowned Palæozoic seeds will be traced to their fern-like possessors.

Further positive indications of this are already presenting themselves. For example, there is a specimen in the British Museum collection showing a cast of a branched rachis accompanied by a multitude of ribbed seeds, many of which are in clear connection with the rachis itself. At one place we see a leaflet of *Sphenopteris obtusiloba*, a well-known Coal-measure "fern," and everything indicates that we have here the fertile, seed-bearing rachis of that species. There are other specimens which point in the same direction, and now that the eyes of collectors are opened to the possibility of their so-called "fern-fronds" bearing seeds—an idea which before seemed too improbable to be entertained—more of such specimens will doubtless find their way into our museums.

The present position, then, of our question is this. Some, probably many, of the fern-like plants of Palæozoic age bore seeds of the same general structure as those of the Cycads among living Gymnosperms. The plants in question were not merely fern-like; their anatomical structure proves them to have had so much in common with true ferns that there can be no doubt of their affinity with them. In fact, apart from the newly discovered seeds, these plants, for the most part, show a balance of characters on the fern side.

The evidence thus points unmistakably to the conclusion

that the Cycadophyta—the most primitive of the seed-plants—sprang from the fern stock. Thus the origin of the great mass of cycadean forms which overspread the world during the Mesozoic epoch is accounted for—they were doubtless derived from the more primitive Cycad-ferns of the preceding Palæozoic age, and through them from some early filicinean ancestry. The first divergence from this original cryptogamic stock must have occurred very far back; the seeds of Lyginodendron and other Carboniferous seeds referable to the Cycadofilices are, as we have seen, already highly organised, and the stages of their evolution from the cryptogamic sporangium are still to be discovered.

The origin of the seed-plants from the fern phylum will probably prove to hold good for other groups besides the Cycadophyta. The great Palæozoic family Cordaiteæ combines the characters of Cycads and Coniferæ, and at the same time shares certain of those anatomical features which first betrayed the true nature of the Cycadofilices. There is thus a strong presumption that the Cycadophyta, the Cordaiteæ, and the Coniferæ themselves had a common origin, or at least that they all sprang, directly or indirectly, from the great plexus of modified ferns which played so large a part in Palæozoic vegetation.

Hence, so far as the gymnospermous seed-plants are concerned, we are led to the conclusion that they were derived, at a very early period, from the fern stock. The following up of the clue, which, as I believe, we have now grasped, will afford a pursuit of the utmost interest and promise.

But the other great problem—the origin of the angiospermous seed-plants, which are now supreme in the vegetable world—is as yet untouched. And so, though real progress has been made, it will be long before we can hope for a complete answer to the question which we have had before us.

## THE GOVERNMENT LABORATORY.

THE report of Dr. T. E. Thorpe, F.R.S., upon the work of the Government Laboratory for the year ended March 31, 1903, with appendices, has now been published, and the following extracts from it are of interest.

It appears from the report that the descriptions of imports as given in merchants' entries are often erratic, and give no clue whatever to the real nature of the goods. For example, crushed bones were entered as "semolina," gingerbread as "paints," sodium peroxide as "fancy goods," varnish as "iron goods," whilst "machinery" and "razor strops" turned out to be tobacco fumigating powder and sugar-coated pills respectively.

Many preparations containing spirit are liable to duty also in respect of other ingredients. Soaps, for example, may contain cocoa-butter, spirit and sugar, the latter being frequently used as a cheap substitute for glycerine. Blacking and polishes are examined for sugar or molasses; confectionery for sugar and chocolate; and essences for dutiable tariff articles, in addition to spirit, such as acetic and butyric ether, used for flavouring purposes.

During the year 1173 samples of beer, wort, and brewing materials were tested for the presence of arsenic, the great majority of which were either quite free from that impurity or contained only traces; but in 44 instances the amount was so notable that the brewers were informed in the case of materials that they should not be used, and in the case of wort or beer that it should not be sent into consumption. The largest quantity of arsenious oxide found was, in malt, 1/50th of a grain per pound, in glucose, 1/40th of a grain per pound, in wort, 1/36th of a grain per gallon, and in water-softening material, 7/10ths of a grain per gallon.

No imported sample of butter has been reported as adulterated during the year. Boric acid preservative was present in 98 per cent. of the samples of butter from Australia and Belgium, 86 per cent. of the French samples, 78 per cent. of those from New Zealand, 77 per cent. of the South American samples, 45 per cent. of those from Holland, and 43 per cent. of the samples from the United States. Sixteen per cent. of the Canadian samples contained this preservative. There has been a decrease in the proportion of samples containing boric preservative from 36·3 per cent. in 1902 to 33·5 per cent. in 1903, for which the samples from Holland are chiefly responsible.

Among articles submitted by manufacturers to the Government Laboratory was a filter which was required to deliver a sterile filtrate, but on examination was found to permit the passage of unfiltered water into the reservoir to which only filtered water was supposed to gain access. This is a danger to which insufficient attention appears to be paid by both manufacturers and users of filters. The inefficiency of many of the old filters was long since established, and as a result improvement was effected in the filtering substance, so as to secure that the water passing through should be free from all micro-organisms. In consequence of the precautions necessary where biological investigations are made, it is to be feared that in some instances, when testing the sterility of the filtrate, the filtering cylinders, cones, or candles, have been examined apart from the filter cases in which they are ordinarily fixed, and no subsequent test has been made of the filter as a whole, with its parts fitted together as in common use. Where this is so it is, of course, possible that though the filtering cylinder itself may be entirely satisfactory, its whole value may be destroyed by a faulty connection.

Among work undertaken for the Home Office was an investigation of the character of the products of combustion in gas and oil stoves. It was desired to ascertain whether along with the main products of complete combustion there was an appreciable production of carbon monoxide and acetylene. Five of the best known stoves—three gas and two oil—were experimented with, and, as a result, it was found after the stoves had been alight for some time (1) that no acetylene was produced by any of the stoves, and (2) that a small amount of carbon monoxide was a regular constituent of the products of combustion of all the stoves, the actual quantity per hour's combustion being, for the gas stoves 0·0024, 0·0048 and 0·0480 cubic foot, and for the oil stoves 0·023 and 0·032 cubic foot.

Of the gas stoves, the first two results quoted were from stoves of different type, the first being of the argand class and burning with a luminous flame, whilst in the second the burners were of the Bunsen type, and the flame impinged on skeleton non-combustible fuel. The production of carbon monoxide is greater in the oil stoves than in two out of the three gas stoves, and it emphasises the necessity of carrying off the products of combustion from every class of stove by means of a flue, if possible, or, where this actually cannot be attained, at least securing that, by good ventilation, there shall be no chance of an accumulation of these gaseous products.

## UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE report has been issued of the commission appointed to inquire into the steps to be taken to bring into existence an institution which should form part of a teaching university for the Transvaal, and which should provide the highest training in the arts and sciences connected with mining and other industries. The commission recommends that, in establishing the proposed technical institute to form an integral part of a teaching university, simultaneous steps should be taken to lay the foundations of the university itself. Recommendations are made for the establishment of a permanent teaching institution and the acquisition of a site within a convenient distance of Johannesburg and Pretoria for a teaching university for the Transvaal, and for any other parts of South Africa which may wish to take part in the scheme. On this site should also be, besides the school of mines, the proposed agricultural school, the State laboratories for chemistry and animal and vegetable pathology. At the outset the appointment is recommended of a principal of the highest scientific attainments and proved organising capacity, with a salary of not less than 3000*l*. a year.

THE Columbia University of New York has, by an agreement with Mr. Joseph Pulitzer, undertaken to establish and conduct a school of journalism. President Eliot, of Harvard University, has proposed an outline for a practical scheme which details the subjects appropriate to a course

of study leading to the profession of journalism. But though Dr. Eliot says "that a journalist needs, more than most men, to be trained in the best methods of ascertaining truth," his scheme does not appear to include a provision for the due instruction of the future journalist in the broad principles of science, which, in view of the large part taken by scientific questions in modern life, seems an omission.

THE Commission of Inquiry into the educational systems of the United States in their bearing upon national commerce and industry, projected last year by Mr. Alfred Mosely, C.M.G., will start on October 3. The itinerary of the commission, drawn up with the assistance of President Butler, of Columbia University, embraces most of the leading educational centres in the United States. Among universities which will be visited may be mentioned Columbia, Yale, Harvard, Cornell, and Pennsylvania, and in addition to the work of these seats of learning, the commission will study the methods, equipment, and curricula of technical colleges and secondary schools for boys and girls, and be given opportunities to examine the procedure of educational institutions of special types. Each member of the commission will, we understand, be invited to record his own impressions, or to combine, if he prefers it, with others interested in the same subjects of education. In this way more varied light will be brought to bear upon all the points in American education. The reports will be printed in a volume or volumes, and distributed to educational bodies throughout the United Kingdom. In an article on the commission in the *Times*, it is stated that "the startling growth of American and German industrial competition is a fact, and a daily more alarming fact. Closely related with it, and in the opinion of many keen observers, largely responsible for it, is the fact that these are precisely the two countries in which national education of all grades has made the greatest strides, and in which its importance is most widely recognised by the people at large." These truths have long been insisted upon in these columns, and we are glad to find they are coming to be more generally appreciated, for it brings us nearer to the day when this country will be properly equipped educationally. The list of commissioners includes with others the following names:—Prof. W. E. Ayrton, F.R.S., Mr. R. Blair, Dr. J. Rose Bradford, F.R.S., Dr. Magnus Maclean, Principal Reichel, Prof. John Rhys, and Prof. W. Ripper.

THE Royal Geographical Society, in response to requests from various school authorities, recently appointed a committee to draw up syllabuses in geography to guide teachers in elementary and secondary schools in their work of imparting geographical knowledge. This committee secured the assistance of Mr. H. J. Mackinder to draw up the syllabus for secondary schools, and of the late Mr. T. G. Rooper to prepare that for elementary schools. Owing to Mr. Rooper's death, Mr. G. G. Chisholm consented to complete the revision of the latter syllabus. The course laid down for elementary schools includes first a preliminary stage for children between five and eight years, who are, it is said, best taught by reading to them suitable extracts from books of famous travellers, and accompanying the readings by the explanation, with the aid of sand-trays, &c., of geographical terms. The second stage is that for children between eight and eleven years old, and includes observational preparation with a view to the necessity of reading maps. Some observations within the reach of town children suggested are the use of the globe, the acquirement of the idea of direction and differences in elevation, and their representation on maps. Country children are, in addition, to learn the use of the compass and to compare Ordnance maps of the same district on different scales. In all study of maps the same ideas must be emphasised as in the observational work. In the third stage children of eleven to fourteen years old begin the systematic study of various parts of the world, and such subjects as climate, rainfall, temperature; the connection between geography and history are also insisted upon. The syllabus for secondary schools is divided into four years' work, and the years between thirteen and seventeen are particularly concerned—in fact, the student is supposed to have mastered the contents of the elementary schedule. In the first year it is proposed that a portion of Britain, extending some distance from the school, should be carefully studied. The portion should be large enough to contain complete examples of river-basins, and such lengths of road and rail to show the influence of physical features on their course. The work should be correlated with instruction in elementary geology. In the second year, Britain as a whole is prescribed as the subject of study, and its several parts are to be traversed by the comparative method, the work of the first year being the standard. For the third year the subject suggested is Europe and the Mediterranean, and it is proposed that the complexion of the teaching shall depend on the other work of the school. The non-European portions of the globe are reserved for the fourth year's work. "What is essential throughout is that nothing should be taught as an isolated fact, and yet that the line of argument should be so chosen that, in the end, every essential fact . . . would have been learnt in its due setting of related facts, and in its proper perspective."

THE report of the Technical Education Committee of the Derbyshire County Council for the session 1901–2 has reached us, and contains detailed statistical information as to recent progress in secondary and technical education in Derbyshire. The statistics relating to the subject of mining are of especial interest. Prior to 1891 not more than twenty students appear to have been attending public classes in this subject, whilst the average enrolment in local classes in coal mining for the past eight years has been about 500. It is also mentioned that, whereas at the time of the initiation of the scholarship scheme in Derbyshire in 1892 only six out of sixty successful candidates were sent to schools in the county, at the present time, out of about 250 minor scholarships, 230 are being held at schools within the administrative county, and only twenty at schools outside the administrative area.

THE catalogue of books on the useful arts contained in the central library at Newcastle-upon-Tyne, which was recently published by the Public Libraries Committee of the city, is the third of a useful series of catalogues prepared by Mr. Basil Anderton, chief librarian. The catalogues provide satisfactory evidence that students residing in Newcastle have at their disposal an excellent library conducted with tact and intelligence. The useful arts dealt with in the present catalogue include all branches of agricultural, chemical, engineering, and mechanical technology, as well as many aspects of medical and domestic science. Some idea of the number of books in the Newcastle central library may be obtained from the statement that the author-list of books on the useful arts runs to 115 closely printed pages of large size.

## SOCIETIES AND ACADEMIES.

### EDINBURGH.

**Royal Society**, July 6.—Principal Sir Wm. Turner, K.C.B., in the chair.—Mr. William **Murray** communicated a paper on statistical evidence regarding the influence of artificial propagation upon the salmon fisheries of the American rivers.—In a paper on the origin of the pineal body as an amesial structure deduced from the study of its development in Amphibia, Dr. John **Cameron** showed that the epiphysis in certain types of Amphibia arose in the form of two recesses or outgrowths from the roof of the fore-brain. The right outgrowth disappeared very early by blending with the left. The latter showed most active growth, and the result of this was to cause the epiphysial opening to become situated to the left of the mesial plane in most cases. The epiphysis in Amphibia was therefore to be regarded as a bilateral, and not as a mesial, structure. These results corresponded in the main with those of Béraneck, Dendy, Gaskell, Hill, and Locy in other vertebrate types.—Dr. O. Charnock **Bradley** communicated an elaborate paper on the abdominal viscera of *Cercocebus fuliginosus* and *Lagothrix humboldti*.—Mr. A. Cameron **Smith** described his final form of apparatus for determining by a direct method latent heats of evaporation at the boiling point in electrical units. The essence of the method is to determine the electrical energy required to effect the evaporation of a measured mass of the liquid. The energy

was supplied by a large current through a small resistance immersed in the liquid. The vessel containing the liquid was surrounded by a double-walled shield filled with the saturated vapour of the liquid itself, and the mass evaporated was measured by weighing on a delicate balance. To have the vessel hanging freely from the one arm of the balance and yet to keep it practically surrounded with the saturated vapour were among the principal difficulties to be surmounted. Promising results had already been obtained.—Dr. Thomas **Muir** communicated a note on a special circulant considered by Catalan.

PARIS.

**Academy of Sciences,** August 10.—M. Albert Gaudry in the chair.—The president announced to the Academy the death of M. Munier-Chalmas, member of the section of mineralogy.—On aërodynamics and the theory of the acoustical field, by M. le Général **Sebert.** Remarks on the theory of M. Charbonnier on the waves set up in air by projectiles moving with a greater velocity than that of sound.—Description of a new apparatus for the preparation of pure gases, by M. Henri **Moissan.** The gases are dried by cooling to about −70°, and then liquefied by boiling oxygen or air; substances gaseous at this latter temperature are removed by the mercury pump, and the pure gas allowed to boil off into a suitable gasholder. Details are given for carbon dioxide, hydrogen iodide, hydrogen phosphide, and sulphide. By the use of suitable temperatures the gas obtained from copper and dilute nitric acid was separated into water, nitrous oxide, nitric oxide, and nitrogen.—On the mechanical analysis of soils, by M. Th. **Schlœsing,** sen. An apparatus is described permitting of the mechanical separation of earth into fractions depending on the time taken to deposit from water. A microscopical examination of the deposits showed that the size of the deposited grains varied with the time required to fall out. Grains less than 0·005mm. remain in suspension in pure water for an indefinite time.—Corrections relating to a note of M. Armand **Gautier** on the estimation of arsenic in sea water, common salt, mineral water, and reagents. In the original note, by an error, there is a confusion between milligrammes and thousandths of a milligramme which is here rectified.—On the death of M. Prosper Henry, by M. **Janssen.**—On the relations between the complete integrals of S. Lie and Lagrange, by M. N. **Saltykow.**—The theory of the acoustical field and the internal friction of gases, by M. P. **Charbonnier.**—The appearance of Bishop's Circle in 1903, by M. F. A. **Forel.** This phenomenon, which appeared last in 1884, after the Krakatoa eruption, has been noticed again this year, and is considered by the author to be connected with the eruptions at Martinique.—On some binary compounds of uranium, by M. A. **Coloni.** Compounds of uranium with sulphur, selenium, tellurium, nitrogen, phosphorus, arsenic, and antimony are described.—The nature of the alkaline reaction of the blood and its estimation, by M. H. **Labbé.** The alkalinity is not completely removed by the precipitation of the phosphates by barium chloride, and it is this residual alkalinity which is most strongly affected by pathological variations.—Phenols and phenolsulphonic acid in the animal economy, by M. L. **Monfet.**—On the passage of the Rhine by the Doubs valley and Bresse valley during the Pliocene age, by M. le Général **de Lamothe.**

NEW SOUTH WALES.

**Linnean Society,** June 24.—Dr. T. Storie Dixson, president, in the chair.—On the botany of the Darling, N.S.W., by Mr. Fred. **Turner.** The characteristics of the flora of the country lying between 29° and 33° S. lat., and 141° and 147° E. long., are discussed. The census of the Phanerogams and vascular Cryptogams now brought forward gives a total of 314 genera and 760 species.—The corpus luteum of *Dasyurus viverrinus,* with observations on the growth and atrophy of the Graafian follicle, by Dr. F. P. **Sandes.** The chief conclusions arrived at in this investigation may be thus summarised:—(1) The characteristic cells of the corpus luteum are formed by hypertrophy of the cells of the membrana granulosa. (2) The theca interna folliculi is rudimentary, and forms only the vascular connective tissue of the corpus luteum. (3) The corpus luteum atreticum is formed in the same way as the corpus luteum verum. (4) Other atresic follicles are reduced to fibrous tissue or remain cystic. (5) The corpus luteum is probably a gland with an internal secretion of use in the organism. It has the function of stopping ovulation during pregnancy and at the cestral periods.—Notes on the genus Psychopsis, Newm., with descriptions of new species, by Mr. W. W. **Froggatt.** Three species of the genus were noticed in a previous paper in the *Proceedings* for 1902. From the study of a fine series of specimens acquired in the interval, the author is now able to show that it has been customary to apply Newman's name, *P. mimica,* to what are in reality the representatives of two different species. These are differentiated; a second species from Queensland is also described as new, raising the total to five.—Notes on Prosobranchiata. No. 3. The neanic shell of *Melo diadema,* Lamk., and the definition of the nepionic stage in the gasteropod mollusc, by Mr. H. Leighton **Kesteven.** A description of the mass of egg-capsules of *M. diadema* is given, and attention is directed to the sequence of the acquisition of the columellar plaits which, in this species, is in perfect conformity with a phylogenetic scheme of their origin advanced by Dr. Dall in 1890. Then follows a comparison of the molluscan stages of development with those of the Lepidoptera.—The continental origin of Fiji, by Mr. W. G. **Woolnough.** Part i., general geology. The author's provisional conclusions are:—(1) That Viti Levu, the chief island of the Fiji group, was part of a continental area probably united to New Hebrides and New Caledonia during early Palæozoic time, and that it remained a land area undergoing denudation probably to at least the close of Palæozoic time. (2) That in Mesozoic time and Older Tertiary time subsidence predominated in the Fiji area, the subsidence at Drau, in Viti Levu, carrying the island at least about 1300 feet further below the sea than it is at present. During this period the Fiji Soapstone was deposited. (3) In late Cainozoic time elevation set in, and synchronously with it occurred violent and extensive eruptions of andesitic dolerite and basalt. Elevation has continued into late Cainozoic time, and may be still in progress. On the whole, therefore, negative movement of the land has probably greatly predominated over positive movement since Palæozoic times.

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