Nature

A WEEKLY

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"*To the solid ground*
Of Nature trusts the mind which builds for aye."—WORDSWORTH

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R. CLAY AND SONS, LTD., BRUNSWICK ST., STAMFORD ST., S.E., AND BUNGAY, SUFFOLK.

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"*To the solid ground*
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

THURSDAY, SEPTEMBER 4, 1913.

NOTES ON THE ABORIGINES OF SOUTH AMERICA.

Aborigines of South America. By the late Colonel G. E. Church. Edited by an Old Friend, Clements R. Markham, K.C.B. Pp. xix+314. (London: Chapman & Hall, Ltd., 1912.) Price 10*s.* 6*d.* net.

THE author of this posthumous work was a descendant of the earliest New England colonists. Born in 1835, he became a surveying engineer, and his first introduction to South America was of a kind sufficient to shape his whole career. As a member of an expedition sent out by the Government of Buenos Aires in 1859 to explore the south-western frontiers, he partook of severe fighting with the then still unsubdued Araucanians and Patagones. Then he served through the whole of the Civil War in the United States, and next he joined the General Staff of Juarez against Maximilian. After that episode we find him in Bolivia, which he reached once by Buenos Aires, another time by Peru, busy with concessions of the navigation of Bolivian and Brazilian rivers. A political mission to Ecuador, the building of an Argentine railway, business in Panama, Costa Rica, and elsewhere afforded him well-nigh unrivalled opportunities of studying land and peoples of South America before he settled down in London, where he devoted much time to his favourite geographical and ethnological studies.

The author's intention to write a comprehensive work on the aborigines of South America was frustrated by his death in 1910, and only the less incomplete chapters have been edited by his friend, Sir C. R. Markham, himself a traveller in those parts of the world. They are apparently not so much notes by the experienced, observant traveller as critical, carefully sifted extracts from the numerous accounts of previous explorers, whose accounts alone can bear upon the "history" of these wild, roaming, barbaric tribes. In many cases the bewildering number of names, mostly nicknames bestowed upon each other by the various clans and muddled by the Europeans, have been reduced to synonymic order. Presumably all the aborigines of the whole continent are of one stock, but time and separation and environment have diversified them. One of the most vigorous were the Caraios, Caraibes, Guaranis, or Tupis, with their origin in Paraguay, whence this dominant race made its influence felt from La Plata to Orinoco and spread even to the Antilles. Several chapters are devoted to the unravelling of the resulting dislodgment of the coast-tribes of Brazil and those of Amazonia, and to the troubles brought upon them by the Portuguese and Spaniards. The scanty notes made by the white man, not always well educated, be he soldier, trader, or missionary, about customs, arms, and ornaments, are often the only facts known about many a so-called tribe.

Within late Tertiary periods the whole continent seems to have been divided into an eastern and a western half, from Uruguay to the Orinoco, by a system of enormous lakes. Our author evidently believed that such a division still existed when man already inhabited South America, before the Pampean and Amazonian inland seas and other lakes, of which Titicaca is a remnant, had yet been drained by the present great river systems. This somewhat rash idea is on a par with the suggestion that South America may have been connected with Africa or Australia via Antarctica at a period when climatic conditions made these dreamlands a pleasant abode for man and thus account for the puzzling origin of the Patagonians.

HYDRAULIC MACHINERY.

Modern Pumping and Hydraulic Machinery: Being a Practical Handbook for Engineers, Designers, and Others. By E. Butler, Pp. xvi + 473. (London: C. Griffin and Co., Ltd., 1913.) Price 18*s.* net.

AN examination of this important work brings home to the reader some idea of the enormous extent and ever-increasing variety of machinery that is used in connection with hydraulics; for, although this treatise is devoted to the consideration of the wide range of machinery and appliances connected with almost every known type used in pumping operations, the amount of other classes of hydraulic machinery which the exigencies of space excluded would well fill the pages of another volume. For this reason the subtitle is too comprehensive and rather misleading, as the book does not deal with hydraulic machinery "as applied to all purposes"; but, it is fair to say, the author has wisely restricted its scope to enable him to deal comprehensively with the sections selected, and in a broad way included in the title "pumping machinery." The ground chosen has been covered in an exhaustive and systematic way, and a glance at the contents shows how varied is the machinery dealt with, for it embraces machinery used for water-supply, wells, mines, drainage, irrigation, dredging, reclamation work, and for raising petroleum from deep wells, and a chapter is devoted to hydraulic power wheels and turbines.

There is no lack of admirable books on the theory of hydraulics and of hydraulic machines, but the many important developments and improvements made in hydraulic machinery in recent years have doubtless created a demand for just such a book as Mr. Butler has so ably produced, and the information it contains cannot fail to be of use to the practical engineer and others engaged either in the construction or application of hydraulic machinery, to say nothing of its educational value to the engineering student. The designer will also appreciate the book, as it contains a wealth of detail and descriptive matter, but his requirements as to the proportioning of parts have not received the attention they might with advantage have had given to them here and there in a treatise of this type. No better work than Seaton's "Marine Engineering" can be cited as an example of what can be done in this direction to help the designer. The Humphrey gas-displacement pump, the most important invention in pumping machinery made in recent years, is fully described, and the author gives some particulars of previous inventions of this type, but omits to mention that the first-known internal combustion pump was Tatham's, patented about 1894, and referred to in the discussion on the Humphrey pump at the Institution of Mechanical Engineers.

The illustrations are extremely well reproduced, with few exceptions; for instance, the longitudinal sections on p. 387 look rather too confusing to be easily read, owing to their coarse section lining. On the other hand, the diagram on p. 377, showing development of vane curvature in an impeller wheel, is admirable.

The book is a notable addition to the literature of the subject, and should be well received.

H. J. S.

MIND, HEALTH AND PURPOSE.

(1) *The Game of Mind: A Study in Psychological Disillusionment.* By Percy M. Campbell. Pp. iii + 80. (New York: Baker and Taylor Co., 1913.) Price 75 cents net.

(2) *Mind and Health. With an Examination of some Systems of Divine Healing.* By Dr. E. E. Weaver. With an Introduction by Dr. G. Stanley Hall. Pp. xv + 500. (New York: The Macmillan Company; London: Macmillan & Co., Ltd., 1913.) Price 8*s.* 6*d.* net.

(3) *Development and Purpose: An Essay towards a Philosophy of Evolution.* By Prof. L. T. Hobhouse. Pp. xxix + 383. (London: Macmillan & Co., Ltd., 1913.) Price 10*s.* net.

(1) IN "The Game of Mind" Mr. Campbell puts the question: "To what extent does the mere reiteration, by the possessor of a toothache, of the complaint that he is indeed feeling pain, influence or *constitute* that pain? In other words, If the victim were so organised that he need not perforce tell himself each instant that he is being hurt, would the hurt exist as such at all?" And Mr. Campbell replies: "We are convinced that it would not." Mr. Campbell, of course, discusses many other questions; but his method of argument displays the same degree of cogency throughout.

(2) In "Mind and Health" Mr. Weaver discusses "some of the distinctive religious and philosophical systems of healing," and lays down "the plan of a valid system of healing on religious ground." The first element of "a valid religious psychotherapy" he declares to be that "sickness comes from want of goodness." "Goodness" is, of course, an ambiguous term; and Mr. Weaver very properly describes the sense in which he uses it: "A goodness that starts in the spiritual and will be allowed to work unfettered and unhindered in the intellectual, emotional, and physical life will not be sick. It knows no sickness." If goodness of this kind—a goodness which knows no sickness—is to be pro-

duced in the patient, then it must first be possessed by the practitioner: "The power of healing released through a religious psychotherapy should be mediated by the minister of religion." If so, then, Mr. Weaver argues, the Christian Church must carry on the ministry of religious psychotherapy. Mr. Weaver's fundamental assumption, then, is: Be good (or get someone to make you good) and you won't be ill. It is a defect of his book, however, that he does not convince the reader of the truth of the assumption.

(3) Mr. Hobhouse's "Development and Purpose" is a contribution to philosophy, serious, solid, and certainly heavy. "The book completes a scheme which has occupied the writer for twenty-six years, and has been carried through successive stages in three previous works." But the scheme has come to be completed in a way which a quarter of a century ago Mr. Hobhouse did not foresee or intend. He has come to hold that in the process of evolution both mechanical causation and teleological causation are at work; and, what is more, that mechanical causation involves teleological causation—hence, according to Mr. Hobhouse, the "organic harmony" of the world process.

Intelligent action is truly purposive, that is to say it is teleological causation and is not resolvable into mechanical laws. The actual order of reality, he tells us, is determined by the impulse to realise the future: what we do now is determined by what we want to be or do in the future. But, if that is so, it seems to the reader as though no place were left for mechanical causation, no need for causes prior in time to their effects. Mr. Hobhouse, however, holds that mechanical causation involves teleological causation, *i.e.* apparently that there could be no cause prior in time to the effects unless there were causes which, being teleological, are not prior in time to their effects. From this it would seem that the source of the trouble lies in the assumption that causes must be in time; on that assumption causes must both be and not be prior in time to their effects.

Mr. Hobhouse, though he sees and says that in the more ultimate sense Reality is not in time, but time is in Reality, does not devote more than this single sentence to the way in which, as it seems to us, the notion of time refracts causation into mechanical and teleological causes. However, Mr. Hobhouse's services to the cause of philosophy are recognised by all interested in philosophy; and all will be glad that the University of Durham has, in recognition of those services, conferred upon him the honorary degree of D.Litt.

IRON AND STEEL METALLURGY.

(1) *Iron Making in Alabama.* Third Edition. By W. B. Phillips. Pp. 254+xxxi plates. (Alabama: The University, 1912.)

(2) *Iron and Steel: An Introductory Text-book for Engineers and Metallurgists.* By O. F. Hudson and Dr. G. D. Bengough. Pp. x+173. (London: Constable and Co., Ltd. 1913.) Price 6*s.* net.

IT would be difficult to find a better illustration of the wide range of subjects involved in the study of iron and steel than these two books. Whereas one deals mainly with the extraction of iron from its ores, the other is largely concerned with the properties of the recovered metal, and the subjects range from the mining of the ore and the washing of coal on the one hand, to the constitution of steel and the electrolytic theory of corrosion on the other.

(1) The book by Mr. Phillips is published by the Geological Survey of Alabama, and is of necessity somewhat statistical. It is seldom, however, that one finds statistics dealt with in such an interesting manner. The title of the book might more accurately and with advantage be described as "Iron and Steel Making in Alabama," for it includes an excellent account of the steel-works of the State, which are responsible for an annual output of nearly half a million tons of steel in all sections, from rails to wire.

The first part of the book deals exhaustively with the iron ores of Alabama, and a chapter is devoted to experimental work on concentration. Fluxes and fuels are then considered, and much useful information is given on coking practice and the employment of by-product coke ovens. Blast-furnace practice, as regards both coke and charcoal furnaces, is considered in detail, and the growth and development of the modern blast-furnace is traced from the year 1894 to 1910. This is followed by an excellent account of the steel-works and rolling-mills of the State, and finally there is a chapter on coal-washing. Not the least useful feature of the book is the large number of tables of statistics, and some reference must be made to the excellent series of illustrations, thirty in number, which are reproduced from photographs.

The extent of the iron and steel industry in Alabama may be gauged from the fact that in the year 1910 nearly five million tons of ore were mined and sixteen million tons of coal, of which five million tons were converted into coke. The production of pig-iron amounted to two million tons, and of steel half a million tons. Such an industry is of more than local importance, and

Mr. Phillips's volume will be greatly appreciated not only by those who are connected with Alabama, but by all who are interested in the manufacture of iron and steel wherever it may be carried on.

(2) Mr. Hudson's book is one of a series of text-books which are described as "introductory to the chemistry of the national industries." It is written in a clear and concise manner, and deals very ably with recent scientific investigations and theories regarding the constitution of iron and steel. The principles underlying the smelting of iron, the manufacture of wrought iron and steel, foundry practice, and such processes as case-hardening, welding, &c., are reviewed very briefly, but no attempt is made to treat these subjects from the manufacturing point of view, and this part of the book can scarcely be regarded as an introduction to the metallurgy of iron and steel, except for very elementary students. The book is intended primarily for those interested in the physico-chemical rather than the practical aspects of the subject, and this is clearly the intention of the author, who states in his preface that "practical details of the methods of production have been avoided almost entirely, in order that more attention may be devoted to such matters as an explanation of the constitution of steel and cast-iron, and the effects of mechanical and heat treatment on the properties of these alloys." In the later chapters these subjects have been very completely dealt with, and, together with the chapter on corrosion by Dr. Bengough, will be welcomed by many students of metallurgy.

OUR BOOKSHELF.

Ueber kausale und konditionale Weltanschauung und deren Stellung zur Entwicklungsmechanik. By Wilhelm Roux. Pp. 66. (Leipzig: W. Engelmann, 1913.) Price 1.50 marks.

PROF. ROUX makes game of Prof. Verworn's recent essay on the causal and the conditional outlook on the world, which was, we think, reviewed some months ago in NATURE. What is true in Verworn's essay is not new, and what is new is not true. The causal outlook, which has been in vogue "from the Stone age down to Verworn," is not to be superseded by a crude "conditionism." What is sound in Verworn's emphasis that the scientific task is to inquire into all the antecedent conditions is recognised by all investigators. The change proposed is verbal, for as soon as a process is set a-going, its conditions become active factors or causes. The complete conditions *are* the complete causes. Verworn lays great stress on what he calls the "effective equivalence" of the conditions of any process or result, but Roux cannot accept the phrase. Equally necessary the factors are, but certainly not equivalent.

In the study of development the *specifitas potentiae* of each of the various factors is well known. In vital processes the internal and the external conditions cannot be spoken of as equivalent, as Verworn proposes. The constitution of an ovum includes factors which determine a certain, within limits, typical result; the external conditions of oxygen, warmth, moisture, and so on, activate and sustain the development. Thus Roux distinguishes between "determining" and "realising" factors, and says that it is nonsense to speak of their "equivalence."

From time to time in his brilliant series of studies in "developmental mechanics" Roux has given a causal analysis of the known factors involved, distinguishing, for instance, between internal and external, determining and realising, necessary and "not necessary" factors; and he is entirely opposed to the false simplicity which Verworn's "conditionism" would suggest. There has been hard hitting on both sides, but perhaps it is instructive to remember that Verworn's life has been largely spent in the study of metabolism, and Roux's in the study of development—which is for him an "autophænesis," "a becoming-visible of manifoldness by the proper activity of the germ." J. A. T.

Brazil in 1912. By J. C. Oakenfull. Pp. viii+498. (London: Robert Atkinson, Ltd., 1913.) Price 5*s*.

THIS is the fourth annual edition of an excellent handbook on Brazil. As usual, it is well and profusely illustrated, the large map of the country and the coloured frontispiece showing the precious stones of Brazil being especially good. The book deals in an interesting manner with the history and geography of Brazil; but the chapters on the anthropology and ethnography, the geology and palæontology, the mineralogy, and the agriculture of Brazil will appeal more directly to scientific readers.

The book is intended for free distribution, but duplicate and trade copies can be obtained at the price stated.

Teachers of geography will find it an interesting and valuable work of reference in the school library.

The Theory and Design of Structures. A Text-book for the Use of Students, Draughtsmen, and Engineers engaged in Constructional Work. By E. S. Andrews. Third edition. Pp. xii+618. (London: Chapman and Hall, Ltd., 1913.) Price 9*s*. net.

THE first edition of this book was reviewed at some length in the issue of NATURE for March 18, 1909 (vol. lxxx., p. 64). The additions made to the present edition are incorporated in an appendix of some twenty-seven pages, and these include a note on Dr. Stanton's experiments on wind pressure. The notation in the chapter on reinforced concrete has been made to agree with that proposed by the Concrete Institute, and numerous exercises have been added to the volume.

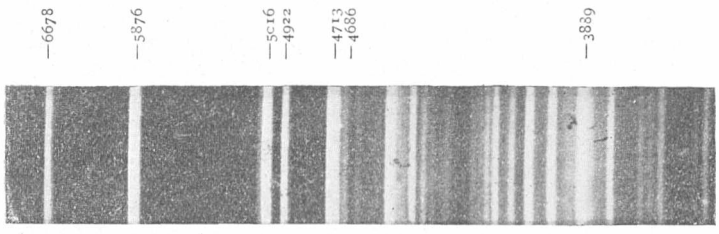
LETTERS TO THE EDITOR.

[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 Spectra of Helium and Hydrogen.

THE spectra of helium and hydrogen have acquired considerable importance in view of the recent experimental researches of Prof. Fowler and the theoretical investigations of Dr. Bohr. Before the appearance of Fowler's investigation the only hydrogen series known terrestrially were the diffuse series, consisting of the Hα, Hβ, &c., lines, and the infra-red series predicted by Ritz, two members of which (18751·3 and 12817·6) were observed by Paschen. However, by passing a strong condensed discharge through mixtures of helium and hydrogen, Fowler was able to photograph four members of the principal series, the strongest line of which is at 4686.

It should be noted that the 4686 line appeared on the photograph of the spectrum of a helium tube, which had been taken at the Solar Physics Observatory at South Kensington several years ago. Sir Norman Lockyer and Baxandall in their paper pointed out that the terrestrial line was very probably identical in origin with the chromospheric line of nearly the same wave-length photographed during the eclipse of January, 1898. They also noticed that the 4685·90 chromospheric line is of the same nature as the helium eclipse lines, being long and sharply defined. They concluded that the line is probably due to a gas, which is associated in some way with helium. The 4686 line has also been observed in the spectra of stars of the fifth type, and in the spectra of certain nebulæ, and had been attributed to hydrogen in accordance with Rydberg's calculations, which depend on the numerical relations existing between the different series.



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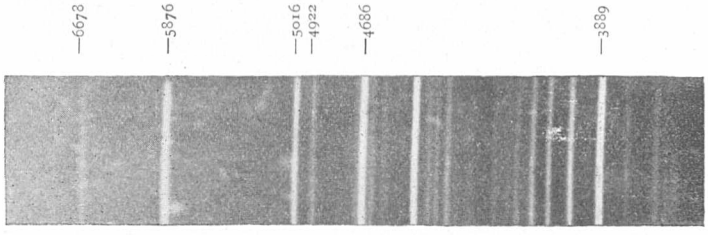

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In addition to the series having the 4686 line as first member, Fowler was able to photograph three members of the sharp series, which are found in the spectrum of ζ Puppis, and three members of a new ultra-violet series, which he calls the second principal series of hydrogen. According to the theory put forward by Dr. Bohr, the two principal series and the sharp series are given by helium. Also it should be possible to obtain the diffuse series from helium containing no hydrogen when the sharp series appears.

For some time I have been investigating the origin of the 4686 line, and the experiments already carried out support Bohr's theory. The chief difficulty consisted in driving out hydrogen from the poles of the helium spectrum tube, but this was accomplished so far as spectroscopic evidence goes. No hydrogen could be detected in the bulbs and capillary when heavy discharges from a coil capable of giving a 20-in. spark were passed through the tube. The 4686 line was strong in the capillary and fairly strong in the bulbs. The pressure of helium employed in these experiments varied from about 0·25 mm. to 1 mm. The capillary, in addition to the helium spectrum and the 4686 line, showed impurity lines due to oxygen.

Photographs I. and II. show the spectra obtained when a strong condensed discharge is passed through helium at pressures of 1 mm. and 0·3 mm. respectively. In the first photograph the 4686 line is of nearly the same intensity as the 4713 helium line, and the two are scarcely separated in the reproduction. The low-pressure photograph (Fig. 2) shows the 4686 line much stronger than the 4713 line. In both cases the hydrogen lines at 6563 and 4861 are not seen. The 4686 line could not be obtained from an ordinary hydrogen tube, nor from a neon tube containing a small amount of hydrogen as impurity. A tube containing a mixture of hydrogen and purified argon was also prepared, but the line was not visible when heavy condensed discharges were passed through the mixture.

E. J. EVANS.

The University, Manchester,
August 11

Coloured Organisms on Sea-Sand.

A VARIED and interesting field of investigation awaits the microscopist who will make a detailed examination of the minute fauna and flora of apparently barren sands on the seashore. To-day, on landing at the island of Oronsay at low tide, the otherwise pure white sand was seen to be coloured pink in one area, for an extent of several yards, green a little further up the beach, and golden-brown in small patches here and there. On examining samples with the microscope the brown colour was found to be due to living diatoms (*not* dinoflagellates in this case), naviculoid forms like Caloneis; the pink is formed of amorphous masses of fine granules in a jelly loosely adhering to the sand-grains, and may perhaps prove to be bacteria in a zoogloea state, while the green is caused by patches of a very simple alga (? a Coccophycid) made up of groups of rounded green cells in a single layer on the sand-grains. I have kept samples of all the organisms and will submit them to a botanist for more precise identification. No Amphidinium patches were present so far as I could see. The variety of organisms present in the one little bay, the extraordinary abundance in each patch, and the brightness of the colour produced on the white sand were very striking, and seemed worthy of note.

The colour was not in any of these cases due to the sand-grains themselves, which are mostly clear quartz with, as usual, a few black specks and some white shell fragments. Nor was there apparently any fresh-water on the beach, and certainly not any sewage or other source of impurity. It is a lonely, sandy bay,

inhabited only by sea-birds and seals, and the nearest house is on the opposite side of the island at least four miles away by the coast. The sea-water seemed very clear, of salinity 26·5, and the sandy bottom could be seen from the yacht anchored in five fathoms.

Diatom patches are no doubt abundant in many places; probably the simple green alga encrusting the sand-grains is known to botanists, and I have certainly seen the pink organism elsewhere. Probably other coloured patches due to micro-organisms are present on many beaches. It would be interesting to have them more thoroughly investigated—biochemically, if possible—by someone living on the spot, and able to study their changes day by day.

W. A. HERDMAN.

S.Y. *Runa*, Sound of Islay, August 27.

Physiological Factors of Consciousness.

MR. ABDUL MAJID (NATURE, August 28) asks: "What is the true explanation of the fact that stimuli sufficiently strong to arouse vivid sensations in a subject while he is wide awake apparently fail to arouse any sensations at all in a state of unconsciousness?" But is there any evidence that stimuli do not arouse identical sensations in the waking and the sleeping states? As a medical man, I am frequently "rung up." As far as I am able to judge, I am invariably awakened out of a dream. I am never dreamless. My consciousness never sleeps.

But, in proportion to the depth of slumber, memory appears to be abolished. Memory is ample in proportion as it is clear and coherent—in proportion as it links the present with the past and so fulfils its function of affording a guide for the future. In dreams, since it is so much in abeyance, we live almost wholly in the "immediate present," taking little thought of the past or the future. Absurd or improbable happenings do not then surprise us; for these do not then contradict stored experience. On that account, also, we seldom remember our dreams unless they occur in light slumber (half-wakefulness), or unless our attention is called to them immediately on waking while our minds are still tingling with them. I am sure, if anyone tries the experiment of having himself awakened for a few occasions by the insistent question, "What are you dreaming about?"—if his attention is immediately fixed on his dream—he will soon be convinced that there is no such thing as dreamless sleep.

By way of illustration; I remember a terrible dream. An enemy had his hand on my mouth and was suffocating me. I awoke to find the tail of my friend the cat, who had come on his morning visit, laid across my lips. The dreams of ill-health, and especially of indigestion, are usually unpleasant and sometimes fearful.

I take it, then, that sensations are the stuff that dreams are made of. They are the same sensations that we feel in our waking states, but, when woven into our dreams, they are wrongly interpreted.

G. ARCHDALL REID.

Netherby, Victoria Road, S. Southsea,
August 29.

The Elephant Trench at Dewlish—Was it Dug?

THE question of the brain capacity of the Piltdown and other fossil skulls must be decided by anatomists; but a sidelight may be thrown on the subject of the intelligence of early man by a consideration of the works of which he was capable. The most indestructible of these, and consequently the most frequently referred to, are worked flints. Upon their testimony Mr. Moir, and those who agree with him, would carry man's work back to the Pliocene period of the Suffolk Crag. Mr. Moir kindly allowed me to see a few of his specimens, and I am inclined to think that some of them show artificial chipping. The deposit in which the Piltdown skull was found is said to be early Pleistocene. Have we any indication of man's work between this and the Crag period? In my opinion we have. I refer to the remarkable trench at Dewlish, Dorset,[1] which before it was excavated contained abundant remains of *Elephas meridionalis* and no other fossils, though Mr. Grist has found eoliths.[2] It is difficult to account for the formation of this peculiar trench in chalk by any natural process. Mr. Clement Reid, who spent four days to examine it, tells us that "the fissure, or rather trough, ended abruptly without any trace of a continuing joint. It was not a fault, for the lines of flint nodules corresponded on each side."[3] Mr. Reid, at the British Association at Cambridge, described the termination of the trench as "apse-like." It opened out diagonally at one end on to the steep slope of the side of a valley. It was 103 ft. long and 12 ft. deep. The width, as the photographs show, was not quite uniform, and Mr. Reid said that in the narrow place he could just get along. It is remarkable that here the walls approach from each side—a feature apparently incompatible with any natural causation. After the trench had been refilled, I met with a description and photograph of a pitfall for elephants in Africa; and that led me to believe that this trench was artificial, and dug out for the same purpose.

If this view is correct, it shows that man existed in Pliocene times, and was already a social being capable of a great undertaking, for no one individual could have effected such a work.

My hope is that this trench may be reopened for the express purpose of testing this question. It has never been bottomed except at the end where it opened on the valley. Elsewhere two or three feet remain undisturbed. If it was artificial, some indication of the tools used might possibly be found at the bottom. The expense could not be great, and my object in writing this is to endeavour to excite such interest in the subject as may perhaps lead to a proper investigation. But a competent geologist, whose verdict would carry weight, ought to undertake it.

Graveley, Huntingdon. O. FISHER.

Note on the Dicynodont Vomer.

IN 1898 I directed attention to the fact that the paired elements in the front of the palate of lizards and snakes seem in all their relations to agree with the pair of bones in Ornithorhynchus, which afterwards fuse to form the dumb-bell bone, and that they cannot be homologous with the median unpaired vomer of mammals, and must have another name, and I proposed to call them *prevomers*. While the embryological evidence seems conclusive, the palæontological testimony has not hitherto been so satisfactory as one could desire. Cynodont reptiles appear to have a single median vomer, very like that of the mammal, and one specimen of Gomphognathus shows what appear to be a pair of elements in front. Dicynodon appears to have also a single median vomer, and no paired elements. The Therocephalians, on the other hand, have a pair of large anterior elements, and apparently no median element. With the palæontological

[1] See paper by the writer with two photographic views, *Quart. Journ. Geol. Soc.*, 1905.
[2] Journ. Roy. Anthropological Institute, vol. xl., 1910.
[3] See "Geological Survey Memoirs," 1899, p. 34.

evidence in this condition, it is not surprising that the theory, though fully accepted by a few, and hesitatingly by others, has failed so far to be generally adopted.

For the last ten or twelve years I have constantly been on the look-out for a specimen which, while possessing a large median true vomer has also a pair of large distinct paired prevomers. Mr. D. M. S. Watson believes he has discovered in the British Museum a specimen of Lycosuchus showing a median vomer between the pterygoids, and certainly a pair of large prevomers in front. Unfortunately, though the specimen is satisfactory enough for those who believe the median vomer to be quite a different element from the reptilian paired "vomers," it is not convincing enough for the doubter.

In two species of the small Upper Permian Therocephalian genus Ictidognathus, I find a peculiarly complicated but single median vomerine bone, but in a third species, closely allied, I find clear evidence that the apparently single bone is composed of the paired prevomers anchylosed. Further, the anchylosed prevomers have exactly similar relations to the palatines and pterygoids that the median bone in Dicynodon has, and at first it looked as though the theory had received a severe blow.

Fortunately a specimen of a large species of Dicynodon has just been discovered that clears up all the confusion. The median bone, which lies between the posterior pairs in Dicynodon is the anchylosed prevomers. Above it, and completely concealed by it, is a large, well-developed, typically mammalian median vomer extending from the basisphenoid behind to the premaxilla in front. Along its upper side the vomer is grooved for the large basal and ethmoidal cartilages. Posteriorly it is closely united to the basisphenoid. The bone completely confirms the view I expressed in 1898 that the mammalian vomer is the reptilian parasphenoid, and quite a different element from the prevomers. R. BROOM.

American Museum of Natural History,
New York, August 10.

THE TWELFTH INTERNATIONAL GEOLOGICAL CONGRESS.

THE first meeting of the International Geological Congress in Canada, and the third in the western continent, held its session in Toronto from August 7 to August 14, under the presidency of Dr. F. D. Adams, of McGill University. Altogether 1152 members were enrolled, about half of whom attended the meeting; and forty-six countries were represented by their leading geologists. Probably never before had Canada entertained a gathering so distinctively international, and great interest was manifested in the work of the congress, not only in Toronto, but throughout the Dominion. The honorary president of the congress, H.R.H. the Duke of Connaught, who was unable to attend, was represented at the opening session by the Right Hon. Sir Charles Fitzpatrick, Chief Justice of the Supreme Court of Canada, and by him a warm welcome to the Dominion was extended to the visiting delegates in a graceful speech in French, the official language of the congress. Ontario was represented by the Hon. W. H. Hearst, Minister of Mines for that province, Toronto by Alderman Church, and the University of Toronto by President Falconer, to whom the congress was indebted for the use of several of the university buildings during the meetings.

The chief work delegated to the twelfth congress had been the preparation of a monograph on the coal resources of the world, to serve as a companion work to the iron resources of the world, prepared for the eleventh congress at Stockholm. The general secretary of the congress, Director Brock, of the Canadian Geological Survey, presented the monograph, and summarised its main features. It consists of three quarto volumes, accompanied by a 68-page atlas, and contains reports from sixty-four different countries. The editing has been in the hands of a committee of the Geological Survey of Canada, consisting of Messrs. McInnes, Leach, and Dowling. Mr. Brock contributes the preface, Mr. Dowling an introduction summarising the main reports, while contributions by experts from the various countries of the world form the major part of the work. The total coal resources of the world are estimated at 7,397,533 million tons, of which 4,000,000 million tons are bituminous, 3,000,000 million tons brown coal, and the remainder anthracite. As the world's production in 1910 was 1,145 million tons, the exhaustion of our coal supplies is by no means an immediate problem. Approximate reserves of some of the chief countries are as follows:—Canada, 1,234,269 million tons; United States, 3,214,174 million tons; United Kingdom, 189,535 million tons; France, 17,585 million tons; Germany, 85,551 million tons; Russia, 233,997 million tons. In Switzerland only 4500 tons of coal remain. The preparation of the monograph involved a large amount of special investigation in several of the countries from which reports were submitted; and the three volumes, with the atlas of beautifully executed maps, will serve as a fitting companion volume to the iron resources of the world.

In order to facilitate business, the congress resolved itself into three sections, which met concurrently. Over eighty papers were presented, the majority of which had direct bearing on the topics which had been suggested for the consideration of the congress. On the subject of the differentiation of rock magmas the session was interesting, rather because of the variety of hypotheses than because of any distinct contribution to views already propounded elsewhere. Daly advocated stoping and gravitational movement, Harker fractional crystallisation, Lœwinson-Lessing differentiation in liquid state, Evans immiscible liquid phases, while Bergent emphasised recurrent basic and acid succession in its bearing on the problem. Iddings and Washington pointed out from different points of view the necessity of sufficient analyses within petrographical provinces. Hobbs referred to the relationship between certain petrographical provinces and clay states, and Cross discussed Hawaiian lavas from the point of view of the Atlantic-Pacific classification. Bäckström, in summing up the discussion, advocated the conservative attitude until experimental work was sufficiently advanced to justify broad conclusions.

The theme "The Influence of Depth on the

Character of Metalliferous Deposits" was of special interest to economic geologists and mining engineers. Kemp dealt generally with primary and secondary precipitation; Krusch with colloidal precipitation of primary and secondary ores; Emmons with experimental evidence bearing on the precipitation of gold, silver, and copper, and the effect of the primary ores; Fermor with the action of oxygen and carbonic acid at considerable depths; Fanning with ore occurrences in the Phillipines. In the general discussion, in which Lindgren, Winchell, Lawson, Kitson, and others took part, the question of the formation of veins consequent on mineral crystallisation, and that of secondary gold deposition from placers, were taken up.

What were perhaps the most interesting discussions to the majority of the members of the congress were those on the sedimentation and the correlation of the Precambrian. The excursions provided to the vast Precambrian areas of Canada had attracted to the congress authorities from the Precambrian fields in all other countries; and the discussions were illuminating in that they focussed the experience of work in many fields on the intricate problems presented. The succession in Finland was given by Sederholm, who also illustrated by slides some clear instances of granitisation on a regional scale. Cole explained the intrusive relationships in north-west Ireland. The difficulties encountered by Scottish geologists in correlating the Precambrian of the Highlands were explained by Horne. An outline of the Precambrian of the British Isles was given by Strahan. Holland pointed out the broad similarities between the series in India and in North America. Coleman and Collins dealt more particularly with the area east of Lake Superior. A rather keen discussion took place when the classification submitted by Lawson as based on work in the Rainy Lake area was questioned by Leith and Lane. Altogether the session was illuminative of the difficulties in the way of any attempt to correlate the Precambrian in widely separated areas.[1]

Other topics considered can only be mentioned in brief. On the physical and faunal characteristics of Palæozoic seas papers were presented by Chamberlin, Schuchert, Ulrich, Frech, and Holtedahl. To the topic of interglacial periods Lamplugh, Coleman, Upham, Alden, Tyrrell, Wolff, and Holst contributed; while at a special session on tectonics papers were given by Paulcke, Dahlblom, Mess, and Smith, McDonald, Howe and Hovey. Numerous miscellaneous papers were also submitted dealing with subjects of geological and mineralogical interest.

During the session of the congress two popular lectures were delivered, to which the Toronto public were invited. The first was by M. Emmanuel de Margerie on the geological map of the world. The lecturer gave some very practical suggestions to the committee in charge of the preparation of the map. He advocated the continental as opposed to the world map, and the discrimination by colour between marine and lacustrine sediments, and between folded and unfolded areas. The continental areas were discussed seriatim, with practical hints as to map-construction. Of more interest to the general public was a lecture by Dr. W. F. Hume on desert phenomena in Egypt. The lecture, which was illustrated by slides, presented a clear picture of the geological conditions, and in particular of the effects of sand erosion on the exposed rocks. Much could be inferred from the slides as to the actual conditions under which work is carried on in desert countries.

Notwithstanding the interest evinced in papers and discussions, the value of the twelfth congress to the visiting delegates lay mainly in the excursions which they were enabled to undertake to many points of geological and mining interest throughout the Dominion. Elaborate preparations had been made by the Geological Survey of Canada to ensure the success of this feature of the meeting, and the total length of line covered by the guide books considerably exceeded 20,000 miles. From July 13 to September 23 excursions practically without a break were arranged for —frequently three, or even more, concurrently. The maritime provinces were visited, before the session, under the guidance of Dr. G. A. Young; Sudbury, Cobalt, and Porcupine before and after the session, the excursions being led by Dr. W. G. Miller; while two transcontinental excursions, the first of more particular interest to petrologists and stratigraphers, the second to economic geologists and mining engineers, had as leaders Dr. Adams and Mr. Brock respectively. An excursion of particular interest, of which many would have gladly availed themselves had time permitted, was that to the Yukon and Alaska boundary, led by Mr. McConnell. Besides these longer excursions numerous field-trips were made, both before and during the session in Toronto. To the localities in the vicinity of Toronto Dr. Coleman and Dr. Parks acted as guides.

For the excursions a series of guide-books was prepared by the Geological Survey of Canada, which contained besides the reading matter numerous coloured maps, topographical maps, and photographs. Apart from the immediate value to the members of the congress, the guide-books represent an important contribution to Canadian geology. They summarise a large amount of investigation accessible only in the reports of the survey, and contribute as well a considerable proportion of new material. They cover the main routes of travel, and will prove valuable books of reference, not only to geologists and engineers, but also to any travellers who may be interested in the resources and rock formations of the country. The interest which the excursions had aroused in Canadian geology was shown by the eagerness with which the literature supplied by the Geological Survey and mines branches was sought after. From this point of view the con-

[1] The discussion had at least one permanent result. A resolution proposed by Dr. Sederholm was passed by the Congress to the effect that geological surveys of countries which have contiguous areas of Precambrian rocks form international committees to include representatives of the geological surveys of all the countries concerned, for the purpose of correlating the Precambrian formations in the different countries.

gress has served as an excellent distributing agency for the literature on the geology and mineral resources of the Dominion.

While the delegates were in Ottawa occasion was taken to do honour to the memory of the first director of the Geological Survey of Canada. Affixed to a block of Laurentian rock, in which formation Sir William Logan did pioneer work, a tablet has been placed in the Victoria Memorial Museum. The tablet, which was unveiled in the presence of the visiting delegates, bears the following inscription:—"William Logan, K.T., LL.D., F.R.S., 1798–1875, the Father of Canadian Geology, Founder and First Director Geological Survey of Canada, 1842–1869. Erected by the International Geological Congress (Canada), 1913." Two of the Canadian universities took advantage of the opportunity afforded them to honour some of the visiting members of the congress. On August 1, McGill University conferred the degree of LL.D. on J. F. Kemp, U.S.A.; H. Bäckström, Sweden; A. Lacroix, France; A. Bergent, Germany; and A. Harker, England. On August 14, the last day of the congress, the University of Toronto paid a similar honour to P. M. Termier, France; T. C. Chamberlin, U.S.A.; R. Beck, Germany; J. J. Sederholm, Finland; T. Tschermyschev, Russia; A. Strahan, England; and W. G. Miller, Canada. A ceremony very different in character—though no less dignified—was performed when the delegates visited Montreal. At the old Indian reservation of Caughnawga the visitors were treated to a short exhibition of the Indian national game, to an Indian play depicting the courtship of former times, and finally four of the party were selected to become chiefs of the tribe. They were:—I. P. Tolmatchew, Russia; W. Paulcke, Germany; H. M. Cadell, Scotland; and F. D. Adams, Canada. After going through the dance of adoption they were given Indian names, and were received as full members of the tribe.

No account of the twelfth congress would be complete without reference to the kindnesses showered on the delegates during their visit to Toronto. The local committee and ladies' committee, aided by the executive committee of the congress, had made very extensive and thorough arrangements, and the people of Toronto responded in a most whole-hearted manner. Receptions, banquets, garden-parties, and afternoon teas were prominent features in the proceedings; automobiles were at the disposal of the members; and several of the clubs in town were thrown open while the congress was in session. If one may judge from the appreciative remarks to be heard on every side, the visiting delegates carried away with them very pleasant memories of Toronto and its people.

On the invitation of M. A. Renier, who represented the Government of Belgium, it was decided to hold the thirteenth congress in Belgium four years hence. The subject on which a special monograph shall be issued by the executive committee of the congress of 1917 was left to the discretion of the new committee. R. C. W.

THE OIL-FIELDS OF BURMA.[1]

THE appearance of this memoir will be welcomed equally by those who are engaged in the study of petroleum from a purely scientific point of view, and by those who are merely concerned with its profitable exploitation in Burma and other parts of the Indian Empire; not only because the author possesses a special knowledge of the subject in both aspects, but also because he has brought together, and arranged in a concise and readable manner, a mass of information that has hitherto been scattered through the pages of a voluminous literature, not always readily accessible.

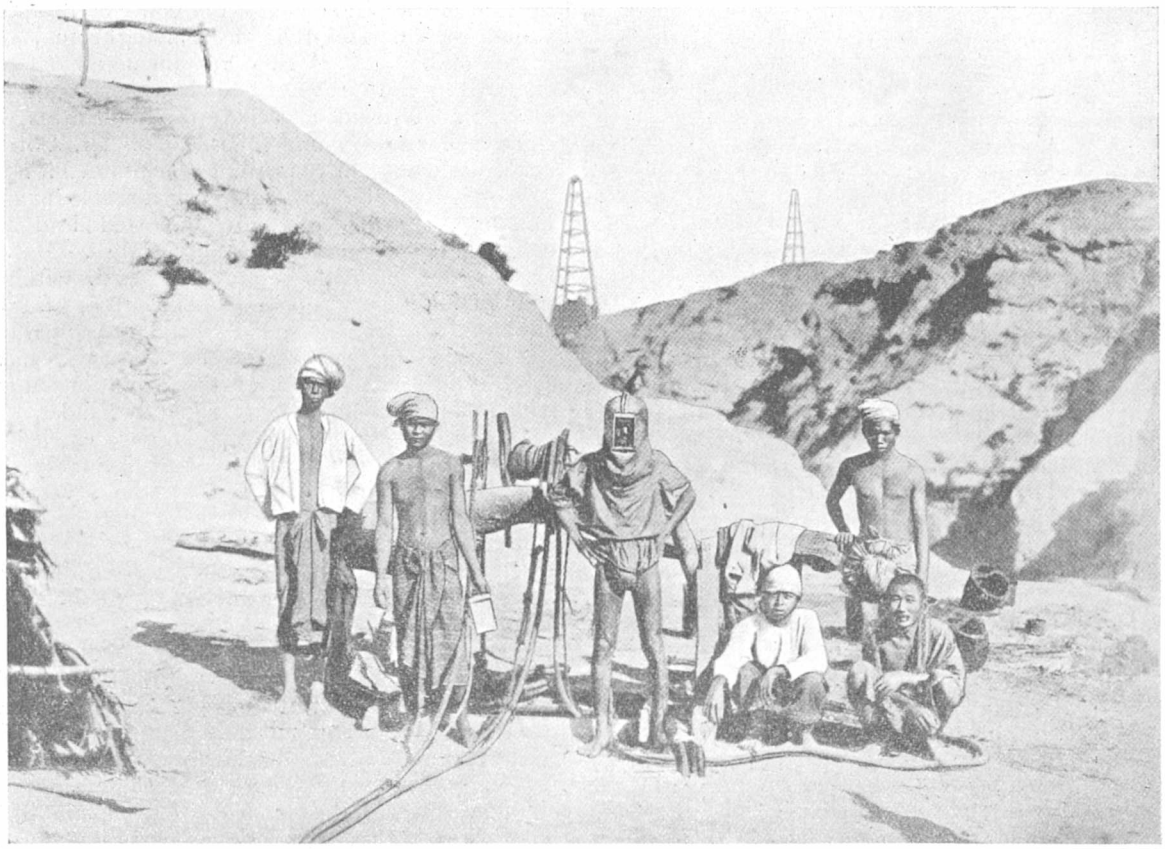
For close upon a century after Michael Symes and Hiram Cox, in the course of their journeys up the "Erai-Wuddey" to the court of Ava, had visited the earth-oil wells of "Yanangheoum," the great oil-belt of Burma remained almost unexplored by Europeans. The virtues of "Rangoon oil" as a lubricant, especially for small arms, became well known; and following on Dr. Christison's discovery, in 1836, that it contained a large proportion of solid paraffin, considerable quantities of the crude oil were imported into this country for the manufacture of candles. But no further developments took place until, within a year of the annexation of Upper Burma, in 1886, exploitation on modern lines began to supersede the antiquated methods of the Burmese, and a systematic investigation of the conditions under which the oil occurred was taken in hand.

As a result of these investigations, carried on not only by officers of the Geological Survey, but also by geologists employed by the several oil companies, it has become apparent that the petroleum is practically confined to certain horizons—whether one or more has not yet been definitely ascertained—in the upper portion of the enormous accumulation of clays and incoherent sandstones known as the Pegu system, corresponding fairly closely with the Miocene of Europe. These beds, according to Mr. Pascoe, were deposited in a great gulf some 400 miles in length, occupying the greater portion of the present Irrawaddy valley. Orogenic folding, proceeding, in part, simultaneously with the deposition of the beds, has thrown them into a series of elongated domes, beneath which the oil has accumulated. The second and third parts of the memoir are devoted to a discussion of the structure of each of the anticlines so far examined, and of its capabilities as a producer of oil.

The most productive of these anticlines as yet discovered is that of Yenangyaung, where Dr. Oldham first recognised, in 1855, the connection between anticlinal structure and the accumulation of petroleum. Here the oil is confined within an area of less than one-and-a-half square miles, and yet, since the year 1888, this little field has produced more than a thousand million gallons. Nothing like this has been discovered elsewhere in

[1] "The Oil-fields of Burma." By E. H. Pascoe. Pp. xxxix+269+54 plates. Memoirs of the Geological Survey of India. (Calcutta: Geological Survey; London: Kegan Paul, Trench, Trübner and Co., Ltd., 1912.) Price 6s. 8d.

Burma, though many an anticline, apparently as well fitted for the storage of petroleum, has been examined and tested. Meanwhile no fewer than nine companies are engaged in a race for the deeper and richer oil-sands in the Yenangyaung field, and it would appear that the end cannot be far off. One may, perhaps, be allowed to express regret that steps were not taken by Government to regulate this competition until it had seriously affected the resources of the field; especially in view of the fact that Burma is the only country directly under Imperial control which is known to possess large stores of petroleum, and that an adequate supply of fuel oil may become, in the near future, of vital importance to the national existence.



Yenangyaung—Native well-digger in diving dress. (The man on his right is holding the mirror used to illuminate the bottom of the well.) From Memoirs of the Geological Survey of India, vol. xl., part i., "The Oil-fields of Burma."

In the final chapters of the work will be found an able discussion of the origin of petroleum, and of its relations to geotectonic structure. The difficulty of accounting for the presence of oil-sands above a water-bearing stratum (a by no means uncommon occurrence at Yenangyaung) on any theory of inorganic origin, which would entail an upward migration of the oil from a deep-seated source, seems to be insuperable; while, on the other hand, the arguments brought forward in favour of an organic origin, at least in Burma, Assam, and other similar areas, seem no less convincing. Though any direct genetic relation between coal and oil is expressly disclaimed, their close juxtaposition in those countries is highly suggestive, as well as the affinity shown to exist between petroleum gas and such admittedly organic products as marsh-gas and firedamp, in respect of the proportion of methane that they contain. The solution of the problem is one of great practical importance, for upon it depends the question whether an oil-sand, once drained of its petroleum, might ever recover its productiveness.

T. H. D. L.

OCEANOGRAPHY OF THE MEDITERRANEAN.[1]

THE Mediterranean Sea has always been an attractive field for oceanographical investigation, since it presents many features which contrast strongly with those of the other enclosed seas. Italy, Sicily, and a submarine ridge over which the greatest depth of water is about 400 metres, separate the whole area into two sea-basins. The western one, comprising the Balearic and Tyrrhenian Seas, is, for the most part, about 2000–3000 metres in depth; while the eastern basin, which includes all the seas to the east of Italy and Sicily, is rather deeper on the average, and soundings of more than 4000 metres have been made. Large coastal areas, like the North Sea, with depths of less than 200 metres do not

[1] Report on the Danish Oceanographical Expeditions of 1908–10 to the Mediterranean and Adjacent Seas. Edited by Joh. Schmidt. Vol. i., Introduction, Hydrography, and Sea-bottom Deposits. (Copenhagen, 1912.) Pp. 270+xx plates.

exist, and because of this absence of extensive tracts of sea-bottom of moderate depth, fisheries on the scale of those of the North Atlantic enclosed seas are non-existent. Because of this relative unimportance of the sea-fisheries, the fauna of the Mediterranean is not nearly so well known as, for instance, that of the North Sea and Baltic; and the remainder of the reports of the Danish expeditions, dealing with the biological investigations, promise to be of exceptional interest on this account.

The sea-bottom deposits are of relatively little interest. Over by far the greater part of the Mediterranean the bottom is covered by terrigenous materials. These contain far less volcanic débris than might have been suspected. Siliceous materials are also relatively rare, and the chief calcareous deposits are to be found over relatively small areas, and contain Pteropod shells.

The hydrographic conditions in the Mediterranean depend mainly on the fact that this water area is one of high concentration. The amount of water received from the rainfall over the land area which it drains is far less (less than a quarter, it is said) than the amount of water removed by evaporation. The temperature of the superficial strata of water is relatively high: even at a depth of 1000 metres it is uniformly 13° C., while the salinity is also relatively high, being everywhere about 38 per mille in the bottom and intermediate strata. This excess of evaporation over precipitation would lead, of course, to a reduction of water-level, were it not compensated by the strong inflow from the Atlantic through the Straits of Gibraltar. But this inflow tends, of course, to raise the hydrostatic pressure of the water in the sea, and therefore a counter-current sets out from the Mediterranean into the open Atlantic Ocean. The inflowing current is superficial, has a velocity of from one to three knots, a temperature which is that of the Atlantic water in the Spanish Bay, and a salinity of about 36 per mille. The outflowing current is a deep one, its velocity varies from one-half to about five knots, its temperature is uniformly about 13° C., and its salinity is about 38 per mille. The variations in velocity are due to the tidal streams in the straits.

The volume of relatively warm and dense water flowing out from the Mediterranean is very considerable. This water is so highly saline that it flows on as a bottom or intermediate current in spite of its high temperature. Although its direction is nearly east to west as it emerges from the straits, it soon becomes deflected to the north and east as the result of the earth's rotation, and it approaches the coasts of the British Islands. Normally it flows to the west of Ireland, and Dickson has shown that it may be present even so far north as the channel between Rockall and Scotland, but as a rule the current must flow along deep depressions of the sea-bottom. If, however, it is unusually strong it may enter the shallower sea-basins, and Bassett has recently suggested that unusually high salinities in such enclosed sea areas as the English Channel or Irish Sea may be due, not to an unusually strong Gulf Stream drift, but more probably to the presence of this highly saline Mediterranean water. This indeed, appears to have been the case in the summer of 1912 in the Irish Sea and adjacent waters.

Precisely the opposite conditions exist in relation to the Black Sea and the Sea of Marmora. The latter basin has a depth of 1000 to 2000 metres, and the Black Sea has a maximum depth of about 2200 metres. The Black Sea is an area of excess of precipitation over evaporation, so that the superficial strata of water are of low salinity. From the surface down to about 20 metres the salinity is about 17·5 per mille, and it is nearly constant at this limiting depth, increasing towards the bottom. The temperature appears to be nearly constant at about 80 metres depth, and also increases slightly towards the bottom. Because of the excess of precipitation over evaporation the water-level of the Black Sea tends to rise, but this is prevented, of course, by an outflow of relatively light water through the Bosporus into the Sea of Marmora, and from the latter basin through the Dardanelles into the Mediterranean. But since this outflow reduces the hydrostatic pressure of the communicating water masses, a counter-current of relatively dense Mediterranean water enters the Sea of Marmora, and then the Black Sea through the Bosporus. The water flowing out from the Black Sea is a surface current, that flowing in a deep one. The depth of water at the entrance to the Black Sea is, however, very small, and the existence of this "sill" prevents the complete renewal or ventilation of the deeper strata of water, a condition which also exists, on a much smaller scale, in some of the Norwegian fjords. The absence of renewal of water leads to the stagnation of most of the water of the Black Sea: not only is oxygen absent in the deeper layers, but its place is actually taken by sulphuretted hydrogen, and except for some forms of bacteria this water-mass is lifeless.

The horizontal water circulation in the Mediterranean depends on the Atlantic inflow. This is at first west to east in direction, but, becoming deflected to the right in consequence of the rotation of the earth, it flows along the coast of Africa. The direction of flow of surface-water then follows the general scheme of that in the northern hemisphere. Two cyclonic circulations are set up in the western basin—one in the Balearic Sea to the west of Sardinia and Corsica, and another in the Tyrrhenian Sea. The main stream enters the eastern basin through the channel between Sicily and Tunis, and then becomes deflected, forming another cyclonic circulation. There is also an intermediate level water circulation which depends for its direction on a complex resultant of superficial horizontal circulation and vertical circulations due to concentration and cooling of superficial waters. This intermediate circulation is difficult to explain, and, indeed, is still imperfectly known. It is, of course, the origin of the westerly flowing deep current in the straits, and seems to

result from the junction of two main streams flowing to the south of Sardinia and the north of Corsica respectively.

Many disputed questions are discussed by the authors of the papers in this report, and we await with interest the results of the biological investigations. There is no doubt that the fishes and other groups of animals inhabiting the Mediterranean area are still imperfectly known; while the investigation of the pelagic microscopic life of these seas is one which is full of interest. A good deal of such work has, of course, already been done, but the results of investigators thoroughly familiar with deep-sea work of this kind in the northern seas are sure to be interesting, and the comparisons which we may expect they will attempt ought to throw new light on many questions of general biological interest. J. J.

THE GUM TREES OF AUSTRALIA.[1]

MR. T. H. MAIDEN, the director of the Botanic Gardens, Sydney, N.S.W., published the first part of his great work on the characteristic Australian genus Eucalyptus in 1903, and it has now reached the seventeenth part. There is no other country of the same extent as Australia in which one genus of trees largely predominates throughout and, at the same time, has few extensions beyond. It has been estimated that three-fourths of the forest vegetation of Australia consists of gum trees and bushes, yet the genus is not represented in the native flora of New Zealand, New Caledonia, Lord Howe Island, and other contiguous countries, including, I believe, New Guinea, though *E. alba* is a native of Timor.

But, like Baeckia and Melaleuca, other myrtaceous genera, Eucalyptus has a considerable northward extension in eastern Asia, limited, however, to one species the present distribution of which is peculiar. Mr. Maiden has succeeded in showing that this species, *E. naudiniana,* abundant in Neu Pommern (New Britain), is the same as that discovered in Mindanao, Philippines, by the United States Exploring Expedition (1838–42), and described under the name multiflora—a name previously occupied. These two localities are separated by about 13° of latitude and 25° of longitude, or, approximately, 1500 miles, and hitherto *E. naudiniana* has not been recorded from any intermediate locality. Its presence in the Philippines is an interesting fact in phytogeography, and the question arises, Is it a straggler of a southern migration, or is it, and similar outliers, a northward extension of a type of southern origin? But this is not the place to discuss the point.

So far Mr. Maiden has described and figured ninety-four species of Eucalyptus, and given all details available of their distribution, based on practically all the important herbarium material in existence, and a very wide personal experience in the forests of all parts of the country. Upwards of one-third of these ninety-four species are of later date than Bentham's "Flora Australiensis," or were not given specific rank by Bentham. From a rough calculation the number of valid species of Eucalyptus will not be fewer than 150; some generally dispersed, though the western species are mostly different from the eastern, and many of them bear more conspicuous flowers than the eastern. Others are very rare and near extinction, notably the very large-flowered, shrubby *E. macrocarpa.* It is to be hoped that Mr. Maiden's health and official duties will permit him to bring this valuable monograph to a relatively early conclusion, as it is only in the complete form that it can be fully useful.

W. BOTTING HEMSLEY.

[1] "A Critical Revision of the Genus Eucalyptus." By J. H. Maiden, Government Botanist of New South Wales. Parts xii–xvii. Plates 50–76, with descriptive letterpress. (Published by Authority of the Government of the State of New South Wales, 1910–13.) Price 2*s.* 6*d.* each part.

NOTES.

WE are informed by Dr. H. Mohn that he has resigned the professorship of meteorology in the University of Christiania and the directorship of the Meteorological Institute of Norway. Mr. Aksel S. Steen has been appointed to succeed him in these positions.

AT the time of going to press with our issue of last week, the race by Mr. H. G. Hawker in an all-British waterplane for the 5000*l.* prize offered by *The Daily Mail* was in progress. The distance to be covered was 1540 miles, and of this 1043 had been accomplished on Wednesday when, according to the aviator, his foot slipping off the rudder bar, he lost control of the machine, which fell into the water of Lough Shinny, Ireland, and was wrecked. Mr. Hawker and his companion, Mr. Kauper, were rescued, the first-named uninjured, but the latter with a broken arm and other injuries. Although the task set him to accomplish was not fulfilled, the aviator must be congratulated upon having made a very satisfactory series of flights. The machine, fitted with a Green engine, was built by the Sopwith Aviation Company, and was a biplane with a span between the wing tips of 50 ft., and a length of 31 ft. 6 in. It had two main floats, with single hydroplane step, each weighing 170 lb., and also a small torpedo float under the tail. The total weight of the machine and passengers was estimated at 2400 lb.

THE next International Conference on Cancer (the fourth) is to be held at Copenhagen in 1916.

ACCORDING to the *New York Medical Journal,* an International Exposition of Safety and Sanitation will take place in New York in December next. It will include exhibits devoted to safety, health, sanitation, the prevention of accidents, the welfare of the public and the individual, and the advancement of the science of industry. Exhibits from foreign countries will, by a special Act of Congress, be admitted free of duty.

A REPORT from Vienna states that a ship has been purchased for an Austrian expedition to the South Polar regions, and that funds are being collected in

aid of the object. The expedition is to be under the leadership of Dr. F. König, of Graz, and the proposal is that it shall leave Trieste in May next. A large donation to the funds has been given by the Austrian Academy of Science, and the Austrian Geographical Society has promised an annual subsidy towards the cost of the undertaking.

MR. D. A. BANNERMAN has returned from a zoological mission to the eastern islands of the Canary group, undertaken with the object of procuring examples of the birds of these islands for the Natural History Museum. The islands visited were Fuerteventura, Lanzarote, Graciosa, Montana Clara, Roque de l'Oueste, and Alegranza, several of which had not previously been visited by a collector. Mr. Bannerman succeeded in obtaining a number of rare and interesting species peculiar to the islands, while the fact that the birds were collected in their breeding plumage renders them of special value to the museum bird room. On Alegranza a new species of chat was discovered.

REFERENCE was made in our last issue to the three educational museums which were founded and equipped by the late Sir Jonathan Hutchinson. We regret to learn from *The Times* that the future of these institutions is in an uncertain state and causing anxiety to those who have been privileged to make use of them. So far as the museum of Haslemere is concerned, there is a strong feeling in the town that everything should be done to retain the institution, and it is understood that the family are willing to hand it over to a responsible committee or body of trustees so that the museum may be placed on a permanent and public basis. The annual cost of maintenance on the present lines is about 400*l.*, and an appeal will shortly be issued with the hope of securing this sum for five years at least, it being thought that by that time those who are interested in the matter will have had an opportunity of deciding what are the best steps to be taken for the permanent control and maintenance of the museum.

As was stated in our issue of July 3 last, plans are being prepared for the new buildings to be erected at the Rothamsted experiment station in commemoration of the centenary of the birth of Sir John Lawes and Sir Henry Gilbert. We now learn from the *Journal* of the Royal Society of Arts that strong committees are being formed to raise the necessary funds for the memorial. It is stated that the sum of 12,000*l.* is required, and of this amount half will have to be raised by public subscription, the remaining half being obtainable from the development fund.

A TABLET was unveiled on Sunday last at Primiero, Southern Tyrol, on the house in which Alois Negrelli was born, to commemorate Negrelli's work as surveyor of the Suez Canal. He began his investigations in 1847, completed his plans in 1855–6, and in 1858 was appointed inspector-general of the Suez Canal works. He died on October 1 of the latter year.

WE note, with regret, the death, at the age of sixty-six, from typhoid fever, while on his voyage home from the Philippines, of Dr. Tempest Anderson, who for a time lectured on volcanoes at the Royal Institution. He was joint author of the report to the Royal Society on the seismic disturbances in the West Indies in 1902 and 1907, and had filled, among other positions, those of president of the Yorkshire Philosophical Society and the Museums Association.

THE death is announced, at the age of sixty-six, of Col. Andrew Clark, a gold medallist of the British Medical Association, lecturer on surgery at the Middlesex Hospital Medical School, and author of the "Middlesex Hospital Surgical Reports, 1872–4," and of "Ambulance Lectures." He also edited the fourth edition of "Fairlie Clark's Manual of Surgery."

IT is stated in *The Allahabad Pioneer Mail* that the Maharaja Scindia of Gwalior is giving special attention to the valuable archæological relics and treasures in his State, and is taking steps to create an archæological department in Gwalior. In furtherance of this object he has sought the advice and cooperation of the Director-General of Archæology in India.

ACCORDING to *The Scientific American*, a large naval radio station is shortly to be constructed by the United States at Caimeto, Panama, to be known as the Darien Radio Station. It will consist of three towers, each 600 ft. in height. The bases of the towers will be 180 ft. above sea-level, and they will be arranged in a triangle measuring 900 ft. on each side. The sending and receiving radius will be about 3000 miles direct reach to the Arlington Station, to San Francisco, and to Valdivia, 420 miles south of Valparaiso, on the Pacific, and Buenos Aires on the Atlantic. It will cover a vessel anywhere on the east coast of the United States, and communicate with St. Vincent. The system to be used is the Poulsen.

NEW lightning conductors have been installed on St. Paul's Cathedral. In the course of the operations part of one of the original iron bar conductors erected more than 140 years ago under the supervision of Benjamin Franklin was discovered. This bar, having been inside one of the towers and so not exposed to the weather, was still in a good state of preservation. *The Times* recalls that the fixing of these "Franklin rods," as they were called, led to a heated controversy as to whether lightning conductors should have points or balls as terminals. The president of the Royal Society, who advocated points, had to resign. King George III. was a strong adherent to ball terminals.

IT is announced in *The Times* that a discovery of oil shale has been made in the island of Skye by Dr. G. W. Lee, a member of the scientific staff of the Scottish Geological Survey and Museum, Edinburgh, who was examining the geological structure of the east coast of Skye. The extent and value of the deposits are not yet fully known, but it is stated that the seam discovered is about 11 ft. in thickness, that it extends over a considerable area, and that, although not of first-class quality or so good as the seams worked in the Lothians, it is likely to prove sufficiently good to be worked successfully, in view of the improved methods of operation now followed by the leading shale oil firms.

THE droughty summer has closed with some exceptionally heavy rainfalls over the south-eastern portion of England, where the rains for the last two or three days of August have materially modified the aggregate measurements for the season. At Greenwich the rainfall for the three days, August 29 to 31, was 1·22 in., which is more than the total for the preceding part of the month. Without the rainfall for the last three days of summer the total for the three months at Greenwich would have been more than an inch less than for the corresponding season in the abnormally fine year 1911. The total rainfall for the summer at Greenwich is 4·69 in., whilst in 1912 it was 7·86 in., and in 1911 it was 3·72 in. The driest summer of the last seventy years occurred in 1864 with 2·50 in., and in the last fifty years there have been fourteen summers drier than the one which has just closed. At Greenwich the summer rains this year are 70 per cent. of the average. In places the recent rains have not had much influence on the total for the summer. At Jersey the summer rains, June, July, and August, are only 28 per cent. of the average; at Leith, 40 per cent., where until August 28 they were only 28 per cent.; at Valencia, 51 per cent.; and at Liverpool, 66 per cent. The mean temperature for the three months at Greenwich was 61°, which is in precise agreement with 1912, and 5° cooler than 1911. The sunshine this summer was 442 hours, in 1912 it was 497 hours, and in 1911 it was 819 hours.

THE proceedings of the third meeting of the General Malarial Committee of the Government of India, held at Madras during November, 1912, have been published recently as a substantial volume, which contains much interesting reading and affords evidence of a great deal of energetic and enthusiastic research upon the etiology of disease in India. The papers and discussions reported cover a wider field than the title indicates. Several papers deal with the question of *Stegomyia fasciata*, the mosquito known to be the carrier of yellow fever in the New World; in view of the approaching opening of the Panama Canal, when the endemic home of yellow fever will be brought into closer communication with the Far East than it is at present, the degree of prevalence of this mosquito in the ports of India is likely to become a matter of urgent practical sanitary importance. Other papers read dealt with the vexed question of the transmission of Kala Azar. Capt. Patton, who regards the parasite causing this disease as a member of a group of Flagellates primarily parasitic in insects, has observed developmental stages of the parasite in the common bed-bug, but as yet no satisfactory experimental proof that the bed-bug transmits Kala Azar has been brought forward, nor has the existence of any "reservoir" of the disease in domestic or wild animals been demonstrated. The problem of Kala Azar is, however, under investigation by a number of competent workers, and its solution in the near future may be confidently expected.

THE Australian Institute of Tropical Medicine has issued its report for the year 1911 (more correctly for the year ending March, 1912). The bulk of the report is written by the director, Dr. Anton Breinl, and contains important investigations dealing chiefly with parasitic worms and Protozoa, illustrated by eleven excellent lithographed plates. Especially noteworthy amongst these researches is an investigation into the morphology and life-history of *Onchocerca gibsoni*, the nematode parasite which causes the so-called worm-nodules in Australian cattle. A number of experiments were recorded which were directed towards solving the problem of the transmission of this parasite, but up to the present these experiments have not led to any conclusive results as to the intermediary host of the worm. Appended to the director's report is that of the entomologist, Mr. Frank H. Taylor, and a report on the Cestoda and Acanthocephala of North Queensland, by Dr. T. Harvey Johnston. The entire report makes a quarto volume of 96 pp. and 17 plates, neatly bound in cloth, but having one defect from the point of view of the bibliographer, namely, that there is nowhere any indication to be found of the date of publication, whether 1912 or 1913. This is an unfortunate omission in a work which describes numerous new species of animals, including even a new species of Cyclops.

IN a recent number of the Annals of Tropical Medicine and Parasitology (vol. vii., No. 3A), Dr. J. W. Scott Macfie gives an account of a new species of trypanosome observed in human beings in Nigeria. It occurs most commonly in young people, and produces a mild form of sleeping sickness in which the trypanosomes cannot be found in the peripheral blood, but are present in the lymphatic glands. To the smaller experimental animals of the laboratory the trypanosome appears to be but slightly pathogenic. In the blood of the guinea-pig the trypanosome is smaller than *Trypanosoma gambiense;* like that species it is polymorphic, with long and slender, short and stumpy, and intermediate forms, and a few minute trypanosomes, measuring as little as 8 μ in length, appear constantly in the blood-films. Some of the short, stumpy forms have the principal nucleus situated far forwards at the anterior (flagellar) end of the body. Forms in which the flagellum appears to be free from the body for its whole length are also found. The Nigerian trypanosome is regarded by Dr. Macfie as a species distinct from *T. gambiense*, and is given the name *T. nigeriense*.

IN part 6, vol. iii., of the Journal of the East Africa and Uganda Natural History Society, Mr. C. W. Hobley discusses, from an examination of weapons used by the Pygmy and other neighbouring tribes, the question of the evolution of the arrow. He comes to the conclusion that the use of the stone point is later than that of the thorn; hence, that the use of poison applied to the tip is probably older than is commonly supposed; the lateral barbs were suggested by some of the many thorny-stemmed plants which flourish in the bush in which the hunter lived. He suggests that the aboriginal tribes of the centre of the continent passed direct from the use of natural thorns to the use of iron points, but the people east of Lake Victoria began with natural thorn points, passed through an age in which stone arrow-points were used, and eventually passed into an iron age, the

variation in development depending on the absence or presence of suitable stone for making arrow-points. The wooden point still survives, but only sporadically; the stone point has disappeared, but the leaf-shaped iron point used by some of the Kavirondo, Nandi, and also found among the Tharaka, is undoubtedly a copy of the leaf-shaped stone arrow-head, of which good examples are now coming to light.

THE possibility of the existence of some hitherto unidentified animals in Central Africa is again raised in a communication by Mr. C. W. Hobley, published in part 6, vol. iii., of the Journal of the East Africa and Uganda Natural History Society. One of them is described as possessing "thick, reddish-brown hair, with a slight streak of white down the hindquarters, rather long from hock to foot, rather bigger than a hyena, with largish ears." Some naturalists are inclined to identify it with the hairy ant-bear, Orycteropus; but most of those who have seen it are well acquainted with the ant-bear, and it is an almost unique phenomenon for an ant-bear to be seen abroad in daylight. The natives, again, have tales of a lake monster which the Baganda call Lukwata. Europeans have seen a strange beast swimming in the Napoleon Gulf, which was apparently not a crocodile. An American sportsman, E. B. Bronson, saw on the Gori River, Lake Victoria, a beast "14 to 15 feet long, head as big as a lioness but shaped and marked as a leopard, two long white fangs sticking down straight out of his upper jaw, scaled like an armadillo, back broad as a hippo, spotted like a leopard, and a broad, fine tail; the imprints of its feet were as large as that of a hippo but clawed like a reptile." Another monster has been seen by natives "as large as a man, sometimes going on four legs, sometimes on two, in general appearance like a huge baboon, and very fierce." Naturalists will await with interest the discovery of specimens of these strange animals.

BEFORE the publication, in *The Philippine Journal of Science* for April last, of Mr. H. O. Beyer's paper on origin myths among the mountain peoples of the Philippines, no representative collection of Philippine myths had been made. Until recent years it was believed that all ancient records written in the syllabic alphabets which the Filipinos possessed at the time of the Spanish conquest had been lost; but two of these alphabets are now found in use by wild tribes of Palawan and Mindoro, and ancient manuscripts written in the old Bisaya character have recently been discovered in a cave in the island of Negros. These still await publication. Mr. Beyer's paper is based on oral tradition and gives a large collection of interesting legends, including an underground death-land, a story of the Atlas type, in which the world is supported by a post created by the chief deity and near which he dwells, and a remarkable flood myth current among the Central Ifugaos. It may be hoped that Mr. Beyer will continue his researches in the new folklore area.

MR. T. SHEPPARD, curator of the Municipal Museum, Hull, has issued a fourth edition of his catalogue of the collections under his charge. This is rendered necessary by the process of rearrangement which followed important additions to the collections, and the establishment of the new Wilberforce House Museum and the Pickering Museum of Fisheries and Shipping, which has done much to remove the pressure on the original buildings. Wilberforce House, built for the Lister family, about the end of Queen Elizabeth's reign, a beautiful old residence with numerous relics, was the birthplace of the philanthropist, William Wilberforce, born here in 1759, and has now become the repository of collections illustrating his life, and of the general history of Kingston-upon-Hull. The Pickering Museum is largely devoted to collections illustrating the whaling, fishing, and shipping industries, the nucleus being the specimens collected by a public-spirited citizen, Mr. C. Pickering. Hull is to be congratulated on the activity displayed by its municipality and residents on the establishment of these museums, and the curator, Mr. T. Sheppard, on the valuable series of catalogues issued at a nominal price.

DR. W. S. HUNTER'S "The Delayed Reaction in Animals and Children," affords an interesting contribution to the "Behavior Monograph Series." A release box is employed leading to three different compartments, any one of which can be illuminated by the experimenter. The compartment which is illuminated can be opened and entered by the subject, whereas the other compartments are closed. Food is obtained by entering the illuminated compartment. Rats, dogs, raccoons, and children were used as subjects. After a clear association had been established between the movements leading to food and the light which might appear in any one of the three boxes, experiments were begun in which the light was turned off *before* the subject had made the appropriate reaction. The research consisted in determining the maximal length of this delay-period which is compatible with a correct response, and in ascertaining the psychological factors at work permitting of the correct response after the delay-period. The author lays stress on the importance of what he terms "sensory thought."

THE current number of *The Psychological Review* contains an important paper on association and inhibition, by Prof. J. F. Shepard and Mr. H. M. Fogelsonge, based on the learning of nonsense-syllables. In the first series of experiments these were learnt in pairs, and subsequently the subject was tested by being shown the first syllable of a pair either alone or in different combinations. These combinations of first syllables were either shown successively or simultaneously. Where two first syllables were shown successively, the second was shown at such an interval that the association set up by the former was not already completed in the subject. In a second series of experiments, three, instead of two, syllables were learnt together, and, in testing, the first two of the three syllables were shown simultaneously; these might belong to the same or to different three-syllable groups. In other series of experiments two different syllables were each separately learnt in conjunction with one and the same syllable; the two syllables were subsequently presented successively to the subject when tested. The resulting reproduction-times, as measured

by the chronoscope, convince the authors that the inhibition or facilitation thus experimentally produced is one "which cannot be . . . explained neurologically as a division of energy, or drainage." They believe that "an association cannot be explained as a mere path of lowered resistance," but that it "involves other processes which prevent any other stimulus from using the same neuroses at the same time . . . and which block any other association that is tending to operate at the same time, even though both will lead to the same end result."

IN vol. viii., Section D, No. 3. of *The Philippine Journal of Science*, Mr. A. E. W. Salt gives an elaborate account of the endowment provided by Francisco de Carriedo y Peredo, the greatest benefactor of the city of Manila, who died in 1743. From the funds received under his will, a water supply was provided for the city until the American occupation. A new system to supplement the ancient supply was opened in 1908. Water is now brought from an almost virgin watershed of one hundred square miles in area, and thence carried to a storage reservoir with a capacity of 210,000,000 gallons. The city, however, is so rapidly developing that this system is barely adequate to the needs of the population. Mr. Salt has done good service in directing attention to the benevolence of a citizen who, at a time when sanitation occupied little public attention, devoted his wealth to this excellent purpose.

IN Professional Paper No. 79 of the United States Geological Survey, Mr. H. S. Williams discusses the recurrent Tropidoleptus zones of the Upper Devonian in New York. In preparing the data for the Watkins Glen-Catatonk folio (No. 169 Geol. Atlas USUS, Geol. Survey, 1909) the occasional discovery of *Tripodolpetus carinatus* (Conrad) in strata far above the supposed range of the species or of the fauna with which the species is normally associated led the writer to undertake an examination of the sections and sequence of fauna where they appeared. The result throws important light upon the regional geography. The departure and return of the fauna must have been due to diastrophic changes which produced recurring favourable or unfavourable conditions for the existence of the fauna. Those changes of conditions may have resulted from the alternate closing and reopening of an actual passage-way which obstructed or admitted the access of the fauna and of waters favourable to them, or from changes that affected the direction, character, or volume of the existing ocean currents.

THE insect food of Canadian fresh-water fishes forms the subject of an article by Dr. Gordon Hewitt, the Dominion entomologist, published in the fourth annual report of the Commision of [Fish] Conservation of Ottawa. Attention is directed by the author to the futility of attempting to restock depleted rivers, or to introduce new kinds of fish into Canadian rivers, without taking measures to ensure an abundant supply of suitable insect food. In Europe it has been demonstrated that the artificial cultivation of many kinds of insects constituting the chief food of fishes is perfectly practicable; and in many rivers an insect hatchery is almost as necessary and important as a fish-hatchery. Before such insectaria can be introduced with satisfactory results in Canada, a close investigation into the nature of the food of native or introduced fishes is absolutely essential.

A RECENT number of the *Zeitschrift für wissenschaftliche Zoologie* (Bd. cv., Heft 3) is entirely devoted to a memoir on the chemical composition of the hæmolymph of insects and its significance as regards sexual differentiation. According to the author, Herr Kurt Geyer, the hæmolymph in caterpillars and pupæ of Lepidoptera is usually green in females and pale yellow or colourless in males. The green pigment is, as Poulton has already shown, slightly altered chlorophyll in solution, derived from the food-plant; it constitutes a protective coloration, and it is improbable that it has any assimilatory function. The yellow colour of the male hæmolymph is due to the yellow constituents of chlorophyll (xanthophyll). The hæmolymph of non-phytophagous insects shows no such colour difference. When the male and female hæmolymph are mixed a heavy precipitate is at once formed, and this reaction can only be distinguished quantitatively from that which takes place between different species. The author concludes that in insects the entire soma is sexually differentiated in male and female.

DR. C. H. OSTENFELD'S account of the biology and distribution of the phytoplankton of Danish seas (De Danske Farvandes Plankton i aarene 1898–1901. Phytoplankton og Protozoer. D. Kgl. Danske, Vidensk. Selsk. Skrifter. 7. Raekke, Naturvidensk og Mathem. Afd. ix. 2. 1913) is of more than local interest. The main work is written in the Danish language, but there is a *résumé* in French, extending to 65 pp., which in itself constitutes one of the best summary accounts which we possess of the present state of our knowledge of the general problems of the biology of plankton organisms. The Danish seas, extending as they do from the Baltic through the deep waters of the Skager Rak to the North Sea, furnish such wide variations in salinity, temperature, and chemical constitution, that they offer exceptional opportunities for studying the effects of physical conditions on the distribution of the plankton, and this aspect of the subject receives a full consideration in the report. A good bibliography will be found on pp. 346–352.

FROM the Kommissionen for Havundersögelser in Copenhagen we have received three further reports dealing with the investigations which have been carried out under the direction of Dr. Johs. Schmidt into the life-histories of eels. These are: Danish researches in the Atlantic and Mediterranean on the life-history of the freshwater-eel (*Anguilla vulgaris*, Turt.), with notes on other species, by Johs. Schmidt (*Internat. Revue Hydrobiologie und Hydrographie*, 1912); on the identification of murænoid larvæ in their early (preleptocephaline) stages, by Johs. Schmidt (*Meddel. Komm. Havunders. Fiskeri Bd.* iv. 2); and the metamorphosis of elvers as influenced by outward conditions—some experiments, by A. Strubberg (*Meddel. Komm. Havunders. Fiskeri Bd.* iv. 3). In NATURE, vol. lxxxix., pp. 633–636, Dr. Schmidt himself

gave a brief account of these researches, and those interested in the subject will no doubt welcome the more detailed reports.

IN his presidential address to the Quekett Microscopical Club for this year, Prof. Dendy dealt with the subject of "By-products of Evolution," illustrating his theme by the spicules, more particularly the microscleres of siliceous sponges. After pointing out that these minute spicules exhibit constant specific characters, and have undoubtedly arisen by some process of evolution, since one form leads on to another, just as in the case of any other characters, it is argued that natural selection cannot be directly responsible for their origin, on the ground that the minute differences in the form of the microscleres cannot be of any importance to the sponge in the soft tissues of which they are scattered without order or arrangement. By the principle of correlation non-adaptive characters of this kind may be linked inseparably with other characters which being adaptive, are directly influenced by natural selection, in such a way that any variation in the one must be accompanied by a corresponding variation in the other. Thus, a non-adaptive character may undergo a progressive evolution indirectly controlled by the action of natural selection. The principle of correlation cannot, however, be invoked to explain the specific forms assumed by the microscleres; it can only help to explain why such characters exist at all and why they should undergo progressive evolution. The specific form of the microsclere must be produced by chemical and physical causes involved in, and controlled by, the hereditary constitution of the mother-cell.

SIR F. W. MOORE contributes a useful paper on hardy water-lilies to *Irish Gardening* (vol. viii. May, 1913), including not merely cultural hints and lists of species suitable for ponds of different depths, but also some interesting remarks on the general biology and mode of growth of these plants. For instance, the author lays stress on the importance of the study of roots to the gardener; observation of water-lilies shows that from early April to June new roots are developed rapidly as the new leaves and flower-buds are formed and the rhizome elongates, while the older roots largely die away after having served as collectors of food reserves during previous years and as anchors during the winter. It is also noted that while, as a rule, the flowers close on bright days between three and four o'clock in the afternoon, if after noon the day becomes wet and gloomy the flowers usually remain open until dark.

IN continuation of his investigations into "Southern Hemisphere Seasonal Correlations" (NATURE, August 7), Mr. R. C. Mossman contributed a fourth article to *Symons's Meteorological Magazine* for August. He pointed out an interesting instance of the temporary character of many correlations. The example chosen was the comparison of April to September rainfall at Trinidad (West Indies) with that at Azo (Argentine Republic) for the following six months. Dealing with the fifty years, 1862–1911, it was found that from 1862 to 1877 and from 1895 to 1911 there was no relation between the rainfall of the six-monthly periods; but during the seventeen years 1878–94 the curves showing the rainfall departure from normal are the reverse of each other. The author observes that these results are of importance, as they show that the physical processes that produced a given precipitation at Trinidad during the period under discussion were associated during the six months following by an opposite effect in the south temperate zone, some 2850 geographical miles distant. Mr. Mossman also refers to one or two interesting correlations in other regions, especially one between the rainfall of Java and Trinidad.

THE Meteorological Office chart of the North Atlantic and Mediterranean for September (first issue) shows that the last report from the scout-ship *Scotia* was dated August 7 in 54° 45′ N., 49° 30′ W.; no ice in sight. It is pointed out that the full scope and value of the work accomplished cannot be estimated until the reports of the captain and scientific staff have been submitted. The ice notices which may prove to have been of most value are those relating to the comparatively small quantities that have been seen drifting south in the polar current. An important feature this year is the fact that the ice has been held up, for the most part, north of latitude 43°. The special reports above mentioned will, it is thought, no doubt decide whether this was due to abnormal strength of the Gulf Stream, to unusual weakness of the Labrador current, or to both causes.

A CIRCULAR headed "Road Dangers" has been widely circulated by the editor of *The Automotor Journal*. It suggests that the dangers both of vehicular and foot-passenger traffic might be greatly minimised if at crossings the traffic of one street were arbitrarily given a right of way and the traffic of the other street which crosses it were made to go dead slow by a sign that must be obeyed. The writer of the circular considers that not only would the accidents that occur from collisions of vehicles at crossings be greatly reduced, but the noisy use of the horn would be no longer necessary. It is difficult to see how the suggestion can be carried out without some enactment giving to a street authority a power to make bye-laws controlling the traffic in the less important streets and which can be enforced by the police. It would be easy for the Chief Commissioner, through his advisers in Scotland Yard, to decide which streets are to be of primary and which are to be of secondary importance, but short of keeping a constable on traffic duty at every crossing it is difficult to see how, with his existing powers, he can instruct them to summon drivers disobeying notices informing them that they must give way to traffic in the preferred streets.

WE have received a copy of the third edition of Merck's "Reagenzien-Verzeichnis." It is a volume of 446 pages, and all the commoner reagents, tests, hardening and preservative fluids, and the like are given alphabetically under authors' names, some 5000 formulæ being thus detailed, with references to the literature. There is further a valuable list of the substances for which the tests are employed, and a similar one for those used in microscopic work. Finally, there is an index of the preparations employed for the various tests, with authors' names attached; thus we find that "arbutin" was recommended by Reichard

as a test for nitric acid. The lists are most complete, and so far as we have been able to refer to them are accurate, and are not confined to recent work; *e.g.* Beale's carmine stain and injection fluids are given. The volume will be of the greatest service in the chemical and the biological laboratory.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES FOR SEPTEMBER :—

Sept. 8. 20h. 46m. Jupiter in conjunction with the Moon (Jupiter 4° 56′ N.).
10. 17h. om. Saturn at quadrature to the Sun (90° distant).
,, 20h. om. Venus in the ascending node.
,, 22h. 14m. Uranus in conjunction with the Moon (Uranus 3° 35′ N.).
14. 20h. om. Juno in conjunction with the Moon (Juno 0° 20′ N.).
15. oh. 48m. Moon eclipsed, invisible at Greenwich.
16. 3h. om. Mercury in superior conjunction with the Sun.
22. 4h. 2m. Saturn in conjunction with the Moon (Saturn 6° 59′ S.).
23. 3h. 53m. Sun enters Sign of Libra; autumn commences.
,, 8h. 22m. Mars in conjunction with the Moon (Mars 5° 6′ S.).
25. oh. 7m. Neptune in conjunction with the Moon (Neptune 5° 0′ S.).
27. 8h. 34m. Venus in conjunction with the Moon (Venus 1° 21′ S.).
29. 16h. 46m. Sun eclipsed, invisible at Greenwich.
30. 12h. om. Saturn stationary.
,, 13h. 2m. Mercury in conjunction with the Moon (Mercury 2° 36′ N.).

THE SPECTRA OF THE STARS.—After many years of patient labour by such pioneers as Rutherfurd, Secchi, Huggins, Vogel, Pickering and his co-workers, Lockyer and McClean, the subject of stellar spectra has attracted during the last decade the attention of an ever-increasing number of students in astronomy, astrophysics, physics, and chemistry. This is no doubt thanks in a great measure to the enormous number of spectra classified in connection with the Draper catalogue, but also largely to the simple nomenclature developed by Miss A. J. Cannon, further simplified by the suggestions of Dr. Hertzsprung. Although classification merely has received a great amount of attention of recent years, perhaps partly due to the prominence given to the matter by the Solar Union making it the work of a special committee, yet many important pieces of work have been accomplished beyond. Such are Campbell's and Kapteyn's work on the relations between radial velocities and type of spectrum, the similar work of Lewis Boss on the relation between proper motion and type, the work of Pickering and others on the distribution of stars of particular type of spectrum with reference to the Milky Way, &c. It is perhaps fitting that the importance of the subject should have led to the publication of a summary in the Memoirs of the Society of Italian Spectroscopists, No. 6, from the pen of Signor G. Abetti. It is, however, passing strange that this writer makes no mention of the work of Rutherfurd, Huggins, Lockyer, or McClean, except perhaps that some of them may be referred to in an "&c." Signor Abetti does not deal at all adequately with the literature on the chemical constitution of the stars. He does state, however, that titanium stars are on a level nearer to the helium stars than are the iron stars—a statement for which we know no justification.

EXHIBITION OF THE ROYAL PHOTOGRAPHIC SOCIETY.

THE Royal Photographic Society's annual exhibition at the Gallery of the Royal Society of British Artists, Suffolk Street, Haymarket, is well worth a visit by anyone interested in photography and its applications before it closes on October 4. Besides an excellent collection of works that are notable for their pictorial quality, and that will be examined by technicians as illustrations of the possibilities of the processes that they represent, there is a larger than usual number of colour transparencies, and also exhibits that are of specially scientific interest. The colour transparencies are chiefly autochromes, but there are many on the new Paget plate and a few "Dufays," both of which latter will quite well bear comparison with the autochromes for the quality of their colour and detail. In the scientific section, Lt.-Col. J. W. Gifford shows a large number of original photographs of spectra of the metals taken with a quartz optical train of large aperture. Mr. G. Reboul shows that cuprous chloride, produced by exposing a polished copper plate to chlorine gas, will furnish photographs by treatment somewhat similar to that employed in the production of daguerreotypes. The insecurity of intaglio plate printing for monetary documents is again demonstrated by Mr. A. E. Bawtree in his copies of stamps, the genuine stamp and the forgeries being indistinguishable. The photo-micrographic section is particularly strong. The method of discovering a difference in the colloids present in jams, and of detecting various adulterations, is excellently shown in a series of low-power photo-micrographs by Mr. E. Marriage. Of other series, the "Histology of the Optic Nerve of Sheep," by Mr. J. T. Holder; the "Corpuscular Elements of Human Blood," by Dr. D. H. Hutchinson; and Mr. J. M. Offord's "Diatoms under High Power," deserve special notice. There is a fine collection of radiographs by Dr. Bela Alexander, Dr. G. H. Rodman, Dr. Gilbert Scott, Dr. Robert Knox, and Dr. Thurstan Holland, some taken in a small fraction of a second. In this direction the most novel work is by M. Pierre Goby, who by the use of ultra-soft rays secures quite full details in the most delicate transparent membranes, such as insects' wings, at the same time as showing the internal structure of the insect. But more wonderful are his micro-radiographs, made by using the fine pencil of Röntgen rays that passes through a small hole in a lead screen. The detail in parts of small vertebrates only a fraction of an inch in length, is so well reproduced that a fifteen or seventeen times enlargement would be considered excellently sharp for a direct radiograph. M. Goby applies his method to foraminifera and other minute objects with similar success. Among the other exhibits there are a process with examples of a method of producing colour transparencies by the absorption of dyes in fish-glue, by Mr. Bawtree, and good collections of natural history photographs, lantern slides, and stereoscopic transparencies.

THE ARCHÆOLOGICAL INVESTIGATIONS IN THE MISSISSIPPI REGION.[1]

IN the publication referred to below Mr. Clarence B. Moore gives us another of his very careful descriptions of the systematic excavations he is undertaking in the Mississippi valley, and, as usual, it is profusely illustrated with most excellent photographs and coloured plates. By these investigations and the superb way in which he publishes his results, Mr. Moore is laying a sure foundation for future general-

[1] "Some Aboriginal Sites on Red River." By Clarence B. Moore. Journ. Acad. Nat. Sci., Philadelphia, xiv., 1912.

isations. The last year's work covered 519 miles of the Red River from its confluence with the Mississippi. Few burial places were found in Louisiana, as these were mainly in the often flooded level ground, and the artificial mounds were erected for places of residence; since most of the finds are obtained from graves the spoil was not very large, and as many of the mounds are now utilised they could not be satisfactorily investigated.

Along the Red River in Arkansas the conditions in the main are different; mounds containing burials, some of them richly endowed with artifacts, are fairly abundant, and further northward the lavish use of pottery with burials has often been described. It seems probable that the Arkansas mound burials were those of people of consequence. The pottery of Arkansas is as a rule tempered with fine gravel or sand, or with small bits of pottery, though kitchen vessels are often shell-tempered. The ware is thin and carefully modelled. There are few unusual shapes, grotesque or life forms were very rarely attempted, though they occur in the region to the north. Many vessels bear a high polish, and nearly all have incised designs filled in with red or white pigment. Circles, often series of concentric circles (probably sun-symbols), form a frequently recurring design. Decoration in polychrome was very exceptional, though common

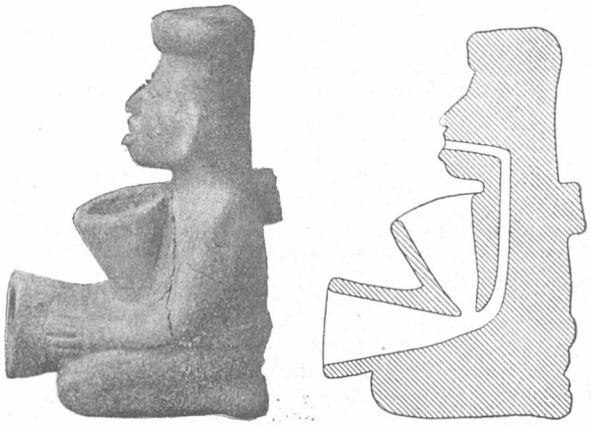


FIG. 1.

more to the north. A remarkable feature—indeed, it is unique—in connection with some of the mounds is the depth of the grave-pits; one reached 15·5 ft. in depth. Among several interesting pipes, two types have not been met with hitherto. One form, from Haley Place, is of earthenware, the truncate conical bowl of which occurs at some distance from the end, the terminal continuation of the stem being hollow; one is nearly 23 in. long. The other, from Gahagan, is moulded to represent a kneeling man; there is a communication between the bowl and the open mouth of the figure, so that smoke can be made to emerge from it when the pipe is in use (Fig. 1). A number of beautiful useful and ceremonial stone implements were found, and various interesting pendants, some of which have the form of a lizard; one was formerly coated with sheet copper, as were also the large circular ear-plugs of limestone. It is, however, impossible to point out all the items of interest in this memoir.

Dr. Hrdlička adds a notice on the human remains. He says the skeletons from Haley Place and the McClure mounds probably may be safely ascribed to an extension of the Natchez people; the skulls exhibited deformation of the "Flathead" variety.

A. C. HADDON.

MAGNETIC STORMS AND SOLAR PHENOMENA.[1]

IN the publication referred to below only the first thesis is printed. It deals with the relations between magnetic storms and solar phenomena. The thesis shows the nimbleness of mind one hopes to see in those who have taken high mathematical degrees at Cambridge, accompanied by a knowledge of terrestrial magnetism most unusual in British seats of learning. There are, it is true, researches bearing on the subjects investigated of which the author seems unaware, but his knowledge of foreign writings, including theoretical work by Kelvin, Larmor, Birkeland, Störmer, and Schuster, and observational work by Walker, Airy, Ellis, Maunder, Hale, and many others, is highly commendable. Also the attitude he adopts towards the work he criticises is generally philosophical. Thus, taking Kelvin's attempted demonstration that solar action cannot be the proximate cause of magnetic storms, Bosler points out that there are possibilities not considered by Kelvin making much smaller demands on the sun's stores of energy, and that in the light of modern knowledge no one can say what is a reasonable limit to solar expenditure. On the other hand, he recognises that Kelvin's work directed attention to a point apt to be overlooked.

Dr. Bosler regards his countryman Marchand (1887) as the first to claim a connection between the occurrence of magnetic storms and the presence of individual sun-spots or faculæ near the sun's central meridian, but he regards Maunder's observations on the recurrence of storms in the solar rotation period as the strongest evidence yet advanced in favour of this view. He seems to be unaware of Broun's early work. He apparently accepts Sabine's deduction of an eleven-year period—corresponding to the solar period—in magnetic disturbances, but while recognising the strength of the evidence adduced—especially that of Maunder—in favour of solar jet theories, he considers Dr. Schuster to have demonstrated the impossibility of swarms of any kind of electrified particles sticking together all the way from the sun to the earth. The view he inclines to is that earth currents are the immediate cause of most, if not all, magnetic disturbances. The evidence he advances in favour of this view is derived from comparisons of records of magnetic storms at Parc St. Maur and Greenwich—especially those known as "sudden commencements"—with corresponding records of earth currents. This from an observational point of view is probably the most important part of the thesis, though only partly novel.

The author thinks earth currents may be produced by movements of electrified matter—associated with protuberances, spots, or faculæ—on the sun. Taking the case of a cable of 0·25 cm.^{2} section, made of copper of resistivity 1600, enclosing a circle 8000 km. in perimeter, he calculates that the current induced in the cable by a magnetic field of amplitude 10γ and period 10 sec., normal to the plane of the circle, would at a distance of one metre from the wire produce an alternating magnetic field of amplitude 1250γ. This is adduced as an illustration of how a small field originating in the sun might be amplified on the earth. The idea may be worth considering, but the problem treated seems somewhat too remote from actuality. The magnetician will find a variety of other interesting matter in the thesis.

C. CHREE.

[1] "Thèses présentées à la Faculté des Sciences de Paris pour obtenir le grade de Docteur ès Sciences Mathématiques." By M. J. Bosler. Pp. 96. (Paris: Gauthier-Villars, 1912.)

THE LIFE-HISTORY OF A WATER-BEETLE.[1]

THE life-history of a water-beetle can be outlined in a very few words. An egg is laid by the mother-beetle: an aquatic larva hatches out which feeds and grows, and, during the process of growth, moults several times. When full grown it leaves the water and burrows into the earth, forming a "cell," in which it changes to a pupa. After a time the pupal skin is cast off, and the perfect insect makes its way out of the cell and resumes its life in the water.

There are, however, all sorts of interesting details in the life-history, and these details often differ considerably in different types. There are differences in the egg-laying habits; differences in the method of development of the embryo; differences in the way the larva gets out of the egg; differences in the way it feeds and in the nature of its food, and so on; and it is these differences which are of importance to each species in enabling it to fit in among other species in the life of the community.

Although there are a number of widely separated species of beetles which inhabit the water, there are two groups which are usually referred to as "water-beetles," and these may be broadly distinguished as the swimming carnivorous group—the Hydradephaga—and the creeping herbivorous group—the Palpicornia, or Hydrophilidæ. The description of this second group is not strictly accurate, as the larvæ are, apparently without exception, carnivorous, and the perfect insects, although capable of subsisting upon a vegetable diet, in at least many cases enjoy animal food; and although they are somewhat differently constructed from the swimming water-beetles, some of them are very fair swimmers.

I propose to outline the life-history of a type of the Hydradephaga, and then to compare with it a type of the Palpicornia; and as a type of the former group I will describe a species of Dytiscus, *D. lapponicus*, the life-history of which I worked out during last summer.

The male and female differ in general appearance, the former having smooth wing-cases, the latter having these grooved or fluted. The male has also a pad on each of the front legs, while the female has quite simple front legs. The slide also shows a full-grown larva, and thus gives an idea of the relative sizes of these two stages of the species.

This species is extremely local in the British Islands, only having been found in a few localities in Scotland, and in one in north-west Ireland. It inhabits lochs, usually mere lochans, at altitudes of from 800 ft. upward, and there are certain characteristics about its habitat which make it possible generally to tell at a glance whether a particular lochan is or is not likely to hold the species.

As a rule the habitat is a bare stony lochan, with very little vegetation; it has no stream flowing into or out of it, and trout and *lapponicus* are mutually exclusive. There are usually newts and fresh-water shrimps (*gammarus*), but otherwise there is always a marked scarcity of animal life. Very few other water-beetles are associated with *lapponicus*, which usually is abundant where it occurs.

The only place I have found the species in great abundance is in a lochan 950 ft. above sea-level on the island of Eigg. Along its eastern side this lochan is strewn with large stones, and under these the beetle is to be found, often as many as four or five under one stone. It occurs in other lochans on Eigg, and has been found also in Rhum, Skye, Mull, and Arran, but otherwise it is only known from Inverness-shire.

One place in Mull where it used to occur abundantly is a peculiar loch, situated in the top of a hill, about 800 ft. behind Tobermory. The place looks like the crater of a volcano, but I believe is not so described by geologists. The species has apparently quite disappeared from this loch; it is probably slowly disappearing from our islands, being a remnant of the fauna which abounded when our climate was much colder than it is at present.

All my specimens came from the one lochan on Eigg, and they were placed in large tubs in my garden in the north of Ireland. The tubs are filled with water, but the bottom is covered by a thick layer of soil, and in the soil a few species of water plants thrive, chiefly the common water-grass, *Glyceria aquatica*. The tubs are covered with wire-gauze to prevent the beetles escaping.

Now the Dytiscus possesses a small apparatus capable of piercing the tissues of the water-plants, and each time this borer makes a hole in the water-plant one egg is deposited. In my tubs the *lapponicus* chose the water-grass as the receptacle for its eggs. In its native home this grass does not grow, the only water-plants being a common rush, a species of *juncus*, and the club rush *eleocharis*, both possessing round stems. Now, the grass possesses a round stem surrounded by leaves, each leaf consisting of a long sheathing base and a free lamina or blade. The sheath is keeled, and in every case the mother-beetle pierced the leaf-sheath, and always in the line of the keel, depositing the egg in the tissues of the sheath, and this shows the peculiar instinct possessed by the mother in the deposition of her eggs and the extreme sensitiveness of the borer or ovipositor. Although I examined very carefully the plants in the tubs, only twice did I find that the ovipositor had passed right through the sheath and dropped the egg between that and the stem.

Lapponicus, unlike our other species of Dytiscus has a very definite egg-laying period, commencing in March and ending in June. From two of the British species I have had eggs in October, December, and February, as well as in the summer months.

I collected a number of the eggs, dissecting them out of the leaf-sheaths, and placed them on wet cotton wool in tumblers and watched their development.

I do not intend to weary you with the details of the development of the embryo, but I wish to point out that the embryo first appears on a part of one side of the mass of yolk—it does not at first occupy the whole length of the egg—and it then extends first backwards and then forwards, and the sides grow up around the yolk until the embryo ultimately encloses it. The nerve-chord does not increase in length with the embryo, and consequently appears to shorten as the embryo extends in the egg.

The development of the embryo occupies about three weeks in June, but temperature affects the length of this embryonic period. In the case of another species, an egg laid in April matured in three weeks, while one laid in winter took six weeks to hatch.

Towards the end of the embryonic period the pressure of the embryo in the shell is very great. I accidentally punctured an egg with a needle when turning it over, and immediately a portion of the embryo bulged through, just as the inner tube of a pneumatic tyre tends to bulge through a tear in the outer cover. The pressure is also indicated by the changed shape of the egg during the final stages.

During the latter part of the egg-period, there are various slight movements of the embryo, but during the last few hours certain very definite movements

[1] Discourse delivered at the Royal Institution on Friday, May 9, by F. Balfour Browne.

become noticeable. In the first place, inside the head a spasmodic pulsation is visible, at first at long intervals, but later more or less continuously. I have observed this pulsation in eggs of other water-beetles, and also in those of the dragon-fly, and although I am not sure that the interpretation is the same in dragon-fly and water-beetle, I am satisfied in the latter case the pulsation is really a swallowing process.

The larvæ of all the water-beetles I have examined possess a special sucking apparatus known as a "pharyngeal pump," the use of which I shall describe directly, and in the embryo this pump apparently comes into use to absorb the fluid which surrounds the embryo in the shell; the embryo merely drinks this up.

After this sucking-pump begins to work, various other movements of the internal organs can be observed, including peristalsis, and also at infrequent intervals the whole body moves slightly in the shell, the tendency being to push the head into the end. One other movement is to be noted, and that is an up-and-down motion of the head, at first very slight, but later becoming very marked.

On either side of the head is a small papilla, at the apex of which is a minute, slightly curved spine. When the embryo is at rest, this papilla lies in a slight depression, but when the sucking-pump is at work the papilla bulges outward, so that the spine touches the shell. Thus when the head moves up and down and the sucking-pump works at the same time, the two spines scrape along the inside of the shell and ultimately burst it open. They are, therefore, "hatching spines," and similar instruments differently situated have been observed in a few insect embryos of other orders.

You see, therefore, that the shell bursts open at the head end; immediately it bursts the compressed larva bulges out, and by slight writhing movements works its way clear of the shell, the whole operation taking less than two minutes. As soon as the larva is clear of the shell the tail straightens out, and the legs and mouth parts assume their natural position. In the embryo there is a peculiar fold in the upper part of each jaw, but within two or three minutes of the larva's escape this fold has completely disappeared.

From the moment the larva escapes it begins to grow in length and breadth. The long air-tubes in the body are flat, but have a bright silvery appearance, suggesting that some gas has been secreted in them; but the larva is heavier than the water, and therefore sinks to the bottom. For a time, half an hour or more, it rests quietly and shows no desire to get to the surface, but sooner or later it gets restless and swims to the surface, using its feathered legs as oars, and raises its tail to the surface film and remains suspended for a few minutes. After this the newly hatched larva is buoyant, and cannot remain away from the surface without holding on to the submerged vegetation. The buoyancy is, however, only temporary, as older larvæ frequently require to swim to the surface to renew their air-supply.

In the insect, breathing and blood-circulation are normally not intimately associated as in other animals. In a human being or a fish, or even in a snail, air is taken into special organs—lungs or gills—where the blood takes up the oxygen and carries it through the whole body. In the insect the blood has usually nothing to do with the aëration of the different organs, the whole body being permeated by innumerable air-tubes.

In all the water-beetle larvæ which come to the surface to obtain their air, these innumerable air-tubes communicate with two large air-tubes which run the length of the body, one on each side, and these open on the last segment. Hence, when a larva requires to renew its air-supply it comes up tail first, bringing the openings of the two lateral tracheæ into communication with the air, and by contracting and expanding the body it exhales the used-up air and inhales fresh air.

For a day or so after hatching the larva is soft and is not hungry, but once its skin and jaws have hardened it begins to look about for food. I found that tadpoles and pieces of chopped worm were suitable food, but under natural conditions small newts, water-shrimps, and insect larvæ—including brothers and sisters—constitute the normal diet. It is impossible to keep two larvæ together in one small vessel, as one invariably attacks and kills the other within a few hours. Even when I gave a tub to four specimens only one survived after a few weeks, so that in a small loch, where at least some thousands of these larvæ hatch out, the death-rate must be enormous.

The method of feeding of the larva is peculiar. The two long sharply pointed jaws are each pierced with a fine tube, of which one end opens on the inner side just below the apex, and the other end opens on the upper side just near the base. When the jaws are closed the inner ends of these tubes communicate with the corners of the mouth, but when the jaws are open the inner ends of these tubes do not communicate with the mouth at all. The mouth itself is also peculiar. In a front view of the head it is visible as a long narrow slit between the bases of the jaws, but if this slit is examined it is found that across the lower side of it is a raised ridge which fits into a groove running across the upper side of it. When the jaws are wide apart the ridge and groove are separated, and the mouth is open, but as soon as the jaws come together the ridge fits into the groove, and the mouth is closed. As soon, therefore, as the larva seizes its prey its mouth is closed, and the only communication into it is through the tubes in the jaws, the basal ends of which now open into the corners of the mouth.

Immediately behind the mouth is the powerful sucking-pump, the pharynx, which I mentioned in connection with the embryo. By expansion and contraction of its muscles it sucks in the juices of the prey through the tubes in the jaws. But if this were the whole process of feeding there would be a considerable waste, as a worm or a tadpole consists of a large amount of solid material; and yet, if one watches one of these larvæ feeding, one will find that almost nothing is left of the prey except the skin. This is due to the fact that at short intervals the sucking-pump stops working and saliva is poured into the prey. This saliva digests and dissolves away the solid parts of the food, which are then sucked in by the larva. The process of digestion, which in most animals takes place internally, is carried on in these larvæ outside the body.

With regard to the *duration of the larval period*, in my examples this varied from six to nine weeks. This period is divided into three stages, there being two moults prior to the final one which produces the pupa. Each of the first two stages only lasts about ten days, so that the last stage is a very long one, as it is in all other insects.

This last stage is also divisible into two parts, the first occupying four or five weeks, during which the larva feeds and grows as in the previous stages, the second occupying two to four weeks, being spent out of the water making a cell in the earth, and resting preparatory to becoming a pupa.

In the few cases which I had the opportunity of observing, the full-grown larva always left the water in the morning between eight and ten o'clock; but whether this is the rule with this species, or whether

it was connected with the artificial conditions in which my larvæ were reared, I do not know.

Once the larva leaves the water it crawls about very actively, seeking a suitable place to enter the earth. If left to itself it usually selected a stone and burrowed underneath it, but I found that if I made an artificial burrow—with a pencil, for instance—the larva could be made to crawl into this, and as a rule would make its "cell" in it. By making such a burrow against the glass side of a box filled with earth, I was able to watch the process of the formation of the pupal cell.

Once the larva has entered and adopted the burrow, it straightway begins to prepare its cell, and this is done by enlarging part of the burrow. The jaws are now used for transporting pellets of soil from one position to another, and for breaking up the pellets into their separate particles. Very little earth is actually pushed into the unused part of the burrow, the cell being formed almost entirely by breaking up the pellets of soil and battering the fine particles against the sides. The vertex of the head is the main battering-ram, but the larva, which during the whole process of making the cell lies with its tail bent over its head, also flattens out the earth with its body.

The actual making of the cell occupies about twelve hours, and during that time the larva does not rest for a moment. At the end of that time it is apparently tired out, and rests in any position, often stretched across the cell, its head pressed against one side and its curved body against the other. It thus rests for about twenty-four hours, after which it bends its tail underneath it and usually adopts a sitting-up position—reminding one of Tenniel's illustration in "Alice in Wonderland" of the caterpillar sitting on the mushroom. It is, however, very restless, and frequently changes its position, tossing from side to side.

The pupa appears, after the larva has been thus resting for a fortnight or more, by the larval skin splitting along the back and being cast off at the tail end. On its back are to be seen a number of short projecting spines, and Lyonnet suggested in the case of another pupa, similarly though better equipped, that these are for the purpose of raising it off the damp soil of the cell. This may be true, but in my experience the pupa most usually lies, so to speak, on its face rather than on its back.

The pupal stage lasts about three weeks, and the only change noticeable during that time is a slight pigmentation of what is at first a perfectly white pupa. At the end of the pupal stage the skin ruptures along the back, and the perfect insect comes forth at first white and soft, but in the course of two or three days it assumes its normal coloration, and after a longer period its normal hardness. After a week or so it makes its way out of the pupal cell by biting and scraping, and at once goes to the water.

In its native haunts it spends most of its time amongst the stones and mud at the bottom, occasionally coming up to renew its air-supply, and in my tubs also it was seldom to be seen.

With regard to its winter habits, it apparently buries itself at the bottom of the loch as soon as the cold weather begins, and sleeps until the following spring. In my tubs it disappeared completely in October or November, burrowing deep into the soft oozy mud at the bottom, and there it remained until the following March. During all this time the metabolic processes must be practically at a standstill, as otherwise the insect would require to renew its air-supply at frequent intervals.

Having now outlined the life-history of this type of the swimming carnivorous water-beetles, I will take an example of the other group, and the one I have chosen goes by the name of *Hydrocharis caraböides*. There is only one species of Hydrocharis in the British Islands, and it is practically confined to the south-east of England, only very occasionally having been found anywhere else in the country. It inhabits stagnant ponds and drains, and is not uncommon in a few places in Surrey, Essex, and Middlesex.

I began to experiment with it five years ago in the north-east of Ireland, having obtained my specimens from Surrey. Each year I obtained eggs, reared the larvæ, and renewed and increased my stock, so that it is obviously not the climate of north-eastern Ireland which prevents this species from being a native there.

The conditions in my tubs were just such as are to be found in any pond or drain in the country, and apparently the only reason why this species is confined to the south-east of England is that competing species prevent it from extending its range.

Whereas Dytiscus lays its eggs singly in holes pierced by it in the living vegetation, Hydrocharis builds an elaborate silken cocoon which floats in the water, and in which about fifty eggs are deposited.

The spinning of the cocoon is a wonderful process. The beetle carries on its underside a film of air, which is part of its supply for breathing. The cocoon is actually spun on a part of this film of air, which is then detached from the rest of the film as a bubble enclosed in silk. The egg-laying commences soon after the cocoon is begun, and the eggs are arranged side by side in the cocoon standing upon one end, being fastened in position by silken threads. A space above the eggs is filled with very loosely woven silk.

In closing up the cocoon a peculiar plate-like structure is formed of very closely woven silk, and this ends in an upward projection known as the "mast." The purpose of this "mast" is not known. It is not a tubular structure, but merely a band of silk. It has been stated that if it is cut off the eggs die, but in the case of another species I have hatched eggs removed from the cocoon and submerged, so that the suggestion that the mast is necessary for keeping up the air-supply is without foundation.

I shall not weary you with details of the development of the embryo beyond mentioning that, unlike Dytiscus, the embryo from the first occupies the whole length of the egg, and that the nerve chord, again unlike Dytiscus, grows with the embryo as it develops. The only other point I need mention is that in the cocoon all the embryos develop head downwards.

The egg-laying period of Hydrocharis extends from about the middle of May until about the middle of July in my tubs, but it may perhaps be rather longer in the south-eastern parts of England. The incubation of the egg occupies nine or ten days, and, as in the case of Dytiscus, towards the end the embryo is very tightly packed within the shell. There is, however, no special hatching apparatus that I have been able to find. The pulsating organ or sucking-pump in the head is visible, and there are also movements of the embryo, but at the end the skin splits along the back and the larva treads it off, giving a peculiar backward wriggle.

Now, under normal conditions the newly hatched larva does not at once leave the cocoon; in fact, it does not appear for one or even two days after hatching. As soon as it bursts the egg-shell it wriggles backwards out of the egg into the space above all the eggs, and it is interesting to note that the hairs on the body of the newly hatched larva all point forwards. As the larvæ hatch, the empty shell and the silk bindings become broken down—I think they are chewed by the larvæ—and the whole cocoon ultimately becomes filled with the larvæ.

In those cases where I dissected the eggs out of

the cocoon and allowed them to develop on the wet cotton wool, the newly hatched larvæ congregated into a mass and remained so for a day or two, after which they became active in search of food.

You will notice that the larva possesses on each body segment a pair of lateral processes, and on the last segment a pair of ventrally placed processes of a different kind. These latter, which are possessed by all water-beetle larvæ which come to the surface for their air, have probably some connection with raising the tail to the surface for breathing, but the hairy lateral processes have been called gills. Many larvæ of the Palpicornia have lateral processes, usually smaller than those of Hydrocharis, but in no case are they really gills, and the larvæ quickly drown if prevented from bringing their tails to the surface to renew their air-supply.

The larvæ of Hydrocharis, like those of Dytiscus, will eat almost any kind of animal matter, and hence they are easily supplied. I fed them mostly upon chopped worms, but their method of feeding is very different from that of Dytiscus. They seize their food with the jaws, antennæ, and the other mouth parts, and they then come to the surface, and raising their heads and part of the body out of the water, they proceed to chew up the food by opening and closing the jaws, turning it from time to time with the other mouth parts. The jaws are not perforated, nor is there any mouth-lock as in Dytiscus, and they suck in the juices of the prey by the mouth, spitting up saliva at intervals, which actually froths over the food and digests it, the dissolved material then being sucked down. The external digestion is so complete that in the case of a thick piece of worm all that is ultimately rejected is the thin transparent outer pellicle.

In the mouth parts of the larva I want to direct your attention to a curious want of bilateral symmetry, noticeable not only in the jaws—one of which, the left, has a small extra tooth near its base—but also in the upper lip. In many species there is an absence of bilateral symmetry where a pair of organs are complementary. Thus in the jaws of the beetle itself, the base of the left one is hollowed out to receive the base of the right one, which is convex, the two being related as pestle and mortar for grinding up the food. The larva of another species of the same group also shows asymmetry of the jaws, but here again it is definitely associated with the method of feeding. This species feeds upon pond snails, and the left jaw holds the shell while the right jaw with its large double tooth cuts through it.

The asymmetry of the upper lip, however, is at present inexplicable, and, curiously enough, it occurs in several other species.

The larva of Hydrocharis, like that of Dytiscus, passes through three stages, the first two of which occupy from five to eight days, and the third stage, up to the time the larva is full grown, occupies about four weeks. It then leaves the water and burrows into the earth, forming a cell, just as the Dytiscus larva did. I had many specimens of these larvæ, and so made many experiments with them, and one curious fact about them is that the instinct which leads them to burrow into the ground and make a pupal cell only lasts for one or, at most, two days. In no case, where I removed a larva even immediately after the completion of its cell, did it make any attempt to form another one, and if left on the surface of the soil it moved about listlessly and ultimately died, apparently of drought, since if placed in a damp position, for instance, in an artificial cell, it survived and pupated. If a cell was damaged before completion the larva often completely destroyed it, apparently in the attempt to repair the damage, and would be found sitting amongst the ruins.

Once the cell is completed the larva rests for about three weeks, at the end of which time the skin is cast off and a greenish-white pupa appears. This is more spinose than that of Dytiscus; but it also prefers to lie upon its face, resting upon the two small tail projections and upon the "collar" of the prothorax.

The perfect insect appears after about ten days, so that the whole life-cycle occupies about nine or ten weeks from the laying of the egg to the appearance of the perfect insect. This time, however, may be greatly prolonged under less favourable conditions. Thus, the later egg-cocoons produce larvæ which take twelve or fourteen weeks to grow up, and the cocoons built in July produce beetles which do not leave the pupal cell for six or seven months. The larvæ leave the water in September and even in October, and after three or four weeks turn into pupæ. These pupæ turn into beetles in late October or November, but the beetles remain, apparently torpid, until the following March or April, when they make their way out and to the water.

I have mentioned that the larvæ of both Dytiscus and Hydrocharis breathe in the same manner by raising the tail to the surface. The perfect insects, however, assume very different positions when taking in their air-supply.

Dytiscus floats up to the surface tail first, taking in air between the body and the great wing-cases which cover it, and it is in this cavity under the wing-cases that the whole reserve of air is carried.

On either side of the body under the wing-cases is a row of pits, spiracles; the last pair of these are much larger than the others. When the insect rises tail first to the surface, the tubes connected with this last pair contract and expand, just as in the larva, renewing the air-supply in the whole tube system, while at the same time the body contracts and expands, renewing the reserve supply under the wing-cases.

Hydrocharis, on the other hand, comes to the surface head first, turns its head on one side, and pushes its short, club-like antenna through the surface-film. Now a large part of the under side of this beetle is covered with fine velvety hair, which retains a thin film of air upon it, just as a piece of velvet does when gently pushed under water. When the beetle raises its antenna above the water it brings this film of air into communication with the air above the water. It also has a reserve supply under its wing-cases, and this communicates at the sides with the ventral film, and by expansion and contraction of the body the used-up air is expelled above the water and fresh air is taken in. In Hydrocharis the most important spiracles are situated well forward, and thus the used air from the air-tubes is expelled and fresh air taken in at the front end of the body instead of the tail end.

Anyone who examines Hydrocharis and compares it with Dytiscus will at once see great structural differences. In a ventral view of the two types, comparing the heads, the most noticeable difference is in the antennæ, which are filamentous in the former and clubbed in the latter, and the maxillary palpi, which are short in the former and long in the latter, in which they are used under water as feelers, just as are the antennæ of Dytiscus.

Passing over other less remarkable differences in the heads of the two types and coming to the body, one at once notices the different disposition of the legs: in Dytiscus the first two pairs are close together, in Hydrocharis the three pairs are about equidistant. In Dytiscus the basal segment of each hind leg—the

coxa marked 3*—on the screen is large, and the two coxæ are fused into a single piece which is firmly fixed into the body. In Hydrocharis the coxa is long and narrow; the two coxæ are separate, and each is hinged on to the body. The firm fixing in Dytiscus gives it a much more powerful leg-drive than the hinging gives to Hydrocharis, and hence Dytiscus is a more efficient swimmer.

These differences between the two types are therefore connected with differences in function. The antennæ of Dytiscus are feelers, while those of Hydrocharis are connected with breathing, and the disposition of the legs and their methods of attachment to the body are connected with differences in mode of progression, Dytiscus being a "swimmer," and Hydrocharis chiefly a "creeper" on the submerged vegetation.

In these two groups of water-beetles, the Hydradephaga represented by Dytiscus and the Palpicornia represented by Hydrocharis, we have two types of adaptation to an aquatic existence. Each type has originated independently of the other—that is, they are not descended from a common aquatic ancestor. Each represents a part of a large terrestrial family, and each has probably developed an aquatic habit as a result of competition, stronger land forms having driven the weaker off the land and into the water.

Just as each group has originated under the stimulus of competition, so, within each group, competition has moulded the different forms, and the peculiar details in the life-history of any one form are just those which enable it to retain its place in the community to which it belongs, and to hold its own in the great struggle for existence.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE announcement is made of the resignation of Dr. A. L. Bowley of the professorship of mathematics and economics at University College, Reading.

PROF. J. S. KINGSLEY, of Tufts College, has been appointed professor of zoology, in charge of vertebrates, in the University of Illinois.

DR. K. F. MEYER, director of the laboratories of the Pennsylvania State Livestock Sanitary Board, has vacated that position to fill the chair of bacteriology at the University of California. Dr. J. B. Hardenbergh has been appointed to succeed Dr. Meyer in the first-named post.

PROF. HERBERT V. NEAL, who has held the chair of biology at Knox College, Illinois, since 1897, has accepted an appointment to a similar post at Tufts College, Massachusetts. He has already had some acquaintance with the work of that college, having been for the last five years an associate director of the Tufts biological laboratory at S. Harpswell, Maine.

IT is announced in *The Indian Medical Gazette* that the scheme for the establishment of a School of Tropical Medicine in Calcutta is now so far advanced towards fulfilment that there is every reason to hope that it will be opened in the autumn of next year. Already valuable work on cholera, epidemic dropsy, dysentery, and other diseases has been done by a few workers in Calcutta. What is now wanted is money. Our Indian contemporary asks for substantial endowments of three or four lakhs for several additional research chairs, or annual subscriptions of 20,000 rupees for each.

AN effort is about to be made to raise a fund of 20,000*l.* for the foundation of a chair of engineering chemistry at Princeton University. This campaign will be undertaken mainly by members of the federation of Princeton clubs of New Jersey, with the object of the advancement of chemical industries in that State. The course of instruction to be given by the occupant of the proposed chair will supply engineering students with a knowledge of the commonest construction materials of the chemical industries, and of various materials that now take the place of the direct products of the soil.

A COURSE of lectures on tuberculosis, for general practitioners and especially for candidates as tuberculosis officers, has been arranged by the Royal Institute of Public Health. The introductory lecture will be delivered by Prof. G. Sims Woodhead on October 10. Subsequent discourses will be given by Dr. C. Porter ("The problem of Tuberculosis in relation to Insurance and Public Health"), by Prof. Woodhead ("The Spread of Tuberculosis"), by Dr. J. E. Squire ("Diagnosis"), by Dr. T. N. Kelynack ("Tuberculosis in Childhood"), by Dr. C. Wall ("General Treatment"), by Dr. C. Riviere ("Specific Treatment," &c.), by Dr. T. D. Lister ("Sanatorium Treatment"), by Dr. A. Greenwood ("The Prevention of Tuberculosis"), and Dr. H. O. West will outline a co-ordinated scheme for dealing with the malady.

THE medical schools of London and the provinces are beginning to announce the opening functions of their winter session. Prof. Sir William Osler, Bart., F.R.S., is to distribute the prizes and deliver an address at St. George's Hospital on October 1; at St. Mary's Hospital, Paddington, the prizes will be presented and an address given by Sir John Prescott Hewett, K.C.S.I., on the same date; Mr. W. Sampson Handley will deliver an address and Sir Squire Bancroft distribute the prizes at the Middlesex Hospital on October 1, on which date also Sir Charles Pardey Lukis, K.C.S.I., will give an address at the London School of Medicine for Women. On October 7 a lecture will be delivered at the University of Birmingham by Prof. Arthur Keith, F.R.S., on "The Present Problems relating to the Antiquity of Man."

MUCH interesting information as to the progress of secondary education in England is contained in the recently published Blue-book (Cd. 6934), "Statistics of Public Education in England and Wales, Part i. Educational Statistics, 1911–12." During the school year dealt with, there were in England 885 efficient secondary schools receiving grants from the Board of Education; of these 358 were for boys, 311 for girls, and 216 admitted both boys and girls. The teaching in these schools was in the hands of 9126 full-time teachers, of whom 4584 were men and 4542 women; and they were assisted by 3082 part-time instructors. The schools were attended by 150,605 pupils—81,383 boys and 69,222 girls. Of the total number of pupils 39,427 were under twelve years of age, 98,623 were between twelve and sixteen years of age, 11,559 between sixteen and eighteen years of age, and 996 more than eighteen years of age. As regards the management of the schools, it may be pointed out that 328 were provided by local education authorities, 427 were foundation and other schools, 48 were Roman Catholic schools, and 28 Girls' Public Day School Trust schools.

THE prospectus for the session 1913–14 of the Day and Evening College for Men and Women at the South-Western Polytechnic Institute, Chelsea, has been received. The day college is intended for students above the age of sixteen, and the courses of study are suited for technological and university purposes. The prospectus, we observe, points out that those who enter for technical instruction should have received previously a sound English education and should have acquired an elementary knowledge of mathematics and, if possible, of physics and chemistry. The courses are arranged to occupy three years.

On entering the student is asked to state whether he wishes to be trained as a mechanical or electrical engineer, or as a consulting or industrial chemist. In any of these cases he will find mapped out for him a complete course of study, involving laboratory instruction, tutorial work, attendance at lectures, exercises in mathematics, geometrical, mechanical, and architectural drawing, and instruction in the workshops. Evening courses in almost every branch of pure and applied science have been arranged at very moderate fees, and in their anxiety that no properly qualified person should be debarred from attending classes through inability to pay fees, the governors have arranged that apprentices, learners, and improvers, under the age of twenty-one years, may be admitted to all classes and courses at half-fees, on production of their employer's certificate.

THE prospectus of the Belfast Municipal Technical Institute for next session has been received. The object of the institute is to provide instruction in the principles of those arts and sciences which bear upon the industries of Belfast, and to show by experiment how these principles may be applied to their advancement. A day technical course has been established to give instruction in mechanical engineering, electrical engineering, the textile industries, and pure and applied chemistry. The course provides a sound training for youths who aim at filling positions of responsibility in various industries. A trade preparatory school, which constitutes a junior section of the day technical department, provides a specialised training for boys who are intended for industrial occupations. The evening classes are suitable for persons engaged during the day who desire to supplement the knowledge and experience gained in the workshop or warehouse. The needs of women are catered for in the same complete manner as those for men. It is not possible here to enumerate all the interesting ways in which the technical instruction committee has endeavoured to assist local industries, but mention may be made of the public textile testing and conditioning house which has been opened in the institute. It undertakes the examination of textile materials with the view of ascertaining their true weight, length, strength, and so on; and it carries out such other investigations as manufacturers and others may desire.

PAMPHLETS giving full particulars in connection with the faculty of medical sciences and with the faculty of engineering for the coming session have been published by University College, London. The college faculty of medical sciences comprises the departments of physics, chemistry, botany, and zoology (the preliminary medical sciences), also the departments of anatomy, physiology, and pharmacology (the intermediate medical sciences), and the departments of hygiene and public health, and of pathological chemistry (post-graduate study). Full preliminary and intermediate courses of study are provided for students desirous of obtaining the medical degrees of the University of London, as well as for students seeking the qualifications of other universities and licensing bodies. Each of the departments is also equipped for more advanced work, and provides facilities for research. The faculty of engineering, including the departments of mechanical, heating and ventilating, electrical, civil and municipal engineering, is intended to provide for students wishing to devote themselves to engineering a systematic training in the application of scientific principles to industrial purposes. The courses are also suited to the requirements of students who intend to enter for appointments in the Indian Public Works Department, Engineering Department of the General Post Office, Department of the Director of Engineering and Architectural Works in the Admiralty, Patent Office, and other similar services, or of those who intend to become patent agents, technical teachers, and chemical engineers. The engineering departments have been recognised by the Board of Trade as providing suitable technical training for marine engineers. Facilities are provided for post-graduate and research work in all the subjects.

THE Yorkshire Summer School of Geography, organised this year by the University of Leeds, completed a successful inaugural session on August 23. More than a hundred students were in residence for three weeks at and near Whitby, the headquarters being in the new buildings of the County School, which were kindly lent for the purpose by the governors. Systematic instruction in the methods of modern geographical study was aimed at by choosing Yorkshire as a representative area, and studying as exhaustively as possible all the factors and relationships connected with its structure and location. A course of five lectures on the physical geography and special geological features of the district was given by Prof. P. F. Kendall, together with lectures on the North Sea, and on meteorology by Mr. A. Gilligan. This led to the study of special topics of industrial or historical character, including plant distribution and agriculture (Dr. W. G. Smith), metalliferous and coal mining (Mr. A. Gilligan), the textile and metallurgical industries, ports, fisheries and communications (Mr. Ll. Rodwell Jones), prehistoric Yorkshire (Prof. P. F. Kendall), the Roman occupation (Mr. P. W. Dodd), Saxon and Danish Yorkshire (Mr. W. G. Collingwood), mediæval Yorkshire (Mr. H. B. McCall), architecture (Mr. S. D. Kitson), place-names and language (Prof. Moorman), Old Whitby as a port (Mr. E. H. Chapman), and river development (Prof. Kendall). The course concluded with two lectures on the teaching of geography by Mr. W. P. Welpton. The practical work included the reading and enlargement of topographical maps, the examination of typical rocks, the making of models and microscope sections, field surveys, and the reading and construction of meteorological charts. Frequent excursions were made to places of geological and industrial interest in the neighbourhood, and an afternoon was devoted to the study of a typical Yorkshire farm, with large-scale plans showing the rotation of crops on each field for the past four years.

SOCIETIES AND ACADEMIES.

CALCUTTA.

Asiatic Society of Bengal, August 6.—E. **Digby.** Nor'-westers and monsoon prediction. Nor'-westers have hitherto received little scientific attention. The entire literature is covered by a monograph by Sir John Eliot in 1876 and certain observations in a paper of his in 1910 on the anemographic records of Saugor Island. His observations and deductions are summarised. The structure of a typical nor'-wester is analysed. Its form and motion appear to show it is not a cyclonic eddy but a rectilinear splitting of the still-air layer between the lower southerly and upper northerly wind, which takes place transversely to the direction of motion of the storm mass. The absence of hail and the rapidity of the motion support this theory. A typically complete nor'-wester indicates a strong northerly upper current, and therefore the probability that the advance of the monsoon will be delayed. Weak or ill-formed nor'-westers indicate a weak upper current and little opposition to the monsoon. The factors that require study are briefly enumerated and divided into those which can be noted by individual observers and those which require co-ordinated effort.

BOOKS RECEIVED.

Michigan Agricultural College. Experiment Station. Division of Soils. Technical Bulletin No. 17: An Investigation of Soil Temperature and some of the most Important Factors Influencing it. By G. J. Bouyoucos. Pp. 196. (East Lansing, Michigan.)

Animals of the Past. An Account of some of the Creatures of the Ancient World. By F. A. Lucas. Pp. xxi+266. (New York: American Museum of Natural History.) (Handbook Series No. 4.)

The Climate and Weather of San Diego, California. By Ford A. Carpenter. Pp. xii+118. (San Diego: Chamber of Commerce.)

New South Wales. Department of Mines. Geological Survey. Mineral Resources, No. 17: Report on the Cobar Gold-field. By E. C. Andrews. Part i. Pp. x+207. (Also Maps to above.) (Sydney.) 7*s.* 6*d.*

Lord Lister: his Life and Work. By Dr. G. T. Wrench. Pp. 384. (London and Leipzig: T. Fisher Unwin.) 15*s.* net.

Fabre, Poet of Science. By Dr. C. V. Legros. Translated by B. Miall. Pp. 352. (London and Leipzig: T. Fisher Unwin.) 10*s.* 6*d.* net.

Die Gärungsgewerbe und ihre naturwissenschaftlichen Grundlagen. By Prof. W. Henneberg and Dr. G. Bode. Pp. v+128. (Leipzig: Quelle and Meyer.) 1.25 marks.

Wie ernährt sich die Pflanze? Naturbeobachtungen draussen und im Hause. By Otto Krieger. Pp. v+188. (Leipzig: Quelle and Meyer.) 1.80 marks.

Geschichte des naturwissenschaftlichen und mathematischen Unterrichts. By Prof. F. Paul. Pp. ix+368. (Leipzig: Quelle and Meyer.) 8.60 marks.

Note sur une Illusion de Relativité. By M. Gandillot. Pp. 88. (Paris: Gauthier-Villars.) 6 francs.

Chemistry and its Relations to Daily Life. By Prof. L. Kahlenberg and Prof. E. B. Hart. Pp. vii+593. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 5*s.* 6*d.* net.

Board of Education. Reports for the Year 1911–12 from those Universities and University Colleges in Great Britain which are in Receipt of Grant from the Board of Education. Vol. I. Pp. xxxi+465. (Cd. 7008.) 2*s.* Vol. II. Pp. ii+454. (Cd. 7009.) 1*s.* 10*d.* (London: H.M. Stationery Office; Wyman and Sons, Ltd.)

The Peregrine Falcon at the Eyrie. By F. Heatherly. Pp. x+78. (London: "Country Life" Offices; G. Newnes, Ltd.) 5*s.* net.

Einführung in die Allgemeine Biologie. By Prof. W. T. Sedgwick and Prof. E. B. Wilson. Autorisierte übersetzung nach der Zweiten auflage by Dr. R. Thesing. Pp. x+302. (Leipzig and Berlin: B. G. Teubner.) 6 marks.

Himmelsglobus aus Modelliernetzen die Sterne durchzustechen und von innen heraus zu betrachten. By Prof. A. Höfler. (In drei Ausgaben.) Ausgabe i. (Leipzig and Berlin: B. G. Teubner.) 1.50 marks.

A Laboratory Manual of Invertebrate Zoology. By Dr. G. A. Drew. Second edition, revised. Pp. ix+213. (Philadelphia and London: W. B. Saunders Co.) 6*s.* net.

Ergebnisse der Zweiten Deutschen Zentral-Afrika-Expedition, 1910–1911. Unter Führung Adolf Friedrichs, Herzogs zu Mecklenberg. Band i.: Zoologie; Teil i., Hamogregarinen. By Dr. H. Schubotz. Pp. 22+4 plates. (Leipzig: Klinkhardt and Biermann.) 1.60 marks.

Gas Testing and Air Measurement. By C. Chandley. Pp. vii+77. (London: Methuen and Co., Ltd.) 1*s.* 6*d.*

A Text-Book of Geography. By A. W. Andrews. Pp. xii+655. (London: E. Arnold.) 5*s.*

A Text-Book of Physics. By Dr. R. S. Willows. Pp. viii+471. (London: E. Arnold.) 7*s.* 6*d.* net.

University of Pennsylvania. The Museum Publications of the Babylonian Section, Vol. iii.: Aramaic Incantation Texts from Nippur. By Prof. J. A. Montgomery. Pp. 326+xli plates. (Philadelphia: University Museum.)

Yorkshire Type Ammonites. Edited by S. S. Buckman. Part x. Pp. v, vi+9 plates+descriptions Nos. 75–83. (London: W. Wesley and Son.) 3*s.* 6*d.* net.

The Differentiation and Specificity of Starches in Relation to Genera, Species, &c. Stereochemistry applied to Protoplasmic Processes and Products, and as a Strictly Scientific Basis for the Classification of Plants and Animals. By Prof. E. T. Reichert. Part i. Pp. xvii+342+21+102 plates. Part ii. Pp. xvii+343–900+18. (Washington, U.S.A.: Carnegie Institution.)

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