THURSDAY, OCTOBER 9, 1913.

HAUSA FOLK-LORE AND CUSTOMS.

Hausa Folk-Lore, Customs, Proverbs, &c., Collected and Transliterated with English Translation and Notes. By R. Sutherland Rattray. With a preface by R. R. Marett. Vol. i., pp. xxiv+327; vol. ii., pp. 315. (Oxford: Clarendon Press, 1913.) Price, 2 vols., 30*s.* net.

THIS book is intended to serve two distinct objects: to serve as a chrestomathy of the Hausa language, and as a collection of the local folk-lore and custom. It contains a series of lithographed Hausa texts, with a transliteration in Roman characters and a literal English translation. The method employed is to reproduce the MSS. written by a learned Hausa Málam or scribe, who wrote down or translated from Arabic sources such information as was required, and this was subsequently translated into Hausa. By this process the primary intention of the work is satisfactorily attained. Mr. Rattray is obviously a competent scholar, and in the course of the work he has been able to correct or extend the work of previous writers on Hausa grammar and phonology.

These admirably printed volumes thus represent a substantial contribution to linguistics, but the attempt to collect folk-lore and custom is not quite so satisfactory. The learned native scribe, like the Indian Pundit or Moulvi, is not the best agent for exploring the peasant beliefs and usages. He is apt to regard popular tradition and custom as of little value when they do not happen to conform to his standard of orthodoxy, and to introduce into his material something which is of purely literary origin and does not smell of the soil. In this respect Major Tremearne, in his recently published "Hausa Superstition and Custom," seems to have followed a sounder method by recording in his own hand the tales and superstitions which he heard from the lips of privates in the Nigeria Regiment, peasants, women and children.

Mr. Rattray has arranged his material in five divisions: traditionary accounts of the origin of the Hausa nation and of their conversion to Islam; tales of heroes and heroines; animal tales; customs and arts; proverbs. Among the tales we find many familiar *motifs* and incidents—the cannibal giant with his "Fee-fo-fum"; Beauty and the Beast, and so on. The animal tales are decidedly the best in the collection, and well illustrate the naïve cunning and wit which characterise the race. The formulæ introducing and closing the tales are interesting. They begin with "This is a story about" so and so; "a tale, let it go, let it come," ending with "Off with the rat's head!" that is, "that is the end of him."

The accounts of custom are rather disappointing, because, unless the Málam is mistaken, Islam has crushed down most of the indigenous practices. Perhaps the most valuable chapters are those describing, from native sources, the *cire perdue* process of brass-casting, as it appears in the remarkable figures from Benin, and an account of the primitive method of tanning skins.

The book, as a whole, deserves hearty commendation. But in his next attempt to add to his stores of local folk-lore and usage Mr. Rattray might with advantage dispense with the services of his Málam and depend upon himself for the task of collection.

INDIAN CHRONOGRAPHY.

Indian Chronography: An extension of the "Indian Calendar," with working examples. By Robert Sewell. Pp. xii+187. (London: George Allen & Co., Ltd., 1912.) Price 31*s.* 6*d.* net.

HINDU chronology appears extremely complex at first glance, but this complexity is more apparent than real, being largely due to the fact that so many different systems of reckoning were used in different places and at different times. Each single system is comparatively simple, and—save for the neglect of the effects due to precession—fairly accurate. The standard work on the subject is the "Indian Calendar," by Messrs. Sewell and Dikshit (NATURE, vol. liv., No. 1393), to which the present volume forms a supplement.

We have here a condensed account of those systems of chronology usually met with in inscriptions and documents, which are more fully treated in the previous work. Some space is devoted to the tropical year in view of the fact that this unit is occasionally met with, while the method of reckoning by Jovian Saṁvatsaras is fully described.

The volume contains a very large number of carefully worked examples and numerous tables, numbered to run consecutively with those of the previous volume. These include tables for the conversion of the moment of Mēsha Saṁkrānti by the First Arya Siddhānta into the same moment of the Present Sūrya Siddhānta; tables of the sixty- and twelve-year cycles of Jupiter, &c. Table I. of the "Indian Calendar" is carried forward to A.D. 1950; while Tables W, Y, Z (now XXXIII., XXXIV., XXXV.) of the Additions and Corrections to the "Indian Calendar" reappear. In Table XXXIII., "For finding the

mean place of Jupiter," the argument is now the time interval from the epoch of the Kaliyuga, so that the table is available for more than 3000 years further back; while Table XXXIV. is now given for days, hours, and minutes, instead of days, ghatikās, and palas.

The tables are clearly printed and the volume is furnished with a comprehensive index. To the Indian epigraphist and many others the volume should prove a welcome supplement to the "Indian Calendar."

R. J. POCOCK.

THE ANTIQUITY AND EVOLUTION OF MAN.

(1) *Man and His Forerunners.* By Prof. H. v. Buttel-Reepen. Incorporating Accounts of Recent Discoveries in Suffolk and Sussex. Authorised Translation by A. G. Thacker. Pp. 96. (London: Longmans, Green and Co., 1913.) Price 2*s.* 6*d.* net.

(2) *The Origin and Antiquity of Man.* By Dr. G. Frederick Wright. Pp. xx+547. (London: John Murray, 1913.) Price 8*s.* net.

(3) *L'Uomo Attuale una Specie Collettiva.* By V. Giuffrida-Ruggeri. Pp. viii+192+xiii plates. (Milano: Albrighi, Segati e C., 1913.) Price 6 lire.

(4) *Die Rehobother Bastards und das Bastardierungsproblem beim Menschen.* Dr. Eugen Fischer. Pp. vii+327+19 plates. (Jena: Gustav Fischer, 1913.) Price 16 marks.

(1) IN this excellent translation of Prof. Buttel-Reepen's little book, with the German title altered to "Man and His Forerunners," the statement occurs that "general treatises on Pleistocene man published before 1908 are now almost valueless." Such a statement implies that our knowledge regarding the ancestry and evolution of man has been revolutionised in the last five years—a statement which no one familiar with the subject could support for a moment. Yet in that space of time certain events have occurred which do materially alter our conception of how and when mankind came by its present estate.

There is, in the first place, the discovery of definite types of worked flints beneath the Red Crag of East Anglia by Mr. J. Reid Moir. Prof. von Buttel-Reepen does not question that the sub-Crag flints show human workmanship, but he seeks to minimise their antiquity by withdrawing the Red Crag from the Pliocene formations and setting it at the commencement of the Pleistocene series—a change which we believe geologists will not be inclined to countenance. Even if the place of the Red Crag be changed to the commencement of the Pleistocene, the sub-Crag flints may still claim a respectable antiquity, for the author quotes with approval Penck's estimate of 500,000 to 1,500,000 years as the duration of the Pleistocene period, and 25,000 years as the time which has elapsed since the Pleistocene closed.

It is during the last five years that we have come to realise fully the significance of Neanderthal man. He was formerly regarded as our Pleistocene ancestor. The recent discoveries in France and a more exact study of prehistoric remains have made amply clear that Neanderthal man is so sharply differentiated in all his features from modern man that we must regard him not as an ancestor, but as a totally different and collateral species, and that in past times there was not one species of man—subdivided into varieties as at present—but that there existed several, perhaps many, different species of man.

We note that Prof. von Buttel-Reepen gives his adhesion to the theory of multiple human species. On the other hand, we also observe that Dr. Frederick Wright, in the "Origin and Antiquity of Man," adopts the view, usually held by geologists, that Neanderthal man is merely a variant of modern man, and brings forward the time-worn examples of Robert the Bruce and the mediæval Bishop of Toul as representatives of Neanderthal man in modern times. The difference between the crania of Robert the Bruce and Neanderthal man is almost as great as that which separates the skulls of the chimpanzee and gorilla.

The third event which has altered our conception of man in the past is the discovery made by Mr. Charles Dawson in a pocket of gravel by the side of a farm-path, at Piltdown, Sussex. The discovery is noted by three of the authors whose books are here reviewed, and it is interesting to see what opinion each of them has formed of *Eoanthropus dawsoni*. Prof. von Buttel-Reepen gives us the first surprise; he places this new species of humanity with Neanderthal man, between the second and third glacial phases of the Pleistocene. It is true that Mr. Dawson and Dr. Smith Woodward did use the term Chellean—which refers to the stage of flint workmanship usually supposed to have been reached between the second and third of Penck's glacial phases—but they were also careful to explain that they regarded the Piltdown gravel as having been deposited and the skull imbedded at a period long anterior to the Chellean age—namely, at the early part of the Pleistocene period—perhaps earlier.

As to the position of Eoanthropus in the human lineage, all our authors show circumspection. Prof. von Buttel-Reepen is "inclined to think that the anterior curve of the jaw passed more sharply

upwards than in Woodward's reconstruction, and that the whole front of the jaw, and consequently the front teeth, were somewhat smaller and more human than he believes." There is no doubt this is the case; a close study of the faithful replicas of the jaw which are now freely in circulation will show that there is neither indication of, nor accommodation for, the large canine tooth postulated by Dr. Smith Woodward. It is true the conformation of the chin is purely simian. It is a feature never before observed in a human skull, but a simian chin does not necessarily indicate a large canine tooth.

The discovery at Piltdown evidently puzzled the author of "l'Uomo Attuale"—Prof. Giuffrida-Ruggeri, of Naples, one of the most expert anthropologists in Europe. He is naturally puzzled by the statement of the discoverers that they regard Eoanthropus as a contemporary of the Heidelberg man, and that flints of the Chellean type were found with the remains—flints of that type belonging to a much later date than that of the Heidelberg jaw. He adds that it was impossible for him to make any further statement regarding the nature of Eoanthropus until figures, or, better still, actual models of the remains were at his disposal. By this time such models are probably at the Neapolitan professor's disposal, and he will have noted, as students of anatomy are certain to observe, that owing to the manner in which the bones of the skull-case have been put together, the brain-size of Eoanthropus has been greatly under-estimated. The size of brain is that of modern man—somewhere about, or a little above, 1500 cubic centimetres. The importance of the discovery of Eoanthropus will be thus apparent. At an early part of the Pleistocene period, perhaps much earlier, there existed human beings with a brain of the modern size, but a chin which was purely simian in conformation.

(2) In discovering the evidence on which the long-past history has to be based three classes of men are involved—the geologist, the archæologist (or lithologist), and the anatomist. It is unlikely that any one man could attain such a knowledge as to become an expert in all three lines of investigation. The geologist must be our time-keeper and time-marker, especially as regards the Pleistocene—the geologist who has paid special attention to the evidence relating to the phases of glaciation. For this reason a work on the origin and antiquity of man, by Dr. Frederick Wright, who has been a life-long student of the glacial phenomena of North America, is of especial value. There is nothing concerning the origin of man in Dr. Wright's book, but much which bears on the length of the Pleistocene period and the relation of man to that period. Penck, from his studies of the glacial deposits in Europe, estimates that the Pleistocene was at least half a million years in duration, perhaps a million and a half. Dr. Frederick Wright's investigations in America have led him to infer that 80,000 years is an ample estimate of the duration of the Ice age from its inception to its close. He admits the existence of pre-Glacial man. "Large areas," he writes, "in Europe and North America which are now principal centres of civilisation were buried under glacial ice thousands of feet thick, while the civilisation of Babylonia was in its heydey (5000 B.C.). . . . Both in its inception and in its close the Glacial epoch was a catastrophe of the most impressive order. No reasoning from present conditions can apply to the Glacial epoch without great reservation."

It will thus be seen that Dr. Frederick Wright has returned to the manner of thinking which was prevalent before the days of Lyell. He is an advocate of "Paroxysms of Nature." By a paroxysm of human evolution—one is inclined to substitute the word "miracle"—he thinks the early civilisation of Babylon and of Egypt may have hurriedly arisen and primitive mankind become separated into the well-marked varieties which are seen in our present-day world. It must also be noted that the duration assigned to the last phase of glaciation by Dr. Wright is in complete agreement with the computations given by the late General Drayson. In one matter especially anthropologists are much beholden to Dr. Wright. He has no hesitation in declaring that the human skeletons found under the loess at Lancing on the Missouri and at Omaha, Nebraska, lay under undisturbed glacial deposits, and the remains were those of men who lived in America in the Glacial period. The importance of the statement lies in the fact that these men were of the modern type—in one case exactly of the Red Indian type.

(3) Prof. Giuffrida Ruggeri's book deals with another aspect of the problem of man's origin. Its inception dates from his visit to London two years ago, when he attended the Universal Races Congress. He was surprised to hear the speculations of Prof. Klaatsch regarding the independent origin of human races—brought forward by those who took part in the discussions of the congress—as if they were facts accepted by all anthropologists. It will be remembered that Prof. Klaatsch saw fanciful resemblances between certain races of mankind and certain anthropoids, and supposed such races and anthropoids had sprung together from a common stock. In the process of dismembering Prof. Klaatsch's theory, the Neapolitan pro-

fessor has done anthropologists a great service by bringing together and systematising all recent investigations concerning the origin and nature of modern races of mankind. He regards the human race not as an "ideal" species—one composed of a predominant single variety: it would become so if one race prevailed and exterminated all the others—but as a collective species comprising many varieties of equal value in the eye of the classifier. His classification of modern races is a very practical one.

(4) We have kept the most important of the four books here reviewed to the last—for there can be no doubt, from every point of view, that Prof. Eugen Fischer's book merits such commendation. What happens when two diverse races of mankind interbreed throughout a long series of generations? Is a new race of mankind thus produced—a race which will continue to reproduce characters intermediate to those of the parent stocks? At the present time such an opinion is tacitly accepted by most anthropologists. It was to test the truth of such an opinion that Dr. Eugen Fischer, professor of anthropology at Freiburg, with financial assistance from the Royal Academy of Sciences of Berlin, set out to investigate the Bastard people in the Rehoboth district of German South-West Africa. The Rehoboth Bastards form a community of 2500–3000 souls, and are the result of intermarriage between early Boer farmers and Hottentot women—an intermixture which began more than a century ago.

This book contains the results of Prof. Fischer's investigations and is a model for those who will follow in his footsteps. His observations have convinced him that a new and permanent human race cannot be formed by the amalgamation of two diverse forms of man—not from any want of fertility—for amongst the Bastards there is an average of 7·4 children to each family—but because certain characters are recessive, others are dominant, and the original types tend to reassert themselves in the course of generations, according to Mendel's law. Although the mean head-form of the Bastards is intermediate to those of the two parent races—Hottentot and Boer—yet in each generation a definite number of the Bastards tend to assume the head-form of the one or of the other of the parent races. There are certain facts relating to head-form known to English anthropologists which can be explained only on a Mendelian basis and are in harmony with Dr. Fischer's observations. Between three and four thousand years ago England was invaded by a race with peculiarly formed, short and high heads. During those thousands of years the Bronze age invaders have been mingling their blood with that of the older and newer residents of England. Yet in every gathering of modern Englishmen—especially of the middle classes—one can see a number of pure examples of the Bronze age head-form. On the Mendelian hypothesis the persistence of such a head-form is explicable.

Dr. Eugen Fischer's study of the Rehoboth Bastards will be welcomed by all students of heredity. No race has so many peculiar human traits as the Hottentots, and hence the laws of human inheritance—as Prof. Fischer was the first to recognise—can be advantageously studied in their hybrid progeny.

"FLORAS" AND PLANT MONOGRAPHS.

(1) *A Manual Flora of Egypt.* By Dr. Reno Muschler. With a preface by Prof. Paul Ascherson and Prof. Georg Schweinfurth. Two volumes. Pp. xii+1312. (Berlin: R. Friedländer und Sohn, 1912.)

(2) *Bush Days.* By Amy E. Mack. With illustrations from photographs by J. Ramsay and L. Harrison. Pp. xii+132. (Sydney: Angus and Robertson, Ltd.; London: Australian Book Company, 1911.) Price 3*s.* 6*d.* net.

(3) *The Flora of Bristol: Being an account of all the Flowering Plants, Ferns, and their Allies that have at any time been found in the district of the Bristol Coal-Fields.* By J. W. White. Pp. ix+722+3 plates+map. (Bristol: John Wright & Sons, Ltd.; London: Simpkin, Marshall and Co., Ltd., 1912.) Price 13*s.* 6*d.* net.

(4) *Pflanzengeographische Monographie des Berninagebietes.* By Dr. E. Rübel. Pp. x+615+xxxvi plates. (Leipzig: W. Engelmann, 1912.) Price 8 marks.

(5) *Das Pflanzenreich: Regni vegetabilis conspectus.* Herausgegeben von A. Engler. 53 Heft. iv. 129. Geraniaceæ. By R. Knuth. Pp. 640. Price 32 marks. 54 Heft. iv. 277 u. 277*a*. Goodeniaceæ und Brunoniaceæ. By K. Krause. Pp. 207+6. (Leipzig: W. Engelmann, 1912.) Price 10.80 marks.

(1) DR. MUSCHLER'S "Flora of Egypt" has grown from the work of Ascherson and Schweinfurth, whose "Illustration de la flora d'Egypte," published in 1887, was the first modern account of the vegetation of the country. In this work 1215 species were enumerated, and the number was increased in a supplement, issued two years later, to 1316. In the preparation of the present work, Dr. Muschler has had the advantage of the unpublished additional notes by the two veteran workers and also the use of their extensive herbarium. The number of species (of flowering plants and ferns) is brought up to 1505,

which, however, includes about 180 cultivated plants.

The work is in English and comprises adequate descriptions of the families, genera, species, and varieties; the systematic arrangement is that of Engler's Syllabus. Under each species references are given to relevant synonymy, and the distribution in the area under consideration is worked out in detail. About one-third of the second volume is occupied by a series of appendixes, including (1) a brief account of botanical work in Egypt; (2) a phytogeographical subdivision of the area into five districts—Mediterranean, Nile-delta, Oases of the Libyan Desert, Desert region, and Red Sea region; (3) a tabulated list of all the species and their distribution in these districts; (4) a similar table showing the distribution of Egyptian species in the Mediterranean basin; (5) a list of the commoner cultivated and garden plants; (6) a glossary; and (7) a list of Arabian names. The "Flora" forms a useful working handbook to the plants of Lower Egypt, and will be much valued by those interested in the botany of this ancient land.

(2) Miss Mack's "Bush Days" is a readable little volume consisting of short chapters on the plants and birds, and their habitats, which are still to be found within easy reach of Sydney. The letterpress is illustrated by numerous well-executed photographic reproductions, and the book, though obviously written for the author's near neighbours, may be read with interest and profit by lovers of nature in other parts of the world.

(3) Mr. White's "Flora of Bristol," described as "the outcome of an ideal hobby, cultivated in the spare moments of a business career," is a good example of a modern local flora. As no descriptions of genera and species are given, it must be used in association with a general "British Flora," but it is rich in critical notes on the plants and their occurrence within the limits of the area under consideration. Full details of habitat are given—a circumstance which will, it is hoped, not lead to the extinction of some of the rarer forms by greedy or over-zealous collectors. 1138 flowering plants are recorded as native or colonists, and a number of aliens are also included in smaller type. Ferns and Characeæ bring the total up to 1178. The number is likely to decrease, as some of the rarer plants are noted as less common than formerly and as extinct in former localities. Mr. White mentions 193 species as rare or local and 218 as very rare. Three, formerly native, are now extinct, namely, sea-kale (*Crambe maritima*), the rare galingale (*Cyperus longus*), which, formerly abundant in a single locality, has been exterminated by draining and cultivating, and a sedge (*Carex Davalliana*), found a century ago near Bath, but long since destroyed by drainage. The last species is of interest as having supplied the figured specimen for "English Botany."

In addition to the systematic portion, Mr. White gives a valuable introduction, including notes on the geology of the district and an analysis of the flora in relation to the different geological areas. There is also an interesting history of Bristol botany, with biographical notices of botanists, from William Turner, the father of English botany, who as Dean of Wells spent some years in the district, onwards to recent workers.

(4) Botanists who have visited the Engadine will turn with interest to Dr. Rübel's exhaustive account of the plant-geography of the Bernina district. The author is a pupil of Dr. Schröter, and his book is a tribute to the well-known zeal of his teacher in the ecological study of the botany of the Swiss Alps. Factors of climate, soil, and position are studied in detail, and a useful account is given of the various plant-formations. There is also a complete flora of the district, including flowering plants and cryptogams, in the elaboration of which Dr. Rübel has had the help of specialists in the various groups. A notable feature of the book are the beautiful photographic reproductions; and there is also an excellent folding map.

(5) Dr. R. Knuth's contribution to "Das Pflanzenreich"— a monograph of the Geraniaceæ —is one of the most important of this series. It is of interest to the horticulturist as well as to the botanist, as it includes an elaborate account of the hybrids of the genus Pelargonium, the source of the so-called geraniums and zonal pelargoniums of our gardens. The plan of the volume is similar to that of the other monographs of the series—a general account of the vegetative and floral morphology and the distribution of the family, followed by a detailed systematic description of the genera, species, and varieties, a fair proportion of which are illustrated in the eighty plates. Dr. Knuth recognises about 600 species, 259 of which are included in Geranium (to which belong our crane's-bills), while 232 belong to the great South African genus Pelargonium. Erodium—including our stork's-bill—has sixty species. These three great genera, with two less important, form the tribe Geranieæ, characterised by the twisted beak of the fruit—the remaining six genera, the fruit of which is not beaked, show greater diversity of floral structure, and are distributed among four small tribes.

Dr. Krause has elaborated for the same series of monographs the two families Goodeniaceæ and

Brunoniaceæ, members of the sympetalous series Campanulatæ. The former is a small but important Australian family with about 300 species; the latter is a monotypic group, restricted to a single species, *Brunonia australis*, a small perennial herb of somewhat daisy-like habit, widely distributed in Australia. It is interesting to note that the wealth of Australian material preserved in the great herbaria at the British Museum and Kew have supplied a large proportion of the material on which Dr. Krause's monographs are based. A. B. R.

OUR BOOKSHELF.

Le Monde Polaire. By Otto Nordenskjöld. Traduit du Suédois par G. Parmentier and M. Zimmermann. Préface du Dr. J. Charcot. Pp. xi+324+xx plates. (Paris: Librairie Armand Colin, 1913.) Price, 5 francs.

HERE is a handbook to the Polar regions, dealing, not with the exploration (of such there are plenty), but with the physical conditions of the regions, for which there was a vacant place. It is well for readers outside Scandinavia that it has been translated from the original Swedish into French: it might well be so into English. In a sense it treats the two polar regions as one, for it is comparative throughout, and for that reason the chapters are not arranged in a topographical sequence. Thus we have successive chapters devoted to Greenland, Iceland, and Spitsbergen; the next chapter deals with the Antarctic lands. The writer ranges widely enough to include among "sub-antarctic" lands Patagonia and Tierra del Fuego, the Falkland and other islands, and New Zealand, so far as that Dominion can be considered to lie under such conditions; correspondingly we find chapters on Arctic America (including Labrador), on Siberia, and on north-western Europe. Numerous photographs and sketch-maps accompany the text, and the French translation, which is prefaced by an introduction by Dr. J. Charcot, appears to have been excellently carried out by MM. G. Parmentier and M. Zimmermann. Dr. Nordenskiöld's chapters deal with the relief of land, ice conditions and effects, plant and animal distribution, climatic conditions and human life, and, where appropriate, with economic products.

Coast Erosion and Protection. By E. R. Matthews. Pp. xiv+147+33 plates. (London: C. Griffin and Co., Ltd., 1913.) Price 10*s.* 6*d.* net.

THE author of this book writes with a practical knowledge of the subject with which he deals. He holds the position of Borough Engineer of Bridlington, and has constructed sea walls, promenades, and sea defence works of considerable magnitude, which are good examples of what such work should be.

The book follows much the same lines as that on the Destruction, Littoral Drift, and Protection of the Sea Coast, published by Messrs. Longman and Co. in 1902, but it does not treat the question of Littoral Drift with the same detail. As that book is now out of print, and the author of the present book has had the advantage of the large body of evidence laid before the Royal Commission on Coast Erosion, this work will be a valuable aid to engineers called upon to take charge of sea defence works.

The text is very fully illustrated with numerous plates showing the effect of waves on sea walls and cliffs in course of erosion, and illustrations of sea walls, groynes, and other sea defence works. As these latter are clearly drawn, and have the dimensions of the several parts marked on, they cannot fail to be of great practical use.

The book is divided into twelve chapters, the subjects dealt with being: wave action; erosion and accretion of the shore; types and designs of sea walls; groynes; reinforced concrete; and the action of sea water on cement and concrete.

In his account of the erosion of the Yorkshire coast, the author repeats the old fallacy of the material eroded from those cliffs being carried southward by the tides and being deposited on the Lincolnshire shore, and also as being carried up the Humber. This subject was fully dealt with in a paper on the source of warp in the Humber, read before the Geological Section of the Glasgow meeting of the British Association in 1901, in which it was shown that it is practically impossible for this eroded material to be carried so far southward; and samples of water taken on several occasions of the water entering the Humber on the flood tide give no indication of alluvial matter being carried into that river.

I Fenomeni Magnetici Nelle Varie Teorie Elettro-Magnetiche. Note Storico-Critiche. By Silvio Magrini. Pp. 165. (Bologna: Nicola Zanichelli, 1912.)

THE scope of this interesting little volume, by an Italian author, is novel to English readers; at least, the present writer cannot recollect any other book devoted entirely to the history of the theory of magnetism. Oersted's fundamental discovery that an electric current gives rise to a magnetic field in surrounding space was important, not only as the starting point of electromagnetism, but also because, in the hands of Ampère, it became the basis of a theory designed to explain the physical nature of magnetism. Beginning at this point, the author passes in review the work of Poisson; Faraday's conception of lines of force, with its necessary recognition of the part played by the medium; the successful development of this idea in mathematical form by Maxwell; the theories of Weber and Ewing; the experimental work of Curie on diamagnetic and feebly magnetic substances; and finally, the modern electronic theory of magnetism as extended by Langevin, Weiss, Gans, and others. The various stages in the historical development are

clearly displayed, and, although more elementary in its treatment, the book is a worthy companion of Whittaker's well-known "History of the Theories of Elasticity and the Ether." An English volume of similar scope would be a very desirable addition to current text-books. R. S. W.

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 Theory of Radiation.

THE natural unit of angular momentum postulated by Dr. Wiels Bohr, of Copenhagen, in his researches on the theory of spectral lines actually exists. It is the angular momentum of the magneton. Rejecting entirely the idea of magnetic or electric substance, the magneton may be regarded as an inner limiting surface of the æther, formed like an anchor-ring. The tubes of electric induction which terminate on its surface give it an electric charge, the magnetic tubes linked through its aperture make it a permanent magnet.

I find that the angular momentum of any such system, whatever its shape or dimensions, about its axis of symmetry is $(8\pi^2 V)^{-1}\epsilon\mu$. V is the velocity of light, ϵ the electric induction over the surface, and μ the magnetic induction over the aperture. I shall consider elsewhere the applications to the theory of complete radiation, spectral series, and the asymmetrical emission of electrons in ultra-violet light. Only this need be mentioned. If an electron (charge ϵ) be thrown off from a magneton like a speck of dust from a flying wheel, then the angular momentum of the magneton changes by the amount $-1(2\pi V)^{-1}\mu$. This is therefore the angular momentum of the ejected electron about the axis of the magneton. Taking the velocity of ejection to be proportional to the angular velocity in the magneton, we have Ladenburg's result that the energy of the emitted rays varies as the frequency.

Dr. Bohr, by first insisting on the fact that Planck's h is an angular momentum, has done something of the greatest importance, whatever the ultimate fate of his particular interpretation. Dr. Nicholson has, I think, used the same idea.

G. B. MCLAREN.

University College, Reading, September 20.

Stability of Aëroplanes.

IN his experiments on the resistance of the air to spheres, M. Eiffel showed that for a certain critical velocity for a given sphere the resistance suddenly fails. The critical velocity appears to be very different for different spheres; *e.g.* in his paper (*Comptes rendus*, December 30, 1912) the sudden change is shown to begin at velocities of 12, 7, and 4 metres per second for spheres of diameter 16·2, 24·4 and 33·0 cm. respectively.

Suppose we make a triangular frame with one of these spheres at each corner and allow the frame to fall from a height. It would appear that if the weights of the spheres were so adjusted that the frame would maintain a horizontal position for a part of its flight, it must reach some velocity at which the equilibrium of the resisting forces would be destroyed, and rotation would ensue, tending to make the frame take up a vertical position.

If such a law holds for bodies of other shapes than spheres, it would appear that an aëroplane would have a much better chance of being stable in winds of great variety of velocities, if the resisting surfaces were all of the same size and shape.

I do not know whether this case has already been dealt with by others, and I make the suggestion for what it may be worth.

G. A. SHAKESPEAR.

The University, Birmingham.

The Pancreatic Treatment of Tuberculosis and Malaria.

THERE are two points in Dr. Saleeby's remarks upon p. 61 of NATURE (September 18, 1913) which I should like to notice briefly. In my letter to you on the same page I did not refer to Baetzner's brilliantly successful results in the treatment of tuberculosis by pancreatic enzymes (*The Practitioner*, January, 1913, pp. 203–219), because after his prolonged investigations the thing is *an accomplished fact*, which cannot be disputed by any interested in its operative treatment. I am neither a medical practitioner nor the apostle of a new faith, but merely a scientific investigator. I foresaw, and foretold, the complete success of this treatment of tuberculosis in 1907; and with the fulfilment of this scientific forecast at the hands of Dr. M. A. Cleaves in that year and of Dr. W. Baetzner more recently, my concern with the matter has ended. Moreover, I have taught medical students for more years than I care to think of, and I know how hopeless it is to try to teach something new of a scientific nature to the medical profession.

As to the *sexual phases* of the life-cycle in malaria, they are of no practical importance at all in the treatment of malaria by enzymes. A reference to Major Lamballe's original manuscript shows that the presence of such *sexual* phases had been verified in several of his cases. Like all the clinical symptoms, such as in grave cases, delirium and coma, these sexual phases vanished and did not return, when the Fairchild injections of trypsin and amylopsin were administered. These sexual phases, the so-called "crescents," have a scientific interest, but scarcely a clinical importance, as Major Lamballe also recognises. The disease is not continued by them any more than cancer is continued by the cells, to which Prof. Farmer gave the name of "gametoid tissue." Probably they are got rid of by the leucocytes, but, in any case, in ordinary circumstances the pancreatic ferments would be devoid of action upon such *sexual* phases, as my experiments upon various non-pathogenic micro-organisms demonstrated (*vide* Beard, J., on the occurrence of dextro-rotatory albumins in organic nature, *Biol. Ctrlblatt*, vol. xxxiii., pp. 150–170, 1913). J. BEARD.

8 Barnton Terrace, Edinburgh, October 1.

Relative Productivity of Farm Crops in Different Countries.

IN view of the repeated statements that British farming is declining and that the world is threatened with a shortage of wheat supplies, the following extract from the results of an investigation into the facts regarding both these questions may be of interest. Lack of space precludes reference to the

sources of information, the statement of the results for all countries, details as to the method of investigation, and so on, but the condensed tabular summary which follows is typical of the results as a whole :—

—		Wheat			Oats			Barley			Potatoes		
		(*a*)	(*b*)	(*c*)	(*a*)	(*b*)	(*c*)	(*a*)	(*b*)	(*c*)	(*a*)	(*b*)	(*c*)
United Kingdom	1.	1·4	3·4	2·4	4·2	6·9	1·6	5·0	9·4	1·9	5·3	6·8	1·3
	2.	1·0	2·3	2·4	3·9	6·0	1·6	3·9	7·3	1·9	4·0	4·9	1·2
	3.	0·7	1·7	2·4	3·4	5·0	1·5	2·6	4·7	1·8	3·4	4·5	1·3
France	1.	9·0	13·2	1·5	8·9	10·2	1·1	5·0	6·0	1·2	13·5	15·6	1·1
	2.	8·1	11·8	1·5	8·7	8·3	1·0	3·9	4·5	1·2	11·1	10·4	0·9
	3.	6·7	9·8	1·5	7·6	7·9	1·0	2·5	2·9	1·2	10·5	8·6	0·9
Russia	1.	15·7	10·7	0·7	34·3	22·0	0·6	25·8	16·3	0·6	14·2	8·3	0·6
	2.	17·2	11·6	0·7	33·0	22·4	0·7	30·9	21·0	0·7	24·6	16·4	0·7
	3.	19·6	14·3	0·7	32·3	22·8	0·7	30·0	21·7	0·7	28·0	19·7	0·7
United States ...	1.	19·3	18·7	1·0	22·6	24·8	1·1	5·6	7·0	1·3	9·2	5·0	0·5
	2.	20·5	21·6	1·0	24·0	2·7	1·0	5·5	6·8	1·2	8·9	4·7	0·5
	3.	19·6	20·4	1·0	24·1	25·1	1·0	8·1	10·3	1·3	8·9	5·5	0·6
		(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
World changes in yield per acre ...		100	103	113	100	112	122	100	166	115	100	108	114

Decades—(1)=1881–1890. (2)=1891–1900. (3)=1901–1910.
(*a*) Percentage of world's acreage. (*b*) Percentage of world's crop.
(*c*) Ratio of (*b*) to (*a*)=relative productivity per acre.

Column (*a*) gives the average percentage acreage for the three last decades, and column (*b*) the average percentage total crop; France is typical of the countries which have declined, and Russia of those which have improved under these heads. Column (*c*) measures relative productivity, which has been practically constant all the world over for the three decades. Information is added to show the increases which have taken place for the world as a whole in relative yield per acre.

The end of the nineteenth century may be considered as the close of a commercial revolution due to improved communications and transport, &c., and therefore the period under review is notably distinct from earlier epochs, so that the relative constancy of the productivity of these and other crops may be held to be a characteristic of this revolutionary period. Farming is a world business; improved results are common to all countries. The figures are instructive with reference to the threat of a world famine, *e.g.* if Russia only improved to the level of the United States, there would be an increase of 6 per cent. in the world's crop of wheat. At the same time it becomes obvious that the British farmer is the most successful farmer in the world; he always obtains a higher yield for each acre of land he tills. These are but the most important conclusions to which these results point; others may suggest themselves to your readers.

B. C. WALLIS.

Granville Road, North Finchley, N.

The Elephant Trench at Dewlish—Was it Dug?

I WAS not aware that it had occurred to Mr. Clement Reid, before it had done so to me, whether the Elephant Trench might have been excavated by man. He does not refer to this in his survey memoir on the Dorchester district; and so far as I can recollect he did not mention it when I described the trench with lantern slides at the meeting of the British Association at Cambridge in 1904. He now states (NATURE, Sept. 25) that he is convinced that the trench was due to *natural agencies*, and suggests that it was "probably wind-cut by the swirl of the fine dust-like quartz sand which, mixed with polished flints, now fills the lower part."

For my part I cannot imagine how such a trench could have been formed in that manner. He says that he found the sides of the trench "curiously smooth, and no tool marks nor rubbings such as might be made by man working in the trench, or by wild beasts," and also that the flint nodules projected into the cavity from either side as though the softer chalk had been scoured away. The fine sand which partially fills the trench is, I think, to all appearances wind-borne; and during the long interval which probably elapsed before the trench had become filled up by natural agencies the surface of its walls would have become weathered away, and, possibly abraded by the sand, leaving the courses of flints projecting, and completely obliterating any tool marks.

Mr. Reid remarks: "If this sand-filled fissure is found to continue downwards, but is too narrow for a man to work in, it will show that the trench is not artificial." On the other hand, my late lamented friend the Rev. R. Ashington Bullen wrote to the *Geological Magazine* (July, 1910, p. 334), describing a pitfall to catch antelopes. It was 10 ft. deep, 2 ft. wide at the top, narrowing at the bottom to a *few inches*.

I may, however, say that when I dug at the end of the trench on the hill-face I came to the conclusion that the bottom of the trench was a flat chalk surface, and near the bottom I found some angular coarse gravel, and among it a nearly worn-down molar along with the polished flints. If, as Mr. Reid suggests, the trench was excavated by wind, which appears to me impossible, all the flints corresponding to the chalk so removed ought to lie, now, unbroken at the bottom, but in my notebook I find the remark that the flints in this gravel did not appear to have come "from the chalk direct."

I am extremely glad that Mr. Reid's interesting reply to my letter shows that I have succeeded in directing the attention of geologists to this, as I believe, important question.

O. FISHER.

Graveley, Huntingdon, September 26.

REFERRING to Mr. Clement Reid's letter on the origin of the Elephant Trench at Dewlish, in NATURE of September 25, on the Yorkshire wolds holes are not infrequently scooped out of the chalk by what are locally termed "cloudbursts." One such, 13 ft. deep, occurred in the parish of South Cave last year.

G. W. B. MACTURK.

15 Bowlalley Lane, Hull, October 4.

A New Poet of Nature.

READERS of *The English Review* must be inured to shocks; but among the revolutionary visions which its young men have seen, surely nothing more startling has been recorded than this, which I extract from a short poem entitled "Early One Morning":—

"Have you heard what the young moon said to me
As I walked in the morning early?

. . . . . .

She lay on her back and laughed at me
As I walked in the morning early."

W. D. E.

TRAVEL IN TIBET.

(1) IN a third volume Dr. Sven Hedin concludes the popular account of his Tibetan expedition of 1905–8, of which the main instalment was published four years ago. The present volume collects "all the material for which there was no room" in the previous two tomes. This includes a description of the explorer's journey northwards from the Mānasarowar Lake to the source of the Indus, which Dr. Hedin was the first European actually to penetrate, and of the well-known route from that lake along the Sutlej Valley back to Simla. Added to this are miscellaneous extracts from the books of previous writers and travellers on a variety of Tibetan topics, also a polemical defence of the author's discovery of the "Trans-Himalaya," a claim which has been disputed by a writer in the *Geographical Journal*, on the ground that the existence of that range was undoubtedly known in a general way over a generation ago. The breezy, rollicking narrative reflects the abounding enthusiasm of the author, and couched largely in dialogue form it reads almost like a romance, conveying at times the impression of a holiday romp rather than a rigorous journey achieved only by the painful toil of man and beast.

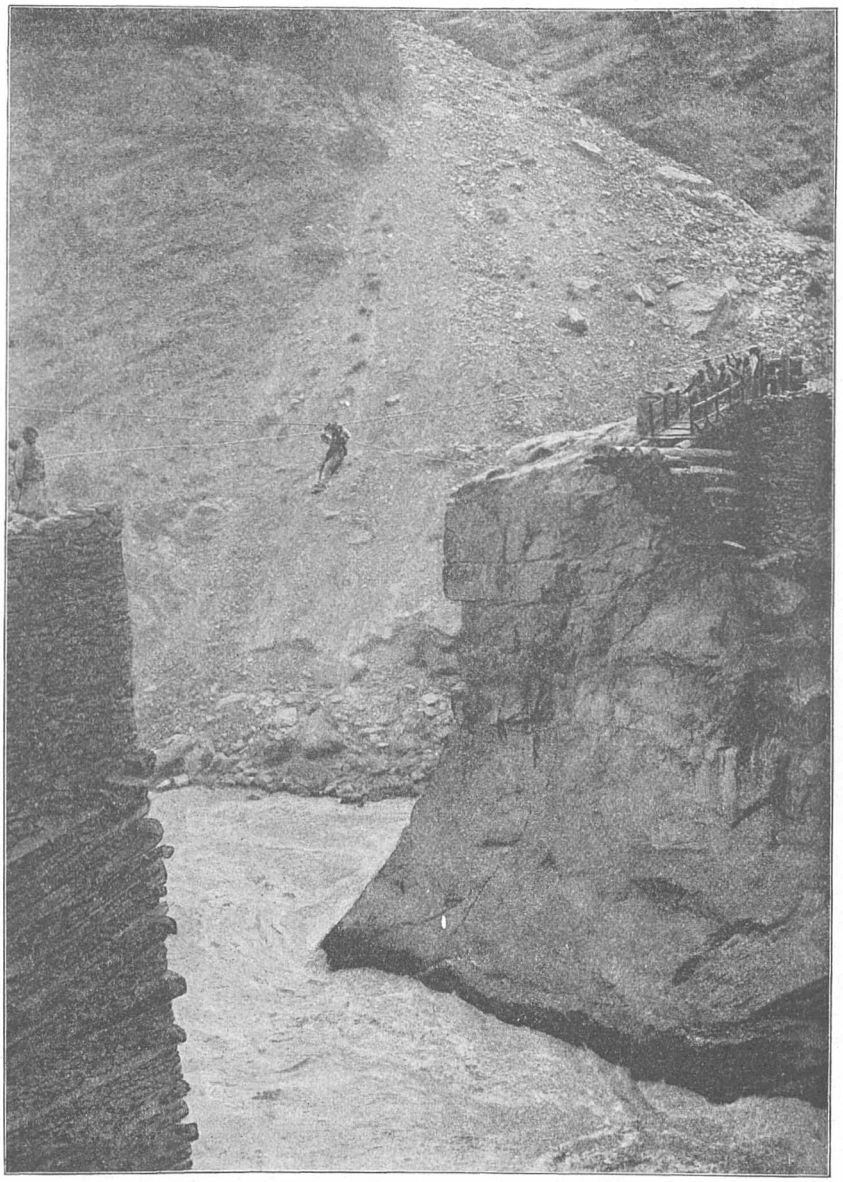


FIG. 1.—"I dangle between Heaven and the murderous Sutlej." From "Trans-Himalaya."

Of the scientific results, "which will shortly be issued," it is mentioned that the geological specimens (1170 in number) have enabled Prof. A. Hennig, of Lund, to say that the older sedimentary rocks of the Trans-Himalaya generally resemble those found on the northern flanks of the Himalayas near Gyantse and Lhasa in Central Tibet. They consist of Jurassic quartzites and phyllitic schists, with subordinate beds of slaty crystalline limestone, which is so strongly metamorphosed that if it did originally contain fossil remains these are quite destroyed. The series is penetrated by an intrusive formation which has suffered metamorphosis by pressure, and therefore is older than the other. The eruptive formation is obviously part of that found in both the eastern and western Himalayas, and ascribed to the Eocene age, and consists in the Trans-Himalaya of intrusive granites, pegmatites, porphyries, &c., with vitrified surface lavas, basalts, and sub-aërial volcanic tuffa. It is noteworthy that the Brahmaputra Valley, which separates the Himalayas from the Trans-Himalaya, must be considered as "a deeply excavated *erosion*-valley, and that faults do not play the leading part here which Oswald has assigned to them in his article based on Dr. Sven Hedin's preliminary communications."

Some mistakes are noticeable in respect to the legends and etymologies of the names of the great rivers rising in the vicinity of Mount Kailas, the Hindu Olympus, and require emendation. They

[1] (1) "Trans-Himalaya: Discoveries and Adventures in Tibet." By Sven Hedin. Vol. iii. Pp. xv+426+plates+maps. (London: Macmillan and Co., Ltd., 1913.) Price 15s. net.

(2) "The Land of the Blue Poppy: Travels of a Naturalist in Eastern Tibet." By F. Kingdon Ward. Pp. xii+283+xxxix+plates+5 maps. (Cambridge University Press, 1913.) Price 12s. net.

are perhaps due to the indirect process made use of in interrogating the Tibetans, of which the author states "I spoke Jagatai Turkish with my men, and Rabsang translated for me into Tibetan." Thus, we read "Mānasarowar means 'Mĭnasa the most beautiful of lakes.' Mānasa means 'created by the soul,' for the lake was created by the soul of Buddha." In this equation our author has evidently confused Brahmā with Buddha. For there is no authentic Buddhist legend associating Sakya Muni or his "soul" with the creation of this lake; indeed, that teacher as an elementary part of his doctrine denied the existence of a soul altogether. On the other hand, Brahmā in Hindu myth is often linked with this lake, doubtless because "*Mānasa*," meaning in Sanskrit "mental or spiritual," or "produced by the mind," is an epithet of Brahmā, and Kailas, the Olympian abode of the other gods created by Brahmā, adjoins this lake. To say that *sarowar* means "the most beautiful of lakes" is neither literally correct nor appropriate. No photograph of that lake is given in the present volume, but no one who has seen this desolate lake, as the writer of this note has, could think of calling it "most beautiful." The word really means "the great lake," or literally "the best or sacred lake," but with no sense whatever of "beautiful." Similarly, the Brahmaputra, the source of which is known to the Tibetans as "the river of the horse's mouth," is, we are told, "so named in honour of Buddha's steed," though, as a fact, neither Buddha nor his steed are denoted in this name, nor is there any authentic legend of such relationship current amongst Tibetans. Again, the statement that "'Singi-kamba' [='the lion's mouth'] the Indus, refers rather to the tiger than the lion," is a mistake, as "*Sing*" means only "lion," and not tiger; and lions are not even yet extinct in the mid-Indus valley, where they are believed to have been formerly generally distributed. The volume is enriched by numerous excellent photographs and sketches, which are admirably reproduced, and add greatly to the attractiveness of the book.

(2) Under the title of the "Land of the Blue Poppy," Mr. Ward, son of the late Professor of Botany at Cambridge, describes his travels on the Chinese border of Eastern Tibet, as a collector of decorative plants for a firm of florists. In this work he spent several months in 1911 in the upper valleys of the Yangtse, Mekong, and Salwin, with his headquarters at the missionary station of "A-tun-tsi" (the A-tun-tzu of the maps), on the north-west frontier of Yunnan. As a result he gathered many rare plants, including more than twenty new species, amongst which was the *Meconopsis*, named after him, and giving the title to his book; also two new voles. Although he displays no very intimate acquaintance with the writings of previous travellers in those regions, his narrative is pleasantly written, and contains some observations of general interest.

The extensive cultivation of opium-poppy, in "solid fields" and otherwise, which he noticed in Western Yunnan, is of political importance at the present time, when India is depriving herself of enormous revenue from opium solely in the interests of assisting China to stamp out the vice of opium-eating, and on the express condition that China herself ceased all cultivation of that drug. On one of the occasions on which Mr. Ward lost his way, and wandered alone for several days in the wilds, he ate a quantity of rhododendron corollas for their nectar, and was surprised to find them poisonous—forgetful of the toxic Pontine honey described by Xenophon, and usually ascribed to rhododendron or azalea. With the exception of *R. arboreum* the Himalayan species are generally regarded as poisonous.

Of the Tibetan character and hospitality he

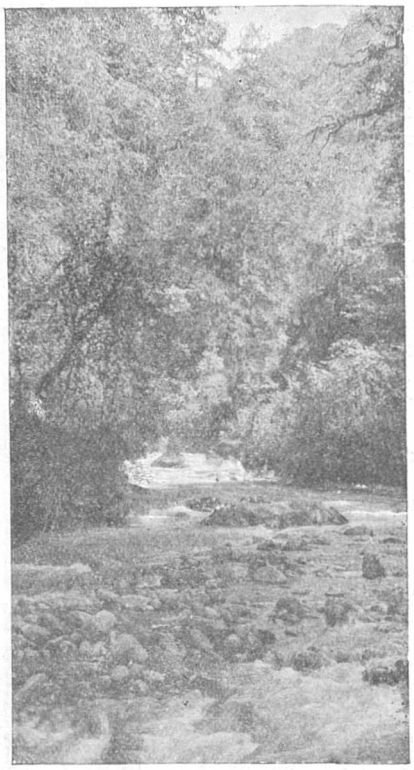


FIG. 2.—The Salween Forests in Summer, Mekong-Salween Divide, 8,000 feet. From "The Land of the Blue Poppy."

speaks with much enthusiasm. In the dress of the Tibetan men he remarks as "very curious a section of an elephant's tusk threaded on to the queue"—this doubtless is the thumb-ring of the ancient bowmen, whose dress the modern Tibetan dandy imitates, and binds the ring on his coiled pigtail when not worn on the thumb on ceremonial occasions. Other border tribes of much ethnological interest amongst which he passed were Lissu, Lutzu, Minchia, "Lama," Pe-tzu, Chu-tzu, and Mosso. The last-named is of especial interest as possessing an elementary hieroglyphic writing, somewhat like that of the Hittite, the origin and development of which is still unsolved, though specimens have been published by Captain Gill, Prince Henri, and Mr. Forrest. Yet our author makes no reference to this matter. He

encountered several hot-springs, but unfortunately took no record of the temperature, nor indicated their location exactly, as a guide to future travellers desirous of making precise scientific observations.

The oft-discussed question of the geological causation of that remarkable wrinkling of the surface of south-east Tibet into a series of parallel valleys, through which the great rivers rush southwards, is not advanced nearer to a solution by the vague theories indulged in in the last chapter. These hypotheses, which are not even new, are not based on examination of the actual rocks, and are uninformed by the many facts collected by the experts of the Indian Geological Survey and others. The great river of Central

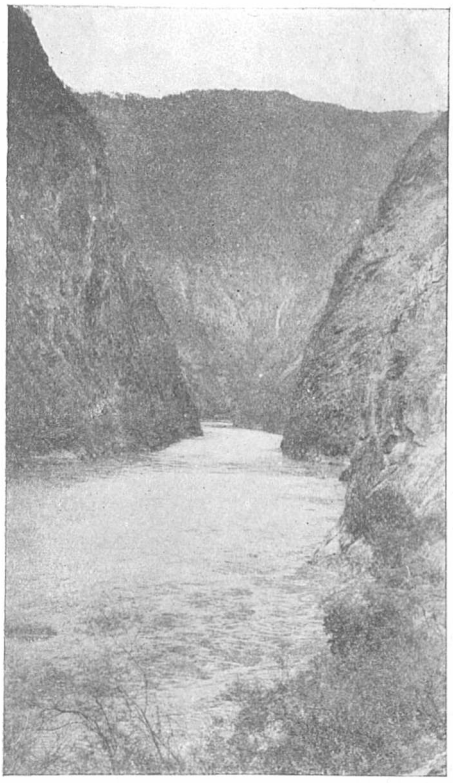


FIG. 3.—The Salween in the arid region, below La-Kor-ah. From "The Land of the Blue Poppy."

Tibet is not usually spelt "Bramapootra" nowadays. Notwithstanding its scientific deficiencies as "the journal of a naturalist," the book gives a lively popular account of adventurous travel off the beaten tracks, and the numerous photographs convey a good idea of the country traversed.

THE OCCURRENCE OF OIL SHALE AMONG THE JURASSIC ROCKS OF RAASAY AND SKYE.[1]

THE Geological Survey of Great Britain in the course of their investigations in the Isle of Skye have discovered an oil-shale which may ultimately prove of economic importance, and as notices of the discovery have appeared in the daily Press, it is desirable that the facts so far as they are known to the Geological Survey should be placed on record without further delay. The discovery was made by Dr. G. W. Lee, who has written the following account:—

The stratigraphical position of the shale is at the very base of the Great Estuarine Series, a group which succeeded strata containing a fauna of Garantiana age (high in the Inferior Oolite),

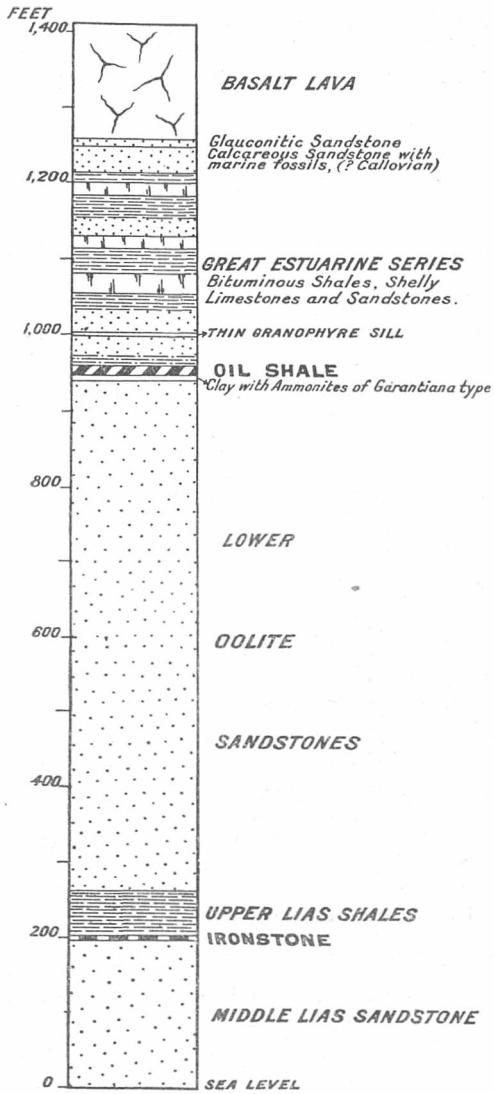


Diagram section illustrating the sequence of the Jurassic rocks below Dùn Caan, Isle of Raasay.

and is overlain by Kellaways Rock. The shale itself yields fossils. They include Entomostraca, a flattened lamellibranch, and plant remains. Since it rests immediately on the marine Garantiana clay, it follows that the incoming of estuarine conditions must have been a sudden one.

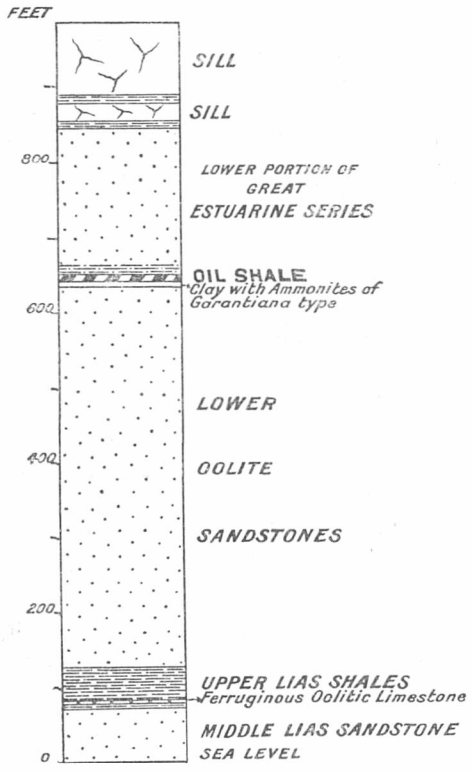
The shale is brownish in colour, fine in grain, gives a wooden sound under the hammer, and has a brown streak. It is tough and resists disintegration by weathering, a character which

[1] Communicated by the Director of the Geological Survey of Great Britain.

distinguishes it from the bituminous shales found throughout the Estuarine Series, all of which crumble into small fragments. It is so far known only from natural exposures, where through weathering, it assumes a lilac or yellowish coating.

The thickness of the seam at the outcrops may be taken to be from seven to ten feet, but its passage into the overlying sediments is gradual.

The samples so far analysed were much weathered, so that we are not yet in possession of exact data concerning the yield of oil and bye-products from the fresh shale. That the fresh shale might be expected to yield more than weathered portions seems probable, but to what



Diagrammatic section illustrating the sequence of the Jurassic rocks in the cliff between Holm and Prince Charles's Cave, Isle of Skye.

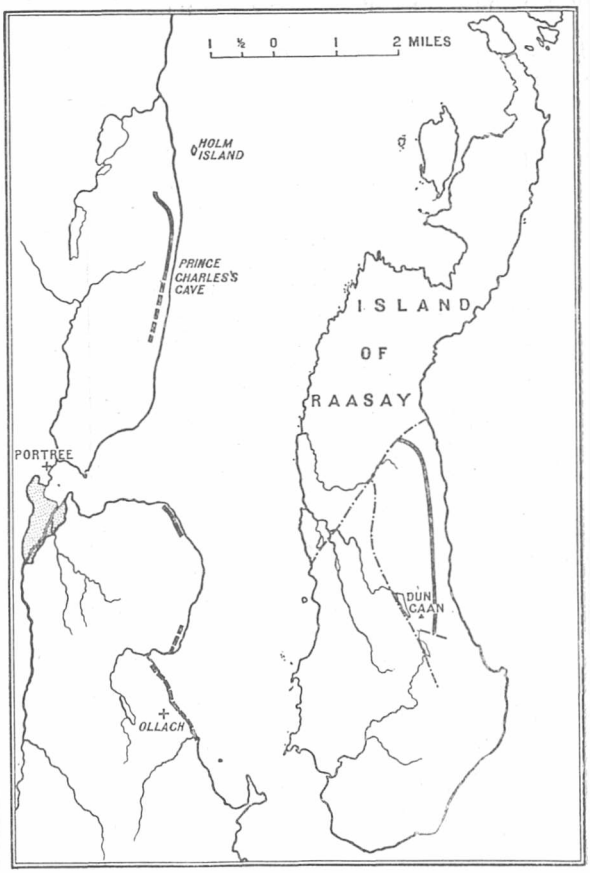
extent is not known, and it is on that that the industrial possibilities of the find depend.

A sample from the outcrop where the shale was first detected in Raasay gave 12 gallons of crude oil per ton of shale, with 6·2 lbs. of sulphate of ammonia, which is equivalent to at least 12 lbs. in a works retort.

A compound sample from the Skye coast between Holm and Prince Charles' Cave yielded 12·8 gallons of crude oil per ton, and 7·4 lbs. of sulphate of ammonia. Mr. D. R. Steuart, who kindly undertook these tests, states that the samples were so weathered that he did not expect to get any oil. Consequently these results indicate that the shale is worth further investigation.

Before the period of denudation which removed so much of the Scottish Jurassic rocks, the shale probably extended over a large area. Still, the portions that escaped denudation are not inconsiderable. In Raasay the field occupies an oblong area stretching from Dun Caan northwards to the boundary fault which throws the Mesozoic rocks against the Torridonian. It is three miles long, with an average width of seven-eighths of a mile, which diminishes southwards. The strata are not folded, but have a dip of about 10 degrees to the west.

In the Portree district of Skye there was once



Sketch map showing the outcrops of the Oil Shale.
Oil Shale.
Oil Shale, where burnt by contact action of igneous rocks.
Faults.

an extensive field, of which much has been destroyed by the contact action of intrusive rocks. The crop has been traced from Ollach—five miles south of Portree—to the Holm burn—five miles north of Portree. The outcrop south of Portree shows much alteration from heat, except between the Tom cave and the Clach Dubh. North of Portree the destructive action of the intrusions is felt as far as Prince Charles' cave, but between that point and the Holm burn—one and a half miles further north—the shale has escaped the action of igneous rocks. There is no inland exposure of the oil shale horizon, which is everywhere covered by higher beds; consequently the

probable extent of the field towards the west cannot be estimated. But the dip being low the shale would be within practicable reach for some distance inland. In the cliff section between Bearreraig and Upper Tote, that is north of the point just considered, the shale facies is replaced by a sandstone facies.

THE ADDRESSES AT THE MEDICAL SCHOOLS.

THE first of October is the opening day of the winter session of our medical schools; and in many of them it is made the occasion of an address, given by some person of high authority. The addresses this year include a wide range of subjects. Mr. Handley, at the Middlesex Hospital, gave a very pleasant discourse on the "renegades of medicine," the men who have forsaken medicine for some other profession, not without advantage to themselves and us—Keats, Goldsmith, Bridges, Huxley, Livingstone, and many more. It is a new subject, and worth working out; but we are not sure that Mr. Handley got hold of the right end of the moral. Sir William Osler at St. George's, Dr. Hunter at Charing Cross, and Prof. Sherrington at Leeds, spoke on certain problems of medical education. Sir John McFadyean, at the Royal Veterinary College, spoke on the working of the new Tuberculosis Order of the Board of Agriculture. He stated that the number of milking or dairy herds in England and Scotland free from tuberculosis was practically negligible; and he urgently advised the owners of valuable pedigree herds, as a matter of their own profit, to eradicate the disease among their animals. He also advised that contagious abortion in cows, and Johnes's disease, should be brought under the Contagious Diseases of Animals Act.

Two of the October addresses this year are of especial interest—one, at the London School of Medicine for Women, by Sir Charles Lukis, Director-General of the Indian Medical Service; the other, at St. Mary's, by Sir John Hewett, sometime Lieut.-Governor of the United Provinces. These two addresses, by men of profound experience and unquestioned authority, should be read carefully by all who want to know what the medical profession is accomplishing, and what it hopes to accomplish, for the peoples of India.

Sir Charles Lukis, speaking to women students, appealed to them for personal service. His appeal, full of wisdom and of sympathy, ought not to fail: for the work done in India by medical women is some of the very best work in the world. He spoke, especially, of the imperative need of more teaching and more acceptance of ordinary rules of sanitation, not only for the prevention of the spread of malaria, plague, and tuberculosis, but for the prevention of food-infection, and water-infection. It is our medical women who alone can get the women of India to help in this good work. "Ladies who have spent all their lives in England are apt to regard their Indian sisters as being very downtrodden and oppressed. This is a grave mistake. Out of doors the man is lord of creation, but once he is inside the house he is absolutely controlled by his wife and mother in all matters concerning domestic economy and the family life. Indeed, I know of no country where the woman is more absolutely the mistress of the house than she is in India; and I am convinced that we shall never make any real headway in promoting the knowledge of domestic and personal hygiene until we have convinced the women of India as to its necessity, and they have thrown their powerful influence into the scale. Here the medical man is useless—the *purdah* bars the way, and it is to the medical woman that we must look." Sir Charles Lukis went on to speak of infant mortality in India, and of its relation to early marriage, and to the native methods of midwifery. Then he described fully the improved scheme for a women's medical service for India, and the plan for a medical college for women to be established in Delhi. Every word of his address is worth reading.

So is every word of Sir John Hewett's address on the work of the medical profession in India. He spoke first of the improved health in the Army, and in the jail population. "The mortality among the wives of soldiers has been reduced to one-third of what it formerly was, and that among their children to one-half." The death-rate among the native troops has come down from more than 20 per thousand in 1871–1880 to less than 7 per thousand in 1911. The death-rate among the jail population has come down from 71 per thousand in 1831–1856 to 18 or 19 per thousand in 1911. Sir John Hewett then spoke, with strong feeling, of the errors of anti-vaccination and anti-vivisection. Truly, in view of the facts of India, they are worse than errors. "It is surely calamitous that the opponents of vaccination in England should have set themselves to make the people of India hostile to a process which has brought them so much benefit." To the anti-vivisectionist, we commend Sir John Hewett's statement of the results of the protective treatment against plague, typhoid, and hydrophobia in India. These results are not only a final verdict against anti-vivisection; they are a magnificent record of the saving of the lives of men, women, and children.

SCOTTISH ORNITHOLOGY IN 1912.[1]

THIS report supplies in an epitomised form the results of the activities of Scottish ornithologists during the past year. It is a comprehensive and well-arranged booklet of ninety-six pages, and is both useful and important, since it affords much information hitherto unpublished, as well as a *résumé* of all that has appeared in serial literature during the period covered. A pleasing feature is to be found in the fact that these well-known lady ornithologists have themselves contributed materially to the year's opera-

[1] Report on Scottish Ornithology in 1912, including Migration. By Leonora Jeffrey Rintoul and Evelyn V. Baxter, hon. members of the British Ornithologists' Union. (Edinburgh: Oliver and Boyd; London: Gurney and Jackson. Price 1*s* 6*d*. net.

tions by their investigations made during a two months' residence in the lighthouse at the Isle of May—a famous bird observatory situated in the North Sea off the mouth of the Firth of Forth. There are also contributions from nearly one hundred observers, posted between the Muckle Flugga (the northernmost limit of the British Isles) and the shores of the Solway and Tweed. This vast amount of material has been arranged under the following headings: birds new to Scotland; uncommon visitors and species new to faunal areas; extension of breeding range; hybrids; summer and nesting; winter; ringing; plumage; food, habits, &c.; and migration.

Much that is interesting is recorded under all these headings, but the special feature of the report lies in the wealth of data from the numerous islands—the most important, in some respects, of all bird stations.

These insular records relate mainly to the spring and autumn passage-movements of those feathered voyagers which traverse our shores when *en route* between their accustomed northern summer haunts beyond our isles, and their winter retreats lying to the south of them. These birds form by far the most numerous class of migrants that visit the British area. At such stations, especially the northern stations, the comings and goings of these travellers are to be observed free from the complications that arise on the mainland through the presence of birds of the same species which are simply local natives or engaged in local movements. In addition, the recent attention devoted to island stations has resulted in the garnering of a remarkable crop of records on the occurrence of rare visitors, some of them mere waifs, while others formerly considered such have unexpectedly proved to be annual in their appearances—among others the yellow-browed warbler, red-spotted bluethroat, little bunting, ortolan bunting, and grey-headed wagtail.

The year 1912 was remarkable for the number of rare species detected at Scottish stations. These included the black chat, northern bullfinch, scarlet grosbeaks, little buntings, Richard's pipit, red-breasted flycatchers, Blyth's reed warblers, icterine warblers, barred warblers, snowy owl, Tengmalm's owl, broad-billed sandpiper, Temminck's stints, little bustard, &c., the visits of which are duly recorded along with the particulars relating to their occurrence.

In conclusion Scottish ornithologists have every reason to be satisfied with the results of the year's investigations and may congratulate themselves on the able and excellent manner in which these results are set forth in the report.

W. E. C.

NOTES.

A FEW days ago (October 2) the daily Press published sensational paragraphs to the effect that Sir Frederick Treves had announced, at the Radium Institute, "a complete revolution in the future of radium." When analysed, the "revolution" amounts to little more than a statement that the Radium Institute has begun to collect radium emanation in sealed glass tubes, and to issue the tubes to doctors for the treatment of their patients. It was assumed by the literary young men who write the leaders and notes in the daily papers that radium emanation had just been discovered instead of being known and named for ten years or more, so they let their enthusiasm overstep the bounds of their knowledge. Even the method referred to by Sir F. Treves is not new; it was published in *The Lancet* on December 11, 1909, p. 1742 ("On the Use of Radium for Local Application within the Body," by Dr. Alfred C. Jordan), and this paper is quoted and fully abstracted by Dr. Dawson Turner in his book on "Radium: its Physics and Therapeutics" (Baillière, Tindall and Cox, 1911), pp. 27 and 28. In *The Lancet* the glass tube containing the emanation was directed to be enclosed in a tube of lead "compo" of 1 mm. thickness, and this in its turn in a length of rubber tubing. Of course, these tubes must be used at once, for the emanation decays to one-half its initial strength in three and a half days. A tube of initial strength equal to 10 mg. of radium may be placed in contact with a tumour, and left to "decay" there. It will be understood that emanation used in this way (in sealed tubes surrounded by 1 mm. of lead) depends for its action on its γ rays and its hardest β rays, the glass stopping all the α radiation, while the lead absorbs most of the β rays. Very different is the action of free radium emanation, as in radio-active waters. In the latter case the α particles are able to bombard the tissues at close quarters; the action of the β and γ radiation then becomes negligible, possessing no more than one-hundredth part of the energy of the α radiation. Great care must be used in applying α radiation to the tissues, for the destructive action is most pronounced. Good results have been obtained with radium in many diseases, but the hopes of the public as well as the medical profession are centred round the treatment of cancer. Even in this dreaded disease many favourable results have been reported both with radium and with the Röntgen rays, but unfortunately disappointments are far more frequent than cures.

THE year 1914 is the centenary of the birth of Sir John Lawes, and 1917 is that of Sir Henry Gilbert; and it is proposed by the Society for Extending the Rothamsted Experiments to raise the sum of 6000*l.* by public subscription for the purpose of erecting a suitable commemoration laboratory at the Rothamsted Experimental Station. It is understood that if 6000*l.* is raised in this way, a further grant of 6000*l.* can be obtained, making a total of 12,000*l.* altogether, for which sum an adequate building could be put up. The rapid development of agricultural chemistry and bacteriology, and particularly of the special branches associated with Rothamsted—the composition of crops and the study of the soil in relation to the plant—has necessitated further increases in the laboratory staff, and has attracted a number of voluntary workers. For all these more modern accommodation is required than can be obtained in the older part of the present buildings. The work of Lawes and Gilbert not only laid the foundations of agricultural

chemistry as a science in this country, but did much to improve British agriculture and raise it to its present high level. It also played a great part in developing the artificial fertiliser industry, which has remained an essentially British industry and has now assumed vast dimensions. The whole country has gained enormously through the work of these two men. It is therefore felt that the appeal should be national, and several committees have been formed for the purpose. Men of science have many calls on them, but it is hoped, nevertheless, that the sympathy which everyone feels with the Rothamsted work will manifest itself by practical assistance towards its development. Subscriptions should be sent to the Secretary, Rothamsted Experimental Station, Harpenden, Herts.

IT is with great regret that we record the disappearance of Dr. Rudolph Diesel from the G.E.R. steamer *Dresden* on her voyage from Antwerp to Harwich on the night of September 29; the circumstances are such as to leave no hope of his being alive. Dr. Diesel will be remembered as the inventor of the oil engine which bears his name. Born in Paris in 1858, of German parentage, his training included courses at the Augsburg technical schools and at the Munich Technical College. His first published description of the Diesel engine appeared in 1893; aided financially by Messrs. Krupp and others, the next few years were spent in arduous efforts to realise the principle of his engine in a commercially successful machine. The difficulties to be overcome were very great. In the earliest attempt, compression of the air was effected in the motor cylinder and the fuel injected direct. This engine exploded with its first charge and nearly killed the inventor. The modern Diesel engine compresses the air in the motor cylinder to a pressure above 400 lb. per square inch, during which process the air becomes hot enough to ignite the fuel. At the end of compression, the fuel is injected by means of a separate air supply at a pressure higher than that in the cylinder. Nothing of the nature of an explosion occurs in the cylinder; the oil burns as it is injected, and, as the piston is moving outwards at the same time, the pressure does not rise to any extent. The fuel consumption of these engines is remarkable, being roughly one-half of any other type of oil motor. Engines both of a two-stroke cycle and of a four-stroke cycle are now being developed by many firms both on the Continent and in Britain. In Dr. Diesel's opinion the two-stroke engine would probably be the standard type for marine purposes. Marine Diesel engines of very large power have not yet been constructed, but many important experiments in this direction are being made. Dr. Diesel's loss will be regretted by men of science on account of his efforts to interpret practically the Carnot ideal cycle, and by engineers on account of the immense strides which his untiring energy and indomitable pluck have made possible.

SIR WILLIAM CHRISTIE, K.C.B., F.R.S., formerly Astronomer-Royal, has been elected Master of the Clockmakers' Company.

THE death is announced, at fifty-four years of age, of Dr. W. Carnegie Brown, joint secretary of the Society of Tropical Medicine and Hygiene, and author of papers on malaria and diseases of the tropics.

IT is announced in *The Athenaeum* that in consequence of the efforts of Dr. C. Holder and others, extending over many years, the Legislature of California has constituted the island of Santa Catalina a fish refuge. In future there will be no netting within three miles of the shore of the island.

THE first ordinary meeting of the Medical Society of London for the session 1913–14 will be held on Monday next, October 13, when the new president, Sir David Ferrier, F.R.S., will deliver his inaugural address. The Lettsomian lectures of the society will be given on February 2 and 16 and March 2 by Dr. F. M. Sandwith, who will treat of the subject of dysentery.

ACCORDING to *The Electrical Review*, a wireless receiving installation has been set up in the cathedral at Florence by the director of the Florence Observatory. All the parts of the equipment are within an enclosed space, the antennæ being within the building. Messages have been received from Paris, Toulon, and Madrid, the efficiency of the receivers being, it is stated, only slightly less than if in the open air.

A PUBLIC meeting in connection with the ninth quinquennial festival of the Royal Albert Institution, Lancaster, will be held at Lancaster on Tuesday, October 21, when the following addresses will be given:—"The Feeble-minded: Historical Retrospect," Sir T. Clifford Allbutt, K.C.B., F.R.S.; "The Future of the Royal Albert Institution," Sir J. Crichton Browne, F.R.S.; "The After-care of the Feeble-minded," Dr. C. H. Bond.

THE fourth exhibition of models, tools, and scientific apparatus, organised by the proprietors of *The Model Engineer*, will be held at the Royal Horticultural Hall, Westminster, S.W., on October 10–18. Special rooms are to be devoted to wireless telegraphy in operation, and to aëroplane models of all kinds, while a completely equipped workshop will be manned by members of the London Society of Model and Experimental Engineers, who will give demonstrations of model-making and workshop operations.

A CONFERENCE of members of the Museums Association and others interested in similar work is to be held at the Warrington Museum on Thursday afternoon, October 30, for the purpose of discussing subjects of common interest to those concerned in the work of museums, art galleries, and kindred institutions. Offers of papers or suggestions of suitable subjects for discussion should be sent to Mr. C. Madeley, director of the Warrington Municipal Museum.

A DEMONSTRATION of the results of his researches into the pathology of rabies will be given on Monday next to the Royal Society of Medicine by Dr. Hideyo Noguchi, of the Rockefeller Institute. Dr. Noguchi proposes to show pure cultures of various pathogenic

and saprophytic spirochætæ; to demonstrate the presence of treponema pallidum in the brain in cases of general paralysis; to show experimental general paralysis in rabbits; and to give a demonstration of cultural studies of the virus of rabies.

IN response to numerous requests, it has been decided to defer until October 31 the closing of the Historical Medical Museum, referred to in our issue of July 3 (vol. xci., p. 456). During the month of October the exhibition will remain open from 10 a.m. to 6 p.m. daily, and from 10 a.m. to 1 p.m. on Saturdays. After this date it will be closed for a few months for re-arrangement as a permanent museum. It is proposed to reopen the museum in its permanent form in the spring of next year.

A MODERATELY strong earthquake was felt in the neighbourhood of the Panama Canal during the night of October 1–2, and has evidently caused some concern with regard to the safety of the canal from future shocks. It would seem, however, that there is little need for anxiety. Though other adjoining districts are frequently visited by destructive earthquakes, the isthmian zone itself is singularly free from such disturbances. Moreover, as Milne and Omori have shown, earthquake vibrations are much less intense in excavations than on the surface of the surrounding land.

IT is announced in *Science* that the Walker prizes in natural history of the Boston Society of Natural History for the present year have been awarded as follows:—The first prize of 100 dollars to Dr. R. A. Spaeth for a paper on an experimental study concerning the chromatophores of fishes, and the second of 50 dollars to Prof. O. D. von Engeln for a paper on the effects of continental glaciation on agriculture. Prizes for 1914 and 1915 will be awarded for original and unpublished research work in any biological or geological subject. Competing essays must reach the secretary of the society on or before April 1 next.

MAJOR BARRETT-HAMILTON, accompanied by Mr. Stammwitz, one of the taxidermists on the staff of the British Museum (Nat. Hist.), sailed in a whaler on Saturday last for South Georgia, on a mission from the Colonial Office, to report on the whaling stations leased by the British Government to a Norwegian firm. The species hunted at the South Georgian stations are chiefly rorquals, of which the slaughter is reported to be very heavy; and we understand that the main object of the mission is to ascertain whether the whales stand in danger of extermination. The taxidermist will endeavour to obtain specimens (not, of course, entire whales) for the museum.

MR. ALVIN LANGDON COBURN'S exhibition of camera pictures, which is to be seen at the Goupil Gallery, 5 Regent Street, until October 25, is well worth a visit from anyone interested in artistic photography. The series of pictures of the Grand Canyon exhibit this remarkable region in a new light. Mr. Coburn's photographs, all enlargements from quarter-plate negatives, are as far apart from Hayden's well-known topographical drawings as could well be imagined; the latter faithfully delineate the grandeur of the vast spaces and lofty walls of the great valley by delicacy and accuracy of line and by their panoramic outlook. Mr. Coburn, limited by his apparatus to a smaller field, conveys the same sensations of vastness by his artistic use of atmosphere and the great shadows cast by hill and cloud. Clouds indeed are made the most of in all these pictures, and No. 44, "The Cloudburst," is not only a striking photograph, but a valuable record of this phenomenon.

AT the recent International Congress of Pharmacy held at the Hague, a proposal to form an international pharmacopœial bureau was discussed, and a commission was appointed to consider the question, and to submit to the International Pharmaceutical Federation at an early date a scheme for the establishment of such a bureau. The commission is composed of seven members, representing respectively Great Britain, the United States, Germany, France, Holland, Belgium, and Switzerland; most of the members are associated with the revision of their national pharmacopœias, the English representative being Prof. H. G. Greenish, joint editor of the "British Pharmacopœia," and the American, Prof. J. P. Remington, editor of the "United States Pharmacopœia." As the outcome of the deliberations of such a strong committee, a useful plan may be expected. Among the duties of such a bureau as that proposed would be the collection and examination of all literature relating to pharmacopœial revision and the experimental investigation of new drugs and preparations, and no doubt the influence of the bureau would tend to encourage the work already commenced in the direction of the unification of pharmacopœias.

The South African Journal of Science for September, being the organ of the South African Association for the Advancement of Science, reports the business proceedings of the meeting of the association held at Lourenço Marques in July last, under the presidency of Dr. A. W. Roberts. The following officers were elected for 1913–14:—President, Prof. R. Marloth; vice-presidents, Prof. L. Crawford, Mr. S. Evans, Dr. W. Johnson, and Mr. A. F. Williams; general secretaries, Dr. C. F. Juritz and Mr. H. E. Wood; general treasurer, Mr. A. Walsh. Invitations to hold the next annual meeting were received from the mayors and councils of both Kimberley and Pretoria; and the final decision as to the place was left to the council. A resolution was passed "that the Government of the Union be asked to pass legislation declaring that meteorites are Government property, and when found should be delivered to the nearest magistrate, for transmission to the nearest museum under Government control." The sixth award of the South Africa Medal, together with a grant of 50*l.*, was made to Dr. A. W. Rogers, assistant director of the Geological Survey of the Union, in recognition of his geological work in the Cape Province. In connection with the grant of 100*l.* made to Dr. A. W. Roberts by the association in 1905 for the reduction of his variable star observations, Dr. Roberts reported that he has had the observations, some 60,000 in number, reduced, copied in dulplicate, and indexed. The question of printing has, however, been a difficulty.

THE Board of Agriculture and Fisheries has issued a "Horses (Importation and Transit) Order of 1913" in accordance with powers conferred by the Diseases of Animals Acts, 1894 to 1911. The Order came into force on October 1; it provides for the proper accommodation of horses, asses, and mules on all vessels on which such animals are carried to or from any port in Great Britain, and for the proper construction of railway trucks used for conveying such animals in Great Britain. Provision is made for the proper feeding and watering at places of unloading and during transit. It is made illegal to convey any horse, ass, or mule by boat or train if, in the opinion of an inspector of the Board and notified by him, the animal cannot, owing to infirmity, illness, injury, fatigue, or any other cause, be so carried without unnecessary suffering. The above regulations, together with instructions as to disinfection, &c., have all been provided for by previous Orders, which have been revoked and re-enacted in the present Order. The principal reason for the present Order is to provide the following most necessary amendment, namely, that horses, asses, and mules brought to Great Britain from abroad are required henceforth to be accompanied by a veterinary certificate of freedom from symptoms of glanders (including farcy), epizootic lymphangitis, ulcerative lymphangitis, dourine, horsepox, sarcoptic mange, psoroptic mange, influenza, ringworm, or strangles, instead of as heretofore from symptoms of glanders (including farcy) only.

WE have to acknowledge the receipt of a copy of a pamphlet issued by the Department of Lands and Survey, Victoria, on various methods of destroying rabbits and other "vermin" employed in that colony, and also containing the regulations with regard to fences of wire-netting.

THE National Equine Defence League has issued a fourth edition of a pamphlet on docking and nicking horses. The fact that Parliament has passed a law, to come into operation on January 1, 1915, making the practice of "docking" horses illegal, and that the purchase of docked remounts for the army is to be discontinued as soon as practicable, seems to render the pamphlet somewhat superfluous—at any rate, in this country.

WE have been favoured with an extract from *Neue Weltanschauung* for 1913, Heft 913 (pp. 321–332), in which Dr. W. Breitenbuch directs attention to the fact that the present year is the jubilee (fiftieth year) of Prof. Ernst Haeckel's work on evolution. The article includes a chronological account of the learned professor's studies during that long period, with brief notes on the numerous memoirs and works which have made his name famous.

To the series of biographical memoirs issued by the National Academy of Sciences, Washington, Prof. H. F. Osborn has contributed an exceedingly interesting account of the life and work of Prof. Joseph Leidy, the founder of vertebrate palæontology in America, and the last great naturalist of the type who made the entire subject of zoology their study, and published papers and works of permanent value in almost every branch. That such encyclopædic knowledge and broad grasp of the whole field of natural history can, as his biographer remarks, never reappear, is a matter for regret, as the specialised lines on which zoology is now, from necessity, studied cannot fail, in many cases at any rate, to result in narrowness of view. Although his study of the rhizopods was sufficient of itself to establish a great reputation, Leidy will chiefly be remembered as a palæontologist, and especially by his descriptions of Poëbrotherium and the so-called oreodonts, or "ruminating hogs," which paved the way for the discovery of the phylogeny of the camels and other artiodactyle ungulates.

TO vol. vii., part 2, of *Annotationes Zoologicae Japonenses* Mr. B. Aoki contributes a list of Japanese and Formosan mammals. The island of Saghalien is also stated to come within the scope of the list, but no mention is made in the introduction that Korea is likewise included, although in the text we find (p. 272) a Korean shrew. On the other hand, Korea is not in the range of the tiger (p. 312), although the animal abounds in that country. The total number of forms, inclusive of subspecies, is 197. If trustworthy, the identification of three foxes with American, rather than with Asiatic or European, races is of considerable interest; but it may be noted that one of these races—the black or silver fox (*Vulpes pennsylvanicus argentatus*)—is not recognised as such in Mr. G. S. Miller's list of North American mammals (1912). In a footnote on p. 317 "Arctocyonidæ" should be "Arctoidea + Cynoidea." Mammals collected in Korea form the subject of an article by Messrs. Allen and Andrews in Bull. Amer. Mus. Nat. Hist., vol. xxxii. (pp. 427–36). In connection with the above may be noted a paper by Messrs. Jordan and Thompson on fishes from the island of Shikoku, Japan, published as No. 2011 of the Proceedings of the U.S. National Museum.

THE Proceedings of the South London Entomological and Natural History Society for the past year contain matter of much interest, and give proof of continued activity on the part of the members of this well-known association of naturalists. Mr. A. E. Tonge's presidential address, delivered at the beginning of the present year, includes some excellent observations on the external characters of British lepidopterous ova. Mr. R. Adkin's communication on the subject of varietal names is marked by strong common sense, and the same may be said of his paper on the labelling of entomological specimens—a matter that was often neglected by the naturalists of a former generation, to the detriment of many results of their labours. Mr. A. E. Gibbs's paper on the genus Cœnonympha gave occasion for some interesting exhibits of the local variation to which species of that genus are subject. A useful account, well illustrated by photographs and drawings, of the British species of Forficulodea is contributed by Mr. W. J. Lucas. Perhaps the most important of the papers printed *in extenso* is Mr. C. J. Gahan's excellent memoir on mimicry in the Coleoptera. The author is a well-known authority on this order, and the great extent

of his special knowledge enables him to treat the subject in a comprehensive and convincing manner. It is noteworthy to find that he considers it "hopeless to try to explain the facts of mimicry in any other way than as the result of natural selection." The reports of the field excursions and the discussions held at the meetings contain some valuable records, and the volume as a whole furnishes good evidence of the excellent work that may be done by local societies, such as the present, in encouraging an intelligent interest in the objects of natural history.

Petermann's Mitteilungen for September contains a characteristic portrait of the late Prof. H. Credner, the well-known geologist of Leipzig. Dr. K. Andrée discusses the important question of the correlation of sedimentary rocks with conditions of deposition, as a guide in the formation of palæogeographic maps.

MR. C. A. COTTON, of Wellington, N.Z., publishes a paper on the physiography of the Middle Clarence Valley, New Zealand (*Geographical Journal*, vol. xlii., p. 225), in which the influence of Prof. W. M. Davis is apparent in the lucid illustrations of local earth-structure and surface features. The author contests Park's view that an ice-sheet passed across the district, which lies in the north-east of the south island.

MESSRS. W. HANNS, A. Rühl, H. Spethmann, and H. Waldbaur, who accompanied Prof. W. M. Davis on a European tour in 1912, have published "Eine geographische Studienreise durch das westliche Europa" (Leipzig: Teubner, price 2.40 marks), a brochure which should well illustrate modern methods of investigation. The regions selected include Snowdonia, Cornwall, central France, and the famous Kirchet of Meiringen.

THE Journal of the Meteorological Society of Japan for May contains, *inter alia*, a useful article on the amount of evaporation of water, by Mr. Y. Horiguti, in which he gives some results of his investigation of the subject with a circular atmometer 8 in. in diameter, 4 in. in depth, and a small layer of water, the instrument being freely exposed to wind and sunshine. The determination of evaporation is a very uncertain operation, and in a recent essay (Strachan, "Basis of Evaporation") it is noted that the methods hitherto tried with tanks have been more or less failures, although, with the assistance of theory, better results ought eventually to be obtained. Many formulæ by well known men of science already exist, and Mr. Horiguti has added another to the number. The result of his investigations shows that his formula, together with others referred to, will fairly well represent evaporation in the shade, but that in the open air this is not the case. He concludes that "there remains an ample space for further studies."

IN 1881 a MS. known as the Bakhsháli, from a village of that name in the Peshawar district, was discovered. If the view of Dr. Hoernle be accepted, that it belongs to the third or fourth century A.D., it would be of unique value as pushing back the mathematical knowledge of the Hindus to a date much earlier than has hitherto been admitted. The question of date has been reopened by Mr. G. R. Kaye in vol. viii., No. 9, of the Proceedings Asiatic Society of Bengal for 1912. After a careful review of its contents he arrives at the conclusion that it is later than the time of Brahmagupta, or even later than Bháskara. "The literary form and the mathematical form of the manuscript point to a comparatively late period; the script is not ancient; the notation used and the rules and examples have nothing ancient about them, and my general conclusion is that the manuscript was not written much before the twelfth century A.D. It may have been an adaptation of a more ancient work, but it is certainly not a faithful copy of any work composed much before the twelfth century." It will be interesting to await Dr. Hoernle's reply to this communication.

IN the Proceedings of the Tokyo Mathematico-Physical Society (2), vii., 5, Mr. S. Yokota gives an analytical solution of the stress distribution in a riveted plate due to a simple push applied to a rivet, the surfaces being smooth. The lines of principal stress are plotted.

IN addition to the usual lists of students and degree proceedings, the Johns Hopkins University Circular contains interesting mathematical notes edited by Prof. Frank Morley. Mr. J. E. Rowe, in a note on Fermat's classical theorem, shows that the sum of two powers of integers cannot be the same power of another integer (excluding, of course, the case of second powers) unless the index is greater than 100 and the largest integer greater than the twenty-ninth power of 10; and further, considering next the two types in which the greatest integer is odd or even respectively, the author says, "Also it is shown that one-half of all possible solutions of each of the two types just described are impossible" (!). In a note on self-dual rational quartics, Mr. L. E. Wear shows that the only quartic curves which reciprocate into themselves are the limaçon and the obvious case of two conics.

PROF. E. B. WILSON, writing in the July Bulletin of the American Mathematical Society on the unification of vector notations, expresses a doubt whether the several steps which have been taken in this direction recently have been steps "backward or forward, sideways or up in the air." The committee appointed at Rome in 1908 has not yet presented a report, so that not much of a step in any direction can be attributed to it. There has been great activity in the use of vector methods in Italy, which has served to stereotype the notations of Burali-Forti and Marcolongo, which differ from those in vogue in Germany and America. A valuable report by the late Dr. Macfarlane has been published in the Bulletin of the International Association for Promoting the Study of Quaternions and Allied Systems of Mathematics for June, 1912, and Prof. Wilson hopes "that the place of publication may not prove a burial ground for the essay." Lastly, Langevin's article in the French Mathematical Encyclopædia proposes a system of notations in which vectors are distinguished by interlineal superscripts, no special founts being used, and this seems likely to be widely adopted in France.

IN the *Journal de Physique* for August, M. A. Henry, physics master at the Reims Lycée, describes how he has applied a well known form of micromanometer to make measurements in a number of directions in which a manometer is not often utilised. The manometer consists of a U tube with wide limbs joined by a horizontal capillary tube. The limbs are about half-filled with carbon tetrachloride, and the capillary contains a small bubble of air Any slight difference of pressure at the ends of the capillary produces a considerable motion of the bubble. The instrument is calibrated by tilting the tube support by means of a screw at one end. M. Henry shows how the instrument may be used to measure the excess of pressure in a soap-bubble and the effect of charging the bubble electrically, a small volume, a mass of a few grams, the density of a gas or of a solid, small amounts of heat, specific inductive capacity, difference of potential, a flow of gas, and the pressure exerted by a sound-wave.

THE determination of sulphur in illuminating gas is the subject of Technologic Paper No. 20 of the Bureau of Standards, by R. S. McBride and E. R. Weaver, issued by the Department of Commerce, Washington. Experiments were made with the gas referees' apparatus and the apparatus designed by Elliot, Hinman-Jenkins, Drehschmidt and Somerville. The results of a series of comparisons are given, in which many variations were made to determine the best conditions of operation and the sources of error. The referees' apparatus appears to be most used in America as well as here, and possesses the advantages of simplicity and convenience; the accuracy obtainable with this, as with other forms, has been often over-estimated. The concluding portion of the pamphlet deals with the estimation of the sulphate in the liquid condensate, and details are given of the gravimetric determination, a rapid turbidimetric method, and a volumetric method based on that due to Holliger. Although most gas companies in this country are now free from any restriction as to the amount of sulphur present in their gas other than sulphuretted hydrogen, the pamphlet will be very useful to any chemists having to deal with this problem.

IN the *Bulletin de la Société d'Encouragment* (No. 6, p. 805) Prof. Camille Matignon discusses in an interesting paper some of the less known recent processes for the industrial fixation of atmospheric nitrogen. The well known methods utilising an electric flame are only briefly touched upon, but especial reference is made to Schloesing's process of absorbing the nitrous gas so obtained with lime at a temperature of 300°. The principal processes dealt with are those of Haber, in which nitrogen and hydrogen are made to combine directly under the influence of a catalytic agent, and that of Serpek based on the formation of aluminium nitride by heating a mixture of alumina and carbon in a current of pure nitrogen at a temperature of 1800°. The latter method has a particularly bright industrial outlook owing to the fact that by decomposing the nitride with dilute alkali not only is ammonia obtained, but it is possible by means of it to transform bauxite into alumina suitable for the aluminium industry at a much reduced cost. The action between the alumina and carbon is effected in revolving cylinders, which are lined with aluminium nitride itself, as being the only sufficiently refractory material which will withstand the high temperatures employed.

RED Book No. 182 of the British Fire Prevention Committee contains an account of tests on three window openings filled in with Luxfer electro-glazing. The record gives the effect of a fire of ninety minutes' duration, the temperature reaching 1500° F. and not exceeding 1650° F., followed by the application of water for two minutes on the fire side. This test again indicates that forms of special glazing are being produced commercially that can serve most efficiently to stop the spread of a fire of considerable severity. It is the second occasion upon which "lights" presented for test by the British Luxfer Prism Syndicate, Ltd., have met the strain of a ninety minutes' test at temperatures exceeding 1500° F. Red Book No. 183 contains records of tests on two steel-cased reinforced concrete doors by Messrs. Chubb and Sons, one hung on runners and made to slide, the other hung on hinges, fixed in a reveal. The latter door secured "full protection" (Class B). The partially successful efforts to produce a single door able to do the work of two iron doors required under the London Building Act are of considerable technical importance. The radiation through the doors was very small. Doubtless the problem of making a sliding door flame-proof around the edges will be overcome.

OUR ASTRONOMICAL COLUMN.

A NEW COMET.—A Reuter message from Perth, W.A., dated October 7, reports that a faint new comet has been observed in the position R.A. 2h. 31m.; Dec. 3° 48′ N.

THE RETURN OF WESTPHAL'S COMET.—The identification of Mr. Delaran's comet with Westphal's comet of 1852 is now complete, its positions being in accord with those predicted on the assumption of the object being the return of the comet of Westphal.

The following ephemeris for the current week is given by Prof. H. Kobold in a Supplement to the *Astronomische Nachrichten*, No. 4684:—

12h. M.T. Berlin.

		R.A. h. m. s	Dec.	Mag.
Oct. 9	...	21 16 24	... + 8 18·2	... 8·4
10	...	13 52	... 9 7·9	
11	...	11 25	... 9 57·1	
12	...	9 2	... 10 45·6	... 8·4
13	...	6 44	... 11 33·8	
14	...	4 32	... 12 21·3	
15	...	2 25	... 13 8·3	
16	...	21 0 24	... +13 54·8	... 8·4

After observations on September 28, the corrections to the above ephemeris are as follows:—R.A. −34s., Dec. +9·9′.

As this comet does not reach perihelion until November 26, and as it is slowly approaching the earth, its brightness will be increased. In appearance the nucleus is described as well defined but elongated, and surrounded by a nebulosity 20′ in diameter. The tail has been observed to be 1·2° in length, while a

photograph taken of it at Bothkamp on September 28 records a tail 3·5° long.

The comet is in a good position for observation in the evening, and its movement northwards will make the conditions more favourable. It is at present passing through the constellations of Equuleus and Delphinus, but later will reach Vulpecula and Cygnus.

In *The Times* of October 2 we read that Westphal's comet is the fourth member of the Neptune group of comets that has been observed at a second apparition, the others being those of Halley, Olbers, and Pons. Two other members of the group appeared in 1846 and 1847, and are expected back about 1921 and 1927. Westphal's comet has much the shortest period (61·118 years) of any member of the group, its aphelion being at almost exactly the same distance from the sun as the orbit of Neptune.

PHOTOGRAPHIC STUDY OF THE SOLAR PHOTOSPHERE.—In an abstract from the Annals of the Observatory of Zô-sé (Tome iii., 1912), M. S. Chevalier, S.J., describes the results of his research on the solar photosphere as studied photographically. He first of all describes the early observations of the solar surface by Sir W. Herschel, and rapidly surveys those who followed him, concluding with the photographic researches of M. Janssen at Meudon. M. Chevalier points out that on these latter photographs the famous granules observed by Secchi, Dawes, &c., were recorded.

He then directs attention to the possibility of errors creeping in when photography is employed. Is the image recorded on the photographic plate necessarily a faithful representation of the object photographed? M. Chevalier says it is not, and in the present investigation he attempts to show that the *réseau photosphérique* discovered on Janssen's clichés is not solar. The phenomenon, he says, is chiefly due to deviations undergone by the luminous rays refracted in an abnormal manner. This abnormal refraction takes place in the interior of the telescope, and more especially in the neighbourhood of the secondary magnifier. M. Chevalier accompanies his memoir with a series of fine reproductions from photographs of the solar surface which he has taken to demonstrate his views, and it is by an examination of these that his conclusions must be studied.

STATISTICS OF NEBULÆ AND CLUSTERS.—In the *Arkiv för Matematik, Astronomi och Fysik* (Band 9, No. 15), Prof. C. V. L. Charlier has published a preliminary paper on the statistics of nebulæ and clusters. This contribution is part of the work of the Lund Observatory, which has undertaken a discussion of the position of the nebulous stars in space, and these statistics form a preliminary part of the investigation. In this publication Prof. Charlier represents both in statistical and graphical form, the information collected on card catalogues of the co-ordinates, brightness, size, and form of nebulæ, as well as other observations of interest. The base of the card catalogues was the three great catalogues of Dreyer. In these pages the results are given purposely without any discussion regarding their bearing upon the question of the distribution of the nebulæ in space. He remarks, however, that while in many respects they speak for themselves, in others conclusions must be drawn with great caution. The main interest here are the relations between the Milky Way and the positions and numbers of the nebulæ.

When it is remembered that distinction is made between five different classes of nebulous objects, namely, clusters, globular clusters, planetary nebulæ, annular nebulæ, and nebulæ, and that the objects number 13,223, some idea of the work involved in the investigation will be gathered.

SPECTROHELIOGRAPHIC RESULTS FROM MEUDON.—A memoir by MM. H. Deslandres and L. d'Azambuja, appearing in No. 9 of the *Comptes rendus* of the Paris Academy of Sciences, contains an interesting historical survey of the spectroheliographic work carried out at Meudon. The paper is more especially concerned with the *qualitative* results obtained by examination of the spectroheliograms secured since 1908, when the spectroheliograph of high dispersion was erected. Whilst careful to point out that the evidence does not permit the formulation of general laws, the authors are content to state that during the period in question the "filaments" (dark and definite stream-like markings seen in hydrogen and calcium light) have followed, but with a distinct lag, more pronounced in the case of the polar disturbances, the sun-spot variations. In this regard the polar disturbances recall the secondary maximum of high-latitude prominences. On the other hand, the "alignments" (markings somewhat less dark and sharp seen only in calcium light) have been without noticeable variations.

AN EXHIBITION OF PROGRESS IN LIGHTING AND HEATING BY COAL GAS.

THE National Gas Exhibition at Shepherd's Bush, which will be open during the whole of October, affords the best object lesson in gas lighting that the public has ever had the opportunity of studying, and the fascination is greatly increased by the absence of competing stalls, the exhibits being shown in model rooms, shops, studios, &c., under all the conditions in which they are likely to be used in practice.

It is something of an achievement to have induced the leading gas undertakings, municipal and private, and the leading manufacturers of gas appliances in the United Kingdom, to sink their individuality and rivalry and to cooperate in a coherent exhibition of the varied uses to which gas can be efficiently and profitably applied. The result should be of benefit both to the industry and to the public generally.

The exhibition impresses one with the enormous strides that have been made during the last few years in the application of gas for manufacturing, domestic, and public purposes. The introduction of vertical retorts, improved methods of purification, and the resulting greater yield of gas, coke, and by-products obtained from the coal carbonised, have resulted in its price being kept down in spite of the gradual rise in the cost of coal, whilst the enormous progress that has been made in the methods employed in its combustion has popularised it to an extent that could hardly have been foreseen a few years ago.

There is not the least doubt but that the introduction of the atmospheric burner and the incandescent mantle has been the real factor which has made gas the most important fuel for both heating and lighting, and in the present exhibition the progress that has been made from the inception of the union jet by Nielson in 1820, which gave less than one candle per cubic foot of gas consumed, to the modern high-pressure incandescent burner, with its sixty candles per cubic foot of gas, is demonstrated in a striking manner.

Various apparatus for raising gas to the pressure of several pounds per square inch, necessary in high-pressure lighting, is to be seen at work in the Industrial Hall, and the bearing which the high-pressure distribution has upon commercial applications is shown by the exhibition of a number of furnaces for a multiplicity of purposes, such as melting metals and hardening steel. In these cases it is necessary to concentrate the temperature over a defined area, and

by increasing the pressure at which the gas is supplied very high temperatures under perfect control can be attained. Specimens of these different types of furnaces are also to be seen in other sections of the exhibition.

In domestic heating the grasping of the conditions necessary to make gas a hygienic domestic fuel has been the great factor that has led to progress. In the early days of the gas fire, only 25 to 33 per cent. of the heat was given out as radiant heat, and convection was relied upon largely to give the heating effect, this giving hot air to breathe, and at the same time leaving the objects in the room often so far below the body temperature as to lead to chill; whilst the capacity for moisture of the heated air caused a degree of discomfort that led to prejudice being raised against this method of warming living-rooms.

When, however, it was realised that a stove to be hygienic must always give a larger amount of radiant heat than of convected heat, advance was at once made, and the severe competition in which, in the last three years, the different makers of gas fires have indulged has resulted in the production of gas stoves which give a high radiant efficiency. Further advances are being made constantly, and it is anticipated that in a short time the percentage of radiant heat given by gas fires will be more than double that which was possible even three years ago. Meantime, the claim that there are gas fires in the exhibition which can transmit 50 per cent. of the heat energy into the room in the form of radiant heat is undoubtedly true, whilst in one case as high as 70 per cent. is claimed. Apparently there is no exhibit of Prof. Bone's interesting "flameless combustion" stove, which would have proved very attractive, but the steam used in the kitchens is generated by a Bonecourt boiler, which is a modification of the same principle.

A very fine collection of products from tar and ammonia liquor are shown in the shops that serve to illustrate the best methods of show-window lighting. These are divided into three classes, tar, ammonia, and cyanogen products, the first class especially being worthy of attention.

Another very suggestive exhibit is a series of compartments illustrating the effect of the colour and surface of wall-papers on the amount of illumination obtained from equal sources of light. Some valuable conferences have been arranged to take place during the period that the exhibition remains open, and especial interest will be felt in the promised discussion on the sanitary influence of gas lighting and heating, whilst the influence of gas as a fuel on smoke abatement will also receive its due share of attention.

CARNEGIE SCHOLARSHIP MEMOIRS.

VOL. v. of the Carnegie Scholarship Memoirs has just been issued by the Iron and Steel Institute. The volume contains six papers which differ very widely in merit and interest, but on the whole it represents a considerable amount of important research work. It is unfortunate, however, that the practice of publishing these papers in a separate volume tends to relegate them to oblivion, and at all events robs them of the advantages of discussion even by correspondence, thus lessening materially the value of the work done under the Carnegie scheme.

The preservation of iron is dealt with by Dr. Newton Friend; his results, if confirmed by future practical experience, are of considerable importance. He finds that the addition of small quantities of paraffin wax to paint lessens very materially corrosion in iron and steel merely exposed to the air, but rather assists corrosion in the case of plates actually immersed in water. Increasing the number of coats of paint beyond two also appears not only to offer no increased protection, but actually to promote corrosion. This result leads one to inquire whether the constant repainting of iron-work often practised on ships may not actually do more harm than good; at all events, an examination of some of these thickly painted surfaces should afford interesting evidence on the point. Finally, Dr. Friend finds that painting over a slightly rusted surface, from which, however, all lumps of scale, dirt, &c., have been removed, is actually more effective as against further rusting than the same paint applied to a completely cleaned surface —the only advantage of thoroughly cleaning the iron before painting lying in a better surface finish of the painted work.

Another paper of special interest is that by Mr. J. A. Pickard dealing with the determination of oxygen in steel. This is a question of steadily increasing importance, and the older methods are known to be quite unsatisfactory. Mr. Pickard's method consists in heating the drillings to be analysed in an atmosphere of hydrogen which is simultaneously kept in contact with phosphorus pentoxide, so that the concentration of water-vapour always remains very low. His results indicate a very satisfactory degree of accuracy, and the further application of his method will be awaited with interest.

A lengthy paper by Mr. A. Kessner deals with the development of the drill test for ascertaining the machining properties of steel; the author, working at Charlottenburg, has developed a form of apparatus whereby the rate of cutting under standard conditions can be measured with a considerable degree of accuracy, and has used this to study the effect of several factors upon the machining properties of metals and to compare the ball-hardness and tensile properties of materials with their machining properties. That ball-hardness is not a guide to machining properties is a result which might have been anticipated, but whether the author's form of drill test does not depend upon the measurement of a quantity which depends upon too large and complicated a system of factors yet remains to be proved.

Of the more theoretical papers, that of Mr. Humfrey, dealing with the influence of the intercrystalline cohesion of metals upon their mechanical properties is perhaps the most interesting. It is another step in the development of our conceptions of the internal mechanical constitution of metals, and although to some extent speculative, it is certainly suggestive, particularly as it offers the first attempt at explaining the mechanism of the effects of mechanical overstrain, which, while it raises the elastic limit in tension, and thus apparently hardens the metal, at the same time lowers the elastic limit in compression. Humfrey explains this by the development of severe internal stresses residing in the amorphous matter at the intercrystalline boundaries, these stresses tending to resist further deformation in the direction of previous strain, but assisting stresses tending to produce deformation in the opposite sense.

The remaining papers, by Messrs. Hailstone and Swinden, are less satisfactory. The latter attacks the problem of the constitution of molybdenum steels by means of numerous cooling-curves and other data, but does not make use of the well-known methods of discussing and considering the equilibria of a ternary system. As a result of this lack of general theoretical guidance in the work, the data lead to no satisfactory conclusion. This want of systematic attack is typical of much of the work which has been done on steel, and especially on alloy steels, and probably accounts for the confusing differences of opinion which still exist in regard to their nature and constitution.

ENTOMOLOGICAL NOTES.

ACCORDING to a note by Mr. J. J. Walker in the September number of *The Entomologists' Monthly Magazine*, 1913 is to rank as a "clouded yellow" year, immigrant specimens of these butterflies (*Colias edusa*) having reached our southern counties in June, and given rise to native broods in August. No British specimen of *C. hyale* had been recorded this year up to the date of the note.

In order to enable planters in Trinidad to cope effectually with the native sugar-cane frog-hopper (*Tomaspis varia*), a member of the family Cercopidæ, the Board of Agriculture of Trinidad and Tobago has issued a pamphlet (Circular No. 9), drawn up by Mr. F. W. Urich, the official entomologist, in which the life-histories of this and certain other members of the same group are very fully described. Three beautifully coloured plates illustrate all the stages of the species forming the main subject of the pamphlet and the adults of its Trinidad relatives. Although reported to have been originally described from Guiana, *T. varia* cannot be identified elsewhere than in Trinidad, and is accordingly regarded as a native of that island. Two charts show that it is most numerous in January, when the rainfall is at its lowest. This mischievous insect is attacked by two kinds of fungus, one of which affords, at present, the best means of keeping it in check; and, with this and other agents, the author is hopeful that the "plague may be stayed" in the near future.

Although holiday-makers roundly cursed the heavy rains of the summer of 1912, they were highly beneficial, in the opinion of Mr. G. H. Carpenter, as expressed in an article on injurious insects observed in Ireland during that year (Economic Proceedings Royal Dublin Society, August) in reducing the great development of insect life due to the abnormally hot summer of 1911.

The editor is indebted to the Rev. R. P. Longinos Navas, S.J., for a copy of a synopsis of the Ascalephides, published in the *Arxius de l'Institut de Ciencias, Barcelona*, vol. i., No. 3. Although these Neuroptera, which are related to the lace-wing flies, are generally classed as a subfamily of the Hemerobiidæ, the author follows MacLachlan in regarding them as representing a family by themselves—Ascalaphidæ. None of these flies are found in the British Islands, but they are abundant in many parts of the Continent, and enjoy an almost cosmopolitan distribution. The present synopsis includes diagnoses of all the known generic and specific types, several of which are named and described for the first time.

Several important entomological articles have recently appeared in the Proceedings of the Philadelphia Academy, notably one in the May and June issues on the grasshoppers of the genus Nemobius. Other papers are published in the July issue of Records of the Indian Museum, in which Mr. J. J. Kieffer reviews the chironomid flies in the collection of the museum, while Mr. K. Jordan does the same for the beetles of the family Anthribidæ.

In describing a new species (*Clomaciella subfusca*) of the mantispid group of Neuroptera in vol. viii., part 2, of *Annotationes Zool. Japon.*, Mr. W. Nakahara takes the opportunity of reviewing the Japanese representatives of the group—eleven in number.

Copies of two entomological papers from vol. xlvi. of the Proceedings U.S. National Museum have been received recently, namely one by Mr. F. Knab on new species of moth-flies bred from bromelias and other plants, and one by Prof. T. D. A. Cockerell on new parasitic Hymenoptera of the genus Eiphosoma.

To the Journal of the College of Agriculture, Tohoku Imperial University, Japan, vol. v., parts 4 and 5, Mr. Yos'himo Tanaka communicates articles, illustrated by one plain and one coloured plate, on Mendelian factors and gametic coupling and repulsion in silkworms.

R. L.

FORTHCOMING BOOKS OF SCIENCE.

AGRICULTURE.

The Cambridge University Press.—The Fertility of the Soil, Dr. E. J. Russell (Cambridge Manuals of Science and Literature). *Werner Laurie, Ltd.*—The Conquest of the Desert, Dr. W. Macdonald, illustrated. *J. B. Lippincott Co.*—Productive Swine Husbandry, Prof. Dav. *Crosby Lockwood and Son.*—The Cultivation of the Oil Palm, F. Milligan; Coconut Cultivation, H. L. Coghlan, illustrated; British and Colonial Dairying for School, Farm, and Factory, G. S. Thomson, illustrated. *Longmans and Co.*—Maize: its History, Cultivation, Handling, and Uses, with Special Reference to South Africa, J. Burtt-Davy, illustrated. *John Murray.*—Imperial Institute Series of Handbooks to the Commercial Resources of the Tropics, with Special Reference to British West Africa: Rubber, H. Brown. *John Wiley and Sons (New York).*—Exercises in Farm Dairying, C. Larsen.

ANTHROPOLOGY.

John Bale, Sons, and Danielsson, Ltd.—Some Austral-African Notes and Anecdotes, Major A. J. N. Tremearne, illustrated; Hausa Superstitions and Customs, Major Tremearne, vol. ii. *The Cambridge University Press.*—The Peoples of India, J. D. Anderson (Cambridge Manuals of Science and Literature). *Chatto and Windus.*—A History of Babylonia and Assyria from Prehistoric Times to the Persian Conquest, L. W. King; vol. ii., A History of Babylon from the Foundation of the Monarchy to the Persian Conquest; vol. iii., A History of Assyria from the Earliest Period to the Fall of Nineveh, illustrated. *Gurney and Jackson.*—The Antiquity of Man in Europe: being the Munro Lecture on Anthropology and Prehistoric Archæology in connection with the University of Edinburgh, Prof. J. Geikie, F.R.S., illustrated. *Macmillan and Co., Ltd.*—The Golden Bough: a Study in Magic and Religion, Prof. J. G. Frazer, third edition; Part vii., Balder the Beautiful, 2 vols.; The Nine Minoan Periods: a Summary Sketch of the Characteristic Stages of Cretan Civilisation, from the Close of the Neolithic to the Beginning of the Iron Age, with special reference to the Antiquities of Knossos, Sir A. Evans, F.R.S., illustrated; An Atlas of Knossian Antiquities, edited, with explanatory text, by Sir A. Evans, F.R.S.; Marriage Ceremonies in Morocco, Prof. E. Westermarck; The Eastern Libyans, O. Bates, illustrated; Athens and its Monuments, Prof. C. H. Weller, illustrated. *Oxford University Press.*—Rustic Speech and Folk-lore, E. M. Wright; Irish Witchcraft and Demonology, St. J. D. Seymour; The Beginnings of Buddhist Art, A. Foucher, translated by L. A. and F. W. Thomas; Black Glaze Pottery from Rhitsona in Bœotia, P. N. Ure; The Philistines: their History and Civilisation, R. A. S. Macalister. *The S.P.C.K.*—The Chinese People: a Handbook on China, Archdeacon Moule, illustrated. *P. Lee Warner.*—The Book of the Dead: the Papyrus of Ani, Scribe and Treasurer of the Temples of Egypt, about B.C. 1450, Dr. E. A. Wallis Budge, illustrated; Antiquities of India: an Account of the History and Culture of Ancient Hindustan, Dr. L. D. Barnett, illustrated; Mexican Archæology, T. A. Joyce, illus-

trated; Prehistoric Greek Archæology, H. R. Hall, illustrated. *Williams and Norgate.*—Prehistoric Times, Lord Avebury, new edition, illustrated.

BIOLOGY.

A. and C. Black.—Wild Life on the Wing, M. D. Haviland, illustrated; Highways and Byways of the Zoological Gardens, C. Innes Pocock, illustrated; The Moose, A. Herbert, illustrated; First Principles of Evolution, Dr. S. Herbert, illustrated; Common British Beetles, Rev. C. A. Hall, illustrated; Reptiles and Amphibians, A. N. Simpson, illustrated; The Naturalist at the Sea-shore, R. Elmhirst, illustrated. *W. Blackwood and Sons.*—The Shetland Pony, C. and A. Douglas, with an appendix on the Making of the Shetland Pony, by Prof. J. Cossar Ewart, F.R.S. *The Cambridge University Press.*—Educational School Gardening, G. W. S. Brewer; The Production and Utilisation of Scots Pine in Great Britain, E. R. Burdon and A. P. Long; Genera of British Plants, arranged according to Engler's Syllabus, Der Pflanzenfamilien (seventh edition, 1912), with the addition of Characters of the Genera, H. G. Carter; Desert and Water Gardens of the Red Sea, C. Crossland; The British Rust Fungi (Uredinales): their Biology and Classification, W. B. Grove; Rubber and Rubber Planting, Dr. R. H. Lock; Weeds: Simple Lessons for Children, R. L. Praeger, illustrated (Cambridge Nature Study Series); The Life-story of Insects, Prof. G. H. Carpenter; The Flea, H. Russell; Pearls, Prof. W. J. Dakin (Cambridge Manuals of Science and Literature); Artificial Parthenogenesis and Fertilisation, Dr. J. Loeb. *Cassell and Co., Ltd.*—Cassell's Natural History, F. M. Duncan, illustrated. *Constable and Co., Ltd.*—In Beaver World, E. A. Mills, illustrated. *W. Engelmann (Leipzig).*—Das Darwin'sche Selektionsprinzip, Plate, new edition; Rohstoffe des Pflanzenreiches, Wiesner, new edition; Geschichte der biolog. Theorien, Radl, Bd. i., new edition. *G. Fischer (Jena).*—Organographie der Pflanzen, Prof. K. Goebel, I. Teil: Allgemeine Organographie, new edition, illustrated; Ueber die Traubenwickler, Prof. F. Schwangart, Zweiter Teil, illustrated. *R. Friedländer and Sohn (Berlin).*—Das Tierreich, edited by Prof. F. E. Schulze:—Cumacea, T. R. Stebbing; Die Vögel der palæarktischen Fauna, Dr. E. Hartert, Heft viii., illustrated; Die Lebensgewohnheiten der Insekten bis zum Erwachen der sozialen Instinkte, Prof. O. M. Reuter, translated into German by A. u. M. Buch, illustrated; Zoologischer Jahresbericht für 1912. *Gurney and Jackson.*—A History of British Mammals, Major G. E. H. Barrett-Hamilton, in monthly parts, illustrated; Yarrell, Newton, and Saunders' History of British Birds, new edition, edited by W. Eagle Clarke, illustrated. *Hodder and Stoughton.*—Wild Life Across the World, Cherry Kearton; The Game Fishes of the World, C. F. Holder; My Adventures among the Wild Animals of the Yellowstone, E. Thompson-Seton; Life of a Fly, J. H. Fabre. *H. Holt and Co. (New York).*—Outlines of Chordate Development, W. E. Kellicott; Text-book of Chemistry, Prof. W. A. Noyes. *John Lane.*—Glimpses of Indian Birds, D. Dewar. *Macmillan and Co., Ltd.*—A Treatise on Embryology, edited by W. Heape, F.R.S.; vol. i., Invertebrata, Prof. E. W. MacBride, F.R.S., illustrated; The Diseases of Tropical Plants, Prof. M. T. Cook, illustrated; Cocoa, Dr. C. J. J. van Hall, illustrated; Physiological Plant Anatomy, Prof. G. Haberlandt, translated by J. M. F. Drummond, illustrated; The Meaning of Evolution, S. C. Schmucker, illustrated; Forage Crops for the South, S. M. Tracy, illustrated; Fruit Insects, M. V. Slingerland and C. R. Crosby, illustrated; A History of Land Mammals in the Western Hemisphere, W. B. Scott, illustrated. *The Methodist Publishing House.*—Holiday Nature Book, Rev. S. N. Sedgwick, illustrated. *Methuen and Co., Ltd.*—The Diversions of a Naturalist, Sir Ray Lankester, K.C.B., F.R.S., illustrated; The Snakes of Europe, Dr. G. A. Boulenger, F.R.S., illustrated; The Life of the Mollusca, B. B. Woodward, illustrated. *John Murray.*—Matter, Origin and Personality, Dr. J. S. Haldane, F.R.S.; Darwin and Wallace: a Study of their Scientific and Literary Writings, with an estimate of the present position of the Theory of Natural Selection as an adequate explanation of the process of Organic Evolution, Rev. J. Marchant, with the assistance of Dr. Alfred Russel Wallace, O.M., F.R.S., with portraits; Trees and Shrubs Hardy in the British Isles, W. J. Bean, illustrated; Concerning Animals and Other Matters, E. H. Aitken, illustrated; The Genus Rosa, E. Willmott, Part xxv., illustrated. *Oxford University Press.*—Index Kewensis, Supplement iv. (1906–1910); Ancient Eugenics, A. G. Roper; The Problems of Genetics, Prof. W. Bateson, F.R.S. *Sir I. Pitman and Sons, Ltd.*—Insect Life: its Why and Wherefore, H. G. Stanley, illustrated. *G. Routledge and Sons, Ltd.*—The Gardener's Dictionary, edited by A. Hemsley and J. Fraser, illustrated; Salmon Rivers of the United Kingdom, A. Grimble, new editions: The Salmon Rivers of Scotland, The Salmon Rivers of Ireland, The Salmon Rivers of England and Wales, each illustrated; Evolution by Cooperation: a Study in Bio-Economics, H. Reinheimer; General Biology, H. Muckermann, translated, illustrated; Handbook of Photomicrography, H. L. Hind and W. B. Randles, illustrated. *The S.P.C.K.*—The Animal Kingdom, illustrated; Butterflies and Moths in Romance and Reality, W. F. Kirby, illustrated. *University Tutorial Press, Ltd.*—Indian Botany, J. M. Lowson and Mrs. Willis. *T. Fisher Unwin.*—Odd Hours with Nature, A. Urquhart, illustrated. *Williams and Norgate.*—The Ocean, Sir J. Murray, K.C.B., F.R.S., illustrated. *Witherby and Co.*—The Gannet: a Bird with a History, J. H. Gurney, illustrated; Indian Pigeons and Doves, E. C. S. Baker, illustrated; The Pheasants, C. W. Beebe, illustrated.

CHEMISTRY.

A. and C. Black.—Chemical Analysis, Qualitative and Quantitative, G. G. Gardiner. *Gebrüder Borntraeger (Berlin).*—Die Gerbstoffe, Botanisch-chemische Monographie der Tannide, Dr. J. Dekker, illustrated; Chemische Technologie der Gespinstfasern, Dr. K. Stirm, illustrated. *J. and A. Churchill.*—Industrial Organic Analysis, P. S. Arup; Quantitative Analysis in Practice, J. Waddell; Bloxam's Chemistry, Inorganic and Organic, tenth edition, *Constable and Co., Ltd.*—Cement, Concrete, and Bricks, Dr. A. B. Searle. *G. Fischer (Jena).*—Biochemie des Wachstums des Menschen und der höheren Tiere, Dr. H. Aron; Biochemie der Pflanzen, Prof. F. Czapek, Band i., new edition, illustrated. *Gurney and Jackson.*—Technical Methods of Chemical Analysis, Prof. G. Lunge, English translation, edited by Dr. C. Keane, vol. iii.; The Manufacture of Sulphuric Acid and Alkali, Prof. G. Lunge; vol. iv., Electrolytical Methods of Producing Alkali and Chlorine; the Fixation of Atmospheric Nitrogen, by Dr. J. Knox (Chemical Monographs). *Longmans and Co.*—An Introduction to Modern Inorganic Chemistry, Dr. J. W. Mellor, illustrated; Photochemistry, Dr. S. E. Sheppard. *Sampson Low and Co., Ltd.*—Triumphs and Wonders of Modern Chemistry, Dr. G. Martin, new edition, illustrated. *Macmillan*

and Co., Ltd.—The Pigments and Mediums of the Old Masters, with a special chapter on the Microphotographic Study of Brushwork, Prof. A. P. Laurie, illustrated; A Treatise on Chemistry, Sir H. E. Roscoe and Prof. C. Schorlemmer, F.R.S.: Vol. ii., The Metals, new edition completely revised by the Rt. Hon. Sir H. E. Roscoe, and others. *Methuen and Co., Ltd.*—A Third-year Course of Organic Chemistry for Technical Institutes, Dr. T. P. Hilditch. *University Tutorial Press, Ltd.*—Chemical Calculations, H. W. Bausor. *John Wiley and Sons (New York).*—Quantitative Analysis by Electrolysis, A. Classen, with the cooperation of H. Cloeren, translated by W. T. Hall; Outlines of Theoretical Chemistry, F. H. Getman; Exercises in Quantitative Chemical Analysis, C. M. Allen; Technical Chemical Analysis, R. H. H. Aungst; Exercises in Qualitative Chemical Analysis, C. E. Bivins.

ENGINEERING.

Gebrüder Borntraeger (Berlin).—Ueber Natronzellstoff, seine Herstellung und chemischen Eigenschaften, Dr. C. Christiansen. *Constable and Co., Ltd.*—Switchgear and the Control of Electric Light and Power Circuits, A. G. Collis, illustrated. *W. Heinemann.*—Lighthouses and Lightships, F. A. Talbot. *Crosby Lockwood and Son.*—The Diesel or Slow Combustion Oil Engine, G. J. Wells and A. J. Wallis-Tayler, illustrated; Carburation in Theory and Practice, R. W. A. Brewer, illustrated; Locomotive Boilers and Engines, Prof. L. V. Ludy, illustrated; The Air-Brake, Prof. L. V. Ludy, illustrated. *Longmans and Co.*—The Specification and Design of Electrical Machinery, M. Walker. *Seeley, Service and Co., Ltd.*—Submarine Engineering of To-day, C. W. Domville-Fife, illustrated. *University Tutorial Press, Ltd.*—Electrical Engineering, W. T. Maccall. *John Wiley and Sons (New York).*—Text-book on Highway Engineering, Prof. A. H. Blanchard and H. B. Drowne, illustrated; Suspension Bridges: Arch, Ribs, and Cantilevers, Prof. W. H. Burr, illustrated; Logging: the Principles and General Methods of Operation in the United States, Prof. R. C. Bryant, illustrated; Screw Propellers and Estimation of Power for Propulsion of Ships, Capt. C. W. Dyson; Farm Gas Engines, Prof. C. F. Hirshfeld and T. C. Ulbricht, illustrated; Working Drawings of Machinery, W. H. James and M. C. Mackenzie; Mechanical Refrigeration, H. J. Mackintire; Text-book on Railroad Surveying, C. W. Pickels and C. C. Wiley; Underground Waters for Commercial Purposes, F. L. Rector, illustrated; Direct and Alternating Current Machinery, J. H. Morecroft.

GEOGRAPHY AND TRAVEL.

Edward Arnold.—Thirty Years in Kashmir, A. Neve, illustrated; Sport and Folk-lore in the Himalaya, Capt. H. L. Haughton, illustrated. *A. and C. Black.*—Visual Geography, Book ii., Continents and Countries, A. Nightingale, illustrated; Geographical Pictures, edited by S. M. Nicholls: Series ii., Elevation and Depression of the Land, illustrated. *Gebrüder Borntraeger (Berlin).*—Die Typen der Bodenbildung, ihre Klassifikation und geographische Verbreitung, Prof. F. Glinka, edited by Prof. H. Stremme, illustrated. *The Cambridge University Press.*—The Madras Presidency with Mysore, Coorg, and the Associated States, E. Thurston, C.I.E. (Provincial Geographies of India); Northumberland, S. R. Haselhurst; Merionethshire, A. Morris (Cambridge County Geographies). *G. Fischer (Jena).*—Zoologische und anthropologische Ergebnisse einer Forschungsreise, im westlichen und zentralen Südafrika, Prof. L. Schultze: Band v., Systematik und Tiergeographie, Lieferung 2, illustrated.—*Hodder and Stoughton.*—Across Unknown South America, A. H. Savage Landor, 2 vols., illustrated. *H. Holt and Co. (New York).*—Industrial and Commercial Geography, Prof. J. R. Smith. *Hutchinson and Co.*—The Voice of Africa: being an Account of the Travels of the German Inner-African Exploration Expedition during the years 1910–12, L. Frobenius, 2 vols., illustrated; Unknown Mongolia: a Record of Travel and Exploration on Russo-Chinese Borderlands, D. Carruthers, with three chapters on Sport, by J. H. Miller, and an Introduction by Earl Curzon of Kedleston, K.G., 2 vols., illustrated. *Macmillan Co., Ltd.*—My Life among the Eskimos, V. Stefánsson, illustrated; Travels in Turkey, Sir Mark Sykes, Bart., M.P., illustrated; Impressions of Canada, F. Parbury, illustrated; Hunting the Elephant in Africa, Capt. C. H. Stigand, with an introduction by Theodore Roosevelt, illustrated. Junior Geography of the World, B. C. Wallis. *Methuen and Co., Ltd.*—A Naturalist in Western China, E. H. Wilson, illustrated. *John Murray.*—The Book of the Lion, Sir A. Pease, Bart., illustrated; Buddhist China, R. F. Johnston, illustrated. *Smith, Elder and Co.*—Scott's Last Expedition, 2 vols., illustrated; Vol. i., Being the Journals of Captain R. F. Scott, C.V.O., R.N., with a Preface by Sir Clements R. Markham, K.C.B., F.R.S.; vol. ii., The Reports of the Journeys and Scientific Work undertaken by Dr. E. A. Wilson and the surviving members of the Expedition, arranged by Leonard Huxley; Hunting and Hunted in the Belgian Congo, R. D. Cooper, illustrated. *Witherby and Co.*—Camping in Crete, A. Trevor-Battye.

GEOLOGY.

Constable and Co., Ltd.—Geology and Physical Geography, C. Vêlain (Thresholds of Science). *Macmillan and Co., Ltd.*—Text-book of Paleontology, edited by Prof. C. R. Eastman, adapted from the German of Prof. K. A. von Zittel, new edition, vol. i., illustrated; The Quaternary Ice Age, W. B. Wright, illustrated. *John Murray.*—Nature and Origin of Fiords, Prof. J. W. Gregory, F.R.S., illustrated. *John Wiley and Sons (New York).*—The A B C of the Useful Minerals, A. McLeod; Engineering Geology, Profs. H. Ries and T. L. Watson.

MATHEMATICAL AND PHYSICAL SCIENCE.

The Cambridge University Press.—Natural Sources of Energy, Prof. A. H. Gibson (Cambridge Manuals of Science and Literature). *Cassell and Co., Ltd.*—Star-Land, Sir R. S. Ball, new edition, illustrated. *Constable and Co., Ltd.*—Astronomy, C. Flammarion (Thresholds of Science); Physics, F. Carré (Thresholds of Science). *Gall and Inglis.*—Dante and the Early Astronomers, M. A. Evershed, illustrated. *Gauthier-Villars (Paris).*—Leçons sur les Fonctions de Lignes, V. Volterra; Les Lois empiriques du Systéme solaire et les Harmoniques tourbillonnaires, F. Butavand; Leçons sur la Theorie des Nombres, A. Châtelet; Le Téléphone instrument de Mesure, A. Guyau, Cours complet de Mathématiques speciales, J. Haug, 3 vols.; Cours de Mécanique, L. Lecornu, 2 vols.; La Technique de la Radiotélégraphie, H. Rein; Leçons de Mathématiques générales, L. Zoretti. *Longmans and Co.*—Positive Rays and their Application to Chemical Analysis, Sir J. J. Thomson, O.M., F.R.S.; The Spectroscopy of the Extreme Ultra-violet, Prof. T. Lyman; Modern Seismology, G. W. Walker, F.R.S.; Colloidal Solutions, Prof. E. F. Burton; Atmospheric Ionization, Prof. J. C. McLennan; Mechanics of Particles and Rigid Bodies, J. Prescott; Photo-electricity, Dr. Stanley Allen;

Ventilation and Humidity in Textile Mills and Factories, C. H. Lander. *Macmillan and Co., Ltd.*—Astronomy: a Popular Handbook, Prof. H. Jacoby, illustrated. Applied Mechanics for Engineers, J. Duncan; Practical Mathematics for Students, T. S. Usherwood and C. J. A. Trimble; Exercises in Mathematics, David Mair. *Methuen and Co., Ltd.*—Aviation, A. E. Berriman, illustrated; Gas Testing and Air Measurement: a Manual for Deputies, Miners, &c., C. Chandley; Practical Science for Engineering Students, H. Stanley. *Oxford University Press.*—The Algebra of Quantics, E. B. Elliott, new edition. *G. Routledge and Sons, Ltd.*—Lectures on the Icosahedron and the Solutions of Equations of the Fifth Degree, Prof. Felix Klein, translated by Dr. G. G. Morrice. *The S.P.C.K.*—The Wonders of Wireless Telegraphy, Prof. J. A. Fleming, F.R.S., illustrated. *University Tutorial Press, Ltd.*—Algebra for Matriculation, A. G. Cracknell; The Laws of Algebra, A. G. Cracknell. *Whittaker and Co.*—Modern Illuminants, L. Gaster and J. S. Dow; Elementary Graphic Statics, J. T. Wight; Electric Circuit Theory and Calculations, W. P. Maycock. *John Wiley and Sons (New York).*—Applied Mechanics: vol. i., Statics and Kinetics; vol. ii., Strength of Materials, Profs. C. E. Fuller and W. A. Johnston; Constructive Text-book of Practical Mathematics: vol. ii., Technical Algebra, part i., H. W. Marsh; Mathematics Work-book, H. W. Marsh; Text-book of Spherical Trigonometry, Prof. R. E. Moritz; Descriptive Geometry, J. C. Tracy and H. B. North; Laboratory Exercises in Elementary Applied Mechanics, J. M. Jameson; Exercises in Heat, J. A. Randall; Laboratory Exercises in Electricity, A.C. and D.C., W. H. Timbie; Alternating Currents, W. H. Timbie and H. H. Higbie.

MEDICAL SCIENCE.

Appleton and Co.—Tuberculin, Hamman and Wolman; Practice of Dentistry, L. and M. Greenbaum; Text-book of Bacteriology, Hiss and Zinsser; Preventive Medicine and Hygiene, M. J. Rosenau; Clinical Laboratory Methods, R. S. Morris; Minor Surgery, E. M. Foote; Psychotherapy, J. J. Walsh.—*Baillière, Tindall and Cox.*—Sciatica, Dr. W. Bruce; The Practice of Veterinary Medicine, E. Courtenay and F. T. G. Hobday, new edition; A System of Veterinary Medicine, by various writers, edited by E. W. Hoare: vol. ii., Constitutional Diseases, &c.; Treatment by Hypnotism and Suggestion, or Psycho-Therapeutics, Dr. C. Lloyd Tuckey, new edition, with an introductory chapter by Sir F. R. Cruise; Clinical Bacteriology and Sero-Vaccine Therapy for Veterinary Surgeons, W. M. Scott; Diet and Hygiene in Diseases of the Skin, Dr. L. D. Bulkley. *John Bale, Sons, and Danielsson, Ltd.*—Outlines of Greek and Roman Medicine, Dr. J. S. Elliott, illustrated; Health Preservation in West Africa, J. C. Ryan, with introduction by Sir Ronald Ross, K.C.B., F.R.S.; Hints for Residents and Travellers in Persia, Dr. A. R. Neligan. *G. Bell and Sons, Ltd.*—Cancer: its Causation, Prevention, and its Curability without Operation, Dr. R. Bell. *A. and C. Black.*—Social Pathology, Dr. A. Grotjahn, translated by Dr. S. Herbert; Practical Pathology and Post-mortem Technique, Dr. J. Miller, illustrated; The Laws of Health for Schools, Dr. A. M. Malcolmson, illustrated. *The Cambridge University Press.*—Embolism and Thrombosis of the Mesenteric Vessels, L. B. C. Trotter; Trachoma and its Complications in Egypt, Dr. A. F. MacCallan; Flies in Relation to Disease: Non-bloodsucking Flies, Dr. G. S. Graham-Smith (Cambridge Public Health Series). *Cassell and Co., Ltd.*—Common Diseases, Dr. W. Hutchinson. *J. and A. Churchill.*—Dental Anatomy, Human and Comparative, C. S. Tomes, F.R.S., new edition, revised by Dr. Marett Tims and A. Hopewell-Smith. *G. Fischer (Jena).*—Ergebnisse und Fortschritte des Krankenhauswesens, Band ii., edited by Profs. Dietrich and Grober, illustrated; Handbuch der gesamten Therapie, edited by Profs. F. Penzoldt and R. Stintzing, new edition. *J. B. Lippincott Co.*—Psychoneuroses and psychotherapy, Dejerine and Gauckler; Muller's Serodiagnostic Methods, Whiteman; Blood Pressure, P. Nicholson; Surgery of the Vascular System, B. M. Bernheim. *Macmillan and Co., Ltd.*—Diseases of the Arteries and Angina Pectoris, Sir T. Clifford Allbutt, K.C.B., F.R.S., 2 vols. *John Murray.*—Therapeutics of the Circulation, Sir T. Lauder Brunton, Bart., F.R.S., new edition illustrated. *Oxford University Press.*—The Evolution of Modern Medicine, Sir W. Osler, Bart, F.R.S. *Williams and Norgate.*—Nerves, Prof. D. Fraser Harris, illustrated.

TECHNOLOGY.

B. T. Batsford.—Handcraft in Wood and Metal, J. Hooper and A. J. Shirley, illustrated; Drainage and Sanitation, E. H. Blake, illustrated; Plumbing Practice, J. W. Clarke: vol. i., edited by W. Scott, illustrated; Modern Technical Drawing, G. Ellis. *The Cambridge University Press.*—Architectural and Building Construction Plates: Part i., Thirty Drawings covering an Elementary Course for Architectural and Building Students, W. R. Jaggard (Cambridge Technical Series). *Cassell and Co., Ltd.*—Electricity in the Service of Man, Dr. R. M. Walmsley, vol. ii., section i., illustrated; Gramophones and Phonographs; Electric Lighting, illustrated. *Constable and Co., Ltd.*—English Industries of the Middle Ages, L. F. Salzmann. *W. Engelmann (Leipzig).*—Technische Altertümer, Feldhaus. *W. Heinemann.*—Fires and Fire Lighting, Chief Kenlon and A. Lethbridge. *Crosby Lockwood and Son.*—Clock Repairing and Making, F. J. Garrard, illustrated; The Clerk of Works: a Handbook on the Supervision of Building Operations, G. Metson; Valuation of Real Property, C. A. Webb, new edition by A. Hunnings; The Public Works Calculator, new edition; Screw Cutting for Engineers, E. Pull, illustrated; Metal Plate Work and Processes, E. G. Barrett; Hand Sketching for Mining Students, G. A. Lodge. *Methuen and Co., Ltd.*—A Text-book of Elementary Building Construction, A. R. Sage and W. E. Fretwell, illustrated. *G. Routledge and Sons, Ltd.*—Flour Milling, P. A. Kozmin, translated by M. Falkner, illustrated; Broadway Text-books of Technology:—The Science of Building and Building Materials, E. Holden; Applied Mechanics, C. E. Handy; Mechanics for Textile Students, D. Hardman; Electrical Engineering, F. Shaw; Drawing for Electrical Engineers, G. W. Worrall; Safety-lamps and the Detection of Fire-damp in Mines, G. H. Winstanley. *Scott, Greenwood and Son.*—Motor Car Mechanism, W. E. Dommett; Elementary Principles of Illumination and Artificial Lighting, A. Blok; Cranes and Hoists: their Construction and Calculation, H. Wilda; Foundry Machinery, E. Treiber; Analyses of Woven Fabrics, A. F. Barker and E. Midgley, illustrated; The Art of Lithography, H. J. Rhodes, illustrated. *University Tutorial Press, Ltd.*—Manual Training, A. H. Jenkins. *Whittaker and Co.*—Electric Light Fitting, S. C. Batstone; Village Electrical Installations, W. T. Wardale; Practical Wireless Telegraphy, W. H. Marchant; Exercises in Engineering Workshop Practice, E. Pull; Carpentry and Joinery, B. F. Fletcher and H. P. Fletcher. *John Wiley and Sons (New York).*—Architectural Drafting, C. B. Howe and A. B. Greenberg; Elementary Electrical Testing, V. Karapetoff.

MISCELLANEOUS.

G. Bell and Sons, Ltd.—Buddhist Psychology, C. A. F. Rhys Davids; Montessori Principles and Practice, Prof. E. P. Culverwell, illustrated. *A. and C. Black.*—A First Book of Experimental Science for Girls, Mrs. Jessie White. *W. Blackwood and Sons.*—A History of European Thought in the Nineteenth Century, J. T. Merz, vol. iv. *Constable and Co., Ltd.*—Letters and Recollections of Alexander Agassiz, edited by G. R. Agassiz. *A. C. Fifield.*—The Discovery of the Future, H. G. Wells, new edition. *Macmillan and Co., Ltd.*—Statistics, by the late Sir R. Giffen, K.C.B., F.R.S., written about the years 1898–1900, edited with an introduction by H. Higgs, C.B., with the assistance of G. U. Yule; Studies in Water Supply, Dr. A. C. Houston, illustrated; Land Surveying, Prof. H. Adams, illustrated. *Methuen and Co., Ltd.*—The Book of the Ball: an Account of what it Does and Why (cricket, football, golf, baseball, tennis, lawn tennis, pelota, polo, fives, pallone, rackets, hockey, lacrosse, croquet, bowls, squash, badminton, billiards), A. E. Crawley, illustrated. *John Murray.*—History of the Royal Society of Arts, Sir H. Trueman Wood, illustrated. *T. Fisher Unwin.*—Surface Waves of Sand and Snow, and the Eddies which Produce them, Dr. Vaughan Cornish, illustrated.

THE BRITISH ASSOCIATION AT BIRMINGHAM.

SECTION G.

ENGINEERING.

OPENING ADDRESS BY PROF. GISBERT KAPP, PRESIDENT OF THE SECTION.

ENGINEERING, the subject with which Section G is concerned, covers so wide a field that it has been found convenient to introduce a rough subdivision into the three branches of civil, mechanical, and electrical engineering. By applying any such term to a particular piece of engineering work we do not necessarily exclude the others; we merely characterise a predominant feature. There is often a considerable amount of overlapping between the three branches, and that is especially the case with mechanical and electrical engineering. Sometimes the boundary-line even becomes indistinct, and then it is difficult to say which branch of our science is the predominant feature. Is the equipment of a works with electric power mechanical or electrical engineering? It is both, but not necessarily to the same degree. The mere replacement of a steam engine by an electric motor to drive the main shafting of a works can scarcely be called a piece of electrical engineering; but if special electric appliances are introduced to perform duties which cannot be done, or not done as well, by purely mechanical machinery, then we have electrical engineering in the true sense of the term.

Electricity has invaded almost every branch of our industrial activity, sometimes as a rival to older methods, but often also as a helpmate, stimulating progress all round. Electricity is a "great source of power in nature," and the "art of directing it for the use and convenience of man" belongs to our generation. Yet, like all new things, it has had to fight its way in the face of strenuous opposition—generally an absolutely honest opposition, not in any way traceable to self-interest, but simply to inability to see things in the right perspective. Let me illustrate my meaning by an example. Shortly after Charles Brown had established the first electric-power transmission between Kriegstetten and Solothurn I happened to visit a well-known mechanical engineer in Zürich, who had in his time been professionally (not financially) interested in so-called teledynamic transmission of power by wire-rope, first introduced into Alsatia by the celebated Prof. Hirn, of thermodynamic fame, about the middle of last century, and then also imported into Switzerland. To my old friend these transmission systems appeared to be the acme of perfection; and on my pointing out that the range was necessarily very limited, he replied that transmission to longer distances would be useless, since there would be no market for the power. My friend was not able to look at the subject in the right perspective; he failed completely in appreciating the fundamental conditions of the problem, and although it is easy for us now, fortified as we are by experience, to appreciate electric transmission of power correctly and feel contempt for the old gentleman's narrow-mindedness, yet we should be careful not to fall into the same error about electrical developments which are new to us, as the transmission of power was new to my Swiss friend.

It is not so very long ago that mechanical engineers thought there was no advantage in electrifying textile mills; and I do not feel quite certain whether a good many and very capable engineers are not still of the same opinion. A commission has been investigating this subject, and its first report was by no means encouraging to the electrical engineer. Yet at the very time when that report was issued hundreds of motors were being installed in Continental mills. The spinners there had found out that by using a motor with very delicate speed regulation they could speed up their frames and increase the output considerably. In the long run a good thing must win through, and the electrification of English textile mills is no exception to this economic law; but in some cases it would almost seem that the way is made longer by the narrowness of the mental horizon of opposing experts. This process of gradually overcoming the opposing expert had to be gone through in all applications of electricity, but the opposition being generally honest, once it is overcome, the very men who opposed become strong friends. There is no question now that electricity can do some things better than could be done formerly. The separation of magnetic from non-magnetic material; the lifting of hot pigs, ingots, plates, and scrap by electromagnets; the production of high-grade steel in the electric furnace; the sinking of shafts by electrically-driven pumps; in mines the use underground of electromotors instead of steam engines, in shipyards the use of magnetically-fixed and electrically-driven tools; the electric driving of rolling mills, and the use of electric traction on tube and other underground railways are familiar examples of the application of electricity in which unanimity as to its advantages has been reached between the electrical engineer and what, without any intention of being disrespectful, we may call the old school of mechanical engineers. There are, however, other applications of electricity where the old and new school of engineers have either not at all, or only partially, reached unanimity of opinion, and it is with one of these applications—namely the electrification of railways—that I propose to deal in this Address.

As regards urban and suburban lines, not only the possibility of electric traction, but its immense superiority over steam traction, is fairly generally admitted. Where we get on debatable ground is when we begin to discuss main-line traffic. Here the process of overcoming opposition, of which I spoke a moment ago in connection with other applications of electricity now generally approved, has only just begun. Will it lead to the same result, or will the electrician have to

confess himself beaten by the steam locomotive? The answer each one of us would give to this question must necessarily be biassed by our early training. Most engineers love their profession, and are enthusiasts; being enthusiasts, they are necessarily biassed. This applies as well to the electrical engineer as to the mechanical engineer—perhaps to the electrical engineer most. In many cases he is so biassed that he will not admit any virtue in any other but his own pet scheme of electric traction. A modern steam locomotive is a beautiful and efficient engine, and one can well understand its designer looking at it with the pride of a father whose son has turned out a good man. One can also understand that this engineer will not readily admit the superiority of an electric locomotive. The mental horizon of each of us must necessarily be narrowed by previous training and professional enthusiasm; let us, then, try to forget for a moment that we are engineers, and let us put out of our minds all questions of mechanical or electrical detail, focussing our thoughts merely on what we see going on all around us as regards electrification of railways. We see year by year more lines being electrified. Some are failures; but the very fact that in spite of these failures the process of electrification is going on, shows that the failures are remediable.

In some cases it is easy to understand why a line should be electrified. If fuel is dear, if the trains must be heavy and frequent, if there are steep grades and long tunnels, then obviously steam is at a disadvantage and electricity can beat it easily. But the electrification is not limited to cases where there are such obvious advantages. We see a military State like Prussia electrifying a fairly long line where the traffic is not extremely heavy, where there are very gentle grades, and only few and short tunnels. Moreover, one of the stock arguments against electrification is that in case of war the whole system may be broken down by the enemy cutting the wires; yet this consideration, if it has any weight—a matter on which I cannot pronounce an opinion—does not deter a military State from at least experimenting with electric traction on a large scale. We see suburban lines growing longer and longer, until they might almost be classed as short main lines, and we see the Swiss Government buying up water-powers with the object of utilising these powers in the electrification of its most important main lines. We see in America the electrification of large systems taking place, not only for passenger service, but also for the goods service, comprising trains of 2000 and more tons weight, and of goods yards, to the complete exclusion of steam.

One need not be an engineer to appreciate the significance of such a general development. No Government department, and certainly no board of railway directors, will spend money merely for the sake of an interesting scientific experiment, and, although it is conceivable that in an isolated case such an experiment may be undertaken under a miscalculation as to its possible success, it is not conceivable that such a miscalculation should be the general rule. When we see that in all countries a vast amount of labour is devoted to, and capital is spent on, the electrification of main lines, we cannot but come to the conclusion that this new application of electricity is bound to progress, and that the persons who tell you that electric traction is all right for tramways and urban railways, but will never be able to compete against steam traction on main lines, are very much in the position of my old Swiss friend, whose conception of power transmission was entirely limited to the use of ropes and pulleys.

It is just thirty years since the first electric railway was opened for public use. That was a small line in Ireland, known as the Portrush-Bushmills Railway. In those days only the continuous-current motor was available, and that only at a very moderate pressure and power. These restrictions were from the first felt to be a serious drawback, and inventors tried to overcome them in various ways. Of these, two may be here noted, in passing. Ward Leonard in 1891 made the suggestion of carrying on the train a converting station. He argued, quite correctly, that for the transmission of power to long distances the alternating current was eminently suitable, and that, consequently, the power should be sent to the train in the shape of high-pressure alternating current. On the other hand, such a current was, in those days, quite unsuitable for motors; hence the necessity of its conversion into continuous current, with which the then available motors could alone deal. Ward Leonard suggested to put on the first vehicle of the train a synchronous motor, which drives an exciter and continuous-current generator. The current obtained from this generator was to be used to drive the train-motors, which might be distributed in a number of motor coaches. The regulation of speed and tractive force was to be effected entirely by suitable adjustment of excitation, and therefore without rheostatic loss. It will be admitted that this proposal has some attractive features. It is essentially a long-distance system, and at the same time it offers the possibility of great and uniform acceleration, a matter of great importance in urban traffic, so that it is equally suitable for both kinds of service. Moreover, the current can be taken with unity-power factor. Unfortunately the extra weight which has to be carried in the shape of converting machinery is a serious drawback; and for this reason the Ward Leonard system (excellent as it has proved in other applications of electric power) has in the domain of traction never got beyond the experimental stage.

The experiment has been made on a fairly large scale, but with this difference, that the traction-motors were placed not only into motor coaches, but on the first vehicle itself, which thus became an electromotive; also, in order to save the weight and cost of starting and synchronising gear, the asynchronous type of single-phase motor was adopted, thus sacrificing the advantage of unity-power factor. The electromotive developed at the hour-rating 200 horse-power, and weighed 46 tons. This is not a very brilliant achievement, and it was beaten by a sister engine of the same power, but using alternating-current motors. This electromotive weighed only 40 tons.

It is probable that a better weight efficiency could be obtained nowadays with this system if carried out on a larger scale, and if the motor-generator were replaced by a converter, in which case the step-down transformer would have tappings on its secondary side for starting and regulation. It is, however, doubtful whether even then it could compete with electromotives using the alternating current in the motors directly. Motors of this type have recently been so much improved that the margin of weight that could be saved by the use of continuous-current motors is probably less than the excess weight of the converting machine.

The other attempt to combine high trolley-voltage with low motor-voltage has shared the same fate. This consisted in the application of the three-wire principle of continuous-current supply to electric traction. It is in successful operation at a moderate voltage on a London tube railway, but as far as main-line working is concerned it has not got beyond an application on two small lines in Bohemia. The principle adopted is to make the trolley wire of the up-line the positive and that of the down-line the negative side of the system, whilst the rails take the

place of the zero wire. Each electromotive is fitted with four motors, of which at least two are in series, taking 1500 volts. Thus, whilst the voltage of one motor is kept within the customary limit of 750 volts, the pressure of the whole system is 3000 volts. The objection to this arrangement is that its fundamental supposition of a fairly close balance between the two halves of the three-wire system must in actual railway working be rather the exception than the rule, and that the obvious remedy of combining both halves of the system in one and the same train would involve the use of two overhead trolley wires, and thus introduce the very feature which the advocates of the continuous-current system find so objectionable in three-phase traction. Moreover, the recent improvements made in continuous-current motors has reduced the importance of the three-wire principle. Continental makers are prepared to build motors for 1200 volts, and one English maker is actually building motors for 1750 volts, so that with two motors in series a trolley-pressure of 2400 and 3500 volts respectively can be used.

The present tendency in electric traction is in the direction of simplicity, in the sense that mixing up of different types of current and dependence of one train on another is avoided. Only three types of current are used—namely continuous, three-phase, and single-phase. The two first-named are used direct; the last through the intervention of a transformer. In a large measure the different systems have already become standardised. As regards the C.C. system, up to 750 volts the process of standardisation has been completed long ago. It is almost generally adopted for urban and suburban lines of moderate length, unless there are local difficulties as regards the third rail, or it is desired to work the suburban and the main-line service on the same system. The three-phase system has also been fairly well standardised, but the single-phase system is still in a process of development—a development which, however, takes place on a fairly large scale. In France the Compagnie du Midi is electrifying on the single-phase system nearly 400 miles of track; the German Government have already electrified the Dessau-Bitterfeld of the Leipzig-Magdeburg line, and are electrifying the line Lauban-Koenigszelt in Silesia, to say nothing of some smaller private lines in the south of Germany, which have been in operation for some years. In Switzerland the Berne-Loetschberg-Simplon Railway, already in operation, and the Rhætian Alp Railway, nearing completion, also employ single-phase electromotives. Both in France and Germany the type of electromotive to be finally adopted has not yet been settled, but half a dozen different types, supplied by as many different makers, are being tried, and it is in this respect that one may look on single-phase traction as still in the process of development. As regards the Loetschberg the period of trial is over. Three years ago the railway company ordered a 2000 horse-power electromotive, and have had it at work ever since with such satisfactory results that they have decided to adopt this type definitely, and have ordered thirteen more engines, but of the slightly larger power of 2500 horse-power on the 1½-hour rating. Of these I shall have to say something more presently; but before entering into the details of single-phase traction it is expedient to glance briefly at the present position of the rival system of three-phase traction.

The first application of this method of working dates back to the end of last century, and took place on a small Swiss line; then followed the well-known Valtellin line, and, later still, when the Italian Government took over the railways, the Government engineers decided to extend the application of three-phase traction to some other lines—a decision which practical experience has shown to have been perfectly justified. The total power represented by three-phase electromotives either at work or on order in Italy to-day exceeds 200,000 horse-power (95,000 horse-power in service, and 120,000 horse-power building). Ten years ago the three-phase system was the only possible one for main-line working, but later on there came on the scene the single-phase, and, later still, the high-pressure continuous-current systems, and I need scarcely mention that between the advocates of the three systems there has been waged a fierce battle, each claiming that his is the best and the others very inferior. I am afraid that battle is still raging; but it is a futile war, for there is no such thing as a best system generally. One system is the best for one set of conditions and another for another set. Thus the German railway engineers found that the single-phase system would serve them best, and they adopted it. There is in this matter no question of personal feeling or national prejudice. I have no intention to enter the lists as an advocate for any one of the three possible systems for main-line traction; each has its special features and special merits, and all I can do is to place before you some of these. As the three-phase system is the oldest, it will be convenient to take it first.

It is curious to note that the three most obvious objections which have been raised against three-phase electromotives by theorists have been found to have but little weight in practical work. These objections were: the complication of a double overhead wire, the danger that the motors would not share the load fairly, and the inability to run without rheostatic waste at intermediate speeds, or to run at a higher than synchronous speed to make up for lost time.

That an overhead wire is inconvenient must be readily admitted, but the inconvenience applies to all methods of main-line working, for the so-called third rail is not applicable to high pressure, and even if it were, the consideration of the safety of the platelayer would preclude its use. The question then is: are two wires twice as objectionable as one? Possibly, but the most objectionable feature is not the wire itself, but the posts or gantries on which it is carried, and the number of posts is the same, whether we use three-phase, single-phase, or continuous current. There is a little more complication at the cross-over points and at the switches; but this is not a serious matter, if one may judge from the perfectly smooth working of so extended a yard as that at Busalla, where there are five miles of track, connected by thirty-seven switches and crossings. The other objection—as to the motors not sharing the load equally—is theoretically sound. The torque developed by the motor is proportional to the slip, and in order that the two motors on an electromotive shall share the load equally their slips, and consequently also their speeds, must be the same. Now, it is conceivable that, owing to a slight difference in the size of the drivers, that motor which is geared to the larger drivers will, by reason of its lower speed and consequently greater slip, take more than its fair share of the load. In practice this difficulty does, however, not arise. With reasonably good workmanship there should be no sensible difference in the size of the wheels; but even if we admit the possibility of there being a difference of ½ per cent. in the diameter of the wheels, this would, with the usual slip of 3 per cent., only mean that the motor geared to the larger wheels develops 8 per cent. more, and the other 8 per cent. less, than its normal power. The larger wheels will develop 16 per cent. more tractive effort than the smaller wheels, and having thus a greater wear, the differ-

ence originally existing will diminish in service. For the same reason, any tendency to wear unequally, say, in consequence of unequal material, is counteracted by the slip-adjustment of the motors. This point has been tested practically by the makers of the Simplon three-phase electromotives. It was found that if originally a slight difference in diameter of the drivers had been permitted to exist, after a short time this had vanished. That is as regards the condition on one electromotive; but if we come to the case of a train being hauled by two engines, then a sensible difference in the size of their wheels may exist. In this case it is necessary artificially to adjust the slip so as to make each motor take half the load.

This problem has been solved by Mr. v. Kando in the electromotives which he designed for the Italian State railways. In these engines only liquid resistances are used in the rotor circuit for starting and speed regulation. The liquid is raised or lowered in the rheostat chambers so as to cover more or less of the contact plates, and the level of the liquid is controlled by a solenoid under the influence of the working current. The working current, and therefore also the tractive effort exerted by each motor, is thereby automatically kept constant, notwithstanding any difference that may exist in the size of the drivers on the two electromotives. Incidentally, it may be mentioned that this method of liquid rheostat control has also the advantage of a perfectly constant acceleration during the starting period—a point which makes for comfort of travel in a three-phase train.

The third objection advanced by theorists against three-phase traction is against the waste of energy consequent on rheostatic speed control and the inability to run at more than synchronous speed so as to make up for lost time. The obvious remedy for the last-named difficulty is to fix the time-table so that the synchronous speed should be high enough for making up lost time and to employ motors which can run economically at less than synchronous speed. As a matter of practical experience, three-phase trains are not more unpunctual than any other kind, steam not excluded. A train pulled by a series motor (C.C. or A.C.) runs slower on an up-grade or if abnormally heavy; this is one of the characteristics of the series motor, and it is valuable, because it limits the excess load thrown on to the source of power; but it is clearly not a condition making for good time-keeping. With a series motor time lost cannot be recovered on an up-grade, whilst with a three-phase motor the speed on an up-grade may be kept practically the same as on the level or on down-grades, so that the process of gaining time is not restricted to the easy parts of the line.

The problem of speed control without rheostatic waste has been solved in various ways. One of the simplest and generally adopted solutions is that of cascade and single working. If the two motors are put into cascade connection the speed is halved. The cascade is used in starting and on heavy grades (unless time has to be made up), and on the easy grades or on down-grades the motors work singly—that is to say, in simple parallel connections. Intermediate speeds may be obtained by some pole-changing device. Ordinarily, such devices have to be applied to stator and rotor, but in some of the Simplon electromotives only the stator is arranged for pole-changing, the rotor being a squirrel cage. In this arrangement the advantage of cascade-working has to be given up, but the system has the merit of great simplicity. The number of poles may be changed from twelve at starting to eight, six, and four at top speed. Thus, four different speeds, all without rheostatic waste, are possible. The single bars in the squirrel cage rotor are connected at their ends by resistance-connectors made of an alloy having a high temperature coefficient. At starting the rotor current is large and heats up these strips, thus automatically providing what is technically termed a starting-resistance. When the motor is running the current is less, and by reason of the fanning action of the connecting-strips these get cooled so as to bring their resistance down to a permissible amount. Thus the efficiency of the motor when running under load is only a few per cent. less than that of a motor with a wound rotor.

A valuable feature of the three-phase system is the automatic recuperation of current whenever the speed exceeds synchronous speed by a few per cent.: and, connected with this property is the further advantage that it is impossible for a train to race on a down-grade. Obviously recuperation can only take place if power is given to the motor. This is provided partly by the electromotive itself and partly by the train pushing it on a down-grade. This means that the train is braked in front only, and railway engineers have raised the objections that such a method is contrary to the accepted rules for safe working, which require that even on a down-grade all the couplings should remain in tension, which means that each coach must be independently braked. Here we have again a case where the theorists' objections have been proved to be without foundation in actual practice. It is no doubt objectionable to brake a train in front only, if the braking action is jerky; but with the automatically controlled liquid rheostat the braking comes in quite gradually, and is throughout so even that it has been found possible to permit a higher down-grade speed with recuperation than with ordinary braking. On the Italian State railways the regulation permits on heavy down-grades a speed of thirty kilometres per hour for steam trains, but the electric goods trains on the Giovi line are permitted to run at forty-five kilometres per hour. This concession is not extended to passenger trains. Nevertheless the economic effect is considerable. Recuperation saves 17 per cent. on the coal bill, and this amount is sufficient to provide for interest and sinking fund on the electrical plant at the generating station.

One advantage of three-phase traction over steam traction is the lessened weight of the locomotive in comparison with its tractive force and power. As an example, we may take the Giovi line in Italy where steam trains, consisting of 310 tons of rolling-stock and 202 tons of locomotive (one in front and the other at the back), have been replaced by three-phase trains, consisting of 380 tons of rolling-stock and two electromotives, each weighing 60 tons (also placed front and rear). Thus there has been a saving in total weight of 12 tons, and at the same time an increase in useful weight hauled of 70 tons. The average grade of this line, over which passes the whole traffic between the Port of Genoa and the Plain of Lombardy, is 27 per mille, and the maximum is 35 per mille. This traffic is now worked with forty electromotives, each of 60 tons weight. These engines have five driving-wheels connected to two eight-pole motors by gear-wheels and rods. The pressure on each driving-axle is 12 tons. Each electromotive develops 2000 horse-power at the hour-rating: thus 1 horse-power is obtained for each 30 kilogramme weight of engine.

The number of patented designs for single-phase traction motors is very large; but, notwithstanding considerable difference in matters of detail, all motors which have been successfully applied in practice may be ranged under three great groups—namely, the so-called repulsion type, the repulsion type with additional excitation of the rotor, and the straightforward series motor. The present tendency is rather in favour

of the series motor, and the practical results obtained with it are certainly very promising. The latest design made by Dr. Behn-Eschenburg shows a remarkable weight efficiency. His 2500 horse-power electromotives (the power being at a one and a half-hour rating) weigh only 108 tons, so that at this rating 1 horse-power is obtained with a total weight of 43 kilogrammes. This compares favourably with the high-pressure C.C. system, where 50 to 70 kilogrammes per horse-power may be taken as normal values.

The so-called "repulsion motor" invented by Prof. Elihu Thomson has been applied to railway work in the slightly modified form due to Mr. Deri, where, instead of there being only two brushes per pair of poles, double the number is provided, and the adjustment for speed and torque is made more accurate, whilst at the same time the commutation, being split up into two steps, becomes easier. In the matter of simplicity, an electromotive fitted with Deri motors cannot be surpassed by any other arrangement. There are no rheostats, contactors, control switches, or other gear; all the regulation is effected by mechanical transmission of the movement of a hand-wheel placed in the driver's cab to the brushes of the motors. At one time it was hoped that this system would win its way to a general application; but, unfortunately, the motor must run somewhere near synchronous speed, and becomes therefore rather heavy with the low frequencies alone possible in traction. Moreover, as the power-factor obtainable is only about 0·80, that is, considerably below the value obtainable with other motors, there does not seem to be any great future for this system for heavy work, although its great simplicity may still turn the balance in its favour on lines with a light traffic. For heavy lines the choice at present lies between the induction motor, with direct rotor excitation, and the straightforward conduction-motor, where rotor and stator are traversed in series by the same current. The former type of motor—also called the Latour-Winter-Eichberg motor—depends for its working current in the rotor on electromagnetic induction, which produces the working current in the rotor much in the same way as the current in the secondary circuit of a transformer is produced by induction. Since the motor has in part the character of a transformer its weight would, as is the case with any transformer, be unduly augmented by too great a reduction in the frequency. Experience has shown that a frequency of twenty-five periods per second is high enough to render the transformer action effective, and at the same time not so high as to introduce serious difficulties as regards e.m.f. of self-induction and commutation. This frequency has been adopted in most cases where electrification of main lines has been carried out by motors of this class.

One valuable feature of this motor is that at a speed slightly exceeding synchronism the power-factor may be brought up to unity. At this speed the commutation takes place under conditions which may be described as theoretically perfect. A fair number of Continental lines have been electrified by using these motors, and they have also been adopted, with very satisfactory results, in the electrification of the London, Brighton and South Coast lines between Victoria and London Bridge and to some distance south of London. On this line no locomotives are used, but only motor coaches. It is therefore not possible to make a direct comparison as to weight efficiency with a locomotive. The latter has only to carry the propelling machinery, whilst the former has to provide accommodation for passengers as well. The 600 horse-power motor coaches on the Brighton line weigh 50 tons, or at the rate of 83 kilogrammes per horse-power. A 1000 horse-power C.C. electromotive taking current at 1200 volts weighs 74 tons.[1] By making a suitable reduction for the extra weight of the passenger accommodation in the A.C. coach, its weight per horse-power comes out at something like 60 kilogrammes, against 62 kilogrammes in the C.C. engine.

Series motors are employed on the electrified lines of the Midland Company between Heysham, Morecambe, and Lancaster. Also in this case motor coaches, and not electromotives, are used. At the hour-rating a motor coach develops 420 horse-power, and as its total weight is about 35 tons, we have here the same weight-efficiency as on the Brighton lines—namely, 83 kilogrammes per horse-power for the whole coach.

Of high-pressure continuous-current lines there are many examples, both in Europe and America. The term high-pressure does, of course, not imply the same order of magnitude as in single-phase A.C. lines. There high-pressure may mean anything up to 15,000 volts, the pressure which is likely to become a standard in future electrifications; but in C.C. work one must class anything over 1000 volts or 1500 volts as high-pressure. The general rule is to employ motor coaches, and not electromotives; but there is a private line belonging to a steel-works in Lorraine, where two electromotives, each of 600 horse-power (four C.C. motors of 150 horse-power) are working the mineral trains under a pressure of 2000 volts. The Southern Pacific Railway also employs C.C. electromotives of 1000 horse-power each. Each engine weighs 74 tons, and hauls a train of 270 tons on grades of 40 per mille. This is a remarkable performance, rendered possible by the fact that with the even torque exerted by the electric motor a much large co-efficient of friction than is possible in steam traction may safely be permitted. Electrical engineers generally base their calculation of the possible tractive effort on a co-efficient of 0·17, without sand, and as high as 0·25, or even 0·28, if sand is used. The voltage in the case of the Southern Pacific engines is only 1200 volts, taken by two motors in series, and there is provision made to change over from the overhead wire to third rail, with 600 volts, when the motors are all in parallel.

On European C.C. lines the voltage is higher—generally 2000 volts, as on the Chur-Arosa and some other Swiss lines—and the tendency is still in the direction of higher pressures. Continental makers are now prepared to go as far as 1200 volts per motor, so that with the usual system of series-parallel control a line-pressure of 2400 volts becomes possible. The greatest step in advance in this direction has, however, been made in England, where Messrs. Dick Kerr, Ltd., have adopted a line-pressure of 3500 volts as their standard, involving the use of motors constructed for 1750 volts. After having experimented with this high-pressure system for two years, they have undertaken the electrification of a short section of the Lancashire and Yorkshire Railway with continuous current at 3500 volts. I am indebted to the firm for the following particulars: The current is collected by pantograph from an overhead wire with catenary suspension. The train consists of a motor coach and two trailers. The motor coach is equipped with four 300 horse-power motors, and weighs 62 tons; the trailers weigh each 26 tons. From these figures it will be seen that the weight of the motor coach per horse-power is only 52 kilogrammes, and thus considerably below what the weight of an equivalent single-phase motor coach would be. It is especially the saving in weight and the avoidance of any telephonic disturbances which renders the C.C. system so attractive that, in spite of

1 See Gratzemueller's paper read at the Paris meeting of the I. E. E. and S. Intern. des Electr. (Paris, May, 1913).

a natural reluctance against the use of high-pressure on a commutator, designers are giving increased attention to the use of continuous current for electric traction. The difficulties which some engineers anticipate with commutator and brushes seem, however, rather imaginary than real, if we may judge from the experience with the 3500-volt motor coach. The makers inform me that they estimate the mileage for a set of carbon brushes at 50,000 miles. The motors drive the car-axles by single reduction gear, and are controlled by contactors operated from a master controller. The current for operating the contactors, driving the air-pump motor, and for the general service of lighting and heating is obtained from a small motor-generator, fed on the primary side at 3500 volts, and delivering C.C. at 210 volts. All motors have commutating poles—a practice which has become universal in C.C. traction work.

From the figures quoted above it will be seen that where motor coaches are employed the C.C. system has an advantage in point of weight over the single-phase A.C. system. But main-line traction, including goods trains, is not going to be done by motor coaches, and if we come to large electromotives of some 2000 to 3000 horse-power, then this advantage is likely to vanish. No high-pressure C.C. electromotive has as yet been built for so large a power, and it is therefore not possible to make a direct comparison; but, if we may judge from the largest engines yet built for moderate-pressure C.C. there is little probability that the C.C. system for high-pressure can beat the single-phase system, and none whatever that it can beat the three-phase system.

In the early days of single-phase traction some trouble has been experienced in the matter of telephonic disturbance. A systematic investigation carried on for over a year on the Seebach-Wettingen line, chiefly by means of the oscillograph, showed that this trouble was due, not as had originally been suspected, to the commutator, but to the employment of open slots in the rotor, and the trouble nearly ceased when new rotors with semi-closed and spiralled slots were used. To improve the telephonic service further the usual remedy of metallic return and drilling the telephone lines was employed. Although by these means it is possible to render telephonic speech over a line alongside a single-phase railway nearly, and perhaps quite, as clear as it is along a C.C. railway, there still remains the danger that the telephone lines may, by electrostatic induction, acquire a very high potential. The remedy against this danger, first applied on some Swedish experimental lines, is to short-circuit the two wires of each circuit by a choking coil of very high inductance, the centre of which is earthed. The static charge is thus carried off to earth, whilst the telephonic currents are only inappreciably weakened.

One of the advantages possessed by the alternating over the continuous current is the simplicity of regulation. There are no contactors and no rheostats used, the power and speed of the motors being adjusted by the use of tappings on the secondary side of the transformers. As transformers are necessary in any case in order to work with a high voltage on the trolley, the introduction of tappings does not materially increase the weight, whilst at the same time it effects a great reduction in the primary starting current. The only difficulty that still remains is that of sparkless commutation, and inventors have evolved many, and sometimes very complicated, arrangements for overcoming it. As so often happens with engineering problems, the most simple solution is, after all, found to be the best in practice; and of all the ingenious inventions patented during the last ten years very little use is made by the designer of traction motors.

Broadly speaking, only two methods are in use; the one is the method first made known by Messrs. Winter and Eichberg, where the working field is produced by direct excitation of the rotor and the transformer e.m.f. in the coils short-circuited by the main brushes is balanced by an e.m.f. of rotation due to a transverse field; and the other method applicable to the straightforward series motor, where a non-inductive shunt is connected to the terminals of the compensating or commutating winding. The effect of a non-inductive shunt is to make the armature field slightly leading over the field produced by the compensating winding. The resultant of these two fields is in position coincident with the brush axis, but has in point of time a phase difference of a quarter period over the working current, thus balancing the e.m.f. of self-induction, which lags by a quarter period. Obviously this balancing effect can only take place when the motor is running, since it depends on the balance between an e.m.f. of self-induction which is independent of speed and an e.m.f. of rotation which is proportional to speed. At starting, when there is no speed, there is no compensation. Thus there would appear to be a new difficulty in the way of the use of single-phase current; but also this has been overcome in quite a simple manner. Experience has shown that a potential difference of 7 volts between heel and toe of brush, and a current density of 15 A. per sq. cm. is permissible.

If, then, we use narrow brushes, covering at any time not more than three segments, use coils of only one turn to each segment, and work at a reasonably low frequency, and not too high a total flux, it is possible to keep the transformer voltage and current density well within the above limits. This is not a severe limitation, for it enables the designer to use a flux out of one pole of 2·4 megalines if the frequency is 25, and 3·6 megalines if it is 15. The number of poles has then to be selected in accordance with the power desired. Obviously the lower periodicity is to be preferred, because the motor may be built with a lesser number of poles, and will then occupy less room—a matter of considerable importance considering the limited space which is available in an electromotive. The frequency of 15 has also some other advantages over that of 25. The e.m.f. of self-induction is proportionately less, and, in consequence, the power-factor is about 5 per cent. better. The skin effect in the rails is much reduced, and also disturbances on neighbouring circuits which may be due to inductive or capacity effects. On the other hand, the generators become a little more expensive and the transformers on the electromotives a little heavier. But, notwithstanding these drawbacks, the balance of advantage is with the lower frequency, and that is the reason why the Commission of Experts called together in 1904 by the Swiss Government to establish standards for the electrification of the Swiss railways has decided that 15 shall be the standard frequency, with a tolerance down to 14, and up to 16⅔. Since then other States have fallen into line, so that 15 is now the standard frequency nearly all over the continent of Europe. The standard pressure is likely to be 15,000 volts. For three-phase tractions the standard pressure is 3000 to 3300 volts.

The subject of electric main-line traction is so vast that in the limited time at my disposal I have only been able to mention a few of the important features of this interesting problem. A detailed account of all that has been done in electrification would take far more time than we can spare; but, by way of example, I give below two tables referring to the Italian State Railways. I am indebted for the information to Mr. v. Kando, who may justly be described as the father of three-phase traction.

Italian State Railways Electrified on the Three-phase System.

Location of line	In service			In construction		
	Lecco Colico Sondrio Chiavenna	Campasso Pontederimo Busalla	Bussoleno Bardonecchia Modone	Savona S. Giuseppe Ceva	Lecco Monza	Genova Sampierdarena Ronco
Length, in kilometres	107	19	58	45	38	28
Heaviest grade per mille	22	35	30	25	12	17
Numbering of transforming stations	10	4	7	4	4	2
Transmission voltage	20,000	13,000	59,000	62,000	25,000	57,000
Trolley voltage	3,000	3,000	3,300	3,300	3,300	3,000
Frequency (cycles per second)	15	15	16⅔	16⅔	16⅔	15
Source of power	Water	Steam	Water	Water (steam reserve)	Water (steam reserve)	Water (steam reserve)
Number of electromotives	14	20	15	61 for the three lines		
Number of motor coaches	10	—	—	—	—	—
Weight of minimum trains	150	190	—	not given		
Weight of maximum trains	370	380	220	not given		

Three-phase Electromotives on the Italian State Railways.

Type	034	036	038	050	030
Maker	Ganz	Ganz	Ganz	Westinghouse	Westinghouse
Number in service	2	3	4	40	—
Number building	—	—	—	45	16
Total weight, tons	45	62	62	60	65
Weight on drivers	45	43·5	43·5	60	48
Number of driving axles	4	3	3	5	3
Total number of axles	4	5	5	5	5
Weight on drivers, tons	11·3	14·5	14·5	12	16
Diam. of drivers, m.m.	1,396	1,600	1,600	1,270	1,630
Frequency (cycles per second)	15	15	15	15	16⅔
Method of transmitting torque of motor to driving axles	Quill and flexible coupling	Cranks and connecting rods			
Speed, in kilometres per hour	30	32—64	22—45—63	22·5—45	37·5—50—75—100
Method of speed regulation	—	Cascade	Cascade	Cascade	Cascade and pole-changing

The most recent example of single-phase electrification is that of the Loetschberg line establishing direct communication between Berne and the Simplon line. I am indebted to Dr. Behn-Eschenburg, the designer of the electromotives, for the following information. The power at the one-and-a-half-hour rating is 2500 horse-power, and the total weight of the engine is 108 tons, of which 85 tons is taken by the five driving axles. At the normal speed of 50 kilometres per hour the tractive effort is 10 tons. This can be increased at starting to 18 tons. On the heaviest grade (27 per mille) the tractive effort is 13·5 tons, which suffices for a train of 310 tons. The maximum speed is 75 kilometres per hour. There are two 1250 horse-power motors on each engine. Each has its own transformer and controller, the principle of duplication being carried out in all the details, so that in the event of a defect to any one part the other remains serviceable. The potential difference between tappings is 45 volts, and the last step gives with 15,000 volts on the trolley 520 volts. This is in excess of what is required by the motor, and thus provides for the event that the trolley-voltage should for some reason fall below the standard pressure. The normal voltage of the motors is 420, and the full-load current 2700 A. At starting on the level the line-current is about one-third of the full load-current, and the power 10 per cent. of the full power. When starting on an up-grade of 27 per mille with a train of 310 tons, the current taken from the trolley is 40 per cent. of the normal full-power value, and the acceleration 0·05 metres per second per second. The current is taken from the overhead trolley by two pantographs, the pressure being 15,000 volts, and the frequency 15. The controller drums are each worked by an electromotor and rocking pawls under the electric control of a master controller, so that the driver is relieved of any physical exertion in attending to the regulation of the motors. These have 16 poles, a compensating winding to increase the power-factor, and commutating poles shunted by a non-inductive resistance to insure sparkless collection. The power-factor is about 0·95 over a wide range of load. The motor is geared by double helical wheels (ratio 1 : 2·23) to a blind axle, from which the turning moment is transmitted to the drivers by cranks and connecting-rods. The weights are as follows: Motor, 11·8 tons; gear, 2 tons; transformer, 7·5 tons; and controller, 1 ton; total, 22·3 tons; or at the rate of 17·8 kilogrammes per horse-power on the one-and-a-half-hour rating. The total weight of the electromotive is at the rate of 43 kilogrammes at the same rating. This is a remarkably high weight-efficiency, which has up to the present not been reached by any continuous-current electromotive, and has only been surpassed by the three-phase 2000 horse-power electromotives (taken at the one-hour rating) of the Italian State railways, which works out at 30 kilogrammes per horse-power.

In conclusion, let us briefly glance at what is being done in the electrification of the Gothard line, that main link of commerce between Germany and Italy. I am indebted for the following notes on the subject to Mr. Huber-Stocker, the scientific adviser to the Swiss Government in the matter of railway electrification: The part to be electrified first is that between Erstfeld and Bellinzona, a total length of 110 kilometres, of which about 29 per cent. is in tunnel. This part also contains the longest and heaviest grades, so that the limitations of steam as compared with electric traction are here most prominent and a relief most urgent. On this section the average daily train movement, taking both directions together, was, in 1911, not less than 1,680,000 kilometre-tons, and the maximum on any day 2,282,000 kilometre-tons. It is estimated that in 1918 the average train movement will have increased by 35 per cent. over 1911, and in 1928 by a further 30 per cent. In the 45 kilometres on the north side of the tunnel the train climbs 569 metres, and in the 65 kilometres on the south it descends to Bellinzona 900 metres, with a steepest grade of 27 per mille. The section Erstfeld-Airolo is to be opened for electric traction in four years from now, and the southern section one year later. The present arrangements are made with the intention of extending the electric service on the north to Lucerne (60 kilometres), and on the south to Chiasso (55 kilometres) at some future date not yet fixed. There will be two large power-stations, one at Amsteg, where at first 32,000 horse-power will be available on the turbine shafts, and 56,000 to 60,000 when the station is completed; and the other at Piotta, where at first 40,000, and finally 50,000 horse-power will be available. The head of water in the northern power-house is 267 metres down to the Reuss, and an accumulation of one million cubic metres is provided for to compensate for diurnal variations. In the southern power-house the head of water is 900 metres, and there the Ritom Lake offers a natural reservoir, with 19 million cubic metres, to

compensate for annual variation in the water-supply. The power-current will be sent along the line by two independent cables, each capable of carrying the full power at twice 30,000 volts, with earthed neutral. The current will be transformed down to 7500 volts at first, and 15,000 volts later on, if the experience gained with the lower pressure should warrant the increase to double pressure. This will not involve any additional plant, since the secondary winding of transformers both along the line and on the locomotives can from the first be arranged with this alteration in view. It is also contemplated to establish sub-stations in Biasca, Goeschenen, Lavorgo, and Bellinzona The trolley wires will be suspended from gantries, each wire independently insulated. The section varies according to the gradient from 100 to 160 square millimetres. The feeders are separate for the up and down line, and are 100 square millimetres in section. At all railway stations there are change-over switches for trolley wire and feeders. In the tunnels the wires are carried by brackets fastened to the crown of the tunnel. The rails will be bonded, and, in addition, there will be a bare return conductor either laid in the ground or placed between the trolley wires. A variation in the supply of voltage of from plus 10 to minus 15 per cent. is allowed for. There will be no motor coaches used, only electromotives. It is intended to haul express trains weighing 420 tons with a speed of 50 kilometres per hour on grades of 26 per mille, for which service the electromotive will have to develop 3000 horse-power on the rails. Goods trains weighing up to 670 tons will run with a speed of from 27 to 28 kilometres per hour, and have two electromotives, one in front and one in the rear, each rated at 2800 horse-power. Passenger trains will be heated by steam, the boiler being carried in a special heating coach. Except for the stipulation that the traction must be single-phase at 15 frequency and a voltage of 7500, which may eventually be raised to 15,000, no definite type of electromotive has as yet been selected, but there can be no doubt that several of the already existing types of mono-phase electromotive can be adapted to the special requirements of the Gothard line.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—Prof. P. F. Frankland, F.R.S., has been elected dean of the faculty of science in succession to Prof. S. M. Dixon.

Dr. F. C. Lee has been nominated to the chair of civil engineering vacated by Prof. S. M. Dixon.

CAMBRIDGE.—The director of the psychological laboratory has appointed Mr. Cyril Burt, psychologist to the London County Council, to be assistant in experimental psychology.

The professor of zoology and comparative anatomy has appointed Mr. T. J. Saunders to be demonstrator of comparative anatomy.

At Emmanuel College, Mr. J. B. Peace, bursar of the college, resigned the tutorship in mathematics at Michaelmas, and Mr. P. Worsley Wood has been appointed his successor. The exhibition of 50*l.* offered to a research student commencing residence this October has been awarded to Mr. J. Conway Davies for research in history. An additional exhibition of 30*l.* has been awarded to Mr. H. Ogden for research in physics.

The next combined examination for fifty-six entrance scholarships and a large number of exhibitions, at Pembroke, Gonville and Caius, Jesus, Christ's, St. John's, and Emmanuel Colleges, will be held on Tuesday, December 2, and following days. Mathematics, classics, natural sciences, and history will be the subjects of examination at all the above-mentioned colleges. Most of the colleges allow candidates who intend to study mechanical sciences to compete for scholarships and exhibitions by taking the papers set in mathematics or natural sciences. A candidate for a scholarship or exhibition at any of the six colleges must not be more than nineteen years of age on October 1. Forms of application for admission to the examination at the respective colleges may be obtained from the masters of the several colleges, from any of whom further information respecting the scholarships and exhibitions and other matters connected with the colleges may be obtained.

GLASGOW.—Prof. Archibald Barr has resigned the Regius chair of civil engineering and mechanics, which he has held since 1889. The magnificent James Watt engineering laboratories, in which the department is accommodated, were erected and equipped under his direction. The Crown has appointed Prof. J. D. Cormack, dean of the faculty of engineering in University College, London, and a governor of the Imperial College of Science and Technology, to the vacant chair. Prof. Cormack is a graduate of Glasgow, and was formerly a lecturer in the engineering department.

MR. C. R. BURY has been appointed assistant lecturer and demonstrator in chemistry at the University College of Wales, Aberystwyth.

A GIFT of ten lakhs of rupees for the promotion of scientific technical knowledge has been made by Dr. Rash Bahari Ghosh to the University of Calcutta.

THE McCosh professorship of philosophy at Princeton University has been resigned by Prof. A. T. Ormond, who has accepted the presidency of Grove City College.

WE learn from *Science* that by the will of Miss Katherine Allen, of Worcester, the Worcester Polytechnic Institute has received a bequest amounting to about 20,000*l.*

MR. L. C. PLANT has resigned his position as head of the department of mathematics in the University of Montana on accepting a similar post in the Michigan Agricultural College. He is succeeded by Dr. N. J. Lennes, of Columbia University.

BY a trust settlement of Dr. Gavin P. Tennent, of Bath Street, Glasgow, the sum of 25,000*l.* is bequeathed to the governing body of the University of Glasgow, to be applied for such objects or object in connection with the faculty of medicine as the trustees may determine.

THE Gresham lecturer on astronomy, Mr. Arthur R. Hinks, F.R.S., will deliver a course of four lectures on astronomy in daily use on October 14, 15, 16, and 17, at 6 p.m., at the City of London School, Victoria Embankment. The subjects of the four lectures are respectively:—The determination of time; the distribution of time; the determination of position; and measurement of the size and shape of the earth. The lectures are free to the public.

A STRONG committee, mainly consisting of old students of the Royal Agricultural College, Cirencester, is about to issue a special appeal with the view, in the first place, of collecting the balance of 1685*l.* still required to complete the 5000*l.* necessary to secure the advance of a similar sum from the Development Fund for erection of King Edward's wing of the college. When this sum has been subscribed, the appeal will still be continued so as to provide for further much needed extensions The honorary secre-

tary of the committee is Mr. A. Goddard, Surveyors' Institution, 12 Great George Street, Westminster.

THE London County Council has arranged for three courses of free lectures at the Horniman Museum, Forest Hill, S.E., during the autumn, viz.:—On Saturday afternoons, at 3.30 p.m., beginning October 11, a course of ten lectures as follows: Nature study in a Croydon garden, E. Lovett; folk-lore of the Balkan peoples (II.), A. R. Wright; native arts and crafts in British New Guinea, Dr. H. S. Harrison; weeds and their influence, Dr. E. Marion Delf; the origin and nature of teeth, Dr. W. A. Cunnington; a folk-lore tour in the southern counties of England, E. Lovett; the history of coined money, A. R. Wright; the evolution of man in the light of recent discoveries, Dr. H. S. Harrison; animal life in the great caves, H. N. Milligan; the stone monuments of prehistoric times, A. L. Lewis. On Wednesday evenings, beginning October 29, a course of five lectures by Mr. H. N. Milligan on the animal life of the sea-shore. On Saturday mornings, beginning October 11, a course of ten lectures to teachers by Dr. A. C. Haddon, F.R.S., on the ethnology of India. Tickets are required only for the Saturday morning lectures, and may be obtained from the museum.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, September 22.—Général Bassot in the chair.—A. **Chauveau**: Comparison of vigorous and feeble organisms from the point of view of their aptitude for receiving and cultivating virulent organisms. According to the views at present generally held, a strong, healthy man is less readily attacked by tuberculosis or other contagious diseases than cases where the body has been weakened by alcoholism or other causes. This view is strongly controverted by the author, who refers to the experimental infection in 1868 of sixty healthy animals by tubercle; not one escaped the infection. Additional experiments on the transmission of scab to sheep are now given. Neither the healthy nor enfeebled subjects escaped.—T. **Levi-Civita**: Torricelli's theorem and the commencement of flow.—Edouard **Heckel** and Cl. **Verne**: Cultural bud mutations of *Solanum immite, S. Jamesii,* and *S. tuberosum.*—R. **Lépine** and **Boulud**: The intra-renal resorption of chlorides in various states of the kidney.—P. **Chofardet**: Observations of the Metcalf comet 1913*b*, made at the observatory of Besançon with the bent equatorial. Data given for September 7 and 11. The comet was of the ninth magnitude, nucleus badly defined, and no tail visible.—P. **Chofardet**: Observations of the Neujmin comet 1914*c*, made at the observatory of Besançon with the *coudé* equatorial. Data given for September 10 and 11. The comet was of the eleventh magnitude, with a small brilliant nucleus and a nebulous tail.—D. **Mirimanoff**: Remarks on a communication of Eugène Fabry. Pointing out an error in a demonstration of Fermat's theorem.—Paul **Lebard**: Remarks on the affinities of the principal genera of the group of ligulate flowers.—P. **Mazé**, M. **Ruot**, and M. **Lemoigne**: Lime chlorosis of green plants. Rôle of the root excretions in the absorption of iron from chalky soils. The presence of excess of chalk in the soil may produce chlorosis by rendering the iron insoluble. The addition of organic acids permitting the solution of small quantities of iron in presence of calcium carbonate removes the chlorosis at once.—Eugène **Pittard**: The comparative analysis of some of the body dimensions in Tartars of both sexes.—Ch. **Dhéré** and L. **Ryncki**: The absorption of visible and ultra-violet rays by carotinoid pigments.

BOOKS RECEIVED.

University of London: University College. Calendar. Session 1913–14. Pp. 598+clxxxiii. (London: Gower Street.)

University College, Reading. Twenty-first Anniversary, Michaelmas Day, 1913. Pp. 88. (Reading.)

A Critical Revision of the Genus Eucalyptus. By J. H. Maiden. Vol. ii., Part 8. (Sydney: Government of the State of New South Wales.) 2*s.* 6*d.*

Memoirs of the Asiatic Society of Bengal. Vol. iii., No. 6. Some Current Pushtu Folk Stories. By F. H. Malyon. Pp. 355–405. 2*s.* 3*d.* Vol. iii., No. 7. The Chank Bangle Industry. By J. Hornell. Pp. 407–488. 2*s.* 8*d.* (Calcutta: Asiatic Society.)

Social Welfare in New Zealand. By H. H. Lusk. Pp. viii+287. (London: W. Heinemann.) 6*s.* net.

Switchgear and the Control of Electric Light and Power Circuits. By A. G. Collis. Pp. 85. (London: Constable and Co., Ltd.) 1*s.* net.

Inductive *versus* Deductive Methods of Teaching: an Experimental Research. By W. H. Winch. Pp. 146. (Baltimore, Md., U.S.A.: Warwick and York, Inc.) 1.25 dollars.

How I Kept my Baby Well. By Anna G. Noyes. Pp. 193. (Baltimore, Md., U.S.A.: Warwick and York, Inc.) 1.25 dollars.

CONTENTS.

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.

Advertisements and business letters to be addressed to the Publishers.

Editorial Communications to the Editor.
Telegraphic Address: PHUSIS, LONDON.
Telephone Number: GERRARD 8830.