THURSDAY, APRIL 25, 1901.

KORSCHELT AND HEIDER'S EMBRYOLOGY.

Text-Book of the Embryology of Invertebrates. By Profs. Korschelt and Heider. Translated by M. Bernard. Vol. ii., 1899 (pp. xv+375); Vol. iii., 1899 (pp. xii + 441); Vol. iv., 1900 (pp. xi+594). (London: Swan Sonnenschein and Co., Ltd.)

WE welcome with great satisfaction the publication of Parts ii., iii. and iv. of this important work. Originally issued in German in three parts, the first two of which were reviewed in these columns in 1891 (vol. xlv. p. 145), the English translation was issued in four parts, the first of which was published in 1896, the second and third in 1899, and the fourth part in 1900. In the somewhat considerable interval which has elapsed between the issue of the original work and that of its English translation, extensive additions have been made to our knowledge in several departments of embryology. These have been met by editorial footnotes and supplementary lists of literature. The latter appear to have been carefully compiled and will be found by students to have great utility. Indeed, it may be said that, so far as the literature is concerned, Parts ii., iii. and iv. are up to date, and there can be no question that they will be of the greatest value to English zoologists. All that was said in praise of the work in the review of Part i. (NATURE, 1896, vol. liii. p. 361) applies with almost greater force to the volumes before us. They constitute an accurate and comprehensive treatise on invertebrate embryology, and no zoologist's library can be considered complete without them.

The work of the translator and editor also appears to us to have been excellently carried out. The style is clear and the work in its English form is eminently readable. We congratulate the editor upon his sensible decision to translate the German word "anlage" by its English equivalent, "rudiment," and we entirely agree with his remarks in the preface to Part i. on the subject. In opposition to him, however, we think that his restoration of the word "rudiment" to its proper use in embryology will satisfy, if not all zoologists, at least all intelligent zoologists. The word has no biological application outside embryology. In embryos alone can we actually see the first rough outline gradually shaping itself into the perfect organ; and there can be no question that we are dealing with a rudiment. But the same cannot be said when the word is applied to organs of the adult. These undergo no change, except retrogressive changes; and to apply the word "rudimentary" to them implies the possession of prophetic power. We mean, if we apply the word "rudimentary" to an adult organ, that in some remote descendant of the animal under consideration the organ will become more perfect as the result of evolutionary change. This is an entirely gratuitous assumption, which we have no right seriously to make. The word "vestige," the use of which our editor also discusses, is on a very similar footing. It may be appropriately applied to organs which undergo regression, after having attained a more perfect structure in the earlier phases of growth, but do not totally disappear; but it cannot legitimately be applied to adult organs on any other condition. For to call an adult organ, which has not undergone such regression, "vestigial," implies a knowledge of the past, which we have not got, just as rudiment, when applied to adults, implies a knowledge of the future. It may be that the small and imperfect muscles of the outer ear of man are vestiges of more perfectly developed muscles in a remote ancestor, but we have no knowledge that they are so; this view of them is a mere presumption, based on no fact whatsoever. To apply the word "vestigial" (unless the above-mentioned condition be satisfied) or "rudimentary" to adult organs is merely to beg the question at issue, and we require another word to apply to organs which we may feel tempted to designate in that manner. The same remark applies to those organs of the embryo like the neurenteric canal or gill slits of vertebrata, which make their appearance in development but give rise to no structures in the later stages or adult.

As a general rule in German works, the treatment of cœlom and body-cavity is not up to date. Our authors, we are glad to see, are not open to serious blame in this respect, but they have not been able entirely to shake themselves free of traditional conceptions with regard to these structures. They constantly make use of the words pseudocoele, primary body-cavity, secondary body-cavity, which all belong to a past epoch of morphology; and they sometimes use language which might lead the reader to suppose that they do not distinguish clearly between hæmocœle and cœlom (iii. 90). Moreover, in dealing with cases in which the nephridia are actually transformations of the cœlom in the ontogeny, they speak of them as though they were really only secondarily related to it (iii. 205). But, in spite of this, it must be admitted that their ideas on these subjects are more advanced than has been usual with German authors.

As was stated in the review of Part i. of this work, the standpoint of our authors is that of the seventies and early eighties of last century. This is clearly seen in their discussions on ancestral derivation, in their chapters on general considerations (which, in our opinion, are too long and often somewhat tedious); in their treatment of the layer-theory, in spite of such statements as those given on p. 301 of Part iv., by which it is shown that the central nervous system arises from ectodermal rudiments which also give rise to mesoderm; in their frequent inability to accept observations which depart at all from traditional conceptions, as witness their treatment, on pp. 166 and 169 of Part iii., of Sedgwick's observations on the cleavage and derivation of the enteron of *Peripatus capensis*. We do not make these remarks in any way to detract from the merit of our authors' work. Morphology is at present in a transition state, and naturalists do not readily part with the old hopes and beliefs which fired them with so much enthusiasm in the early Darwinian days and spurred them on to make those comprehensive researches of which this book is such a worthy record.

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CHEMISTRY FROM HARVARD.

Elementary Studies in Chemistry. By Joseph Torrey junr., Instructor in Harvard University. Pp. viii+487. (Westminster: Archibald Constable and Co., Ltd. 1900.)

THIS book is written with an evident desire to present elementary chemistry in such a way as to give full effect to its educational capabilities without neglecting other ends and without a sacrifice of those external features of interest which in the past have covered such a multitude of sins. Mr. Torrey has, in fact, had but one aim, and that to make the best of his subject. A spirit of entire forgetfulness of examiners and syllabuses pervades the work, and things and theories are dealt with according to their intrinsic importance. To say so much is to say a great deal in favour of the book, and to this it must yet be added that the author writes like a practised and enlightened teacher. English teachers of chemistry, both in secondary schools and colleges, will do well to look at Mr. Torrey's book, if only to see the sort of thing that is put forward from Harvard as a suitable course of elementary chemistry. It must be remarked, however, that the course is not intended for quite the same class of pupil that in this country has in recent years been supplied with reformed courses of elementary science. Mr. Torrey's course seems intended for the later stages of the secondary school or for beginners in a college.

To point out the essential difference of plan between teaching chemistry in a stimulating way and teaching it in a deadening way would be to repeat what has often been said before in these columns. It is becoming the habit to summarise these two plans in the words heuristic and didactic, and these philosophical terms have acquired something of the character of verbal missiles, to be hurled by contending parties as weapons of offence.

Two main contentions are heard against the feasibility of improved methods of science teaching. The first is to the effect that a certain proportion of youth have a natural repugnance to science, even in its most inviting form. They refuse to be interested, they will not find out; therefore they must be told things and made to listen and repeat. It seems very doubtful whether this allegation does not very frequently arise from an injudicious or a too impatient teacher, or from one who has the misfortune to deal with good material already spoiled by bad treatment. Where it is wholly true the reply would be, let such pupils be tried with some other subject. If the same resistance continues to be shown, we surely are dealing with something akin to the deficient or feeble-minded class for which at last some separate treatment must be provided. It seems an unfortunate conclusion to reach, that because a good method does not appeal to all, it should be alloyed with an inferior one for the sake of a few.

The second contention is that a good course of science teaching presents difficulties from the examinational standpoint. This is, unfortunately, only too true. It is, undoubtedly, a great practical obstacle, and its removal can only be looked for when further abatement has taken place in the rigour of the whole examinational system, which holds so many good teachers of all subjects in its paralysing grasp.

It is difficult to give in narrow limits an indication of the sequence and style of Mr. Torrey's course. The book is written in the form of short lectures of a suggestive kind, followed by indications of the laboratory work to be done in connection with, or consequent upon, the lectures. It begins with physical topics, including certain measurements, thermometry, vapour pressure and density of gases. The chemistry begins with hydrogen and the composition of water, which is to be studied quantitatively; the composition of hydrogen chloride is then dealt with, in order to accumulate enough material for a discussion of Avogadro's theory. Then follow oxidation, symbols and formulæ, determination of atomic weights, acids, bases and salts, electrolysis and electrolytic dissociation, sodium as a metallic element and its chief compounds, the sodium group of metals, the atmosphere, ammonia, nitric acid, the nitrogen family, the sulphur family, the calcium group, &c., ending with carbon and its inorganic compounds. In an appendix we find hints on the manipulation of glass, a list of apparatus required, a list of books for a teacher's library, a few numerical tables and two pages of logarithms.

It would not be difficult to find fault with the order of topics, and the chief objection would perhaps be to the early introduction of the theory of atoms and molecules and other theoretical matters. Mr. Torrey's order is probably not so good as some which have been elaborated in this country, but the method of the book in detail is so good that some faults of arrangement may be allowed to pass, and besides this it must be remembered that the book is not intended for children.

It is possible that on working through the book some faults of detail would be discovered. Many of the experiments described are novel in form, and some seem hardly likely to succeed. For example, on p. 98 an experiment is described, in which manganese dioxide is to be heated in a tube containing hydrogen chloride. The shrinkage of volume on opening the tube below a saturated solution of brine is said to represent the hydrogen which has disappeared. This is obviously wrong, and, practically speaking, the experiment is altogether an undesirable one.

In conclusion, it may be remarked that the book is unusually free from words or pedantries peculiar to America. An exception to this statement occurs on p. 7, where there is a reference to "the graduate being held in front of a dark surface to make the lines show more clearly." The graduate there means a glass vessel and not the careworn teacher. A. SMITHELLS.

A NEW EDITION OF WHITE'S "SELBORNE."

The Natural History and Antiquities of Selborne, and a Garden Kalendar. By the Rev. Gilbert White, M.A. Edited by R. Bowdler Sharpe, LL.D. Two vols. (London: S. T. Freemantle, 1900.)

IT will be as well to state exactly what is contained in these handsome but rather bulky volumes; the price is high (3*l.*), and purchasers will be glad to know what they are buying. In the first volume are the letters to

Pennant, *i.e.* the first part of the "Natural History of Selborne," freely interpolated with bracketed addenda from the originals in the British Museum, and including three or four letters of which White did not make use in preparing his book for the press. Then, pleasantly introduced by Dean Hole, and occupying more than 200 pages, come White's garden diaries from 1751 to 1771; of which a specimen, and enough to give an idea of White's personal activity as a gardener, was printed as an appendix to Bell's edition of the "Selborne" in 1877. The second volume contains the letters to Barrington, also with additions and interpolations from the originals, except in the case of the famous "monographies" of the Hirundinidæ, which were published separately by White in the *Philosophical Transactions*; the antiquities of Selborne are also here, and at the end we find a bibliography and a useful index, which appear to be sufficiently complete. Each volume is profusely illustrated. Mr. Keulemanns' drawings of birds are familiar and welcome; we have also a large number of fancy sketches by Mr. E. Sullivan, in most of which an imaginary Gilbert White is a prominent figure. Mr. Herbert Railton's head- and tail-pieces are, for the most part, delicate and attractive. As regards the notes, Dr. Sharpe's name is, of course, a sufficient guarantee of the soundness of those on birds, and the only fault to be found with them is that they are occasionally a little wanting in succinctness and self-repression. Several of Dr. Sharpe's colleagues at the British Museum have provided him with useful notes relating to their departments of natural history, and a judicious selection has been made from the notes of previous editors, especially Bell and Harting.

From what has been said above, it will be seen that this is not really an edition of the book that White so carefully wrought into an artistic form, and that we all know and love. It is not pleasant to say it, but said it must be emphatically, that the liberties here taken with White's work have absolutely no literary justification, and have robbed it of much of that peculiar charm which, as Prof. Newton has well said in his admirable article on White in the "Dictionary of Biography," it is impossible to explain in words. What would have been White's own feelings if he had been forced to see in print the very portions of his letters which, with his own good sense and the respect of his age for publication, he had deliberately cut out, and the insertion of two hundred pages of his gardening notes between the letters to Pennant and those to Barrington? If it be argued that (as Dr. Sharpe seems to think) we learn something new about White himself by getting an idea of the original form of his letters and of the way in which he wrought his book out of them, the plain answer is that we already know all that is essential about him, and that one thing we know for certain is that he had a sense of literary form which has made his book immortal, and which should have secured for it more reverential handling than is to be found in these volumes. It might, indeed, be possibly justifiable to print the whole of the original letters as they left his hand; but not as an edition of the "Natural History of Selborne," which should always be allowed to stand exactly as his genius designed it. It will be the duty of future editors to see that none of the passages now interpolated are allowed to creep permanently into the text of the original work.

Dr. Sharpe's enthusiasm for his author is unquestionable, as may be seen from his brief but pleasant introduction to the first volume; so, too, is the labour that he has spent on his editorial task. But the perils of the editor of a classic are great, and enthusiasm alone will not teach him how to avoid them.

OUR BOOK SHELF.

The Romance of the Heavens. By A. W. Bickerton. Pp. 284. (London: Swan Sonnenschein and Co., Ltd., 1901.) 5*s*.

THE theory of constructive impact, of which a popular account is given in the present book, appears to have had its origin in an attempt to explain the phenomena of new stars by the grazing collision of two dark bodies. Hitherto the theory has not been hospitably received by astronomers, and the more elaborate exposition now presented will probably meet no better fate. The truth seems to be that in spite of his claim to have discovered numerous facts not known to "ordinary" astronomers, the author lacks familiarity with spectroscopic work and astronomical methods generally. He quite condemns himself by suggesting (p. 235) that more confirmatory evidence in the case of Nova Aurigæ was only wanting because astronomers, unguided by the theory, did not make "more liberal and careful observation." As a matter of fact, the most valuable records were photographic, and are still as much in evidence as during the visibility of the Nova, and the observations certainly cannot be interpreted as indicating the presence of three bodies of the kind required by the theory. The theory thus breaks down at the outset, and it would not be difficult to show the weakness of most of the "overwhelming" astronomical evidence on which depends its extension into collisions of nebulæ, clusters and cosmic systems by which it is argued that the existing forms and distribution of celestial bodies are completely explained. The merest possibilities are frequently magnified into certainties, as, for example, the occurrence of variable stars in pairs, and the preponderance of variability in double stars.

The resources of the theory appear to be unlimited. While one collision produces a new star, another results in a star cluster, another blows a planet into asteroids, and still another disperses a satellite into a ring such as that of Saturn.

We have not examined all the calculations which are given, but we may point out that the results arrived at for the separation of two stars of assumed distance and velocity (p. 58) are in each case six times too great.

The book is admirably written and is by no means without interest; but readers should be warned against mistaking the author's assertions for demonstrated truths.

Les Diastases et leurs Applications. By E. Pozzi-Escot Pp. 218. (Paris: Masson and Co., 1900.)

THIS little volume forms one of the series of Aide-Mémoire, some of which have been previously reviewed in this journal. Its modest preface disarms criticism. "Le lecteur ne devra pas chercher ici l'exposé de théories nouvelles; nous nous sommes contenté d'exposer les faits connus, de les relier l'un à l'autre et d'en tirer chaque fois qu'il y a eu lieu des conclusions légitimes." And further, "Forcément incomplet, nous espérons que notre travail (qui n'est point fait pour des biologistes, mais bien pour une collection destinée aux ingénieurs et aux chimistes), rendra néanmoins quelques services et

facilitera la diffusion de la notion des actions diastasiques, dans le domaine pratique."

The author fulfils the promise of his preface in giving a clear though brief exposition of the action of enzymes or *diastases*, special attention being directed to the experimental methods employed in the study of this subject and in their application to the brewery and the distillery.

The errors in spelling are numerous, and should be revised in a subsequent edition. Schunck appears as Schmuk; Marshall Ward figures as two persons, Marshall and Word; Croft Hill's individuality is also lost as Crop and Hill; O'Sullivan loses the O' and Lindner is spelt Linter, whilst the English name Heron and the German, Geduld, are converted into the French Héron and Gédulte.

Erythrozyme is written erythrozine, racemosus is spelt raciniosus, penicillium appears as penicellium and octosporus as octopodus.

An index would be a valuable addition. J. B. C.

Mongolia and the Mongols: Results of an Expedition to Mongolia in the Years 1892 *and* 1893. By A. Pozdnéeff. Vol. ii. 8vo. Pp. 516. Numerous photo-engravings (Russian, 1900).

THIS is the second of a series of volumes on Mongolia and its inhabitants which are being prepared by Dr. A. Pozdnéeff, and it contains the traveller's diaries during the second year of his journey, when South-eastern and Eastern Mongolia were visited. Starting from Pekin, Dr. Pozdnéeff went to Kalgan—the centre and depot for Russian trade with China—and thence to Kuku-khoto, or Gui-hua-chen, the next important commercial centre of Southern Mongolia. Returning to Kalgan, he visited that portion of Mongolia which lies on the eastern slopes of the Great Khingan—namely, the towns Fen-nin-sian and Zhe-ho, or Chen-de-fu, whence he went to Dolon-nor (Lama-miao). All these places are well known long since, but, speaking currently Mongolian, Dr. Pozdnéeff has learned much more about the trade in these towns than other travellers had before him, and having, moreover, in his capacity of learned Mongolist a free access to the Lamaite monasteries, he was enabled to collect a great amount of information about the inner life of Mongolia, various questions of worship, and especially about the antiquities preserved in the monasteries. Proceeding from Dolon-nor northwards and northwestwards, towards the Kerulen River, he visited the ruins of Kai-pin-fu—the thirteenth century capital of Khubilai-khan—and obtained there full casts and photographs of an interesting inscription dating from the fourteenth century. Another very interesting Tibetan and Mongolian inscription, dating from 1626, was copied in the same way at Tsagan-suburga, on the Shara-muren River. It may now be taken that this much-controversed spot was one of the five Lao or Kidan capitals—Lin-han-fu.

The remarks of the diary on the way across the Gobi are especially interesting, in that they give the exact limits between the Gobi proper and the zone of land which lies on the western slopes of the Great Khingan. This limit corresponds with a line which may be drawn on the Russian General Staff Map through the spots where the rivers shown on this map as flowing from the Khingan end in small lakes or marshes as they enter the Gobi. M. Pozdnéeff, who crossed the Gobi in June, fully confirms the view upon this region which begins now to prevail, namely, that it is not a desert, but a dry, rolling prairie. In fact, it has the same physical aspects as the dry "rolling prairies" of Canada at the approach of the Rocky Mountains.

The volume gains very much from the excellent photo-engravings with which it is illustrated. They give a good idea of the physical characters of these portions of Mongolia. P. K.

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.*]

Gothic Vestiges in Central Asia.

I AM in thorough accord with the main principles indicated in Dr. A. C. Haddon's communication, which appeared in NATURE, vol. lxiii. p. 309 (January 24), more especially as to the eastern extension of a fair dolichocephalic race or races, at least as far east as the north-western frontiers of China. It has, however, always struck me, as a student of the ethnology of these districts, that sufficient attention has not been given to the geographical changes that have certainly occurred throughout the whole of Central Asia, and without which it appears impossible to understand such writers as Herodotus, Arrian and Ammianus Marcellinus. I claim no new discovery in suggesting, with Colonel Tchaikofsky (quoted by Schuyler, vol. i. p. 53), that during the Classical period the rivers Chu and Sary-su, instead of losing their waters in desert lakes, united at Perovsky with the Jaxartes, and flowed along the deserted bed, now known as the Jany Darya, joining finally the old Oxus and making their way along what is still known as the "Ancient Bed" of the Amu Darya to the Caspian. We thus arrive at a satisfactory explanation of the crossing of the "Araxes" by Cyrus, and his description of the homeland of the Massagetæ, whom we are then justified in associating ethnologically with the Getæ or Goths of other authors. This would throw light also on the position of Arrian's Alexandria Eschate, which I would identify with the modern Jizakh. This was situated on the Tanais, which seems to have been an overflow channel of the upper Jaxartes, leaving the main river at the bend below Khojend and flowing past Jizakh into the Taz Khane, whence it found its way into the Jany Darya.

We thus also get a satisfactory position for the Issedones, also a Gothic tribe ("West-Saetons"), east of whom were the Asii, Asiani or Pasiani, the Wusuns of the Chinese, who are described as "having blue (or green[1]) eyes, red beards and monkey-like faces"—alluding to their faces covered with tawny hair.

When, however, Dr. Haddon comes to his Chinese authorities several inaccuracies appear in his account. As Dr. Haddon himself is, apparently, not a student of that language, he has naturally been dependent on others, and the second-hand information with which he has been supplied is in the last degree misleading. He speaks, for instance, of the "Ssé or Sek (who are identified with the Sacæ)." I have a fair first-hand acquaintance with the older Chinese writers, and find myself unable to place these tribes. There were, at the period of which he speaks, Shuks, or rather Pa-shuks, in Szechwen; but there is no reason to connect them with any external tribe, nor have we a suggestion that they have ever migrated. There was a country—not a people—called Su-li, but the phonetic element here is Sulak, and we must identify the district with the Surak of the Bundahîsh, the country about the lower Jaxartes. The later writers, it is true, talk of a kingdom—not a people—called by Matwanlin Sse; but it is, apparently, the modern Sarakhs. The classical Sacæ, Scyths and Dahæ seem to be variations of the one word, and may be connected with the Tochari of Strabo the Tahia of the Chinese. I am, however, doubtful of Scyth or Sacæ being used by the Greeks in any sense as an ethnographic term; rather it applies to their stage of civilisation. We learn very little of these Tokhars from Chinese sources, but from Strabo we gather that they, in conjunction with the Wusuns and the Sakarauli (possibly the inhabitants of the Sarik-kol Pamir), bore down on Bactria and put an end to the Greek line of kings. About the same time the Yueh-ti, driven from their homes by the Hiung Nu (Turks), arrived in the country, and the two peoples seem to have more or less coalesced, and we find them a few years later living in apparent harmony, but occupying each its own side of the Oxus, the Yueh-ti apparently being the predominant race, or at least supplying the royal race. This is very different from the account given by his supposed authorities to Dr. Haddon. I have had the misfortune to have met with M. Drouin before, but now become acquainted with

[1] T'sing, the word used, means the colour of deep, pure water—grey, blue or green.

M. Ujfalvy for the first time. Apparently these authors have gathered their ideas from the French writers of the last century, whose knowledge of Chinese was confined to such works as the *B'ungkien Kangmu*, or even later works of about as much authority as Rollin's "Universal History."

A good deal of interest attaches to the Yueh-ti. Their original name was possibly Viddhal, and they seem to have had some prehistoric connection with the Yâdavas, who took part in the Indian immigration. There never was any doubt about their being the same people afterwards known to Greeks and Arabs as Ephthalitæ and Haithals respectively. With the Yueh-ti were associated in ancient Chinese legend the Mats, or Mat-su, apparently Maddhals, as in Indian lore Maddhu is associated with the Yâdavas, and this brings us to the later branch of the Yueh-ti, who in these authors by a strange mistake are called Yetha. Really the name in modern Chinese is Yenta, a very different sound. In the old language it was I'm-dat. Where the first syllable appears frequently doing duty as merely the initial *m*, Da, or rather Dat, where final *t* represents *l*, stands then for Maddhal. This subtribe seems about the fifth century to have been settled in the neighbourhood of Bamian, and, except that it was less civilised than the other branches of the family, to have had little to distinguish it.

Both Greek and Chinese authors concur in describing these Ephthalites as being distinctly blond, with full beards, of a handsome type, and of lively manners. Menander calls the king under whose guidance they crossed the Hindukush Catulphus, at whose Teutonic aspect Colonel Yule expresses surprise. The Chinese, however, name him Kitolo, evidently the same word; most Chinese names consisting of only three words, the remainder is generally omitted in the transliteration of foreign names. Catulphus is, however, evidently the nearest Greek equivalent for Gothic Caedwulf. These allied peoples went amongst the Indians by the common appellation of Hunas, whence the alternative Greek name of White Huns, which has no connection whatever with that of the European Huns of the fourth century, whose swarthy complexions and hairless faces indicate a very different origin. These apparent Gothic connections are not confined to the Ephthalites, but occur throughout, the leader of the Scythians, ἐκ τῆς Ἀσίας, *i.e.* Wusuns, whom Alexander defeated outside Kyropolis, was, according to Arrian Satrakes, the Greek equivalent for Gothic Sietrich.

Of Dr. Haddon's Hoa, evidently derived from some mistaken French transliteration, I cannot even guess the origin. There is no such name to be found in the earlier and more authentic Chinese writers. Dr. Haddon is, however, quite correct in identifying the modern Chinese Yuan yoan, or Jwan Jwan, with the Avars of Gibbon.

Dr. Haddon expresses some surprise at the beardless faces of the later Huna kings; from the appearance of the king depicted on the coin, and its overhanging brows and prominent nose, he certainly did not belong to the smooth-faced races of the extreme north and east of Asia. So we may be sure that the bareness was artificial; it was probably the fashion of the time to shave.

With regard to the type of face and skull represented on the coin of Jayatu Mihirakula, I may remark that I met last night at dinner a gentleman of whom it might be called a portrait. I may describe him almost in Dr. Haddon's words as: Nose large, jaw powerful, neck fleshy, the occipital region of the head deficient, the vertex produced into a truncated cone. This remarkable shape was in his case quite natural. Moreover, with the exception of a moustache his face, as in the coin, was hairless. He had similar overhanging eyebrows, a like marked notch at the bridge of the nose, and an almost identically aquiline nose. His eyes, however, were not oblique, nor had he the slightest trace of the "Tatar," nor did he in any way approach the "Mongolian" type. The gentleman is, in fact, a Parsee of the highest type, polished and affable.

Shanghai, China, March 13. THOS. W. KINGSMILL.

Graphic Solution of the Cubics.

THE note by Mr. T. Hayashi, published in NATURE of March 28, suggests to me the following little historical remark. The method given by Mr. Hayashi for the cubics is due to Monge, "Correspondance sur l'École impériale polytechnique," par M. Hachette, vol. iii. p. 201; "Solution graphique de l'équation du troisième degré, $x^3 - px + q = o$," par M. Monge.

"L'équation proposée résulte de l'élimination de y entre les deux $y = x^3$, $y = fx + q$; l'une est le parabole cubique, . . . l'autre répresente une droite. . . . Ayant construit ces deux lignes, les abscisses x des points où elles se coupent, sont evidemment les racines de l'équation proposée."

Monge gives also a practical construction of the curve on a small sheet of paper *Nil sub sole novi!* G. VACCA.

Via Bogino, 4, Torino (Italy).

THE WORK OF THE NATIONAL ANTARCTIC EXPEDITION.

THE final programme of the scientific work of the National Antarctic Expedition had not been arranged at the date of my departure from England, as the Joint Committee of the Royal Society and the Royal Geographical Society had not issued its full instructions as to the route and plan to be adopted. A provisional summary may, however, be useful by calling forth suggestions while there is yet time to use them.

FIELD OF OPERATIONS.

It is, perhaps, hardly necessary to remark that it is not the object of the expedition to reach the South Pole, but to investigate the Antarctic regions; and though some of the problems cannot be solved unless the existing southern record is broken, the expedition is not being equipped especially for the attainment of much higher latitudes than have already been reached. Had that been one of the main objects of the expedition, either the ship might have been sent southward on a different line, or the expedition would have been provided with greater sledge-hauling power.

The operations of the British expedition are restricted to the half of the Antarctic area east of the meridians of 90° E. and 90° W., *i.e.* to the region south of Australia and the Pacific. The western half, including the region south of America, the Atlantic and Africa, is to be explored simultaneously by the German expedition under Prof. von Drygalski, by a Swedish expedition under Dr. O. Nordenskjold, and, it is hoped, also by a Scotch expedition under Mr. W. S. Bruce. This division of the field of work between the British and German expeditions was proposed at the Geographical Congress at Berlin, and has now been accepted on both sides and the plan of work arranged accordingly. So far as can be judged with our present knowledge, this plan, other things being equal, gives the German expedition the chance of the most striking geographical discoveries and the British expedition the opportunities for a richer harvest of scientific results.

The scientific work of the expedition is directed to cover as wide a field of research as is consistent with the essential objects of the expedition. Of these the object of primary importance is the study of terrestrial magnetism. It was upon the need for work upon this subject that the appeal to the Treasury for funds was based, and it was to enable the magnetic observations to be properly made that it was thought advisable to provide a new ship rather than adopt the less expensive course of adapting an existing whaler. A new ship—the *Discovery*—has accordingly been built by the Dundee Shipbuilding Co. She is a modified whaler of somewhat more than 1500 tons displacement, and with engines of 450 horse power.

The staff of the expedition is as follows:—The executive staff consists of Commander R. F. Scott, R.N., commander of the expedition; Lieutenant Albert Armitage, R.N.R., who distinguished himself in the Jackson-Harmsworth expedition to Franz-Josef Land, second in command and navigator; Lieutenants Royds, Barne and Shackleton; and Mr. Skelton, engineer. The civilian staff consists of Mr. T. V. Hodgson, formerly of the Plymouth Biological Laboratory and curator of the Plymouth Museum, biologist; Dr. R. Koettlitz, botanist; Mr.

Wm. Shackleton, of the Solar Physics Laboratory, physicist and astronomer; Dr. E. A. Wilson, zoologist and doctor to the land party; and the writer, who is director of the civilian staff and in command of the operations on shore. It is hoped that it may be possible to arrange for additional scientific assistance from volunteers who will accompany the ship in her cruises from Melbourne. Mr. G. Murray, F.R.S., who is editing the "Antarctic Manual," has kindly consented to act as deputy director of the civilian staff, and will superintend the scientific equipment in England, and probably accompany the *Discovery* as far as Melbourne.

TERRESTRIAL MAGNETISM.

Considerations for the magnetic work have exercised a dominant influence in the plan of operations ordered by the Joint Committee. Magnetic work in the British field of operations has difficulties from which work in the western half of the Antarctic area is free; the horizontal magnetic force is exceptionally low, and great decimal variations in declination are frequent. These variations will, of course, affect the observations made on the *Discovery*, and unless this factor can be allowed for, it will be impossible to determine the proper magnetic elements for the ship's points of observation. Accordingly, the Magnetic Committee has declared it essential that there should be a station on shore in Southern Victoria Land to act as secondary magnetic base. It will be the first duty of the party landed at this station to secure a continuous magnetic record for a period of twelve months. For that purpose it will be supplied with a magnetograph, which will be under the special care of Mr. Shackleton; should the recording instrument fail, personal observations must be taken as frequently as possible. The records at this station will enable the observations taken during the magnetic survey at sea to be corrected for diurnal changes.

The Joint Committee has, therefore, decided that the *Discovery* shall proceed from her southern headquarters at Melbourne to Southern Victoria Land, where Captain Scott will land a party somewhere between McMurdo Bay and Wood Bay. The land party will consist of eight men, including Mr. Shackleton as physicist and Dr. E. A. Wilson as doctor and zoologist.

THE GEOGRAPHICAL PROBLEMS.

The selection of Southern Victoria Land, and the neighbourhood of Mounts Erebus and Terror, for the site of the land station is recommended by geographical as well as by magnetic considerations. Topographical exploration is the second important branch of the work of the expedition, for it is necessary as a base for much of the other work; and it was probably interest in this subject that inspired Colonel Longstaff's munificent donation, which brought the expedition within the range of practical politics.

Fortunately, sufficient is now known of the geography of the eastern half of the Antarctic area to enable a definite plan of operations to be arranged. We need not, like Cook, strike blindly into the Antarctic, knowing no more of one line than of another. There are two main geographical problems in the British field of work. The first problem is whether the known lands to the south of Australia—Victoria Land, Wilkes Land, Adelie Land, Geikie Land, Newnes Land, Termination Land, &c.—are all part of one great continent or are members of an Antarctic archipelago. The classical and mediæval geographers accepted the existence of an Antarctic continent, belief in which is now supported by Suess's principles of geographical distribution.

Australia, as Suess has explained to us, consists of a great plateau bounded to the north and east by the important tectonic line which passes through New Guinea, New Caledonia and New Zealand. Ritter has therefore very plausibly suggested that the volcanic chain that forms the eastern face of Victoria Land is the continuation of the New Zealand volcanic line, and that the coast of Wilkes Land is a southern extension of the Australian plateau.

This hypothesis, advanced at first on general considerations, is consistent with all available geological evidence. The specimens collected by Wilkes and the boulders dredged by the *Challenger* and the *Valdivia* include archæan and sedimentary rocks similar to those of Southern Australia; and Mr. Borchgrevink has brought home a collection of specimens which have been kindly shown to me by Mr. Prior, and are practically identical with some of the Lower Palæozoic rocks of Victoria.

The rocks of the eastern face of Victoria Land have been described by Teall and David; and their identifications show that the volcanic rocks resemble those of New Zealand.[1]

There is, therefore, little doubt that Antarctica is *geologically* a continent, consisting of a western plateau, composed of archæan and sedimentary rocks like those of Australia, and of an eastern volcanic chain. But whether Antarctica is still a continent *geographically* is less certain; and this question can only be conclusively settled by a survey. Land journeys westward and southward from Mount Erebus ought to settle this problem.

The volcanic line of Victoria Land runs north and south for some 8 or 10 degrees of latitude; at 77° S. lat. the coast and the volcanic chain bends abruptly to the east. The discovery of their eastward continuation is the second main geographical problem to be settled in the British half of the Antarctic area.

Ross sailed to the east for some 30 degrees, along the face of the "Ice-Barrier"; and though the origin of the barrier-ice is not yet certainly known, it has probably been formed on land. Ross has recorded a "strong appearance of land" beyond the eastern end of the barrier (160° W.), and the barrier may be roughly parallel to the edge of a land line connecting the Parry Mountains and Ross's "apparent land."

Beyond this point is a gap until, 70° further to the east, we come to Graham's Land. In the intermediate area there has been no direct record of any large land area that would connect Graham's Land and Victoria Land. But Cook's description of his view from his turning-point at 137° W. 67° S. is suggestive of a land with peaks rising through an ice-sheet rather than of a number of icebergs frozen into pack-ice. Cook, however, clearly interpreted it as the latter. The indirect evidence as to the geographical character of the line between Graham's Land and Mounts Erebus and Terror is more important. It is based on Suess's law of coast distribution.

The Pacific Ocean is bounded by coasts the trend of which is determined by mountain ranges which run parallel to the shore. This rule holds in Eastern Australia, Eastern Asia, Malaysia, and throughout the western coast of America with an unimportant exception in Central America. The remaining coasts of the world are on the Atlantic type, in which the coast lines are not determined by the trend of long, folded mountain chains; the mountain ranges are cut transversely or obliquely, and the coasts are mainly formed of plateaux and coast plains. Ritter has made the probable suggestion that the low coast of Wilkes Land is on the Atlantic type, and the high mountain chain of Victoria Land is on the Pacific type. Graham's Land has a characteristic Pacific coast; and when we remember the persistence of that type round the whole of the

[1] The continuation of the tectonic line that crosses Southern New Zealand obliquely to the main New Zealand line has not yet been determined, and it may be found to play an important part in the southern shore of the Pacific.

known shores of the Pacific, it appears not improbable that the Southern Pacific is bounded by a coast of the same type. If so, we should expect the Parry Mountains and Graham's Land to be connected by a series of mountain bows, the curves convex to the north, and with at least the traces of island festoons.

In that case the great tectonic lines which bound the Pacific to east and west are connected across the Antarctic area; and if that can be proved the unity of the great Pacific depression will be completely established.

That this South Pacific coast line can be discovered and surveyed by the expedition is improbable; when we remember the limited extent of the areas explored by Arctic expeditions, one ship cannot be expected to investigate half the Antarctic zone in the course of sixteen or eighteen months.

Considerable indirect evidence bearing on this problem may, however, be obtained; information as to the geology of Dougherty Island, and an extensive collection of bottom deposits along the edge of the ice-pack in the Southern Pacific, would no doubt throw much light on the geographical character of the area to the south. The expedition, moreover, should secure information as to the oceanic circulation and ice-drift which will enable a carefully-thought-out attack on this quadrant to be made. Our knowledge of the Ross quadrant, as Sir Clements Markham has called it, is so limited that it gives us no trustworthy suggestion as to the best lines of entry. And the Joint Committee appears to have accepted the principle that the expedition should work where present knowledge gives most guidance as to profitable lines of discovery and research.

GEODETIC WORK.

The principal geodetic work of the expedition will be the continuation of the line of gravity determinations that has now been carried from California across the Pacific to Sydney, and thence through Melbourne, Tasmania and New Zealand. This work will be done by a new set of three of the Ellery half-seconds pendulums, which, thanks to Mr. Baracchi, have been made for loan to the expedition by the Victorian Government. The pendulum results will be checked by the use of two of the gravity torsion balances designed by Profs. Threlfall and Pollock.

If it be possible to land for a couple of days at Cape Adare, gravity determinations should be made there as well as at the land station in Southern Victoria Land.

SEISMOLOGY.

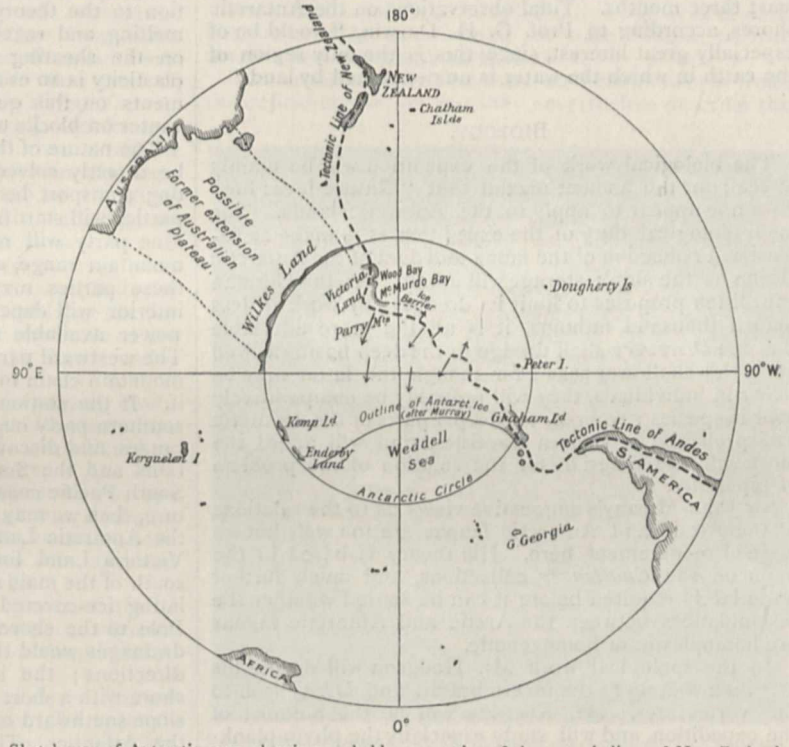
At this station a seismographic observatory will also be established. A Milne seismometer of the British Association pattern and a Ewing's duplex recorder are both to be installed.

METEOROLOGY.

A station on shore that will give a complete year's observations is necessary for the meteorological work as well as for the magnetic. The meteorological equipment will be exceptionally complete, thanks to the Admiralty, the Meteorological Council, Dr. R. H. Scott, Dr. H. R. Mill and Mr. W. N. Shaw. Recording instruments, including barographs, thermographs and hygrographs, will be established and checked by four-hourly direct observations; in case of the collapse of the recording instruments, observations will be taken every two hours, and during part of the year it will probably be possible to take them every hour.

As the observatory will probably be near the face of a lofty mountain range, the atmospheric conditions may be abnormal. To ascertain the conditions of the free air, it is proposed to fly kites with meteorographs. The Hargreaves kites, as modified at Dr. Rotch's observatory at Blue Hill, will be used.

The special meteorological problem to be determined by the combined expeditions is the existence of the hypothetical anticyclone over the South Pole. The careful meteorological observations made by Mr. Bernacchi during the Borchgrevink expedition have given almost a complete year's record for Cape Adare; they have shown the prevalence there of south-easterly winds which were unexpectedly warm, and are apparently due to a northern air-current being forced to sea-level and to return northward in the area to the south-east of Cape Adare.



Sketch map of Antarctic area, showing probable connection of the tectonic lines of New Zealand and the Andes through Victoria and Graham Lands. The arrows indicate probable directions of ice movement. The upper half of the map includes the British field of work; the lower half is that assigned to the German expedition.

OCEANOGRAPHY.

The expedition is also being generously equipped for oceanographic work, as the Admiralty, thanks to Sir William Wharton, is supplying the whole of the material. The first branch of this work will be the continuation of the contributions of former expeditions to the contour of the Antarctic ocean floor; and it is hoped that, in addition to complete series of soundings in special areas, new lines of soundings will cover a wide area around the edge of the ice-pack. The study of the bottom deposits collected during the soundings will be of especial interest, as bearing on the range and structure of the Antarctic lands; and their evidence will be supplemented by dredging for boulders with a special bucket-dredge.

The determination of the oceanic circulation as shown by the varying temperature, salinity, specific gravity and refractive index of the sea water will be the most arduous part of the oceanographic work. Owing to the importance and difficulty of this research, independent methods will be used concurrently. In the aërial temperature determinations we hope, like the German expedition, to have the assistance of a platinum thermometer, arrangements for which are being made by Prof. Ayrton. The mechanical difficulties in the management of the cable renders it indispensable that a full equipment of mercurial thermometers shall be carried; but electric thermometry has reached a stage at which we may hope that in determining temperatures under the great pressures of oceanic depths we need not rely on a method dependent on volume.

The tidal work will be done at the shore station, where a tide pole will be erected and observations taken for at least three months. Tidal observations on the Antarctic shores, according to Prof. G. H. Darwin, "would be of especially great interest, since this is the only region of the earth in which the water is uninterrupted by land."

BIOLOGY.

The biological work of the expedition will be mainly at sea; for the ancient maxim that "Nature loves life" does not appear to apply to the Antarctic lands. The main biological duty of the expedition is to make as extensive a collection of the fauna and flora of the Antarctic Ocean as the ship's storage will admit. As the German expedition proposes to limit its dredging to work of less than a thousand fathoms, it is all the more advisable that the *Discovery* shall dredge in the deep basins as well as in the shallower seas; for though the latter may be richer in individuals, they will probably be comparatively poor in species; whereas the deeper parts of the Antarctic will probably be rich in novelties, and will afford the most valuable materials for the solution of the problem of bipolarity.

Sir John Murray's suggestive views as to the relations of the Arctic and Antarctic faunas are too well known to need re-statement here. His theory is based in the main on the *Challenger* collections, and much further material is required before it can be settled whether the resemblances between the Arctic and Antarctic faunas are homoplastic or homogenetic.

In the zoological work Mr. Hodgson will devote his attention mainly to the invertebrates, and Dr. Wilson to the vertebrates. Mr. Koettlitz will be the botanist of the expedition, and will study especially the phyto-plankton and bacteria of the Antarctic seas.

GEOLOGY.

The Antarctic continent being often described as buried completely under a pall of ice and snow is not regarded as a hopeful field for geological work. But though the conditions may be unfavourable, the geological problems of the Antarctic are exceptionally interesting.

Stratigraphically we may expect Wilkes Land to show us a continuation of the rocks of the Australian plateau; and as part of the South Australian coast is at least of Lower Cainozoic age, we may hope for marine deposits of the same age on the northern face of the Antarctic lands. That Palæozoic sediments and limestones occur there is now certain, and they ought to yield fossils if the right zones are exposed. Palæozoic fossils will be of value, but the discovery of Cainozoic land fossils would be of far wider interest. The Biological Committee has called attention to the importance of geological work on the Antarctic lands, and that alone can settle the problems of zoological distribution in South America, South Africa and Australia during Cainozoic times.

It is, however, the way with fossils to occur in soft beds which have been worn into hollows and buried in a country that has been roughly used by the elements. Hence the palæontological results may be meagre, and the palæontological and physical branches of geology will probably gain most from a preliminary traverse.

The glacial work, including the character and distribution of the different ice-agents, the relations of the valley glaciers to the main ice-sheets, the physics of glacier ice, and especially the relation of shearing planes to the orientation of the ice-grains; the distribution of morainic and intraglacial material and the rate of flow of the glaciers are all problems which it is recommended that the members of the expedition should study. Prof. von Drygalski's work in Greenland has called renewed attention to the theory that glacial flow is due to repeated melting and regelation; whereas Müggé's experiments on the shearing planes in ice support the view that plasticity is an essential property of ice. Further experiments on this question will be conducted during the winter on blocks of glacier ice.

The nature of the inland ice is a problem that can only be directly solved by sledge journeys; and if sufficient dog transport be provided, it is hoped that two sledge parties will start from the land station in the early spring. One party will naturally strike westward to cross the mountain range, and the other to the south. How far these parties may be expected to penetrate into the interior will depend on the amount of sledge-hauling power available and on the structure of the country. The westward party would, it is hoped, cross the volcanic mountain chain to the plateau that probably lies beyond it. If the station be established at McMurdo Bay, the southern party ought also to penetrate beyond the coast ranges and discover what lies between the Parry Mountains and the South Pole. On the hypothesis that the South Pacific coast is on the Pacific type of coast structure, then we may expect that the greatest elevations on the Antarctic Lands will lie along the Graham's Land-Victoria Land line, and will be near the sea. To the south of the main mountain range there may be an undulating ice-covered region descending slowly across the Pole to the shore of the Weddell Sea. The main ice-drainages would then be not from the Pole radially in all directions; the ice-shed would run along the Pacific shore with a short steep northern face and a long gradual slope southward to the Pole and across it northward to the Atlantic. That the main ice discharge from the Antarctic lands is into the Weddell Sea is probable, since the biggest of the Antarctic icebergs, including those described as sixty miles long and forty miles broad, are apparently discharged from the Weddell Sea. As these bergs are discharged intermittently, it has been suggested from earthquake action, the Weddell Sea route to the south probably varies greatly in different years, and success in penetrating to the coast-line there might yield comparatively barren results, for the ship would probably be stopped against the stranded border of a vast ice-sheet, and find neither land for a shore station nor harbour for a ship; and travel over the ice-sheet would be unprofitable. As Sir Clements Markham has expressed it, "the Weddell route offers the minimum of results with the maximum of risks."

The Erebus and Terror region, on the other hand, offers a known base of operations, for a landing has already been effected on its shore. And the available geographical, geological and meteorological data all point to it, as in the critical part of the Antarctic lands.

J. W. GREGORY.

PRACTICAL PROBLEMS IN THE METALLOGRAPHY OF STEEL.

SINCE Sorby in 1864 established the all-important fact that steel must be regarded as a crystallised igneous rock, his work has been greatly expanded by the international labours of many able microscopists. Much of the work done, however, has been of academical rather than of practical interest, and busy steel works' metallurgists, appalled by the rapid growth of constituents ending in "ite," of "eutectics" and of solid solutions of carbon or carbides in unisolated allotropic modifications of iron, are already beginning to ask themselves the question, Is micrographic analysis going to be of any real use to us, and, if so, in what direction? The present article is an attempt to very briefly answer the above questions.

The theory prevalent a quarter of a century ago that steels of identical chemical composition would necessarily have the same mechanical properties has long since been discarded. But perhaps steel metallurgists have not yet fully realised the disconcerting fact that steel of excellent chemical composition, giving highly satisfactory mechanical tests, may nevertheless utterly fail in use, possibly with disastrous results. In other words, a ductile steel which bends double cold without any sign of flaw or failure may, under the influence of vibration, snap like a piece of glass, though only subjected to mechanical stresses well below its elastic limit.

In connection with the materials of construction used for high-speed engines, both land and marine, it is at the present time a problem of paramount importance for the scientific steel metallurgist to determine the cause of the sudden infidelity of steel (or wrought iron) under vibration.

Data in the writer's possession prove beyond all doubt that steel giving splendid chemical and mechanical tests may rupture under vibration possibly in a few hours or perhaps only after the lapse of twenty years.

There is little doubt that in many cases the microscope is capable of giving warning of the dangerous character of a steel, chemically, and apparently mechanically, safe. To intelligibly describe the structures of safe and dangerous steels it is necessary to consider:

(*a*) The micrographic constituents of structural steel.

(*b*) The molecular migrations of these constituents when at a red heat the metallic mass is in a semi-plastic state.

To put the case concretely, the chemical constituents of a typical rail may (in addition to iron) be approximately taken as carbon 0·40, silicon 0·05, manganese 0·90, sulphur 0·06, phosphorus 0·06 per cent., together with small percentages of arsenic and copper. The micrographic constituents of such a steel are:

(1) The pale, simple constituent ferrite (in this case somewhat impure iron).

(2) The dark etching compound constituent pearlite, consisting of mixed granules of iron and of a double carbide of iron and manganese.

(3) The dove-grey simple constituent sulphide of manganese, MnS.

It is important to remember that in manganiferous steels the foregoing constituents are only completely differentiated visually on slow cooling from a full red heat, a fact which at once introduces the vital question of the migration of constituents. Speaking broadly, it may be said that sulphide of manganese is not, under working conditions, capable of migration to any appreciable extent. Thus it remains to consider only the migrations of the ferrite and pearlite.

The movements of these constituents on heating may be termed "diffusion," and their movements on cooling "segregation."

On heating the typical steel specified to about 700° C. the compound constituent pearlite is converted, with absorption of heat, into the simple constituent, martensite, at Osmond's point A_c1. Then, passing through Osmond's points A_c2–3, the constituents ferrite and martensite diffuse one into the other till, at about 800° C., molecular equilibrium is eventually established.

If, however, the steel be cooled very slowly, the molecules of martensite and of ferrite will perfectly segregate in the respective proportions of about 45 and 55 per cent. Then at Ar. 1, about 640° C., the martensite will decompose into the compound constituent pearlite, which, owing to the presence of manganese, will be granular and not laminated. On the other hand, if the steel is somewhat quickly cooled in air, the segregation of the constituents will be imperfect and the apparent proportion of pearlite relatively large, because, owing to the influence of the manganese present, the phenomenon of constitutional segregation is retarded.

As a matter of fact, the apparently large area of dark pearlite is really an extremely intimate mixture of true pearlite and unsegregated ferrite.

The writer is aware that these statements may provoke theoretical opposition, but they nevertheless describe the observed facts, and by these, and not by theories, the practical metallurgist must be guided.

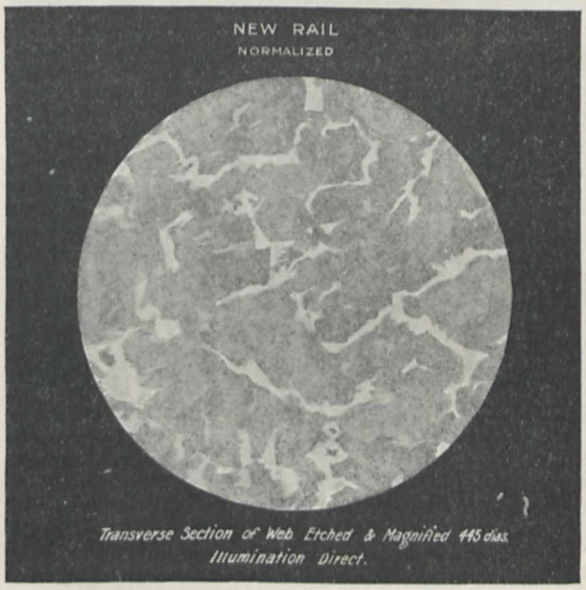


FIG. 1.—Size of original drawing, six inches; magnification, 445 diameters. The magnification here represented is about 166 diameters.

The micrograph Fig. 1 shows the transverse section of a rail web re-heated to 900° C. and allowed to cool in air; and this web exhibits the same structure in all the three planes of section presently to be referred to.

The micrograph Fig. 2 shows the structure when the rail was slowly cooled in the re-heating furnace during a period of 50 hours.

In Fig. 1 the pale ferrite has imperfectly segregated in the form of ragged and broken cell walls imperfectly environing cells of pearlite mixed with unsegregated ferrite.

In Fig. 2 the pale ferrite and dark granular pearlite have perfectly segregated mainly in the form of thick, alternating laminæ. The structure last named must be regarded as highly dangerous, because under vibration the adhesion between the constituents is liable to gradually loosen and finally to be destroyed. Nevertheless, mechanical tests would initially reveal little difference in the ductility of the two pieces of rail.

The foregoing facts give the clue to the direction in which the steel microscopist must look for danger with reference to rupture under vibration.

In a brief article it is difficult to do more than give suggestions, but it is necessary to point out that the majority of published micrographs exhibit a single plane of transverse section. Such representation can give only a very partial knowledge of what may be termed the solid geometry of steel.

To determine this it is necessary, in rolled metals, to make three micrographs in three planes of section at right-angles to each other, namely (*a*) a tranverse section, (*b*) a longitudinal horizontal section, (*c*) a longitudinal vertical section. From these the exact form in which any constituent exists in the mass can be determined.

As an example, the case of the constituent sulphide of manganese may be taken. It must be remembered that 0·09 per cent. by weight of sulphur corresponds to no less than 0·5 per cent. by volume of manganese sulphide, a very appreciable amount for a micro-constituent.

In the original ingot during solidification and cooling the sulphide segregates into roughly globular masses

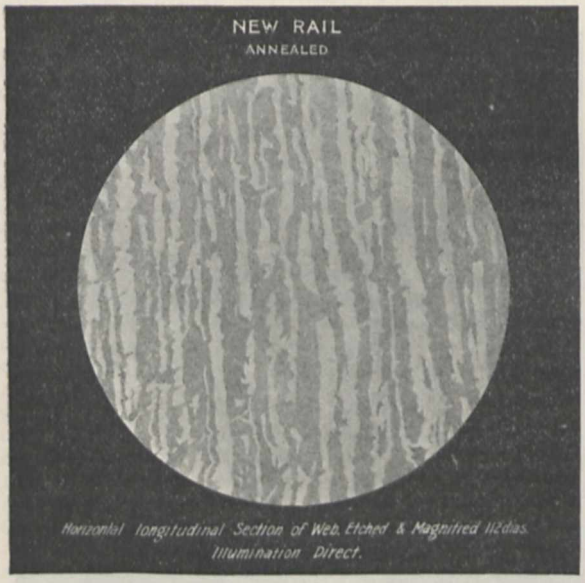


FIG. 2.—Size of original drawing, six inches; magnification, 112 diameters. The magnification here represented is about 42 diameters.

On reheating the ingot for rolling, the sulphide liquefies and the liquid globules are elongated in the direction of the rolling, and necessarily to some extent in a line at right-angles to that direction. Hence in a steel plate, the sulphide may present in the three planes of section above specified the appearances exhibited in Fig. 3, which shows that the sulphide is distributed throughout the steel in the form of irregular, oval laminæ.

It will be obvious that the evil mechanical influence of this constituent will be at its minimum along the length of the plate, somewhat greater across the plate, and at its dangerous maximum through the thickness of the plate.

Perhaps an obstacle to the development of steel works' metallography, even greater than the terror inspired by an unnecessarily complicated nomenclature, is the apparatus, time, care and special reagents supposed to be necessary to obtain, by polishing and etching, a good micro-section. In the advocacy of this view no one has been more earnest than the writer, and for research purposes it is doubtless sound. But for works' purposes, in connection with most steels, it must be confessed that such necessity has been exaggerated.

The writer has, therefore, pleasure in withdrawing his former view owing to experience having proved that by a very much simplified modification of method, a micro-section may be placed upon the stage for examination in five minutes after it leaves the dead smooth file in the machine shop. This process, which entirely does away with elaborate polishing apparatus or special etching reagents, is as follows:

Take two pieces of hard wood, 12″×9″×1″, planed dead smooth on one side; then by means of liquid glue evenly attach to the smooth faces two sheets of the London Emery Works Co.'s Atlas cloth, No. 0. Allow the glue to set under strong pressure. Next, by means of a smooth piece of steel, rub off from one of the blocks as much as possible of the detachable emery. This is No. 2 block, the other, necessarily, No. 1 block.

The steel section, say $\frac{1}{8}$ inch thick and $\frac{1}{2}$ inch diameter, is rubbed for one minute on No. 1 block, the motion being straight and not circular; then, for the same time and in the same manner, rub on No. 2 block. Next place the bright but visibly scratched section in a glass etching dish 3″×1′×$\frac{1}{2}$″, and cover the steel with nitric acid, sp. gr. 1·20.

Watch closely, until in a few seconds the evolved gases adhering to the section change from pale to deep brown and effervescence ensues. Then, under the tap, quickly wash away the acid and for a minute immerse

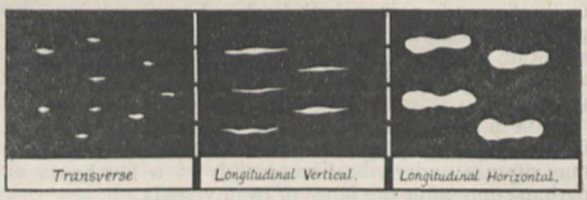


FIG. 3.

the piece in a second dish containing rectified methylated spirits. Dry the section by pressing it several times on a soft folded linen handkerchief, when it will be ready for examination. The structure will be clearly exhibited, the innumerable fine scratches visible before etching having virtually vanished.

The micrographs illustrating this article were prepared in a very few minutes by the above process, and have been accurately reproduced by Mr. F. Ibbotson. The writer hopes that this simple and rapid method may help to stimulate in steel works' practice a more extensive study of metallography.

J. O. ARNOLD.

THE WORK OF THE REICHSANSTALT.

A THICK quarto volume of nearly five hundred pages[1] gives a full account of the recent scientific researches of the Reichsanstalt. It is impossible, and perhaps not very useful, to attempt in the brief compass of a notice any full description of these varied investigations. All who are interested in physical measurement know that when a paper on any subject is issued from the Reichsanstalt it must be studied by any workers who come after.

In some respects the volume is sad reading to an Englishman. Problems which originated in England have in too many cases received their final solution from the researches of one or more of the distinguished band of workers gathered round the Director, Prof. Kohlrausch.

The volume opens with Dr. Thiessen's research on the

[1] Wissenschaftliche Abhandlungen der Physikalisch Technischen Reichsanstalt. Band iii. Pp. 477. (Berlin: J. Springer, 1900).

thermal expansion of water between 0° and 40°. To this problem Regnault's method of measuring the thermal expansion of mercury is applied, with suitable modifications. Elaborate precautions are taken to secure that the temperature of each of the two balancing columns should be the same throughout, but the difficulty of the measurement lies in determining the difference in level of the ends of these two columns, and Dr. Thiessen's apparatus designed for this purpose proved in his hands most successful. It may perhaps be useful to give the table of the density of water at various temperatures under atmospheric pressure, assuming the density at 4° C. to be unity.

t.	Density according to Thiessen.	Difference from Chappuis' values.
0°	·9998676	− 2
10	·9997270	+ 2
15	·9991263	+22
20	·9982299	+29
25	·9970715	+11
30	·9956736	+19
35	·9940576	+47
40	·9922418	+43

In the third column are given the differences between Chappuis' values found in 1897 and those obtained by Thiessen.

It will be observed that throughout they are very small; indeed a closer examination shows that from 0° to 12° the differences only amount to one or two units in the seventh figure. Chappuis' measurements, it may be mentioned, were made by aid of a dilatometer of platinum-iridium, and involve a knowledge of the thermal expansion of that substance.

In a second paper Dr. Thiessen applies to the same apparatus for measuring the difference of height of two columns to the determination of the pressure of saturated water vapour. The value found for this quantity at 0° C. is 4·579 mm. of mercury, with a probable error of ·001 mm.

Another paper which should have many readers is that by Profs. Jæger and Kahle, on the mercury standards of resistance. This is a continuation of Dr. Jæger's paper in the second volume of the *Transactions* of the Reichsanstalt. A very full description is given of the work of constructing the standards and determining by calibration their resistance in terms of the ohm as defined legally, viz., the resistance of a column of mercury at 0° C., 106·3 centimetres in length and 14·4521 grammes in mass. The tubes were then compared electrically among themselves, and also with the manganin standards of the Reichsanstalt. For this purpose four manganin coils are used. The mean value of the resistance of these four coils at 18° C., as determined from the original tubes calibrated in 1892, was found to be 1·004582, and from the new tubes calibrated in 1897, 1·004578. Changes amounting to about ·00002 were observed in some of the manganin coils during the period of observation.

Dr. Kohlrausch himself contributes a very important paper on the resistance of aqueous solutions of the chlorides and nitrates of the alkalis.

This is followed by a comparison of thermometers made of various kinds of glass, with a further intercomparison of the standard thermometers of the institution.

As regards the depression of the freezing point, the former observations of Wiebe and others are confirmed; it increases for the older kinds of glass, according to a more or less parabolic law, with the temperature to which the thermometer has been raised; while, as before, it is clearly shown that the depression is much greater in glasses containing both soda and potash than it is in glasses which contain either soda or potash only.

Perhaps, however, the most striking results in the volume are those contained in a paper by Drs. Jæger and Diesselhorst on the thermal and electric conductivities, the specific heats and thermo-electromotive forces of certain metals.

When a current passes through a conductor it is heated; when, however, a stationary state is reached, the distribution both of current and of temperature does not change with the time. The conditions for this involve the ratio between the electric and thermal conductivities of the material, and Kohlrausch showed how this ratio might be readily determined by observations on the temperature and potential of three points of a conductor carrying a constant current, provided the ends of the conductor be maintained at a constant temperature.

The theory and the experimental details are both fully given in the paper; the temperatures were determined by the aid of very small thermal elements. The bars of metal experimented on were in most cases about 27 cm. in length, and from 1 to 2 cm. in diameter. The metals examined included gold, silver and platinum, while bars of rhodium and iridium, weighing respectively about ·75 and 1·33 kilogrammes, were prepared by Herr Heræus, but could not be used because of their extreme hardness.

In addition to determining the electric and thermal conductivities at 18° and at 100° C., the specific heats at these two temperatures and their thermo-electromotive forces as against copper were also determined.

Attention had been called by Wiedemann and Franz, in 1853, to the fact that the electrical and thermal conductivities of many substances are approximately proportional, and L. Lorenz, in 1881, had shown that the ratio of the thermal to the electric conductivities at various temperatures is approximately proportional to the absolute temperature. The experiments here described enable us to test these laws. The ratio is shown not to be accurately a constant, it varies in the case of the materials tested, excluding constantan, from 636 for aluminium to 964 for bismuth, but in far the greater number of cases its value lies between 670 and 800, a striking result when it is recollected that the electric conductivities vary between 5 and 60. The temperature coefficient of the ratio ranges, omitting bismuth and one or two high resistance alloys such as constantan and manganin, from ·034 to ·046; if the Lorenz law were true it would be ·0366 in all cases.

Sufficient, perhaps, has been said to indicate the importance of the volume and the high value of the researches which continue to be carried on at the Reichsanstalt.

MEDIÆVAL NATURAL HISTORY IN POLAND.[1]

THERE are few more interesting occupations than to trace the growth of scientific knowledge in the field of natural history. We are heirs of the labours of our forefathers, who were fain to struggle through obscure and devious paths to build up the mass of information on these subjects with which we are furnished. We find them living in a wonderland of the strangest credulity and superstition, and their errors have only gradually disappeared in the process of scientific investigation. With herbs, animals and precious stones were connected the wildest theories. Folk-lore played a busy part; the mandrake uttered groans when it was pulled up; the toad had a jewel in its head; the barnacle was half herb and half animal, and the barometz was a lamb which partook of a vegetable

[1] "Symbola ad historiam naturalem medii ævi. Sredniowieczna Historya Naturalna. Systematyczne zestawienie roslin, zwierzat, mineralow oraz wszystkich innego rodzaju, lekow prostych, uzywanych w Polsce od xii do xvi w. przez Jozefa Rostafinskiego." ("Mediæval Natural History. A systematic account of the plants, animals, minerals and all kinds of simple herbs known in Poland from the twelfth to the sixteenth century." By Joseph Rostafinski. (Cracow: University Press.)

nature. These beliefs have slowly died out, but Sir Thomas Browne, who lived so recently as the latter part of the seventeenth century, in his *Pseudodoxia Epidemica* wrote a book against the delusions of his countrymen, himself believing in many absurdities. The medicinal uses to which animals and herbs were applied strike us forcibly in these modern times. The scientific medical man of the nineteenth century was to be slowly evolved out of the medicine-man and conjurer. Nor are the two last entirely gone; they still may be found in the less civilised parts of Europe and in the more unfrequented nooks of our own country. We have no space to enumerate here the old works treating of popular therapeutics in England, such as the Anglo-Saxon medical books edited by the late Oswald Cockayne, in 1864, under the fantastic title, "Leechcraft and Wortcunning." The late Mr. Mowat, of Oxford, published two contributions on the subject in his *Alphita* and *Sinonoma Bartholomaei*. Many other works could be cited in English literature, but the immediate object of our article is to call the attention of our readers to the two volumes which have appeared from the pen of Mr. Joseph Rostafinski, professor of botany in the University of Cracow, and the title of which is given at the foot of p. 615. Prof. Rostafinski has furnished lists of the names of plants, animals, minerals and various kinds of herbs which were known in Poland from the twelfth to the sixteenth century. The greater part of these names are preserved in manuscript vocabularies in the libraries of Cracow (especially the so-called Jagiellon), Lemberg, Prague and St. Petersburg. Some of these vocabularies first became known in the pages of the Warsaw review, *Prace Filologiczne*, to which they were contributed by Prof. Brückner, of Berlin, one of the foremost Polish scholars.

For the botanist and student of natural history, these volumes have much value. Prof. Rostafinski catalogues the names of the plants, &c., upon a carefully-arranged system; compares the different names under which they are found, and gives us the Latin equivalents, which will help us in our search for them. He shows us where information has been gathered from Pliny and Dioscorides. His notes abound with folk-lore, and most people know how interesting folk-medicine is. Thus, of the herb koniochrom (*Hippocrepis comosa, L.*) we are told that it has this name (lit., making a horse lame) because if a horse treads upon it his shoe will fall off. The Slavonic appellation for the linden, or lime-tree, is lipa, and comes up in the original Slavonic name for Leipzig, Lipsk. On p. 443, vol. i., we get interesting details of the auerochs, of which a picture is given in Hartknoch's quaint old book on Prussia. It has now been almost exterminated, and is only found in some forests of Lithuania, where it is preserved for the Emperor's hunting. It is singular that in the sixteenth century camels were used in Poland; thus we find them employed in the time of Sigismund Augustus, when that monarch was journeying from Cracow to Wilno. The Slavonic name for camel is derived from the Gothic word ulbandus, which is really a very ancient adaptation of the Greek ἐλέφας.

One of the most curious parts of this interesting book is where the writer deals with the fabulous animals, basilisks, &c. The folk-lore connected with these is abundant. We are reminded of the work of our own countryman, Topsell. In fact, we have a good account of the flora, fauna and minerals, how they were called and what was known of them in Poland during the Middle Ages. Although the scope of the work is in a way limited to Poland, yet, as the author says in his introduction, which appears in Latin as well as in Polish, the book will be serviceable for north Europe generally. There is in reality a great unanimity in many of these legends about plants and animals. Pliny leads off, we may say, in his "Natural History," which was the great storehouse during the Middle Ages for folk-lore of all kinds. We must not forget, also, Bartholomæus' "De Proprietatibus Rerum," *a.* 1400. The Slavonic riches are being gradually collected; much has been already done in Russian, and the late Mr. Ralston made use of it in his books of Russian folk-songs and Russian folk-tales. The *Sbornik*, or *Miscellany*, published yearly by the Bulgarian Government, generally devotes a section of each new volume to these popular traditions. In England we have no special organ, except it be the *Folk-lore Journal*; our popular superstitions must be gathered from the miscellaneous pages of *Notes and Queries* and such books as "Gerard's Herbal." No little light is afforded by the curious medical works published in the sixteenth and seventeenth centuries, among which may be expressly mentioned the "Breuyary" of Andrew Borde and the choicely quaint work of Dr. Tobias Venner. In the life of Seth Ward, by Dr. Walter Pope, some extraordinary tales are told of a surgical operator of that time, and also in Aubrey's Lives.

In all countries the popular names given to plants may be said to be richly significant, and therefore not only the man of science, but the philologist may find much material in Prof. Rostafinski's volumes.

INTERNATIONAL ASSOCIATION OF ACADEMIES.

THE meetings of the International Association of Acadamies were concluded last Saturday, when it was determined unanimously that the next Congress should be held in London in 1904. Although the *Comptes rendus* of the various meetings have not yet been published, it is known that much useful work has been accomplished. Nothing could exceed the cordiality of the reception accorded to the foreign delegates by the French authorities and their scientific *confrères*. After the final meeting on Saturday, the delegates were received by the President of the Republic and Madame Loubet, and later in the day they attended a dinner and concert given in their honour at the Hôtel de Ville.

NOTES.

AS already announced, a complimentary dinner to Sir Archibald Geikie will be given next Wednesday, May 1, at the Criterion Restaurant. A number of distinguished men of science will be present, and the chair will be occupied by Lord Avebury. It is felt that the retirement of Sir Archibald Geikie from the position of director-general of the Geological Survey should not be permitted to pass without an expression of appreciation of his services to science and to the nation. All who are able will, we are sure, show by their presence at the dinner that they delight to do honour to one who has worked so worthily and with such success for the extension of scientific knowledge. Tickets may be obtained from Mr. F. W. Rudler, 28, Jermyn Street, S.W.

WE regret to see the announcement of the death of Prof. H. A. Rowland, professor of physics at the Johns Hopkins University, Baltimore, U.S.A.

THE Australian mail brings us news that Messrs. Baldwin Spencer and Gillen left Adelaide on March 15 for their twelve months' North Australian expedition. Owing to the presence of drought in the interior, the start, which was to have been made early in February, had to be delayed. The original intention of the explorers was to have worked out through the McDonnell Range and the Arunta tribes, and then north, until the mouth of either the Daly or Victoria river was reached; but it seems likely that this course might have to be given up in preference for an inverse one starting from Port Darwin,

which, with either the north and east or the west coast, was to have been the returning route. Our information from the explorers themselves is that they have simply "started away for the far north," but it affords us great pleasure to add that it embodies the news that, in addition to the 1000*l.* contributed to the expenses of the expedition by Mr. D. Syme, of the Melbourne *Argus*, there has been given a further sum of 500*l.* by Mr. Reuben Spencer, of Darley Hall, Manchester, father of the leader.

THE committee of the National Physical Laboratory will shortly appoint several members of the staff of the laboratory. Applications are invited for the post of superintendent of the engineering department; and other appointments to be made include two or three assistants in the physics department—one of them to take charge of chemical investigations—and a few junior assistants. Particulars as to salaries, &c., will be found in our advertisement columns.

MANY people wonder why the Thames is not used for passenger traffic to the same extent as the Seine. With a quick and punctual service, and neat vessels, the Thames might become the most popular means of travel in the metropolis. The Thames Steamboat Company possesses thirty-six vessels, having a total carrying capacity of more than sixteen thousand passengers. The vessels will be reviewed on May 1, and the service will commence on the following day. There will be a ten-minutes service between London Bridge and Battersea, a half-an-hour service between Chelsea and Kew, and a service of the same frequency eastwards from Westminster to Greenwich and Woolwich. It is sometimes objected that on account of the windings of the river the distance from one point to another is much greater than by road; but it must be remembered that omnibuses—with which the steamboats are comparable—follow routes which deviate from a direct line almost as much as the river. The better the service of steamboats on the Thames the more people will take advantage of this pleasant means of communication, and in the course of time London might be so well served in this respect as Paris is now.

THE Senate of Minnesota has passed a Bill prohibiting the marriage of insane, epileptic and idiotic persons, and requiring a medical certificate of all applicants for marriage licenses.

WE learn from *Engineering* that the valuable collection of early scientific works made by the late Mr. Latimer Clark, F.R.S., has been purchased by Mr. S. S. Wheeler and presented to the American Institute of Electrical Engineers. Mr. Andrew Carnegie has offered to provide the large sum necessary to house the entire collection in its new quarters.

THE Agricultural Research Association is a Scottish organisation, founded about twenty-five years ago and having for its objects the carrying out of two branches of work of the utmost importance to farmers, viz. scientific investigations bearing upon agriculture, and the dissemination of the information thus obtained among those to whom it is likely to be of practical use. The research station is at Glasterberry, Milltimber, Aberdeen. The Association has a strong list of names of patrons, office-bearers and members of the executive committee, and the director of research is Mr. Thomas Jamieson, of Aberdeen, under whose able administration some excellent work has been carried out and many most valuable results have been made public. From the report of the Association for the year 1900 it appears that experiments have at various times been conducted on the comparative values of finely ground and soluble phosphates, on the aperture in root hairs, on the relative values of different forms of nitrogenous, phosphatic and potash manures, on the cause of finger and toe disease in turnips, on the characters of roots of grasses and clovers, on the permanence of rye grass, and other subjects. Among the more recent inquiries has been a most carefully conducted set of experiments demonstrating that natural cross-fertilisation of oats leads to larger and more productive crops without extra outlay. It is proposed to extend the experiments to other crops in view of the decisive results obtained with oats. The Association is dependent on the subscriptions of landowners and farmers, and although the latter take the greatest personal interest in the work, the amount of the subscriptions has been insufficient to meet the necessary expenditure, and the director has in consequence had to meet the deficiency incurred during last year's work. In view of the practical value, to say nothing of the scientific importance, of the results hitherto achieved, it is to be hoped that the appeal of the committee for a further measure of support will meet with that response on the part of the landowners which the work of the Association most certainly merits.

THE Easter party is now at work at the Port Erin Biological Station. The curator, Mr. H. C. Chadwick, who has recently been for a couple of weeks at the Lancashire Sea-Fisheries Hatchery, making himself acquainted with the methods employed there, has now returned to Port Erin, and Prof. Herdman is there with a party of students. Dr. O. V. Darbishire, from Owens College, occupies a table and is at work on his forthcoming L.M.B.C. memoir on Gigartina; Miss Thornely, of Liverpool, is examining Polyzoa, and there are three senior students from the zoological department of Owens College at work. Other naturalists are expected during the latter part of this month. The boisterous weather of late has prevented much work at sea, but several shore collecting expeditions have taken place, and arrangements have been made for a steam-trawler for dredging. This is a late season amongst marine animals in the Irish Sea, probably on account of the recent cold weather. The fish spawning is not so far advanced as is usual at this time, and sedentary colonial animals, like compound ascidians, on the shore seem to be less abundant and smaller than usual. In the tanks of the Aquarium several common shore invertebrates are now spawning; Ephyræ made their appearance in swarms during the greater part of March; *Porania pulvillus*, obtained on dredging expeditions from deep water, has established itself and is living healthily; while several of the large wooden tanks contain crops of self-planted algæ and other small organisms, and support a varied fauna without change of water and with very little attention.

WE learn from *Science* that the following grants from the Gould Fund have recently been made:—to Mr. John A. Parkhurst, 30 dollars; to Dr. Herman S. Davis, 500 dollars; to Mr. Paul S. Yendell, 225 dollars; to Prof. Simon Newcomb, 25 dollars. A considerable additional amount of income has accrued, for the distribution of which applications are awaited. These applications may be made by letter to any of the directors, stating the amount desired, the nature of the proposed investigation, and the manner in which the money is to be expended. The directors, desiring to stimulate the participation of American astronomers in the attempt to bring up the arrears of cometary research, offer to them the sum of 500 dollars for computation of the "definitive" orbits of comets, this sum to be distributed at the average rate of 100 dollars for each computation—the amount to vary according to the relative difficulty of the computation, and to be determined by the directors of the Gould Fund. Computers should promptly notify the directors of their participation or desire to participate, and manuscripts should be submitted not later than July 1, 1902.

Apropos of the red rains of African dust which have recently excited considerable attention in the south of Italy, Dr. H. R. Mill, the editor of *Symons's Meteorological Magazine*, directs attention, in the issue for the current month, to a blood-rain plant which has invaded the large evaporation tank at Camden

Square. The plant has been examined microscopically by Mr. V. H. Blackman, of the Botanical Department of the British Museum, and is found to be a minute motile alga called *Sphaerella pluvialis*. It is usually found in small pools, and is closely allied to the microscopic plant which gives its colour to red snow. Its occurrence in rain is a rarity, and it has nothing in common with the red sand-rains of the Continent—except the colour—but if a whirlwind were to pass over the tank, showers coloured red might be produced along its subsequent track by the same process as the familiar showers of frogs and fish.

WE have received from the director of the Meteorological Service of Canada an interesting account of the cloud observations made at the Toronto Observatory during 1896 and 1897. The instruments used consisted essentially of two ordinary surveyor's theodolites, the telescopes being replaced by a long axis made for each and mounted in the Y's of the standards. The length of the base line was 1552 metres; the observer at one station selects some well-defined point of a cloud and telephones its position to the observer at the other station, and on his identifying it the two observers sight it at the same instant of time, and this operation is repeated after an interval varying from 40 seconds to 8 or 10 minutes. Not much photography was done, owing to the difficulty of keeping the cameras in adjustment. The highest cirrus measured in the latter part of 1896 was at 10,000 metres, velocity 79 miles an hour, and the lowest 8100 metres, velocity 55 miles. In June 1897, altitudes exceeding 11,000 metres were obtained, with velocities of about 100 to 150 miles an hour. Mean height during the summer season was 10,900 metres, mean velocity 40 miles, and in the winter season 9,978 metres, velocity 26 miles. The heights and velocities of the various clouds are given in the same way, the mean heights of the lowest cloud, the cumulus, being in the summer season 1697 metres and in the winter season 1326 metres; the mean velocity was only about 10 miles an hour.

THE second sheet of the North Atlantic and Mediterranean Pilot Charts, issued by the Meteorological Office last week, exhibits the salient features of the region in the month of May. In dealing with the winds it is pointed out that, as indicated by the isobars on one of the inset charts, the barometric gradient between the anticyclone of the horse latitudes and the depression near Iceland is now only about ¼ inch, so that the winds over the northern half of the Atlantic are of moderate force and strong gales are uncommon, the southern limit of 10 per cent. frequency of gales receding northward to between the 45th and and 50th parallels. Some characteristics of the tornadoes on the African coast are mentioned, and advice given as to how a vessel should be handled. It is instructive to observe that with the advance of the year fog is not only increasing on the banks but the area is creeping eastward, while another area is spreading westward from the Bay of Biscay. The great advantages of ocean current charts for each month of the year are becoming very evident. To quote the latest chart, "The results show the changes, both local and general, which are associated with the advance of the seasons. In the month of May it will be seen that to the westward of the British Isles, between the 50th and 60th parallels, the drift is largely to the west and south-west, there being no evidence of the north-eastward extension of the Gulf Stream beyond about 47° N., 27° W. Between the 30th and 50th parallels westward to the 30th meridian, nearly the whole of the surface water has a south-going movement. These features are probably closely related to the prevalence of polar winds off the coasts of North-Western Europe at this season." The distribution of atmospheric pressure, with the accompanying northerly winds, distinguishing the European "Cold Spell" of May, is illustrated by means of an inset chart and remarks, and there is information bearing on several other topics; but sufficient has been said to show that the chart may be of service to many others in addition to seamen.

THE Sydney Botanic Gardens, which are admittedly among the finest in existence, comprise about forty acres, and their northern edge forms a semicircle round Farm Cove, one of the many charming indents of the harbour, and forming the anchorage of the vessels belonging to the Australasian squadron. Adjoining the western boundary of the gardens are the grounds surrounding the residence of the Australian Governor-General. Recently the gardens have been enriched by the addition of the first museum in Australia strictly botanical in character, all existing museums in which plant products are exhibited being either technological or partly botanical and partly technological. The building, which has been erected under the supervision of the State Government architect, now comprises a museum, herbarium, library, store room, photographic room, seed room and offices. The museum was formally opened by Mrs. John See, whose husband, the acting-Premier and Chief Secretary of New South Wales, said the collection was a national one, and that so long as he occupied the position he would do all he could to provide money for extending its usefulness.

DR. B. SHARP described, at a recent meeting of the Academy of Natural Sciences of Philadelphia, some observations he has made on the contents of the stomachs of the common cod. Several hundred stomachs were opened with the hope of finding shells of gastropods and bivalves. Numerous valuable shells were taken from the cod years ago by Stimpson and Gould on the New England coast, north of Cape Cod, and it was supposed that similar finds would come to light from the cod caught off Nantucket. The stomachs examined were filled almost exclusively with crustaceans and for the most part with species of Panopeus. Hermit crabs, without shells, and a few Crepidulæ were also seen. Here and there young lobsters were found in the stomachs, occasionally two in one stomach. Dr. Sharp believes that the decrease in quantity of the lobsters, which has been so marked within the past few years, is partly due to their consumption by the cod; and as these have of late greatly increased in numbers, owing to the work of the United States Fish Commission, the lobsters have not been able to keep pace with the increase of their enemies.

Petermann's Mitteilungen contains a short descriptive paper on the region surrounding the junction of the Trombetas with the Amazon, by Dr. Friedrich Katzer, with a map based on surveys made under direction of the Belgian engineer, Haag, chiefly by Captains Le Blanc and Robert. The map indicates considerable modifications of those already extant.

PROF. E. RICHTER communicates to *Petermann's Mitteilungen* a letter addressed to him by Herr Schuh, of Gmunden, on some temperature observations made in the Gmunden See, which seem to settle the question of why water at the surface of a lake on which ice is forming has always been recorded as warmer than the freezing point. Using an ordinary thermometer, Herr Schuh observed temperatures of 0°·4, 1°·5, 2°·0 and 3°·4 C. within an area of 1 sq. m. on which ice was actually forming. A special form of thermometer was then devised, of which the lower part was drawn out into the form of a pear 7 mm. in diameter, the instrument being filled with spirit and carrying a minimum index, and the whole was so arranged as to swim on the water with the pear-shaped part immersed horizontally. Repeated observations showed that where ice was forming the spirit showed a temperature of 1° to 3° when the instrument was lifted out of the water, but the index invariably read 0° C. Hence it appears that the

ice-forming layer is one of extreme thinness just at the surface, and that in observing with the ordinary thermometer this layer gets mixed with the warmer water underneath.

A MATHEMATICAL investigation of the motions of seismographs, which from its nature bids fair to have important applications, is published by Dr. M. Contarini in the *Atti dei Lincei*, x. 5, 6. In it the author determines the differential equations regulating the motion of the forms of seismograph considered relative to three rectangular axes, and shows how these equations may be integrated. The assumption on which this work is based is that all the points of attachment, both of the pendular masses and of the registering levers, are treated as being rigidly connected with the earth.

IN the *Bulletin* of the Cracow Academy, November 1900, Herr Zorawski studies the motion of a continuous system of material points regarded as a group with the infinitesimal transformation determined by the well-known operator of the ordinary equations of hydrodynamics. It appears that if the characteristic equation possesses three distinct roots, the principal axes of the quadric connecting the rates of strain are transformed into principal axes, if two roots of the characteristic equation are equal only one principal axis is transformed into a principal axis, finally, in the case of a triple root, the line element possesses properties which the author designates as "perfectly symmetrical."

THE resistance of cereal smuts to formalin and hot water forms the subject of a short paper by Mr. William Stuart in the *Proceedings* for 1898 of the Indiana Academy of Science, which has recently reached us. The results obtained in the treatment of the spores are well within the bounds of successful practice, the spores being much more easily injured with either hot water or formalin than is the grain. It is apparent that the essential feature in the successful treatment of grain for smut is to bring each seed in contact with the solution used for a sufficent length of time to enable it to reach the spores. The advantage possessed by formalin over hot water in the treatment of seed grain lies in its greater ease of application, doing away with the necessity of heating water and maintaining a sufficiently uniform temperature during the treatment. Mr. Mason B. Thomas describes some field experiments with formalin in the same volume.

PART 67 of the *Communications* from the Leyden Physical Laboratory contains a paper by J. C. Schalkwijk on precise isothermals, in which the author describes methods of determining the corrections to be applied in taking account of the volume of the meniscus of mercury in working with standard gas-manometers.

A DISCUSSION on the properties of steel containing nickel is presented to the Report of the Congrés International des Méthodes d'Essai (Paris, 1900). In passing from ordinary steel to that containing a considerable proportion of nickel the principal changes are the lowering of the temperature of transformation of the carbon, the fusion of two of the transformations and the exaggeration of the phenomena accompanying the double point. In ferro-nickels containing traces of carbon, but more than 20 per cent. of nickel, the transformations are determined by the nickel, the carbon acting as a retardent. It appears that the magnetic properties are due to a certain molecular transformation which takes place with evolution of heat, and when this molecular grouping is prevented by the presence of some other body, the metal may be reduced to ordinary temperatures without exhibiting magnetic phenomena. The author compares ferro-nickels to solutions rather than combinations. Finally, it is suggested that by the addition of nickel many properties of steel may be studied at temperatures considerably below those at which they occur in pure steel. As an example the author mentions the gradual changes of volume which take place in the course of years, and which in the case of nickel steels may be observed at the temperature of the laboratory, whereas it would be impossible to study similar changes occurring at an elevated temperature in pure steel.

IN the April number of the *Zoologist* Mr. J. H. Gurney mentions that the nestling of the green woodpecker, when a few days old, develops a pea-like knob on each side of the hinder part of the mandible. It would be interesting to discover the use of this peculiar growth, which appears to have been hitherto unnoticed.

A LARGE portion of vol. xxii. part 3 of *Notes* from the Leyden Museum is taken up by instalments of Dr. O. Finsch's catalogue of the birds in the collection; these deal with certain eagles, the parrots of the South Sea islands, and various passerines. Another article, by Dr. Jentink, treats of certain alleged errors in the description of the large West African diuker antelope (*Cephalophus sylvicultor*). Considering that one of the articles is dated March 1901, it is somewhat difficult to understand why this part of the *Notes* is issued for July 1900.

PART 3 of vol. lxix. of the *Zeitschrift für wissenschaftliche Zoologie* contains six memoirs, five of which deal with the anatomy and morphology of invertebrates, while the sixth (by Herr E. Botezat) treats of the nerves of the hard palate of mammals, a subject which has hitherto received but little attention from anatomists. To specialists, Prof. F. Vejdovský's communication on the morphology of the antennæ and shell-glands of the crustacea should prove interesting. Another paper, by Herr N. Kassianow, deals with the nervous system of the lucernarian medusæ.

THE concluding portion of Mr. E. J. B. Sopp's address on the importance of the study of life-history among insects is published in the *Entomologist* for April. After mentioning that insects in captivity are often somewhat misleading in their habits, and that all observations should be verified on specimens in the wild condition, the author cites a few instances where our ignorance of insect physiology is most noticeable. It is quite unknown, for example, how the water-beetles of the genus Dytiscus produce their well-known stridulating sound. Neither do we know the use of the peculiar cord-like structure found in "bloodworms," or larvæ of the gnat-like fly *Chironomus plumosus*, nor how the respiratory air-sacs of the "phantom larvæ" of another gnat, *Corethra plumicornis*, become inflated with air, and that, too, in all probability of a highly oxygenated character. The author also calls attention to the importance of coalition between natural history societies for the purpose of recording the local abundance of insects in their respective districts. It is the common and not the rare species to which attention should be directed, as by this means we may in time be able to predict and thus prevent the appearance of "plagues" of noxious kinds.

A DESCRIPTIVE catalogue of the Coleoptera of South Africa, by Mr. L. Péringuey, assistant director of the South African Museum, constitutes vol. xii. of the *Transactions* of the South African Philosophical Society. The catalogue occupies 563 pages, and is illustrated by nine plates.

WE have received a copy of *Electrical Investments*, a new fortnightly journal devoted mainly to the financial side of electrical undertakings. Besides an extensive share list, the paper contains a leading article and comments on matters of interest to those concerned, financially or otherwise, with electrical matters.

IT will interest archæologists to know that the concluding volume (vol. iv.) of "Old Northern Runic Monuments of Scandinavia and England," by the late Prof. George Stephens, will be published shortly in English by Messrs. Williams and Norgate. The work was left incomplete by Prof. Stephens, but from his notes and papers his son has been enabled to prepare the volume for publication.

MUCH information not easily obtainable is brought together in a little publication just added to the Patent Office Library Series, of which it forms No. 4, under the title "Guide to the Search Department of the Patent Office Library, with a Dictionary of 'Trade or Fancy' Names." The book shows in what publications, and for what periods, grants of patents and registration of trade marks and designs are recorded, the information being arranged under the names of countries. The dictionary of words used to designate materials, processes and mechanical appliances will often prove of service, for the etymology of the words rarely gives a clue to the nature of the things designated.

THE *Proceedings* of the American Association for the Advancement of Science, containing addresses and abstracts of papers read at the forty-ninth meeting, held last June in New York, have just been received. By an arrangement with the Macmillan Company, members of the Association now receive the weekly journal, *Science*, free of charge; and as the journal publishes the official notices and proceedings of the Association, the members are kept in touch with these affairs as well as with the progress of science in return for their single subscription.

THE *Psychological Index* this year occupies 179 pages of the special number of the *Psychological Review*. The index is a bibliography of the literature of psychology and cognate subjects for the year 1900, and includes publications in all languages, together with translations and new editions in French, German and English. There is a comprehensive subject-index, containing 2627 entries, and also an authors' index. Prof. H. C. Warren, of Princeton University, who is the compiler of the index, deserves the thanks of psychologists for the careful way in which he has done his work.

"THE Handbook of Jamaica" for 1901, compiled by Messrs. T. L. Roxburgh and J. C. Ford, has been published by Mr. Edward Stanford. The work is now in its twenty-first year of publication, and contains an immense amount of historical, statistical and general information concerning the island

THE additions to the Zoological Society's Gardens during the past week include a Macaque Monkey (*Macacus cynomolgus*) from India, presented by the Rev. J. M. Glubb; a Bennett's Wallaby (*Macropus bennetti*) from Tasmania, presented by Mrs. L. Brown; a Water Rail (*Rallus aquaticus*), British, presented by Mr. A. W. Arrowsmith; a Blue-breasted Waxbill (*Estrelda cyanogastra*) from West Africa, presented by Miss E. C. Stephens; a Raven (*Corvus corax*), European, presented by Mr. J. C. Cadogan; two Red-eared Bulbuls (*Pycnonotus jocosus*), a Red-vented Bulbul (*Pycnonotus haemorrhous*) from India, a Chinese Bulbul (*Pycnonotus sinensis*), a Chinese White-eye (*Zosterops simplex*), a Chinese Mynah (*Acridotheres cristatellus*) from China, a Wattled Honey-eater (*Anthochaera carunculata*) from Australia, a Black Tanager (*Tachyphonus melaleucus*), a Silky Cow-bird (*Molothrus bonariensis*), a Red-headed Marsh-bird (*Agelaeus ruficapillus*), two Sulphury Tyrants (*Pitangus sulphuratus*) from South America, a Brazilian Tanager (*Ramphocoelus brasilius*), a Red-headed Cardinal (*Paroaria larvata*), a Brazilian Hangnest (*Icterus jamaicai*), a Bay Cow-bird (*Molothrus badius*) from Brazil, a Black-tailed Hawfinch (*Coccothraustes melanurus*) from Japan, a Long-tailed Glossy Starling (*Lamprotornis aeneus*) from West Africa, a Nutcracker (*Nucifraga caryocatactes*), European, two Black Larks (*Melanocorypha yeltonensis*) from Siberia, presented by Mr. J. M. C. Johnston; a One-wattled Cassowary (*Casuarius uniappendiculatus*) from New Guinea, a Blackish Sternothere (*Sternothoerus nigricans*) from Madagascar, Six Ceylonese Terrapins (*Nicoria trijuga*), three Bungoma River Turtle (*Emyda granosa*) from India, a Black Tortoise (*Testudo nigra*) from the Galapagos Islands, deposited; a Garnett's Galago (*Galago garnetti*) from East Africa, three Brazilian Grosbeaks (*Guiraca cyanea*) from Brazil, purchased.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN MAY.

May 1.	15h. 18m. to 16h. 19m.	Moon occults *i* Virginis (mag. 5·5).
1–6.		Epoch of Aquarid meteoric shower (Radiant 338°—2°).
3.	4h. 6m. to 8h. 55m.	A penumbral eclipse of the moon.
3.	6h. 31m.	Middle of the eclipse.
3.	7h. 28m.	Moon rises at Greenwich.
7.	12h. 39m. to 13h. 51m.	Moon occults 21 Sagittarii (mag. 4·9).
8.	12h. 26m. to 13h. 23m.	Moon occults *d* Sagittarii (mag. 4·9).
8.	13h.	Saturn in conjunction with moon. Saturn 3° 48′ South.
9.	13h. 3m. to 14h. 59m.	Transit of Jupiter's Sat. IV.
12.	11h. 48m.	Minimum of Algol (*β* Persei).
13.	13h. 57m. to 14h. 48m.	Moon occults λ Piscium (mag. 4·7).
14.	11h. 30m. to 14h. 34m.	Transit of Jupiter's Sat. III.
15.		Venus. Illuminated portion of disc = 0·998.
15.		Mars. Illuminated portion of disc = 0·895.
17.	17h. 29m.	Sun eclipsed, invisible at Greenwich.
21.	15h. 1m.	Transit (ingress) of Jupiter's Sat. III.
25.		Saturn. Outer minor axis of outer ring = 17″·06.
31.	11h. 49m. to 12h. 36m.	Moon occults B.A.C. 5109 (mag. 5·4).

NEW VARIABLE STAR 70 (1901) URSA MAJORIS.—In the *Astronomische Nachrichten* (Bd. 155, No. 3701) Dr. T. D. Anderson announces the discovery of a new variable star having the position

R.A. = 8h. 57·9m.
Decl. = +51° 42′ (1855).

The magnitudes observed were:—

1901	February	13 ...	10·4
		15 ...	10·4
	March	24 ...	9·8
		27 ...	9·7
	April	3 ...	9·6

NOVA PERSEI.—Prof. H. C. Vogel gives particulars of some of his later work on the spectrum of the new star in the *Astronomische Nachrichten* (Bd. 155, No. 3701). Measures of seven lines between H_a and H_β are given, being ascribed to sodium, helium and possibly magnesium. A discussion is included of the possible explanation of the great width of the lines by the work of Humphrey and Mohler, Wilsing and others.

Herr J. Plassmann, the well-known variable star observer, gives a series of estimates, by Argelander's method, of the brightness of the Nova from February 23 to March 27. In many cases estimates taken at different times during the same night show the variation of the star (*Astronomische Nachrichten*, No. 3705).

REDUCTION OF PHOTOGRAPHS OF STELLAR SPECTRA.—Nos. 3702–3 of the *Astronomische Nachrichten* are devoted to a treatise by Dr. Hartmann on the measurement and reduction of photographs of stellar spectra, using the dispersion formula put forward by him some time ago, with special reference to the determination of velocities in the line of sight.

DR. METCHNIKOFF ON MICROBES AND THE HUMAN BODY.

A SPECIAL meeting of the Manchester Literary and Philosopical Society was held on Monday, April 22, when Dr. Elie Metchnikoff, of the Pasteur Institute, Paris, delivered the Wilde Lecture. Before the lecture, the president of the Society (Prof. Lamb) presented the Wilde Medal for 1901 to Dr. Metchnikoff, and the Wilde Premium for 1901 to Mr. Thomas Thorp.

Dr. Metchnikoff's lecture, which was in French, was on "La Flore microbienne du Corps humain." Dr. Metchnikoff explained that men were free from microbes at birth, but immediately after birth the surface of the skin and the mucous membranes became peopled with them, and at the end of some days they were numerous and varied. Their germs were derived from the air, or from the water used in washing the child. In summer they developed faster than in winter, and sometimes within four hours after birth there would be found several different sorts of microbes in the intestines. But as a rule their appearance was first observed between the tenth and seventeenth hour after birth. The habitation preferred by the microbes found in the skin was unquestionably the capillary follicles, a kind of deep sheath for the formation of hair. The mucous membranes, the surface of which was always moist and covered with substances by which microbes were readily nourished, were generally supplied with them more abundantly than the skin. The conjunctiva of the eye, however, thanks to its being continually washed by tears, usually rid itself of most of the microbes that found their way into the eye either with the fine dust in the air or through contact with the fingers. There was no doubt that microbes penetrated into the very deepest parts of the respiratory passages, though it was difficult to give a precise account of those ordinarily inhabiting the windpipe, the bronchial tubes and the lungs, since the presence of those which are found there after death might be explained by the intrusion, after death, of microbes from adjacent organs of the body. However that might be, the growth of microbes in the lower respiratory passages ought never, in a healthy man, to be great.

It was the digestive organs that exhibited them in the greatest abundance. Dr. Miller, of Berlin, had described more than thirty species inhabiting the cavity of the human mouth, some of them also to be found on the human skin; others, which were found about the teeth, were peculiar to the mouth and were not met with anywhere else. Several of the species characteristic of the mouth made their way deep into the digestive organs and were recognisable in the stomach and the intestines. The stomach, with its acid contents, offered conditions affecting in a quite exceptional way the development of microscopic growths. Many kinds of bacteria could not endure an acid environment; still, the bacterial system of the human stomach was pretty rich, thirty different species having already been distinguished, most of which were not found elsewhere in the digestive system. In the stomach, and still more in the small intestine, bacilli were the predominating form of microbe, the number and relative proportions of microbes in the small intestine varying with the food eaten. Meat and vegetable diets respectively stimulated the development of special bacterial forms, though even when the diet was unaltered noteworthy fluctuations in the microbian population were observable. From the smaller intestine the microbes passed to the larger, where they were joined by a great number of new kinds. Of all the parts of the human body, the large intestine was undoubtedly the most abundantly teeming with these growths. It was inhabited by about forty-five species of microbe, chiefly bacteria, among which bacilli were much the most numerous. The large intestine began to be inhabited immediately after birth. Even on the first day of life, before any food whatever had been taken, a fairly great variety of microbes was to be found there. When the child was suckled the population of the large intestine very soon underwent a change. It became more uniform and was composed mainly, and sometimes almost exclusively, of a particular bacillus. In children fed with the bottle, on cow's milk, this bacillus was found too, but in smaller numbers, the large intestine in these children being much richer in microbes of various types. After weaning, the abundance of microbes became much greater still. The number of distinct species of microbes to be found in a man in health could not be exactly estimated, but quite roughly and provisionally might be put between sixty and seventy.

What could one say of the function of these varied growths? Among invertebrate animals there were some covered with much more copious growths than were found on the human skin. On the southern and western coasts of England there was found in great numbers a kind of crab whose whole shell was generally covered thickly with vegetable growths. Their use was obvious. They assimilated the crab to the marine vegetation, and made him invisible alike to his enemies and to his prey. No such demonstration could be given of the utility of the microbes on the human skin. On the other hand, the flora of the cavity of the mouth might render man a service. Everybody had noticed that wounds inside the mouth healed much sooner than those on the outer skin. Moistened by the saliva, the wounds remained in contact with the microbes and their soluble products, which stimulated in a marked degree the reaction of the human organism. The secretions of the microbes attracted a great number of white blood-corpuscles, which cleaned the wound, cleared it of microbes and mortified tissues, and so favoured the process of recovery. In the lower parts of the digestive system this function of microbes was less important, the mucous membrane there being much more seldom torn. But it was probable that the acids secreted by many bacteria in the small intestine rendered a real service by preventing the development of certain other microbes which might impede digestion. This preventive function was manifested also in the course of conflict between the human organism and microbes of a very dangerous kind, and there was reason to believe that in some cases the germs of Asiatic cholera were rendered innocuous by the action of the microbes which they encountered in the intestines. It had also been contended by some authorities that the microbes in the digestive system played an important part in the digesting of food, and that without them food could not be assimilated; but the data available would lead rather to the general conclusion that for the normal action of the human digestion the presence of the intestinal microbes was by no means indispensable.

They should now try to ascertain whether the microbes in the human system might injure its health. When the defensive forces of the body flagged, whatever might be the reason, the microbes on the skin began to multiply and to pour their noxious products into the tissues and the blood. It often happened that serious boils and anthrax developed themselves in persons suffering from diabetes or some other general disease, their cause being, not the introduction of a morbid germ from without, but the excessive multiplication of certain microbes which are found in the healthy human skin and which now took advantage of the enfeeblement of the defensive cells. But the greatest harm was done by the microbes of the stomach and intestines. It had been recognised that the gravity of the danger incurred in cases of perforation of the intestines was due to the inflammatory action of the microbes that escaped into the peritoneum. Nor was the injurious effect restricted to cases where the microbes penetrated directly into the other organs or into the blood, for the microbes produced soluble substances which could be absorbed through the wall of the intestines and so make their way into the circulation. Several of these were substances more or less poisonous in their action, and it was very probable that a great many of these toxic products of our intestinal flora had still to be ascertained. In spite of our imperfect knowledge, there was reason to state, with the greatest strength of conviction, that the poisons produced by the intestinal microbes played a considerable part in causing many and various maladies. Headaches, exhaustion, neurasthenia, dyspeptic asthma, certain forms of epilepsy, several skin diseases, including acne, had by certain authorities been attributed wholly or in part to the action of poisons originated in the digestive system. Even in cases of mental disease its importance could not be denied; it had a noteworthy connection with diseases involving atrophy of the higher organs, such as the brain, the heart, the kidneys and the liver.

Dr. Metchnikoff then discussed at some length the relations of the normal microbian population of the human body—that is, the microbes present in it in a state of health—and the pathological microbes, or microbes directly inducing specific disease. He pointed to the methods practised in medicine and surgery to limit or counteract the action of microbes ascertainedly or potentially generative of disease, and to what he believed to be limitations to the beneficial operation of antiseptics. There was a tendency to renounce more or less completely the use of antiseptics, and to have recourse more and more to simply mechanical measures for keeping microbes out of the body—the prolonged washing of the hands, for instance, or the moistening

of the conjunctiva of the eye and other mucous membranes with liquids not strong enough to injure the living cells of the skin. The best method of antiseptic treatment of the intestine, merely relative as its efficacy might be, was now recognised in the use of drugs which produced frequent and abundant evacuation.

How were we to square the conviction that so many of the microbes usually found in the body were injurious with the argument, drawn from the work of Darwin, that if our microbes are so dangerous they ought long ago to have been eliminated simply by the operation of natural selection? One observed constantly that not merely natural characteristics unfavourable to their possessor's life, but even organs which had merely ceased to be useful to him, disappeared more or less completely. To bring out more clearly this paradoxical aspect of the survival of our microbes, most of which were not merely useless but unquestionably injurious, he would draw attention to the fact that the very organs of the body which sustained this flora were themselves for the most part either useless or injurious to health and life. They would remember that the ducts of the capillary follicles in the skin were the seat of a microbian vegetation often composed largely of microbes capable of producing more or less serious disease. Well, those follicles were useless organs, and represented merely what was left of the hair that covered the skin of animals who were our ancestors. In the digestive apparatus of man, the part of the body richest in microbes, there were also to be found parts which, to say the least of them, were now useless. The vermiform appendix, for instance, was the remains of an organ which was more fully developed in our animal forefathers; in the anthropoid apes it was already found in the process of reduction. Even the stomach, that organ which might seem so indispensable for digestion and the normal existence of man, was in reality nothing but a large reservoir for food, a reservoir which could without serious inconvenience be dispensed with. There were at that moment four persons living without stomachs, and thus furnishing a strong argument against the utility of that organ.

Of all the parts of our digestive system it was certainly the small intestine alone that was indispensable to the continuance of life. And yet in man, who could support himself on food easily digestible, the small intestine was disproportionately fully developed. Instead of having it between 18 and 21 feet long, man might do with one-third of that length. Kukula reported a case in which he had removed almost two-thirds of the small intestine with the greatest advantage to the patient. In one case Körte had removed, together with part of the small intestine, the greater part of the large intestine, leaving only the terminal section. As a result of this operation the patient had been completely cured. He could cite other cases of successful surgical operations to prove the uselessness of the large intestine to human beings. In one case the whole of the large intestine had atrophied of itself, without operation, in consequence of a fistula, without interfering with the active life of the subject. The sum of all this was that we possessed a voluminous and highly developed organ, the large intestine, which fulfilled no useful function and bred a very copious and varied mass of microbes, capable of injuring us through their poisons.

In face of thisf act it remained to ask what the large intestine was, what its origin and the reason of its existence. The history of the capillary follicles was comparatively simple, for they were the surviving traces of hair which had protected from the cold the animals from which man was descended. The large intestine, on the contrary, was no mere relic, but an organ highly developed. It was, as a rule, found only in the mammiferous animals, and not in birds, reptiles, or others of the lower vertebrates. Dr. Metchnikoff went on to trace in some detail the development of the large intestine to the prevalence of certain special conditions in the life of herbivorous vertebrate animals capable of running at great speed, conditions no longer present in the life of their descendants, and no longer calling for the peculiar organisation developed to meet them. The slow tendency of evolution to bring about the atrophy of such organs or characteristics might, however, be assisted by medicine and surgery, medicine coping more effectually with the noxious microbes and their effects, while the progress of surgery had already brought it within its power to remove by operation organs or parts of organs propitious to the growth of the "flora."

Dr. Schunck proposed, and Prof. Hickson seconded, a vote of thanks to the lecturer, and the resolution was carried by acclamation.

MODERN METHODS OF GAS MANUFACTURE.

A PAPER on modern practice in the manufacture and distribution of illuminating gas was read by Mr. Harry E. Jones at the meeting of the Institution of Civil Engineers on April 16, and some of the points dealt with are here summarised.

The author remarked that improved returns from residuals at gasworks have been obtained by giving greater attention to the saving of fuel by the use of generator furnaces; by manufacturing the ammonia at the gas-works; by the preparation of cyanogen; and by the more extensive application of the antiseptics which are largely and cheaply produced from the tar.

The enrichment of gas, by reducing the return from residuals, has adversely affected the progress of gas-supply. The materials needed are all costly, and yield no return. Moreover, with incandescent burners, the cost of enrichment is wasted. Of the means of enrichment available, carburetted water-gas is preferred for cheapness and permanency. The advantages of this method are: facility for rapid and considerable addition to the output of gas, and for suspension of such additional supply without consequent expense; complete control of illuminating power over a wide range; avoidance of excessive accumulation of coke in winter; prevention of the deposit of naphthalene in the distributing mains and services, which formerly caused great loss and inconvenience; and reduction of space required by the plant, and for storage of materials. It was pointed out, however, that it is chiefly for mid-winter use, to relieve the strain on the coal-gas plant and the drain on the collieries, and to meet fogs and sudden climatic changes, that the system is profitable, as the price of oil advances with the price of coal, and to a figure that, having regard to value of residuals, cannot be paid without loss. During the winter of 1900–1901 the price of oil was practically prohibitive of its use, except for necessary enrichment or emergency use. Should it, however, be possible to supply unenriched water-gas, which, with the Welsbach burner, gives equal illuminating power, then the use of oil could be dispensed with and the combined coal- and water-gas processes could be carried on with a large saving and would enable the price of gas to be lowered by between 1*s.* 2*d.* and 1*s.* 8*d.* per 1000 cubic feet.

In purifying-plant the author recommended the abandonment of the old hydraulic seal, which is unstable, costly and very perishable. In his practice the entire cover is removable, being very light and held down by small bolts at the margin, and by bolts passing through both cover and floor and spaced at equal distances. The vessels are 8 feet deep and are arranged in groups of five worked in ordinary sequence, having both lime and oxide of iron in each. This system fulfils without nuisance all the requirements of the sulphur-purification demanded by the London Gas Referees without the cost, risk and space of the system of three separate groups previously necessary, in order, for carbonic acid, carbon bisulphide and sulphuretted hydrogen. For condensers the author prefers horizontal tubes, in which the tar and gas are cooled together, which have been found to remove naphthalene. Coke scrubbers are simplest and cheapest, and in practice more than secure the degree of purification from ammonia exacted by the London Gas Referees, and, by the ammonia retained, purifies the gas also from carbonic acid and sulphur. The residuals of gas are useful in purification, and a cycle of reactions was traced in the processes of manufacturing sulphate of ammonia by sulphuric acid made partly from the sulphur in the ammoniacal liquor and partly from that in the residual spent oxide of iron from purifiers.

The pressure for distribution of gas is usually 3 inches to 4 inches head of water, but Mr. C. C. Carpenter has for some time been delivering by means of Sturtevant fans, at pressures between 12 inches and 18 inches. In America distribution has been accomplished over long distances by employment of pressures of several pounds per square inch. Service pipes are now laid in steam-tubing 30 per cent. thicker than gas-tubing; they are coated with pitch before filling the ground in, and their life has thus been extended from 12 years or 14 years to more than 20 years. Meters of the "dry" form are now invariably employed, which, if examined periodically, at intervals of 6 or 8 years, can be maintained fairly accurate; by improvements in manufacture their life has been increased from 12 years to nearly 20 years.

THE FORMATION OF WAVE SURFACES IN SAND.[1]

ATTENTION was first called to tidal sand ripples by Prof. Osborne Reynolds,[2] who found them submerged in channels between sand banks in estuaries. My observations were on tidal sand ripples which I found above low water (Fig. 1). They are generally unsymmetrical in form, with the steep face on the sheltered side, as are "current marks" and æolian sand ripples. They apparently do not require for their formation any co-operation between flood and ebb currents, although where such co-operation occurs, the wave fronts probably become less sinuous. They are to be seen, not only in tidal estuaries, but also in some localities on the seashore[1] where the sands are exposed to waves as well as to currents, but they face with the current, not with the waves, and are thus readily distinguished from the wave-formed ripple mark. The smallest tidal sand ripples which I have found exposed at low tide were 3 feet from crest to crest, and all sizes from this to 20 feet wave-length are common. On a sand bank in the Dovey estuary (North Wales), opposite to the town of Aberdovey, I marked out a plot with stakes driven deeply into the sand, and recorded by daily measurements the increase, diminution and march of the sand waves. At neap tides the sands were nearly smooth, and as the tides increased the tidal sand ripples appeared, short and relatively steep. The amplitude increased steadily, the average wave-length also increased, apparently by elimination of some of the ridges. When the highest spring tide was passed the amplitude rapidly diminished, the wave-length remaining nearly, but not quite, constant, and the mean sand level remaining practically unchanged. Details of the measurements will be given in the *Geographical Journal*. The circumstances favourable to the formation and preservation of tidal sand ripples above low-water mark are, gentle current at first of the flood and last of the ebb, and strong current when the water is deep over the sands. I have often watched the course of events when the last of the ebb has been running over the ridges. The process is then one of decay, not of growth, the sand being swept from the crests into the troughs. What goes on during the *growth* of the ridges? Let the depth of water be sufficient; then, if the velocity of the current be small, the sand grains roll and slide along the bottom, but, as the speed increases, the water, almost suddenly, becomes highly charged with sand in "eddying suspension." A uniform current flowing swiftly over extensive sands picks up as much sand as it drops, thus causing a drift of sand which on the whole is uniform, neither raising nor lowering the bed.[2] My observations indicate, however, that *in detail* the drift is not uniform, but attended by alternate silt and scour along lines at right angles to the current and equidistant from one another, the surface of the sand bank being thus carved into transverse ridge and furrow without change of mean level. The slightest convexity of surface causes a convergence of currents, a concavity a divergence, and, under the conditions specified, deposition occurs upon the convexities, whilst the concavities are scoured. The vertical inequalities are thus increased,[3] and it is easy to see that the ridges will extend themselves laterally.[4] Thus the ridge and furrow inevitably form and grow. What, then, are the limits of this growth? Obviously the depth of water is one limit. When the cross section of the stream above the sand ridge is reduced by a certain amount, the greater force of water there

FIG. 1.—Tidal sand ridges in the Dovey estuary. Photograph taken June 15, 1900. Wave-lengths about 15 feet.

FIG. 2.—Current mark upon tidal sand ridges. Photograph taken June 15, 1900, in the Dovey estuary.

[1] Abridged from a paper by Mr. Vaughan Cornish in the *Scottish Geographical Magazine*, January 1901.

[2] Reports of committee appointed to investigate the action of waves and currents on the beds and foreshores of estuaries by means of working models.—*British Association Reports* of meetings of 1889, 1890 and 1891.

[1] And on the Goodwin Sands, where I found them, May 12, 1900. [Since the paper was written I have seen the same structures in a non-tidal part of the Fraser River, British Columbia.]

[2] *British Association Report*, Manchester meeting (1887). Osborne Reynolds on "Certain Laws relating to the Régime of Rivers and Estuaries and on the Possibility of Experiments on a small scale."

[3] Compare G. H. Darwin's observation of the sand creeping up both sides of a ridge when a current was caused to flow over it.—*Proc. Roy. Soc.*, vol. xxxvi. 1883: "On Ripple Mark."

[4] Compare James Thompson on the "Winding of Rivers in Alluvial Plains."—*Proc. Roy. Soc.*, 1876 and 1877.

removes the sand as quickly as it is brought, and further growth is thus stopped. If the depth be further reduced, *e.g.* during an ebbing tide, the ridges decay. In deep water the height of the ridges is limited to that at which the velocity of the stream can maintain an active eddy on the lee of the ridge, and if the velocity be reduced the troughs silt up owing to the sand falling into dead water. It is probable, also, that the amplitude is sometimes restricted by the velocity of the current surpassing the limit suitable to the fineness or lightness of the material of which the ridges are composed. For it is evident that there is a difference between the pressure upon the weather side and upon the lee side of a ridge. I notice when wading on sand banks ridged with tidal sand ripples that the pressure of one's tread often causes a bodily sliding of the sand from trough to crest. The growth and even the maintenance of the ripples demands a *differential* movement of the material. There must be a part to stand fast as well as a part to be redistributed. Thus a moderate range in the sizes of the particles of the loose granular material is favourable to the formation and retention of a wavy surface through a considerable range of velocity of the inducing fluid. It is evident that two sets of crossing ridges cannot be simultaneously produced by true current action, and, in fact, crossing tidal sand ripples are seldom seen. Sometimes, when the direction of current has suddenly changed at a particular time of tide, two sets of ridges are successively formed. The "tidal sand ripples" seem, in fact, to be true current-formed sand waves. They are themselves rippled over with "current mark," which is more properly a ripple, in that (like capillary ripples) it only goes skin-deep (Fig. 2). It seems to be due rather to the pulsations of a current than to the current as such. I have often seen little sand ripples in fairly deep rapid streams, which I suppose would properly be called current mark, facing obliquely or transversely to the direction in which the sand was travelling. This was near the shore where the most marked pulsation was shorewards.

I have described elsewhere[1] some little dunes formed by the wind out of the very fine and light sand of the dry Nile bed, when the river was at its lowest. These dunes, which in size and shape somewhat resembled tidal sand ridges, were covered with a beautiful tracery of little ripples. In the formation of the æolian sand ripples the heterogeneity of the sand plays a much more important, the pulsation of the fluid a much less important, part than in the case of the current mark of streams. I have one more observation on this point to add to those already published. I noticed, during strong winds lasting several days, at Montrose, N.B., March 1900, that the rippling of the remarkably uniform dry drifting sand was very slow in beginning. As soon, however, as there was a fair supply of the coarser kind of sand grains aggregated together, the rippling action went on vigorously and rapidly. A moderate range of sizes of material, *e.g.* fine sand and coarse sand, is best for æolian rippling. In the vicinity of big stones the scour of the wind is too great. During the occasions on which I visited this little dune tract the strong breeze drifted the fine light sand thickly near the surface, and in the afternoons there was a haze of flying sand extending 20–30 feet above the foreland. The conditions were, in fact, very similar to those with which I have since become familiar in the case of formation of tidal sand ripples. It seems highly probable that the fine, light sand in this wind was in a condition similar to the "eddying suspension" of water drift, proceeding in the manner described by Osborne Reynolds, plus the rapid increase of slight inequalities forming waves, as above described. The same brisk breezes which were forming dunes as regular trains of sand waves, as high as the quantity of dry Nile sand permitted, were not able to deal in the same free fashion with the coarse quartz sand of the larger desert dunes west and east of the Delta.

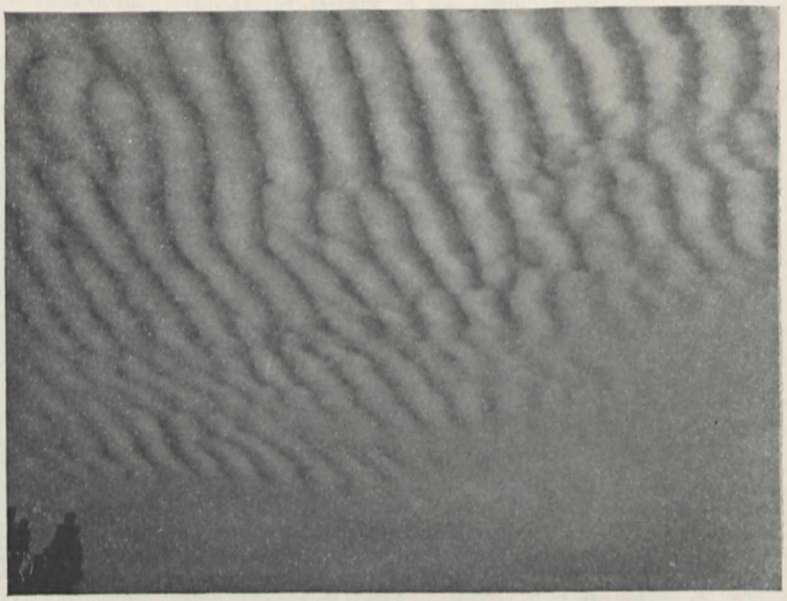


FIG. 3.—Rippled clouds. Photograph taken August 5, 1900, near Bournemouth, 5.15 p.m., looking S.

FIG. 4.—The true aërial ripple mark. This is the negative of Fig. 3, and shows the ridges of still air between the whirling air of the clouds.

[1] "On Desert Sand Dunes Bordering the Nile Delta."—*Geogr. Journ.* January 1900.

NOTE ON PHOTOGRAPHING AËRIAL RIPPLE MARK.

Fig. 3 is reproduced from a photograph which I took of some remarkable ripple clouds near Bournemouth, on August 5, 1900, at about 5.15 p.m. The camera was pointed south; the sun, of course, is on the right, and the shadow of each cloud can be seen on the right-hand edge of the next one. These clouds were drifting rapidly to the east (left), the breeze at the ground level blowing towards the same direction. Ruskin wrote[1] long since of vapour "falling into ripples like sand." The general likeness is indeed striking, but the differences of detail are also noticeable, which is not to be wondered at, seeing that the cloud ripples are not the counterpart of the rippled sand, but of the whirling water between the sand ridges. How then shall we see the form of the aërial ripple mark where there is only blue sky? Simply by reproducing our photograph as a negative (Fig. 4). With this compare Fig. 5, an ordinary (positive) view of the wave-formed ripple mark of the strand, taken at Montrose, N.B., March 1900. Note the similarity of the sharp-topped ridges of still air, between the revolving cores where the clouds are, to the knife-edged ridges of the sand. But most remarkable of all is the precise correspondence of the confluence of ridges, wherever the wave-length of the ripple mark is about to change *per saltum* (for the wave-length of ripple mark increases in "multiple proportion," three ridges merging into two). And here our sky photographs are superior to, and throw light upon, our sand ripple mark photograph, for the latter had to be taken when the rippling action had ceased and the troughs were no longer filled with whirling water. Fig. 3, however, indicates what is going on where the ripple ridges are being merged, for the lights and shadows of the cloud indicate the activities of the working parts of the system. The rippled cloud here photographed, and consequently the true air ripples also, are symmetrical. This is not always the case; the clouds are often opaque (thick) at one edge and transparent (thin) at the other. In this case the form of the aërial ripple mark must be more like that of current mark, of æolian sand ripples and of tidal sand ripples. The likeness between cloud negative and sand ripple positive would be more striking but for the circumstance that we look up at the clouds and down at the sand. This makes the perspective different in the two. The real resemblance is best seen when separate prints are handled, one or other of which being inverted the perspective becomes similar in both.

FIG. 5.—Ripple mark of the strand. Photograph taken at Montrose, N.B., March 10, 1900.

[1] *Modern Painters*, vol. v. part 7, chap. i.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—A meeting of members of the Senate and others interested in the proposal to make some acknowledgment to Prof. Liveing for his valuable services to science and to the University will be held in the combination room of St. John's College on Saturday next, April 27, at 2.30 p.m.

MR. RANDOLPH MORGAN, of Philadelphia, has given the sum of 200,000 dollars to the University of Pennsylvania for a new physical laboratory.

FROM the Catalogue of the University of Cincinnati, for 1900–1901, we see that the total endowment of the University amounts to 3,357,308 dollars, or nearly 700,000*l*. The latest large donation was in the year 1899, when Mr. David Sinton gave the University 100,000 dollars upon the condition that the income derived therefrom should be used in maintaining the Academic Department. The University has an observatory well equipped for carrying on astronomical work. The observatory is at the present time co-operating with the International Geodetic Association in the determination of the variation of latitude.

LORD CURZON, Viceroy of India, visited on Tuesday the Mahomedan Anglo-Oriental College, which was founded at Aligarh by Sir Syed Ahmad in 1875 with the view of affording Mahomedan youths an opportunity of gaining a first-class education under English professors. A marked success has since been obtained, the Nizam and all the Mahomedan notables affording liberal support. Alluding to the desire of Mr. Beck, the late principal, who devoted his life to the College, to expand the institution into a residential University, the *Times* reports Lord Curzon to have said that the project had reached the ears of the late Queen, who inquired most sympathetically about it. Lord Curzon warned his hearers that they would never get from a University consisting of little but examining boards that lofty ideal of education, the sustained purpose and the spirit of personal devotion associated with the historic Universities of England, and also produced in some measure by the ancient Universities of Islam.

THE reality of the competition between School Board classes and Technical Institutions in some places is clearly exemplified by the following extract, from the latest Report of the Governing Body of the Goldsmiths' Institute, New Cross—in every respect an excellent institution, where thorough instruction is given in science and technology. "The Governors in their last Report drew attention to the decline in the number of students attending certain classes. This decline began in 1898 (down to that year the class entries had been uniformly progressive), and was mainly due to the extension of the Free Evening Continuation Schools of the London School Board, and particularly to certain special centres which have been opened close to the Institute. It will be sufficient on the present occasion to state that the same causes still operate to check the natural growth of the classes affected." Reference has been made (p. 553) to the recent decision in the Court of Appeal that School Boards cannot legally support classes of this character or science schools out of the rates, but it has not yet been decided whether this ruling will be accepted. The foregoing extract emphasises the necessity for finally deciding upon the scope or area of influence of the various educational authorities, and so giving our educational system an organic structure in which each part has clearly defined work to do.

A MEETING of the Agricultural Education Committee was held on Tuesday, Sir William Hart Dyke presiding. The executive committee reported that the two subjects most urgently requiring

attention at the present moment were:—(1) The union or co-ordination of the work of the Board of Education and the Board of Agriculture in dealing with agricultural and rural instruction; and (2) the training of teachers in nature knowledge and other rural subjects. Speaking upon the first of these subjects, Mr. Hobhouse, M.P., said the Board of Agriculture only inspected certain of the higher agricultural schools, and did not systematically advise or report on the work of the local authorities. It had no voice in drawing up schemes for agricultural instruction for which grants were given under the Directory or Code. It thus failed to take the position assumed by the agricultural departments of nearly every other country, including Ireland and our own colonies, where the progress of agriculture was systematically promoted by encouraging the best methods of instruction. The yearly sum devoted to agricultural instruction and research in the United States was (federal grants only) 700,000*l.*; in Canada, 156,000*l.*; in France, 152,460*l.*; and in Würtemberg, 65,000*l.*; while in England the sum was only about 15,000*l.* It would seem that the example of Scotland should be followed in England, and that the educational powers of the Board of Agriculture should be transferred to the Board of Education, especially as under the Board of Education Act, 1899, there already existed power to make a similar transfer by Order in Council. The Board of Agriculture would then, much to its own relief, cease to be an educational authority, though it might, perhaps, retain some supervision over certain experimental work carried on by agricultural societies.

SCIENTIFIC SERIALS.

American Journal of Science, April.—The magnetic theory of the solar corona, by F. H. Bigelow. A discussion of an experiment of Ebert on the behaviour of an electrified sphere in a magnetic field, when placed in a rarefied gas. The phenomena observed in the corona of the sun agree in a remarkable way with the effects produced in the above experiment.—Tertiary springs of Western Kansas and Oklahoma, by C. N. Gould.—Some fundamental propositions in the theory of elasticity. A study of primary or self-balancing stresses, by F. H. Cilley. A discussion of the effects of initial or "primary" strain of a body upon its elasticity. Since these strains and stresses are a component of the actual strains and stresses existing in substances, it is concluded that the latter cannot be defined through the equations of elasticity alone.—The boiling point of liquid hydrogen determined by the hydrogen and helium gas thermometers, by T. Dewar. From the *Proceedings* of the Royal Society.—On the nature of vowels, by E. W. Scripture. Reproductions of a magnified set of curves from a gramophone. The results tend to show that the movement of the air in the mouth cavity is a free vibration and not a forced one. The cord movements in the vowels are of the nature of explosive openings and not of the usual vibratory form found in most musical instruments.—Note on the behaviour of the phosphorus emanation in spherical condensers, by C. Barus.—The remarkable concretions of Ottawa County, Kansas, by W. T. Bell.

Annalen der Physik, April 1.—The application of the method of residual rays to the proof of the law of radiation, by H. Rubens and F. Kurlbaum. A discussion of the various expressions which have been proposed to show the relations between the intensity of radiation, the wave length and the temperature. A detailed account of the experimental methods is given, measurements being carried out at temperatures between − 180° C. and 1450° C., a graphical comparison being given between the experimental results and those calculated from the formulæ proposed by Wien, Thiesen, Rayleigh and Planck. The simple formula of Planck would appear to be the best hitherto proposed.—The elementary laws of electrodynamics, by E. Wiechert.—On the absorption of heat by carbonic acid, by S. Arrhenius. An account of the results of measurements of the absorptive capacity for heat of carbonic acid. The results are applied to the discussion of the effects of carbonic acid in the atmosphere upon the temperature of the air.—On the surface tension of water surfaces covered with an oil layer, and on the range of molecular action, by R. H. Weber. The value deduced from the experiments for the radius of molecular action is 115 $\mu\mu$., considerably greater than that deduced from the experiments of Reinold and Rucker, 10 to 17 $\mu\mu$.—On the phenomena in induction coils, by K. R. Johnson.—Mechanical vibrations of an isolated stretched wire with visible electrical discharges, by O. Viol. If an isolated stretched wire is charged from one end with electricity at high potential, transverse vibrations are set up in the wire, and if the electricity is negative and the charge sufficiently high for a visible discharge to take place along the wire, only the nodes appear to shine.—On the mode of action of coherers, by K. E. Guthe.—Contribution to the knowledge of the thermomagnetic longitudinal effect, by L. Lownds.—On the band spectra of alumina and nitrogen, by G. Berndt.—On the change of the absorption of light in solid bodies with the temperature, by J. Kœnigsberger.—On the influence of a resistance free from self-induction on the oscillatory discharge of a condenser, by T. Mizuno.—The air barometer, by H. A. Naber.—On the spectrum equation of polished platinum, by D. A. Goldhammer.—On the pressure of light rays, by D. A. Goldhammer.—On the magnetism of iron, by C. Fromme.

SOCIETIES AND ACADEMIES.

LONDON.

Chemical Society, March 21.—Prof. Thorpe, president, in the chair.—The following papers were read:—Researches on morphine, part ii., by S. B. Schryver and F. H. Lees. The authors have previously shown that bromomorphide is decomposed by water with formation of isomorphine, a base isomeric with morphine; it is now shown that another isomeride, β-isomorphine, is also produced in small quantity. Phosphorus trichloride converts codeine into chlorocodeide, which corresponds with bromomorphide and is convertible into isocodeine, a base isomeric with codeine.—The constitution of pilocarpine, part ii., by H. A. D. Jowett. Bromine acts upon isopilocarpine with formation of dibromoisopilocarpine perbromide and small quantities of monobromoisopilocarpine and isopilocarpinic acid; the latter is an oil of the composition $C_{11}H_{16}O_4N_2$. On oxidising dibromoisopilocarpine with permanganate, pilopinic acid, $C_8H_{11}O_4N$, and pilopic acid, $C_7H_{10}O_4$, are obtained. At 100°, in presence of water, bromine acts on isopilocarpine with production of dibromoisopilocarpinic, monobromoisopilocarpinic, bromopilopinic and bromopilopic acids.—The chemical action of *Bacillus coli communis* and similar organisms on carbohydrates and allied compounds, by A. Harden. The author has examined the products of the action of *B. coli communis* and *B. typhosus* on carbohydrates, and notes that the production of alcohol by the former organism appears to depend on the presence of the group $CH_2(OH)\cdot CH.OH$ in the compound to be fermented.—Action of dry silver oxide and ethyl iodide on benzoylacetic ester, deoxybenzoin and benzyl cyanide, by G. D. Lander.—Alkylation of acylarylamines, by G. D. Lander. Dry silver oxide and ethyl iodide convert the acylarylamines into the imino-ether, whilst if methyl iodide is substituted for ethyl iodide, a mixture of the imino-ether and the acylalkylamine usually results.—The preparation of aliphatic imino-ethers from amides, by G. D. Lander.—Note on the latent heats of evaporation of liquids, by H. Crompton.—On the atomic weight of lanthanum and on the error of the "sulphate method" for the determination of the "equivalent" of the rare earths, by B. Brauner and F. Pavlíček. It is shown that in the conversion of lanthanum oxide into sulphate for atomic weight determinations, small quantities of acid sulphate are produced and cause error in the determination of the equivalent; it is further shown that lanthanum, as hitherto known, is a mixture of two earth metals in which the true lanthanum of atomic weight 139·0 predominates.—On the atomic weight of praseodymium, by B. Brauner. The author has determined the atomic weight of praseodymium by four methods and made ebullioscopic determinations with the chloride in alcohol solutions; the final atomic weight of praseodymium is given as 140·94.—On praseodymium tetroxide and peroxide, by B. Brauner. Praseodymium tetroxide, Pr_2O_4, is obtained as a black powder, by fusing the nitrate with nitre and on treating praseodymium nitrate with hydrogen peroxide the hydrate of praseodymium peroxide, Pr_2O_5, is produced.—Note on neodymium, by B. Brauner. The number 143·5 was found by the sulphate method for the atomic weight of neodymium; this metal gives a tetroxide, Nd_2O_4, and a peroxide, Nd_2O_5.—Contribution to the chemistry of thorium, by B. Brauner. The author concludes that thorium does not consist of a single element because on fractional hydrolysis of ammonium thorium oxalate, fractions are obtained in which the

atomic weight of the metal varies from 220 to 232.—Pheno-α-ketoheptamethylene and its derivatives, by F. S. Kipping and A. E. Hunter. Pheno-α-ketoheptamethylene is obtained by the action of aluminium chloride on phenylvaleric chloride; its oxime is reducible to pheno-α-aminoheptamethylene,

$$C_6H_4\begin{cases}CH_2.CH_2.CH_2\\ \qquad\qquad\quad |\\ CH(NH_2).CH_2\end{cases}.$$

—Note on diphenyldinitroethylene, by J. J. Sudborough.—Para- and ortho-cyanohydroxy-derivatives of pyridine, by J. Moir.

Geological Society, April 3.—Mr. Horace W. Monckton, vice-president, in the chair.—The igneous rocks and associated sedimentary beds of the Tortworth inlier, by Prof. C. Lloyd Morgan, F.R.S. and Mr. S. H. Reynolds. It has long been known that igneous rocks occur in the district under consideration, but opinions are divided as to their intrusive or contemporaneous character. Evidence is here brought forward to show that the igneous rocks form two bands, the lower interbedded with Upper Llandovery strata, and the upper overlain by Wenlock, and that both bands are probably contemporaneous lavas. The microscopic examination of the lower igneous rock shows that it is a basaltic andesite containing plagioclase (acid andesine or oligoclase), pseudomorphs after enstatite, with chloritic and iron-oxide patches. The higher bed sometimes contains fresh augite, and both bands frequently contain rounded grains of quartz. In other examples the felspars appear in three forms, with augite and enstatite, and the rock ranges from an andesite to a porphyritic basalt. The quartz-grains present appear to be xenoliths. The silica-percentage of the rocks on a moisture-free basis varies from 61 to 67, while the specific gravities are from 2·74 to 2·99.

Linnean Society, April 4.—Mr. C. B. Clarke, F.R.S., vice-president, in the chair.—The secretary exhibited some British species of plants forwarded by M. Buysman, of Middelburg, to show the character of a proposed issue to include the whole of the British flora, on which some remarks were made by the chairman and Mr. James Groves.—Mr. W. B. Hemsley, F.R.S., exhibited specimens of Sapium and Hevea (Euphorbiaceæ) and Castilloa (Artocarpaceæ), with a view to clear up certain questions concerning the rubber-trees, by examining a large series of plants and seeds forwarded by Mr. Jenman, Government botanist in British Guiana. The genus Hevea included ten or a dozen described species inhabiting eastern tropical South America, but none in the West Indies. *Hevea brasiliensis*, the source of the true Pará rubber, was not very different from *Hevea guianensis*, which is restricted to French Guiana, the differences between them being shown in the figures given of the floral structure and seeds in Hooker's *Icones Plantarum*, plates 2570-2577. It was formerly supposed that two species of Hevea might be distinguished in British Guiana, one (*Hevea pauciflora*) having thin leaves and a hairy ovary, the other thick coriaceous leaves and a glabrous ovary; but after examining a large number of specimens, Mr. Hemsley had come to the conclusion that the differences were not constant, and that all the specimens exhibited might belong to one species, and merely represented individual variation. The exhibition demonstrated the difficulty of determining species of Hevea from imperfect specimens, and especially from seeds alone.—A paper was read by Messrs. W. B. Hemsley and H. H. Pearson on a small collection of dried plants made by Sir Martin Conway in the Bolivian Andes in 1898-99. This collection contained but forty-six species, but these were of special interest from the great height at which they were found, *i.e.* between 18,000 feet and 18,700 feet above sea-level. The highest Andine plants on record were stated to be *Malvastrum flabellatum*, Wedd., and a grass, *Deyeuxia glacialis*, Wedd.—A paper was read by Mr. G. S. West on some British freshwater Rhizopods and Heliozoa. When collecting freshwater algæ in different parts of the country the author had found Rhizopods and Heliozoa in abundance, and had preserved them for future examination. The observations now made related to their habits and structure, and comprised descriptions of peculiar forms of some of the commoner types, as well as remarks on several little-known species. Half a dozen species were described as new, and one (*Leptochlamys ampullacea*) was referred to a new genus. Two points of special interest were (1) the presence of a perforation at the apex of the shell in some forms of *Difflugia acuminata*, the shell thus possessing two openings: and (2) the possession of certain characters by members of the genus Vampyrella which sharply demarcate them from other Rhizopods. In the latter case, Mr. West had been able to observe several of these minute creatures feeding on the cell-contents of a species of Mougeotia.

Mathematical Society, Thursday, April 11.—Dr. Hobson, F.R.S., president, in the chair.—Mr. A. B. Basset, F.R.S., made a brief communication on the projective properties of cubic and quartic curves. Prof. Love, F.R.S., also made a few remarks on the communication.—A paper by Dr. F. Morley, entitled "Summation of the Series

$$\sum_{n=0}^{\infty}\Gamma^3(a+n)/\Gamma^3(1+n),"$$

was communicated by its title.—Lieut.-Colonel Cunningham, R.E., announced the factorisation of the algebraic prime factors of $5^{75}-1$ and of $5^{105}-1$.
The first =

151.3301. 183794551. 99244414459501,

and the second =

21226783250214361. 207468970805907721.

He has not determined the composition of the three large factors.

Zoological Society, April 16.—Mr. Howard Saunders, vice-president, in the chair.—A communication was read from Mr. W. L. Distant entitled, "A Revision of the Insects of the Order Rhynchota belonging to the Family Coreidæ in the Hope collection at Oxford." It was stated to be supplementary to the paper on the same subject already published in the *Proceedings* (*cf.* P.Z.S. 1900, p. 807)—Mr. F. E. Beddard, F.R.S., read a series of notes on earthworms, which comprised (1) an account of some earthworms from eastern tropical Africa in the collection of the British Museum; (2) a note on the spermatophores of *Polytoreutus*; (3) a note on the spermatophores of *Stuhlmannia*; (4) remarks on the ovaries, oviducts and spermducts of *Stuhlmannia*; and (5) a contribution to our knowledge of the genus *Gordiodrilus*.—Mr. F. E. Beddard also read a paper on the anatomy and systematic position of the open-billed stork (*Anastomus oscitans*), based on an examination of a specimen of this bird that had died in the Society's gardens. The author was of opinion that the structural differences between *Anastomus* and the typical storks were so slight that they did not warrant the placing of this bird in a separate family or subfamily.—A paper was read from Dr. H. Lyster Jameson giving an account of the mother-of-pearl oysters (*Margaritiferae*). It was based upon a study of the series of these oysters in the British Museum and upon an examination of a large series of marketable mother-of-pearl oysters of various species in the London shell-warehouses, and dealt with the specific identity, geographical distribution, local variation, original name and synonymy of the different members of *Margaritifera*. The subgenus was divided into two sections, characterised respectively by the absence or presence of rudimentary hinge-teeth. Several new species and local forms were described in this paper.—A communication from Miss Emily M. Sharpe contained a list of the Lepidoptera collected by Mr. Ewart S. Grogan during his expedition from the Cape to Cairo. The names of sixty-six species represented in the collection were enumerated in the paper. Two of these were described as new under the names *Amauris grogani* and *Gnophodes grogani*.

Royal Astronomical Society, April 12.—Prof. Turner read a paper by Mr. H. C. Plummer on a method for mechanically compensating the rotation of the field of a siderostat. Prof. Turner had in a previous paper given the principle of several methods by which this might be effected, but Mr. Plummer's appeared a still simpler arrangement. Prof. Turner gave an account of his own paper—Tables and Formulæ for connecting the Co-ordinates of Stars on different Photographic Plates—particularly in connection with the Astrographic Chart of the Heavens.—Mr. Bryant read a further investigation on the "two method" personal equation, in which he brought forward many interesting points in connection with the changes in the personal equation of three different observers at the Royal Observatory, Greenwich.—Mr. McClean read a paper on the spectrum of Nova Persei, and showed photographs, in which its spectrum was compared with those of η Argûs and Nova Normæ. Father

Sidgreaves had sent a communication in which the Nova was considered as a variable star with a variable spectrum.—Mr. Whittaker read some observations by Mr. Sharp of the changes of brightness in the Nova, and Dr. Rambaut read the observations made at the Radcliffe Observatory, Oxford. It appeared from these that while the light of the new star was steadily diminishing there had been fluctuations of brightness to the extent of about a magnitude and a half. Minima had been observed on March 22, 25, 28, 31, also on April 3 and 6. The latter minimum was prolonged to April 7, after which the light increased, and again diminished.—Papers by Mr. Innes on anomalous occultations of stars by the moon, and by Mr. Denning on meteoric showers from the region between α and β Persei were also read.

PARIS.

Academy of Sciences, April 15.—M. Fouqué in the chair.—New researches on the action of hydrogen peroxide upon silver oxide, by M. Berthelot. The action of hydrogen peroxide upon silver oxide is regarded by the author as first resulting in the formation of an unstable silver peroxide, which then decomposes in two ways, partly into silver and oxygen, and partly enters into combination with some of the unchanged silver oxide present, giving an oxide Ag_4O_3.—On the representative power of a finite portion of a continuous curve, by M. G. Lippmann.—On the decomposition of meromorphic functions into simple elements, by M. Émile Borel.—On the roots of transcendental equations, by M. Edmond Maillet.—On the continued fraction of Stieltjes, by M. H. Padé.—On groups of operations, by M. G. A. Miller.—Action of the radium radiation upon selenium, by M. Eugène Bloch. A selenium cell submitted to the action of the radium rays undergoes a diminution of resistance of the same character as that produced by light or by the Röntgen rays, except that the effect is more slowly produced and that its magnitude is smaller. These experiments form an argument in favour of the idea that the radium rays are formed of a complex of kathode rays and of Röntgen rays.—Disruptive discharge in electrolytes, by MM. André Broca and Turchini. It is shown that the conductivity of electrolytes requires a certain time for its establishment, and that for sufficiently high frequencies electrolytes are pure dielectrics. This is in accordance with the requirements of the electro-magnetic theory of light.—On oscillating sparks, by M. G. A. Hemsalech.—The detection of alkaloids by the micro-chemical method, by M. E. Pozzi-Escot. The use of picric acid as a micro-chemical reagent for alkaloids, suggested by M. Popoff, is not found to form a trustworthy method, the only really characteristic crystals being given by strychnine.—On the flora of mosses in caverns, by MM. L. Géneau de Lamarlière and J. Maheu.—On the rational pruning of ligneous plants, by M. F. Kövessi.—On the probable existence of a recent sea in the region of Timbuctoo, by M. Aug. Chevalier.

DIARY OF SOCIETIES.

THURSDAY, APRIL 25.

ROYAL INSTITUTION, at 3.—Naturalism in Italian Painting: Roger Fry.
INSTITUTION OF CIVIL ENGINEERS, at 8.—"James Forrest" Lecture—On Chemistry in its Relations to Engineering: Prof. Frank Clowes.

FRIDAY, APRIL 26.

ROYAL INSTITUTION, at 9.—Colour in the Amphibia: Dr. Hans Gadow, F.R.S.
SOCIETY OF ARTS, at 8.—Polyphase Electric Working: Alfred C. Eborall.
PHYSICAL SOCIETY, at 5.—On the Thermodynamical Correction of the Gas Thermometer: Prof. Callendar, F.R.S.—On the Production of a Bright-line Spectrum by Anomalous Dispersion and its Application to the Flash-Spectrum: Prof. R. W. Wood.
INSTITUTION OF CIVIL ENGINEERS, at 4.—Repetition of "James Forrest" Lecture—On Chemistry in its Relations to Engineering: Prof. F. Clowes.

SATURDAY, APRIL 27.

ROYAL INSTITUTION, at 3.—Climate: its Causes and its Effects: J. Y. Buchanan, F.R.S.

MONDAY, APRIL 29.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Travels in Central Kurdistan: Major F. R. Maunsell.
SOCIETY OF ARTS, at 8.—Alloys: Sir W. C. Roberts-Austen, K.C.B., F.R.S.
INSTITUTE OF ACTUARIES, at 5.30.—On the Valuation of Staff Pension Funds: H. W. Manly. With Tables and Examples by E. C. Thomas.

TUESDAY, APRIL 30.

ROYAL INSTITUTION, at 3.—Cellular Physiology: Dr. A. Macfadyen.
SOCIETY OF ARTS, at 4.30.—The British West Indies: Sir Nevile Lubbock, K.C.M.G.
INSTITUTION OF CIVIL ENGINEERS, at 8.—Annual General Meeting.

WEDNESDAY, MAY 1.

SOCIETY OF ARTS, at 8.—The Thames Steamboat Service: Arnold F Hills.
ENTOMOLOGICAL SOCIETY, at 8.—The Metamorphoses of *Æschna cyanea*, illustrated by Photographs taken from Life: Frederick Enock.—The Classification of a New family of the Lepidoptera: Sir George F. Hampson, Bart.
SOCIETY OF PUBLIC ANALYSTS, at 8.—Alkaline Waters from the Chalk: W. W. Fisher.—Citron Oil: Herbert E. Burgess.—Arsenic in Coal and Coke: Alfred C. Chapman.

THURSDAY, MAY 2.

ROYAL SOCIETY, at 4.30.
LINNEAN SOCIETY, at 8.—Studies in Heterogenesis: Prof. H. C. Bastian, F.R.S.
CHEMICAL SOCIETY, at 8.—The Synthetical Formation of Bridged-Rings Part I. Some Derivatives of Bicyclopentane: Prof. W. H. Perkin, jun., F.R.S., and Dr J. F. Thorpe.—Ballot for the Election of Fellows.
INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—An Instrument for Measuring the Permeability of Iron and Steel: C. G. Lamb and Miles Walker.—A Watt-Hour Meter: Frank Holden.

FRIDAY, MAY 3

ROYAL INSTITUTION, at 9.—Memory: C. Mercier.
SOCIETY OF ARTS, at 8.—Polyphase Electric Working: A. C. Eborall.
ANATOMICAL SOCIETY, at 4.—(*a*) Additional Notes on the Articulations between the Occipital Bone, Atlas, and Axis in the Mammalia: (*b*) On the Development of Digits in Cetacea; (*c*) Observations on the Development of the Human Brain before and after Birth: Prof. Symington.—A Contribution to the Study of the Morphology of Adipose Tissue: Dr. H. Batty Shaw.—A Lantern Demonstration showing the Origin and Nature of the Hydatiform Bodies of the Testicle and Broad Ligament, with Special Reference to the Fate of the Mullerian Duct in the Epididymis: J. H. Watson.—Relation of Structure to Function, as illustrated by the Growth of the Inferior Femoral Epiphysis: Prof. Arthur Thomson.

SATURDAY, MAY 4.

ROYAL INSTITUTION, at 3.—Climate: its Causes and its Effects: J. Y. Buchanan, F.R.S.

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