THURSDAY, OCTOBER 22, 1903.

ANCIENT CALENDARS.

Ancient Calendars and Constellations. By the Hon. Emmeline M. Plunket. Pp. xvi + 263. (London: Murray, 1903.) Price 9s. net.

THIS fascinating work consists of a series of reprints, arranged in logical order, of papers contributed at different times, chiefly to the *Proceedings* of the Society of Biblical Archæology. Altogether they give us an able summary of what is now known respecting the ancient calendars of the Babylonians, Egyptians, Indians, and Chinese, and a very interesting discussion of the vexed question of the origin of the ancient (especially the zodiacal) constellations, on which subject the author has succeeded in throwing fresh light, her conclusions being corroborated by approaching the question of precessional change from different points of view.

The first chapter is on the calendar of the Accadians, who possessed the country watered by the Euphrates and Tigris before the Semitic conquest. Now this calendar was sidereal, not tropical like ours; it was founded, that is to say, on the positions of the sun amongst the zodiacal constellations, not those with respect to the equinoxes. Although the importance to us in these climates of seasonal changes leads us to make our calendar conform in length to the tropical year, as it is called, yet reminiscences of the old usage remain. Thus in the "Nautical Almanac" the sun is said to enter Aries at the time of the vernal equinox, though he is really then situated in the constellation Pisces; and this having excited the surprise of some people who in these days dabble in astronomical questions without having studied them, the superintendent has, beginning with this year, tried to help them by inserting "sun enters *sign* Aries." But as it has generally been erroneously supposed that most of the ancient calendars began the year with the vernal equinox or thereabouts (in this way the old Roman usage made March the first month in the year, whence we still have September to December nominally the seventh to the tenth months), the conclusion was drawn that the zodiacal constellations were formed into a series to mark the different times of the year at an epoch when the sun was really entering Aries at the vernal equinox, which would be about three thousand years ago.

The Accadian calendar, however, it is now known, went back ages before that, and Miss Plunket puts forth the very probable theory that the true date of its commencement and of the twelve Mazzaroth (if we may use the Hebrew term for the zodiacal signs) was about B.C. 6000. That the initial sign was from the first the Ram (of the eminence of which we have so many indications in Egyptian antiquities) there seems no reason to doubt, but our author suggests that the year was made to begin, as we begin it now, about the time, not of the vernal equinox, but of the winter solstice. Eight thousand years amount to about a third part of the *annus magnus*, during which a whole round of precessional change is effected, and the sun eight thousand years ago would be at the beginning of Aries about the time of the winter solstice. This suggestion seems to be a key which unlocks the door to the explanation of many difficulties.

But we must pass on, for our hope is that nearly all our readers will study this volume for themselves. The second chapter is devoted to the constellation Aries and the importance attributed to it in ancient calendars. It is true that the surpassing importance to the Egyptians of the rising of the Nile, which takes place about the time of the summer solstice, led them in early times to transfer the beginning of the year to that season. But every student of Egyptian antiquities is constantly reminded of the prominence assigned on the monuments to the ram, or rather the head of the ram, which marks the position of the two brightest stars in the constellation. Other indications are pointed out from the orientation of the Egyptian temples of the importance attached to the stars of Aries. How this was carried afterwards into Greece is explained in the last chapter of Sir Norman Lockyer's "Dawn of Astronomy," and we may direct attention to two interesting articles by the same writer in NATURE for January 16 and May 29, 1902, on "The Farmers' Years," in which it is shown that not merely temples, but dolmens and cromlechs, were oriented to the sun when half-way between the solstices and equinoxes. Miss Plunket says:—

"As we further study the records of antiquity, now within our reach, it will, I believe, become evident that not only the Egyptians, but also all the great civilised nations of the East had traditions of a year beginning when the sun and moon entered the constellation Aries—such a year as that in use amongst the Babylonians during their long existence as a nation, and such as that which is used by the Hindus in India to this present day" (p. 41).

The ancient Median calendar is next dealt with. Its starting-point seems to have been about B.C. 3000, when the sun was in Taurus at the vernal equinox. The adoption of this by the conquering Assyrians was probably the cause of their fondness for Tauric symbolism and our present familiarity with the Assyrian bull. Miss Plunket thinks that they also adopted in part the religion they found there, on the same principle that induced Sargon, after he had repeopled the conquered kingdom of Samaria, to send one of the former priests to teach the new inhabitants "the manner of the God of the land" (2 Kings, xvii. 26). She contends that Assur, the name of the great god of the Assyrians, is, in fact, a modification of the Aryan word Asura. Several other points are elucidated in the Median calendar, and the cause of the prominence given to some ultra-zodiacal stars, particularly Altair or α Aquilæ.

We now pass on to the Indian and Chinese calendars. When Sir William Jones opened out such a flood of light upon ancient Indian lore, there were many scholars who refused to accept the antiquity of the astronomy of the Brahmins, and would have it that they derived their calendar from the Greeks after the conquests of Alexander the Great. But since that time the spade has effected as great a revolution in archæology as the spectroscope has subsequently done in astronomy. When Sir George Cornewall Lewis pub-

lished his "Historical Survey of the Astronomy of the Ancients" in 1862, he threw cold water upon the attempts which had then been made to decipher the cuneiform inscriptions. He died the year after, just forty years ago last spring; had he survived until now, very different would have been the line which he must have taken. The wealth of the material since accumulated has made it impossible to reject the conclusions of Assyriologists, and though some of the early attempts have necessarily been modified, we have enormous results now in our hands from the library of Assurbanipal and other sources which cannot in the main be gainsaid. The consequences are indirect as well as direct. For if the Assyrian and Babylonian calendars are so ancient, there is no longer any reason to call in question the antiquity also of those of India, or to suppose that they derived this knowledge from the Greeks, who themselves express great respect for the Indian lore.

Now, with regard to the Chineses, if we may follow the obsolete, but perfectly correct, form used by Milton ("Paradise Lost," iii., 438), Miss Plunket's chapter on their calendar-system is worthy, like the rest of her book, of careful perusal. In China the year is now tropical, and does not begin either at the winter solstice or the vernal equinox, but at a time midway between these. But the Gregorian length of the calendar-year was really introduced into that country by some Jesuit fathers who obtained great influence at the Chinese Court early in the seventeenth century. The date used as that of the commencement of the year began much earlier. Their old reckoning was reformed by the Emperor Tchuen about the year corresponding to B.C. 2500, and many indications point to the conclusion that it originally began, like the Accadian calendar, at the winter solstice about B.C. 6000. Miss Plunket comments on the circumstance that this is two thousand years before the creation of man according to the Ussherian chronology, formerly inserted in the margins of our Bibles; but she rightly remarks that a consideration of the variations of the readings in different ancient versions has shown that no reliance can be placed on the Ussher theory, and his dates are accordingly not inserted in the margin of our revised version.

On one point it may be worth while to take exception to a remark by our author about the Julian reformation. There is every reason to believe that it was then known that the true length of the year was several minutes short of 365¼ days, but Cæsar probably thought the insertion of a bissextile every fourth year was near enough for all practical purposes. It was unfortunate that his rule was at first misunderstood. But Pope Gregory, in 1582, not only ordered certain future centurial leap-years to be dropped, but omitted ten days from the calendar that the vernal equinox (and other seasons) might fall as at the epoch of the Council of Nicæa. Miss Plunket concludes these chapters by once more directing attention to the identity of the earliest astronomical traditions of the nations of the east, which suggests matter for reflection. Her book is excellently illustrated throughout, but the second part consists of a series of illustrations of ancient constellations with descriptive letterpress; although we have not space to enter into this at length, we cannot refrain from mentioning the ingenious suggestion that the position of Pegasus was originally upright, the horse striking the vase of Aquarius with his hoof (p. 251). The whole is very carefully printed, and a full index is provided.

W. T. L.

PHYSIOLOGICAL CHEMISTRY.

A Laboratory Manual of Physiological Chemistry. By Ralph W. Webster, M.D., Ph.D., and Waldemar Koch. Pp. 107; 21 plates. (Chicago: the University of Chicago Press; London: William Wesley and Son, 1903.) Price 6*s.* 6*d.* net.

THE introduction to this manual is written by Dr. A. P. Mathews. He dwells upon the rapid development of physiological chemistry, and the efforts which are being made to bring it into closer touch with the biological sciences. He therefore considers it necessary that the science should be presented in a broader way than has hitherto been the case, and implies that the present manual meets this requirement. I therefore proceeded to study the work with considerable expectations of profit, especially when I considered that it was an outcome from the laboratories of the University of Chicago, which have, in recent years, produced so much of original and valuable work in various physiological fields.

I have closed the book with a feeling of great disappointment. The ideal the authors have set before them has not been realised; in fact, it is not often I have read a book which is so full of faults. It has a few good points; every teacher can always learn something from other teachers; the idea of inserting a chapter on the general characters of the cell, taking yeast as an example, is a good one; the directions given for the examination of milk from the sanitary standpoint form a new and useful departure in such text-books. In several other particulars, a competent teacher will glean some useful hints in adding to or amending his repertory of class exercises.

It was, however, for the student that the book was originally written, and for him it is practically useless.

From some points of view the work is a pretentious one, giving information on complex subjects which indicate a desire on the part of the authors to be considered up to date; but this character is lamentably lacking on many questions where one should have expected to find recent and important work described in detail; thus there is no reference to work of Bayliss and Starling on the pancreas, no mention of the distinctions between the euglobulins and pseudoglobulins, and the description of the urinary pigments is hopelessly out of date.

The arrangement of the exercises may be logical as the preface states, but it is absolutely unpractical. For instance, the first exercises the student is set to work out are the preparation of lecithin and cholesterin from the yolk of the egg. The egg may be the starting point of life, but the complicated methods necessary for the obtaining of a complex fat like lecithin hardly

form a suitable introduction to the study of physiological chemistry, but would have come more fittingly after the student knew a little about the nature of the simpler fats. There is, moreover, little or no indication of the relative importance of the substances described; the space devoted to cystin and cerebrin, for instance, is entirely disproportionate to their importance.

The description of the analytical methods is most slipshod; they are usually given in telegraphic or notebook English; they are interlarded with questions, "why is this?" or "what does this mean?" which, in the case of the majority of students, will remain for ever unanswered, for nine out of ten will never take the trouble to "consult this or that text-book," or "ask the instructor," which is the only answer the present work affords.

The omission of small but often important points is not confined to the description of the more complicated methods of analysis, but is seen also in those which are elementary; thus in the directions given for the making of hæmin crystals, the application of heat is omitted; in the description of the Adamkiewicz test, the student is left in doubt as to whether the glyoxylic acid to which the reaction is due is contained in the substance to be tested or the reagents added. In the description of the biuret reaction, no indication is given of its value as a diagnostic test between the native proteids and the products of proteolysis; in the description of the nitric acid test for proteoses, the most characteristic portion of the test, namely, the reappearance of the precipitate on cooling, is omitted; the only experiments relating to blood-clotting are those connected with the inhibitory influence of oxalates; those who follow the directions given for the performance of Hopkins's method of uric acid estimation will fail because of the omission of small details; in Gmelin's test for bile pigments the important detail that *fuming* nitric acid must be used is left out; directions are given for testing for iron in the liver, but no directions for the preliminary removal of blood from the organ; uric acid is spoken of as the result of metabolism of the white blood corpuscles, but the essential fact is omitted that it is from their nuclei, and the nuclei of other cells also, that this substance originates. We are told that ammonium urate is apt to be mistaken for globulin in urine, but no means are furnished of distinguishing the two; and in another part the student is led to suppose that true peptones may appear in the urine. The only method given for the estimation of urea is the hypobromite process, and the apparatus recommended, that of Doremus, is one of the least satisfactory for the carrying out of this test, the importance of which is now mainly historical.

Such are a few of the faults of omission with which the pages abound. Let us next turn to instances of faults of commission, the actual mistakes with which the book bristles. The coagulating points of the muscle proteids are wrongly given, and the most important proteid of all, myosmogen, is altogether left out; histone is classified with the native albumins, and globin with the globulins; for the performance of the biuret test, heating is recommended; in the phenylhydrazine test for dextrose, it is stated that crystals only appear on cooling; indol and tryptophan are spoken of as synonymous; starch is stated to be convertible into sugar by acid in a *few* minutes; in the preparation of serum globulin, water is recommended for washing the precipitate; the sugar formed by the pancreatic juice is stated to be glucose; to obtain the iodine reaction with glycogen boiling with the reagent is the means adopted; the yellow colour of urine is ascribed to a mixture of several pigments not yet isolated, to which are added in brackets the astonishing words "called by Garrod urochrom." Albumose is stated to be a normal constituent of blood; at least that is how I read it, though I admit the passage is so obscure that it might equally well read the other way; the old misstatement that gelatin does not give Millon's reaction is perpetuated; students are led to suppose that the reaction of normal human urine is alkaline; at all events they are told to ascertain whether the alkalinity is due to fixed or volatile alkali; and as a final instance of the careless way in which the book has been prepared, the name of v. Fleischl is persistently misspelt. This does not by any means exhaust the list of glaring errors with which the book abounds, but enough has been said to show that this is an unsafe work to place in students' hands.

W. D. HALLIBURTON.

POPULAR AMERICAN ENTOMOLOGY.

The Insect Folk. By Margaret Warner Morley. Pp. vi+204; illustrated by the author. (Boston and London: Ginn and Co., 1903.) Price 2*s*.

Ways of the Six-Footed. By Anna Botsford Comstock, B.S., Lecturer in Cornell University Extension. Pp. xii+152. (Boston and London: Ginn and Co., 1903.) Price 2*s*.

THESE are two popular publications on the insects of North America, and may conveniently be noticed together, though, except that they are uniform in size and appearance, and are both by ladies, there is little resemblance between them.

The first is for young children, and seems to be intended partly as a reading book, for it is in very simple language, and is mostly in words of one or two syllables, and all long or technical words are explained in a glossary at the end of the book.

We are pleased to see that children are advised to keep insects under observation, and not to kill them, except in the case of those which are injurious.

Neuroptera, Hemiptera, and Orthoptera are the orders dealt with, and the first chapter is on dragonflies, which are more numerous and of more varied colours in America than in Europe.

We may, perhaps, quote one of the longer sentences.

"I once went up the side of a beautiful mountain in North Carolina, where was such a mighty host of cicadas in the trees that I could not hear my companion speak, and a little way off the noise sounded like a torrent of rushing water."

Notwithstanding the simple style of the book, the authoress has contrived to include in it a good deal of information that will be new to most people who are not fairly well acquainted with entomology; and part

of it relates to insects which are found in Europe as well as in America, and it appears to be accurate and trustworthy. We may, however, dispute the statement which we meet with here, not for the first time, that the small cockroach (*Blatta germanica*), called in America the croton bug, "is supposed to have been brought to England by soldiers from the Crimea," if this is supposed to imply that it was then first introduced into England, for it was well known as an inhabitant of most parts of Europe, England included, long before that time, though it may perhaps have become commoner after the Crimean War.

Frequently the information is directly addressed to the children who are supposed to be instructed, as :—

"Mollie wants to know why it would not be a good plan for people who live where there are many mosquitoes to raise dragonflies?"

"That is a very sensible idea, Mollie, and it has been tried."

Mrs. Comstock is already well known as an entomologist, especially as the illustrator of her husband's "Manual for the Study of Insects," &c. Her book consists of a series of ten popular articles on entomology, most of which have previously appeared in magazines. The subjects are "Pipers and Minnesingers" (mosquitoes, cicadas, crickets, &c.), "A Little Nomad" (*Incurvaria acerifoliella*), "A Sheep in Wolf's Clothing" (*Basilarchia archippus* mimicking *Anosia plexippus*), "The Perfect Socialism" (bees, ants, termites and wasps), "Two Mother Masons" (Pelopæus and Eumenes), "The Story we Love Best" (*Ceratina dupla*), "A Dweller in Tents" (*Pantographa limata*), "A Tactful Mother" (Chrysopa), "A Seine Maker" (Hydropsyche), and "Hermit and Troubadour" (Cicada).

The book is written in a popular and attractive, but not childish, style, and is very nicely illustrated. There are forty-seven illustrations altogether, several of which occupy a full page.

OUR BOOK SHELF.

Catalogue of Books, Manuscripts, Maps, and Drawings in the British Museum (Natural History). Vol. i., A—D. Pp. 500. (London: Printed by Order of the Trustees, 1903.)

Few even of the *habitués* of the Natural History Museum have any adequate idea of the extent and value of the collection of books on natural history (in its widest sense) subjects contained within its walls. Nor is this difficult to account for. Owing to the exigencies of work, the collection is split up into a zoological, a geological, a mineralogical, a botanical, and a general library, the latter containing all those works which treat of subjects belonging to more than one department of the museum. But even this subdivision by no means expresses the real facts of the case, the various departmental libraries being further divided into subsections. For instance, the bird room, the spirit building, the entomological department have each libraries of their own, while even individual officers who have charge of one group of animals possess a collection of books in their own rooms.

In these circumstances there can be no question but that the director has been well advised in recommending the Trustees to sanction the publication of the "Catalogue," of which the first volume is before us, since it is certain that such a series of volumes will be of great interest and value not only to workers in the museum, but likewise to naturalists and bibliographists all over the world.

The collection had its origin in the departmental libraries of the establishment at Bloomsbury, and was largely augmented by purchase, by means of a special Parliamentary grant, at the time of, and subsequent to, the transference of the natural history collections to South Kensington. An important addition was the bequest of the Tweeddale library, some years after the transference. In spite of certain gaps, the collection is believed to be one of the finest in the world. When complete, it is estimated that the catalogue will include some 60,000 entries, the present volume containing about one-fourth of this number.

The editing has been confided to Mr. B. B. Woodward, who, in the present volume, appears to have discharged an arduous task with conspicuous success. Although the work is only an "author-catalogue," many of the entries contain information with regard to the contents of the works, their dates of publication, or other bibliographical detail. It should be added that, on account of their special interest and importance, four subject-headings, namely, atlases, dictionaries, encyclopædias, and gazetteers, have been included. R. L.

A Class Book of Botany. By G. P. Mudge and A. J. Maslen. Pp. xvi + 512. (London: Edward Arnold, n.d.) Price 7*s.* 6*d.*

The scope of this book is somewhat ambitious, for although it is limited to the requirements of intermediate examinations, it takes up in considerable detail the four main branches of botany. Morphology and anatomy are treated in the course of a series of types; classification with special chapters on floral morphology and physiology occupy the second and third parts of the book. Judging by experience, the relegation of morphology to the amount which is distributed throughout the discussion of a series of types is injudicious, because a sound knowledge of external morphology is necessary to the elementary student, partly as a preliminary to anatomy and generally as a foundation for other branches of the subject. It should be pointed out that the authors have not tied down the types to one or two specimens, but, where necessary, additional examples are given; nevertheless, the specific training value of a morphological introduction is wanting. Further, by adopting the type system, the authors provoke comparison with the admirable book written by Dr. Scott, more especially since the cryptogamic types are practically the same in both cases, and Mr. Mudge is not endowed with the same happy power of expression, nor does he display the accuracy which distinguishes the "Structural Botany." The style is, indeed, too rigid, and this only serves to emphasise the numerous mistakes or to give rise to misconceptions. To mention a few instances we find p. 13, "a root . . . always . . . grows downward"; p. 16, "spines have become enlarged and form thorns"; p. 60, "the petiole is polystelic"; and p. 80, a samara is described as a "winged, one-seeded capsule."

Turning to the chapters dealing with classification and morphology of the flower, for which Mr. Maslen is responsible, these are much more satisfactory, and both in choice and arrangement of subject-matter the author's judgment commends itself. The physiological section might with advantage be more practical, and would be much improved by some rearrangement. It is not obvious why the consideration of the absorption of food material by the roots should

be placed after photosynthesis, and after the account of parasites and saprophytes; here it is noticeable that Lathræa is placed amongst carnivorous plants, without any mention of Groom's work. But few practical experiments are suggested, and it would be easy to improve the apparatus depicted in figs. 204, 206, 208, and 219. Finally, the last chapter, in which irritability is discussed, is headed "Movements of Plants," which quite ignores the phenomena of stimulus, and the stimulating source.

In the introduction, the authors state that they have been impressed with the need of a work which should contain all the information which is necessary for certain examinations. On the contrary, the present tendency, and there is much to be said in favour of it, is to bring out smaller books, written by specialists, which deal only with one branch of the subject.

Traité de Chimie physique, Les Principes. By Jean Perrin. Pp. xvi + 300. (Paris: Gauthier-Villars, 1903.)

THIS volume deals with the elements of dynamics, the thermodynamical potential, the phase law and other allied subjects of which a knowledge is indispensable to the modern chemist. The treatment is non-mathematical, but the author indulges in a good many discussions of a philosophical character. In defining the scope and aim of physical chemistry, he refers to the old style of thinking, according to which physics was the science of reversible phenomena, and chemistry the science of irreversible phenomena. The notion of *force* is defined by means of the extension of a stretched elastic string or wire. Why should not this treatment be adopted in books where relations involving mass and acceleration do not play a prominent part? We notice, as a useful feature, that Lord Kelvin's definition of absolute temperature is dealt with at some length. In the preface the author rightly directs attention to the desirability of abandoning such misleading notions as that of absolute in contradistinction to relative velocity, the statement that "heat cannot pass from a cold to a hot body," which is like speaking of an apple passing from one hand to the other, and the prevalent confusion of language in speaking of ideas involving force and energy.

The Arithmetic of Elementary Physics and Chemistry. By H. M. Timpany. Pp. 74. (London: Blackie and Son, Ltd., 1903.) Price 1s.

THIS collection of numerical exercises is very limited in its scope. It is composed of four sections; one includes problems on relative densities, another is devoted to examples on moments and centres of gravity, a third is concerned with the conversion of thermometric scales and with specific and latent heats, while the last deals with the calculation of the weights and volumes of the substances taking part in chemical reactions. Typical examples are worked out for the guidance of the student.

Gisements minéraux. Stratigraphie et Composition. By François Miron. Pp. 157. (Paris: Gauthier-Villars and Masson et Cie, n.d.)

M. MIRON here provides geologists and others with a compact account of numerous non-metalliferous mineral deposits which are useful in numerous branches of technology. A previous volume in the series known as the "Encyclopédie scientifique des Aide-Mémoire," to which the present book also belongs, dealt with those minerals in which the metallurgist is particularly interested, and attention is here chiefly directed to the natural sources of sulphur, nitrates, phosphates, borates, compounds of the alkali and alkaline earth metals, and other minerals.

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.*]

Human Science and Education.

THERE surely never was a time when there was more need for consideration of the root-principles of higher education. It is generally allowed that we in England are behindhand in the matter, that we have allowed the Germans and Americans to have the start of us. And awaking to this conviction we have a difficulty in seeing in what direction we should move in an attempt to recover our lost ground.

I accede with pleasure to a suggestion of the Editor of NATURE that I should endeavour to lay before his readers some of my views as to the direction in which those studies which have *man* for their subject should move. At first sight it might seem that the present place is inappropriate for a paper of this kind. Yet it is among the students of nature that my contentions as to the study of man are perhaps most likely to find support.

What I plead for is that the two great branches of knowledge, the science of nature and the science of man, should be brought nearer together, that it should be recognised how much they have in common, and that the reasonable votaries of both should make common cause against the same enemies.

The enemy in higher education of the science of nature is the technical spirit, which will not take a wide outlook, which ties all investigation down to narrow points of practice, which does not see that breadth of study and imaginative insight are necessary in our schools of science if we would produce men of real efficacy for the work of the world and not mere technical experts. The enemy of the science of man is the spirit of convention, which is dominated by rhetoric and commonplace, which has no ambition to see the facts of human nature and of history as they really are, but interprets them by tradition by self-interest, by sentiment. And between these two enemies of the children of the light there springs up a natural alliance. The man who has received a narrow technical training may be a good linguist or the like, but is not likely to appreciate a wide humanistic culture. The man who has received a merely conventional literary education may master technical details, but will scarcely understand how the steady growth of science, of ordered knowledge, has changed our whole way of regarding life, religion or society. The two enemies will combine when they can to keep education at its present level, and to ridicule all attempts to provide a really scientific training in universities and schools.

It is scarcely necessary to say much in these days as to the importance of a thorough organisation of the study of nature and natural forces in our colleges. There has been in this matter extraordinary progress in the last thirty years. At any rate it would be an impertinence for me, who have never been trained in any branch of natural science, to dwell on this matter. But while natural studies have moved forward rapidly, those which concern man have in our universities scarcely moved. The course in humanity, and in modern history, is at Oxford almost exactly what it was thirty years ago. Cambridge is less averse to change than Oxford, and has been more mobile; yet it may be doubted whether human studies have imbibed much more of the modern spirit in Cambridge than at Oxford. In the new universities which are springing up on all sides, generally speaking the side of natural science is more or less well developed with teachers and apparatus, but in the matter of history, psychology, archæology and the like they are much to seek. In the case of the new University of London, one sees the germs of better things. Several of the schemes of study there arranged look well on paper. Only funds are needed to set the machine in motion. In London there are great institutions, like the Record Office and the British Museum, which are in the nature of things obliged to be scientific, and one hears great things of the London School of Economics.

I think the readers of NATURE will admit that the slow-

ness and incompleteness with which reorganisation is going on in the studies concerned with man is an undesirable, even a dangerous, fact. The disparity between the two halves of human knowledge has grown so great that there is a fear that almost all young men of original or inventive mind will turn to the study of material nature. It would be foolish to make any comparison between the importance of the knowledge of man's surroundings and the knowledge of his nature, his works, and his history. Both are beyond value. But if the two halves of the human brain, so to speak, work on different plans, what will become of the unity of man himself?

A reason why the votaries of natural science should have some sympathy with those who are endeavouring to remodel humanist studies is that it is from the natural sciences that methods and ideas have flowed into those relating to man. The ideas of continuity, of adaptation to environment, of evolution, were transplanted into historic studies from those of biology, and it was soon found that they flourished almost as well, and bore almost as much fruit, in the new field as in the old. But whereas the highly trained and scientific worker in history, psychology, archæology, and kindred studies is quite alive to the use of the new scientific methods, they have as yet only partially affected education in these subjects, even in our universities. The books used by the students are changed in character, but not the ways of working. Undergraduates are not thoroughly taught the principles of weighing evidence, they are not accustomed to work on the comparative method, they do not acquire historic imagination. They have not learned to judge by evidence rather than by authority, nor rigidly to distinguish degrees of probability.

Of course, education is not, and cannot be, only scientific. To everyone's education there should be other sides. There should be a religious side, in some ways the most important of all. There should be an artistic side. Every boy and every girl should be taught to draw or to play some instrument, and to appreciate good work done in the art which is thus practised. And every student should be taught to use the English language to some purpose, and to appreciate what has been best written in that language, and in one or two other languages. But at present I am not speaking of religious, of artistic, or of literary education, but of scientific education, of the direct training of the faculties for dealing with the facts of the world; and it is my contention that this scientific side of education has been comparatively neglected in the case of those who have not taken up some branch of physical science. In fact, so completely has the really scientific character of such studies as history and archæology and economics and the like been, at least in this country, overlooked that when we hear of a man studying science it is at once assumed that he is giving his attention to the facts of the natural rather than of the human world. But the word science has not and cannot rightly have any meaning but "ordered knowledge." Whatever can be surely known is matter of science.

But I must come to the practical question of the organisation of study, and especially of university study. Knowledge of the physical world has so greatly grown by two things, the improvement of method and the organisation of research. Improved methods of investigation in the study of man and of history have fairly come in: they are scarcely yet fully recognised in schools and universities, but the best authorities in the various branches of the subject are acquainted with them. What is most needed is a new organisation of research.

At present in our universities the spread of better methods in the human studies has principally effected this, that the student works on better text-books. This in itself is something, but not very much. Compare, for example, such a subject as geology. Would it be regarded as sufficient if the students of geology read books in which the latest and most approved views are expressed? Surely not; until the student has grubbed for himself in the chalk pit and the cliff, and learned in museums to recognise the substances belonging to various strata of the earth, he has done nothing worth doing. He must not take results ready made, but must work for himself, see for himself, learn the value of evidence and the touch of fact. I venture to think that the case is the same in human studies. Here also it is of little use to accept the best results, unless the student grasps the grounds on which they are reached. Here also he must for himself work on the data, see why one view is more probable than another, map out the exact state of the evidence.

Our remedy is to adopt in the human sciences organisation and methods of study which have triumphed in the natural sciences. In every college and university there should be, beside the laboratory of the chemist and the dissecting room of the physiologist, work-rooms for the students of man. As regards psychology and anthropology, which are two foundation stones of the arch, this is already conceded. Specimens and apparatus are there acknowledged to be necessary. The same necessity exists as regards other branches of human study. Work-rooms are needed in which the student should be, so far as possible, brought into contact with evidence. All the important books, dictionaries and the like should, of course, be there. And besides, the authorities for the books should be so far as possible put together, facsimiles of documents and of inscriptions, maps, chronicles, coins, seals, and the like. In the economic section every kind of statistics should be at hand. In the department of ancient history there should be casts of inscriptions, photographs of sites, facsimiles of manuscripts, casts of statues and of coins. Even when such objects are not direct authorities for the points of which the student is in search, they form his mind by bringing him into contact with fact and evidence, and they greatly stimulate his imagination by placing him in presence of some of the surroundings of history. The result of work of this kind would be a change of outlook and of method, the substitution of investigation for theory, of science for fancy. It would prepare the student for wider work in the actual world, for which, of course, it would be no substitute but a *propaedeutic*.

Those who teach and organise natural studies are fully alive to the great demands made by the changed state of the world, and are demanding endowment with energy and persistency. They are quite right. But the teachers of human studies are more inert and less keenly alive to the need of expansion. But science, ordered knowledge, is, in spite of all divisions, one, and it will be a great misfortune for the country if in the extension and re-endowment of our university system the necessity of thorough and elaborate investigation of man in all his aspects, his history and his works, falls into the background.

Oxford, October. P. GARDNER.

Uniformity in Scientific Literature.

IN 1894 a committee was appointed by the British Association to inquire into the question of uniformity in the size of the pages of proceedings, transactions, and scientific journals in which original papers are published. The appearance of a number of *Proceedings* of the London Mathematical Society of a different size from its predecessors, in accordance with an announcement circulated as recently as the end of August, suggests that it may be desirable to direct attention to the report of this committee (Brit. Ass. Rep., 1895, p. 77).

In this country all the more important octavo journals in question are printed on either medium or demy paper; as examples we may cite the Royal Society's *Proceedings*, the *Philosophical Magazine*, the *Proceedings* of the Physical Society, &c. A considerable number of foreign journals (*e.g.* Wiedemann's *Annalen*) are of practically the same size. The difference between medium and demy octavo is too small to cause any inconvenience either in placing the volumes together on a shelf or in binding together reprints of papers. In the case of certain American and Italian journals a somewhat larger sized page has been adopted, but the difference is entirely in the margin, the printed portion being in some cases smaller even than in our demy octavo journals. This allows of reprints being cut down for binding with others from the *Philosophical Magazine* or British Association *Report*, and still leaving plenty of margin. Where papers are too long to be published in octavo form, medium and demy quarto are the most prevalent sizes. Here again there is not much to choose between the two, and, as in the case of octavo, the committee decided to recommend the demy size as a standard. The most inconvenient pamphlets to deal with are those in which the paper is too small for binding up

with demy quarto, and the printed page is too large to allow of the paper being cut down to demy or even medium octavo size. The *Atti* of the Lincei Academy may be cited as an important example. Fortunately, however, such exceptions are comparatively few in number, and they include none of the main English journals in which original papers are published on mathematics or physics.

It is my hope that by again directing attention to this matter further uniformity may be secured in the sizes of proceedings and transactions by the gradual elimination of inconvenient sizes, and by the avoidance of further divergences. The size of the new number of London Mathematical *Proceedings* is peculiarly unfortunate, as it is not uniform even with those outstanding foreign journals which do not conform to the recommendations of the committee.

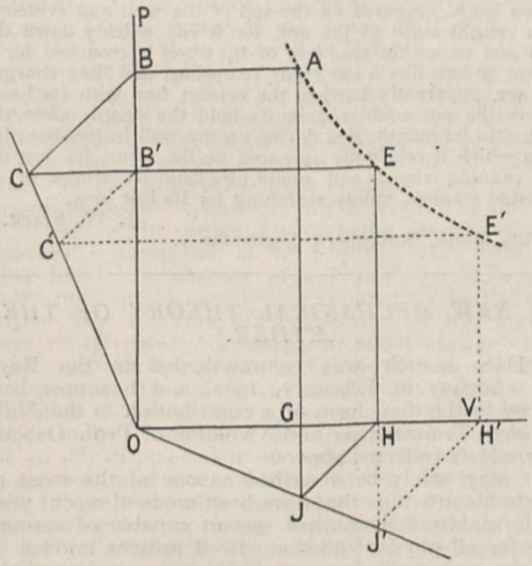
G. H. BRYAN.

Expansion Curves.

MR. STODDART'S method of finding points on the curve pv^n = constant, to which Prof. Perry directed attention on October 8 (p. 548), is interesting, but it does not give a great number of convenient points on the curve. If the points A, E, . . . are called (v_1, p_1), (v_2, p_2), . . ., the values of v and p form two series of quantities in continued proportion, *i.e.* such that $v_1/v_2 = v_2/v_3 = \ldots$, and $p_1/p_2 = p_2/p_3 = \ldots$

A modification of the method, bringing out more clearly its essential simplicity, and, moreover, far easier in practice, would be to calculate the positions of *two* points A, E instead of finding A and the specially related angles α, β.

It will then be seen from the diagram, by drawing the lines needful to find a third point (say for definiteness in



the direction of increasing v and decreasing p), that the method advocated is only that of finding the above two series of continued proportionals, and that *any* angles would serve the purpose, all that is necessary being that all the construction lines like JH must be parallel to each other, and similarly all the lines like BC parallel to each other. But no modification of the method will give more than the points I have indicated.

By drawing the tangents at the points so found, the accurate construction of the curve would evidently be facilitated. This can be neatly done by taking care in the choice of the first two points; for in these curves the gradient is $-p \div v/n$, so that the tangent at the point (v,p) cuts the axis of x at the point the abscissa of which is $v(1+1/n)$. Hence if we choose the first two points (v_1, p_1) and (v_2, p_2) so that $v_2 = v_1(1+1/n)$, the tangent at the first point will pass through the foot of the second ordinate, and similarly the tangent at the second point will pass through the foot of the third ordinate, and so on.

Or, if we take $v_2 = v_1\sqrt{(1+1/n)}$, so that $v_3 = v_1(1+1/n)$, the first tangent will pass through the foot of the third ordinate, and so on.

This happens to be approximately the case in Prof. Perry's diagram, which for convenience has been reproduced here with a set of additional construction lines.

Coopers Hill. ALFRED LODGE.

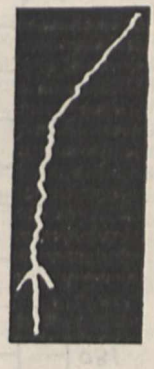
Rocket Lightning.

A PECULIAR species of lightning, bearing a strong resemblance to ascending rockets, was witnessed on the evening of July 22 by two of the professors in Sibpur Engineering College, Howrah, near Calcutta, one of whom wrote me the following careful account in a letter dated the next day. I wrote back suggesting local inquiry in the direction in which the phenomenon appeared, and sending some extracts from Hann's "Lehrbuch der Meteorologie" bearing on the subject. The reply, dated September 1, shows that the suggested inquiry is impracticable.

11 Leopold Road, Ealing, W. J. D. EVERETT.

WE saw some strange lightning yesterday evening at about 9 p.m. It was a clear, moonless night, with just a bank of cloud very low in the S.S.W., with a well-marked edge, height say from horizon (flat) to 5° up. There was a misty cloud above this. These clouds we could only see properly when the flashes came. Stars were visible at about 10° above the horizon at this point, and the sky was quite clear all over elsewhere. Now and then flashes showed from behind the lower cloud (the flashes themselves were mostly hidden, and thunder was not audible). The flashes were not so frequent as usual, say one per minute or so. Generally here they are almost incessant during thunderstorms.

At intervals of three minutes or so, immediately after a flash—which, as common here, was mostly multiple, lasting a second or so altogether—a luminous trail shot straight up to 15° or so, about as fast as, or rather faster than, a rocket, and of very similar appearance, but with minute waves, like ribbon lightning. It was hardly as bright as most lightning. S. and I saw it repeated seven times, and Prof. Brühl (physics) three or four times after we directed his attention to it. He was equally surprised at the novelty, and he has been out here some eighteen years. One of the trails turned off, as shown; the others were about vertical as seen from here. Each grew up steadily from below, and then disappeared at once. The upper end was definite, and did not branch or spread.



In each case it followed immediately on a vivid flash or set of flashes. It was certainly not fireworks of any kind. It terminated in apparently clear sky. Its appearance as a uniformly and very bright ribbon was different from any fireworks. It was somewhat yellowish, not purple as lightning often is. It was much too far off for fireworks to be so high and bright. No thunder was audible.

July 23. W. H. EVERETT.

THANKS for trouble of making extracts from Hann *re* lightning, which, as you say, describe phenomena different from what we saw.

Peake is in charge of the Meteorological Office for India, and did not hear about it, nor did I see anything in the Calcutta newspapers.

There would be practically no Europeans or any competent observers nearer the lightning than we were; as it must have occurred at a spot above the Sunderabunds, a wilderness of waterways and jungle. And there are probably not a score of men in all Bengal who would take serious interest in such lightning if they did happen to see it. I was lucky to have Brühl as a witness, he being an old resident, and one who keeps his eyes open.

It was not like a string of fireballs, for it was of uniform width. But it had, as Hann says of globular lightning, doubtless some connection with the breaking down of the air by the volleys of discharges. W. H. E.

September 1.

Our Winters in Relation to Brückner's Cycle.

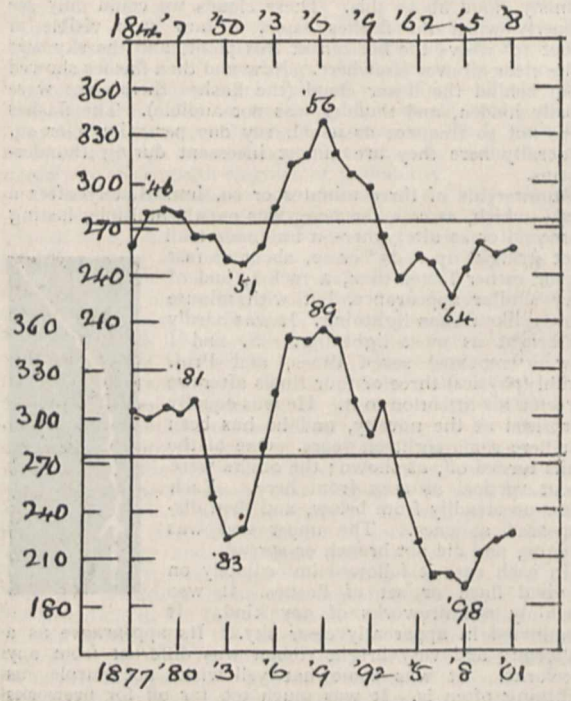
It was said in Bacon's time that every thirty-five years "the same kind of suite of years and weathers comes about again" (see his essay "Of Vicissitude of Things"), and the important researches of Brückner on this subject are now receiving considerable attention.

The value, 35 years, as used by Brückner, is, of course, an average. The interval from centre to centre of his cold and wet periods (or the opposite) is sometimes as much as 40, sometimes as little as 30. It has been noted, further, that 35 is very nearly three times the sun-spot cycle of 11·1 years.

Now if we look into the variation of certain weather-elements at Greenwich since 1841, it may, I think, be truly said to-day that the same kind of weather has come round again after about 33 years. Let us take *e.g.* our winter seasons as measured by the total number of frost days from September to May.

In the upper curve of the diagram herewith, each year point represents the sum of frost days in five winters so understood; the first (1844) for winters ending 1842–46, the second, winters ending 1843–47, and so on.

Similarly, in the lower curve, each point represents a five-winter group, but thirty-three years later, commencing



Curve showing the variation of frost days from five-year sums for the period 1842—1902.

with 1877, and ending with 1901 (which includes last winter).

There is obviously a general correspondence between these curves; high values in one matched with high values in the other, and low with low. Twenty-five pairs of values being thus compared, there are only four in which the members of the pair are on opposite sides of the average line (273).

Again, we have, in general,

Diminishing cold	1846–51	(5 years)
	1879–83	(4 ,,)
Increasing cold	1851–56	(5 ,,)
	1883–89	(6 ,,)
Diminishing cold	1856–64	(8 ,,)
	1889–98	(9 ,,)

From these last dates there is a rise.

The earlier curve might thus be considered a kind of programme for the series of winters commencing 33 years after the first. It will be interesting, I think, to see how far it continues to be so in the future.

The winters about 1856 and 1889 appear to have been conspicuously cold times. We might, perhaps, anticipate another such time in the early 'twenties, the curve not rising so high between, though, of course, individual winters might be very severe. This seems to be suggested by the course of the curve after 1868, but the correspondence may perhaps fail.

Other examples of such recurrence, corresponding more or less closely, might be given. The long record of Rothesay rainfall (from 1800) will be found worth treatment in this way; conspicuously dry times occur about 1822, 1855, and 1887, and the smoothed curve from 1835 to date may be said to repeat in its main features that from 1802 to 1867.

ALEX. B. MACDOWALL.

An Ant Robbed by a Lizard.

The following account of the robbery from an ant by a lizard may interest some of your readers.

While walking along the main road on the outskirts of Bordighera yesterday morning, I noticed a strange-looking insect moving across it in a peculiar way. On getting nearer, I saw that what had attracted my notice was a black ant—about an inch long with brown wings—dragging a cricket bigger than itself. It held the cricket by the head, and as the ant moved backwards it drew the cricket towards it. While doing so it entered the shadow cast by my umbrella, and instantly released its hold and got out of the shadow, but finding there was no danger it returned and seized its prey again by the head, and recommenced its backward movement. A low wall ran alongside the road, and when the ant got within six feet of it a common brown lizard appeared on the top of the wall and evidently soon caught sight of the ant, for it ran quickly down the wall and to within two feet of it, when it crouched for a second or two like a cat ready to spring, and then charged the ant, apparently butting the cricket free with its head. Before the ant could regain its hold the lizard seized the cricket in its mouth, and darted up the wall in the direction from which it originally appeared on the scene, leaving the ant running round and round, moving its wings in an agitated manner, vainly searching for its lost prey.

J. W. STACK.

Villa Mona, Bordighera, September 1.

A NEW MECHANICAL THEORY OF THE ÆTHER.[1]

THIS memoir was communicated to the Royal Society in February, 1902, and has now been issued in the dual form of a contribution to the *Philosophical Transactions* and a volume of Prof. Osborne Reynolds's collected papers.

It may safely be described as one of the most remarkable attempts that have been made of recent years to formulate a dynamical system capable of accounting for all physical phenomena at present known. A theory such as is here set forth may not improbably play the same part in modern science that was assumed by the atomic theory and the kinetic theory of gases in the science of the time when these theories were propounded.

If we suppose the ultimate particles—Prof. Reynolds calls them "grains"—constituting the material universe to be either spheres, or what comes to the same thing, point atoms behaving in the same manner as uniform smooth spheres, then it is impossible to assume these grains to be of equal size and distributed at random through space without assuming them (as in the kinetic theory of gases) to be in motion among themselves. On the other hand, a medium in which the motion of the different grains among themselves partakes of the nature of diffusion does not lend

[1] "The Sub-Mechanics of the Universe." By Osborne Reynolds, M.A., F.R.S., LL.D., M.Inst.C.E. Pp. xvii + 256. (Cambridge University Press: Published for the Royal Society of London, 1903.) Price 10*s.* 6*d.* net.

itself kindly to the explanation of such phenomena as the propagation of transverse waves. The medium considered in the present investigation is assumed to consist of uniform spherical grains which are so close together as to prevent diffusion, and when in a state of "normal piling" the centre of each grain is supposed to be equidistant from those of twelve neighbouring grains, this being the distribution corresponding to minimum volume, and the system "constituting to a first approximation an elastic medium with six axes of elasticity symmetrically placed." [It may be pointed out before proceeding further that there is more than one way of piling balls so that each ball is in contact with twelve neighbouring ones and the total volume is a minimum.]

The grains are supposed to be capable of limited relative motion, and local inequalities may exist due to the presence or absence of a number of grains above or below that necessary for normal piling. In such cases singular surfaces are formed between the grains in unstrained and those in strained piling. The author finds that the local negative inequalities produced by the absence of grains present the ordinary properties of matter. They are free to move through the medium without resistance, the grains streaming freely through their singular surfaces, and they attract one another according to the law of the inverse square. The density of matter is thus negative, taking that of the medium to be positive, and if the density of water be taken as -1, the author finds that of the medium to be 10^4. The diameter of the grains in C.G.S. units is $5{\cdot}534 \times 10^{-18}$, their mean path is $8{\cdot}612 \times 10^{-28}$, their mean relative velocity is $6{\cdot}777 \times 10$, the mean pressure is $1{\cdot}172 \times 10^{14}$, the rate of propagation of the transverse wave is $3{\cdot}004 \times 10^{10}$, and the rate of degradation of the transverse wave is such that it would require 56 million years to reduce the total energy in the ratio of 1 to e^2. The absorption thus produced is of such a magnitude as to account for the blackness of the sky on a clear night compatibly with the absence of any measurable absorption of light by the ether. On the other hand, the absence of any evidence of normal waves until quite recently is accounted for by the conclusion that the rate of degradation of the normal wave would reduce its energy to about one-eighth in $3{\cdot}923 \times 10^{-6}$ of a second, or before it had traversed 2200 metres. In addition to positive and negative inequalities of which the latter correspond to matter, the existence is assumed of "complex inequalities" due to the displacement of grains from one position to another, and a comparison of the attractions of such inequalities with those due to the inequalities representing matter is in complete accordance with the known smallness of gravitative as compared with electric action.

The theory accounts for the refraction, dispersion, polarisation by reflection, metallic reflection and aberration of light.

The analytical investigation is based on the general equations of motion and conservation of any entity (Section ii.), these equations being generalisations of the well-known equations of continuity of hydrodynamical and allied systems; the formation of the equations of motion in a purely mechanical medium (Section iii.), the separation of the motion into its components of "mean" and relative motion (Sections iv.–vii.), the extension of the kinetic theory to granular media (Sections viii.–x.), and an elaborate analysis of the changes taking place in the angular inequalities, the momentum and energy, the mean and relative systems, and the mean inequalities and their motions (Sections xi.–xiv.). It should be observed that the present theory involves the assumption that positively electrified bodies do not repel each other, and for this the author gives arguments in § 226. In the final section (xv.) the numerical values of the quantities which define the condition of the granular medium, as stated above, are deduced from the results of physical experience.

The mathematical reasoning is very difficult, in some places almost impossible, to follow, owing to the large number of doubtful points or inaccuracies in the equations. Even if the fundamental conclusions should prove to be correct, there are many points in the argument which are at present obscure, and require to be cleared up. To take a few examples, in equation (4), p. 10, a new symbol r is introduced without any explanation, and the dual use of δ is very confusing. Having used δS to denote a volume element, and δs a surface element on this page, the author suddenly changes from δS to δs in the first of equations (20) on p 16, and to ds in the second and third, although he refers to equation (2) of p. 10, which involves δS. On p. 13 in equation (13), the differential is omitted after the treble sign of integration; also in (16) one of the expressions under the sign of summation is multiplied by the differential element dS, while the other is not; in the former equation the reader will naturally supply the missing $dx\,dy\,dz$, but the meaning of the latter equation is obscure. Again, turning to p. 105, we find that § 116 refers to "The mean velocities of pairs having relative velocities $\sqrt{2}V_1'$ and $V_1'/\sqrt{2}$," while in § 120 we read, "Since the mean velocities of pairs of grains having relative velocity $\sqrt{2}V_1'$ is $V_1'/\sqrt{2}$ . . . ." In § 117, "All directions of mean velocity of a pair are equally probable whatever the direction of the mean velocity." On p. 120, equation (181), it is not easy to see how, if N be equal to the number of grains in unit volume, the square root of N should be equal to N $dx\,dy\,dz$ multiplied by a certain function of the coordinates, nor how by integrating the equation with respect to y and z the square root of N now becomes equal to N multiplied by another function multiplied by the linear differential dx. In ordinary circumstances there is no useful purpose served in filling a review with a list of *errata* which any reader could easily correct for himself. But the present investigation would be difficult to follow even under the most favourable conditions, and the presence of so many formulæ and statements which cannot possibly be correct as they stand renders the task well nigh hopeless.

An objection of an entirely different character applies to the sections in which Maxwell's law of distribution of velocity components and partition of energy is extended to a medium of closely packed spheres such as that considered by Prof. Reynolds. A great deal has been written as to the validity of Maxwell's law, and of the fundamental assumptions involved in the proofs of it. The general opinion on which all mathematical physicists are pretty well agreed is that the law holds good to a first approximation in gaseous media the molecules of which are not too closely crowded together; but one method of proof after another has on closer examination been found to involve some assumption or other which usually breaks down in the case even of a dense gas. Moreover, Mr. Burbury has gone so far as to establish a different formula for the law of distribution in dense gases. To assume the law to hold good in the extreme case of a medium the ultimate particles of which are permanently interlocked must be regarded, failing other evidence than that given by Maxwell, as a very doubtful step.

A number of interesting questions suggest themselves for the consideration of physicists, such as the ultimate distribution of energy between the grains and molecules, the determination of the temperature of cosmic space as defined by the mean kinetic energy of the grains, the influence of the absorption of the medium, however small, on the progress of cosmic

events, the existence of directional properties of the ether determined by the regular arrangement of the grains, and the finity or infinity of extent of the medium. It may be confidently anticipated that Prof. Osborne Reynolds's granular medium will play an important part in the physics of the future. It is, however, to be hoped that the subject will receive careful and critical study in the hands of numerous mathematical physicists, and that it will not be left for the experimenter and philosopher blindly to accept Prof. Reynolds's doctrines as the basis of speculations about things which they do not understand. The practice of assuming statements to be true because Maxwell made them has been too prevalent in the past, and there is not very much difference between those who adopt this attitude and writers who publish papers at their own expense to show that the earth is not round or that gravitation does not exist. The dogmatic statements of the former class of philosopher often afford plenty of material for the abusive attacks of the latter.

G. H. BRYAN.

THE EFFECT OF EDUCATION AND LEGISLATION ON TRADE.

IN his second presidential address to the Society of Chemical Industry at its annual meeting held in Bradford, Mr. Levinstein again addressed himself to the subject of education. He thinks that almost too much importance has been attached to education as being the *only* factor which has caused the industrial progress and superiority, in certain classes of merchandise, of Germany in comparison with this country. Attention is therefore directed to other considerations which he considers have also to be taken into account, such as the unification of the various German States after the Franco-German war, which, of course, gave an internal free trade to the German nation, the nationalisation of the railways and canals, and the protective patent laws.

He then refers to America, which he does not consider to be a better educated country than our own. Naturally the new Education Act of 1902 comes under review. Mr. Levinstein is doubtful, as are many others, if the Bill will advance secondary education, because the number of persons appointed to the councils who represent secondary education is exceedingly small. No remark is made upon another aspect of the case, namely, that a great many of those appointed know practically nothing about primary, and still less about secondary education. In some cases which have come before our notice, persons of little education (beyond their own inflated opinion of themselves), but desirous of local fame, and having plenty of "push," have brought themselves forward and been elected, while those who really are educated, and know what education means, have been passed by.

The raising of secondary education to a really high and uniform standard will be extremely costly. But the expenditure on primary education, according to the provisions of the new Act, will absorb such a large amount of the ratepayers' money that they will be disinclined to incur further expenditure in order to make it really efficient. No student can enter a German technical college without passing an extremely searching and thorough examination. In Great Britain the total number of students, from fifteen years and upwards, taking complete day technological courses is 3873; probably not more than 10 per cent. could pass the entrance examination of Charlottenburg.

As an illustration of what Manchester is doing in the way of technical training, Mr. Levinstein gives an account of "the department for preparing, bleaching, dyeing, printing, mercerising and finishing textiles, together with the manufacture of paper." There is no dabbling here with manufacture in a test tube, such as we see in some of our educational institutes. The department is lodged in a separate building apart from the school of technology. It is fitted with the latest and most up-to-date machinery, taken from this country and abroad. As all the machinery is driven by separate motors, there will be no difficulty in replacing it, as it becomes out of date and obsolete, by means of newer and more modern machinery.

In this country we excel in the production of first-class yarn and cloth, made from first-class raw material. These goods will always fetch a good price. But within the last quarter of a century a demand has sprung up for cheap imitations, made from inferior materials, but which must have the external appearance of the first-class article. It is in the weighting of silk, the intermixing of fibres and the manufacture of imitation velvets that the foreigner excels. But the demand is enormous, and if we would hold our own in the markets of the world, we must learn how to manufacture these cheap goods. The British manufacturer must learn to adapt himself to the times and to the tastes and wishes of the consumer.

Manufacturers have often refused to employ chemists, except as "testing machines," because the chemist is so often only a theorist, sometimes not even that, and understands absolutely nothing about machinery. This excuse will, however, soon be no longer tenable. Students who have passed through the department just mentioned at the Manchester Technical School should be fully qualified to take a position not only in dye, bleach, print, mercerising, or finishing works, but also in paper mills. They will have not only a knowledge of chemistry, but also of machinery. It is a pity that technical institutes do not make it compulsory for those who intend to become works chemists to include in the syllabus a course in engineering, both practical and theoretical.

Referring to the "Patent Law Amendment Act," Mr. Levinstein has great hopes that satisfactory results will accrue to our manufacturers. The chief clause in the Act, and one for which British manufacturers have been agitating for many years, is that which deals with the granting of licences. Hitherto the foreigner could patent anything he chose, manufacture it abroad, and "dump" it down here, without his being under any obligation to manufacture it on British soil. And it was a matter of great difficulty to compel him to grant a licence to a British firm to manufacture the goods. Under the new Act, if he does not manufacture in this country, he can be compelled to grant a licence for the manufacture of the product, or failing this his patent may be declared void.

It is only after more than twenty years of agitation that this Act has been passed. Mr. Levinstein reviews the pioneering work which had to be done before the inertia of the Board of Trade was overcome.

Finally, the difficult and vexed question of foreign tariffs is dealt with. Mr. Levinstein considers that the reasons we have not made greater headway, so far as our export trade is concerned, are:—our education has been at fault, our patent laws were bad, and foreign tariffs have often been prohibitive; and we would add the want of adaptability of some of our manfacturers. The Government is also exceedingly slack in making known to our traders, at the earliest moment possible, changes in foreign tariffs. Interested Continental traders learn at once, through their Minister of Commerce, not only changes which have taken place, but changes which are contemplated. But the wheels of our Government, in respect to information which may

be of vital importance to the traders, move so exceedingly slow. The fact is, we require a Minister of Commerce with a competent staff, and the sooner the Government awakes to the fact the better for the country. F. MOLLWO PERKIN.

NOTES.

IT is probably known to some that a project has been started, and is already well advanced, to found a prize for physics at St. Peter's College, Cambridge, as a tribute to the memory of the late Prof. Tait, of Edinburgh, honorary fellow of the college. Besides members of the college who have heartily taken part in the enterprise, many friends of Prof. Tait, both in Belfast and Edinburgh, have recorded their appreciation of him and of his great services to the advancement of science by joining in this memorial of him at the college of which he was so brilliant a member; and it is believed that others, if they were made aware of the proposal, would desire, for a like reason, to be associated with it. Mr. I. D. H. Dickson, St. Peter's College, Cambridge, will reply to any inquiries, and until more formal thanks are made by the college, will gratefully receive and acknowledge any donations that may be sent to him for the purpose of the memorial.

IT is expected that a monument to the electrician, Zenobe Gramme, will shortly be raised in Brussels. Owing to the efforts of M. Léon Janssen, the general manager of the tramways of Brussels, a committee has been appointed to accomplish this purpose.

WE learn from the *British Medical Journal* that the proposal of the German committee of the Virchow memorial to erect a statue of Virchow in one of the public streets of Berlin, near the place where his scientific work was conducted, will be carried out. Contributions towards this memorial should be sent to the Bankhaus Mendelssohn und Cie, Berlin, W., Jägerstr. 49, 50. An obelisk of unpolished grey granite has been placed over Virchow's grave in the old Matthäikirchof, Berlin. It bears on one side a black marble tablet, on which is inscribed "Rudolph Virchow," and the date of his birth and death.

WE regret to see the announcement of the death, in his seventy-first year, of Prof. Rudolf Lipschitz, the professor of mathematics at the University of Bonn.

THE death is announced of Prof. Alexander Rollet, of Graz, in his seventieth year. He was educated at Vienna, but was deeply influenced by Ludwig, and devoted himself especially to the physiology of the blood and muscles. He was called to Graz in 1863, and was four times rector of that university.

A MESSAGE from Rome, through Laffan's Agency, dated October 20, states that Mount Vesuvius is again active, enormous globes of steam being emitted from the principal crater, accompanied by incessant subterranean rumblings and explosions. A stream of lava is flowing down one side of the volcano.

THE Odontological Society of Great Britain announces that it is prepared to receive applications for grants in aid of the furtherance of scientific research in connection with dentistry. For particulars and forms of application inquiry should be made of the honorary secretary, Scientific Research Committee, Odontological Society, 20 Hanover Square, London, W.

THE new college farm established at Madryn, midway between Aber and Llanfairfechan, in connection with the Agricultural Department of the University College of North Wales, was formally opened on October 17 by the Earl of Onslow, President of the Board of Agriculture. In the course of his inaugural address, Lord Onslow advocated the desirability of giving greater attention to forestry in this country.

FOR a long time plague has been endemic in Hong Kong, the disease reappearing after a period of intermission in an inexplicable manner. Prof. Simpson has lately pointed out in a report to the Colonial Office that domestic animals and poultry may contract plague in a latent form from feeding upon plague-infected material, and has suggested that infected food may be a potent source in disseminating the disease. According to the *Times* (October 17) Sir Henry Blake, the Governor, has recently instituted an investigation of the inhabitants and vermin of a large native quarter in the colony certified to be free from plague. This has revealed that a considerable number of the bugs, fleas, spiders and cockroaches contain plague bacilli. Samples of blood from supposed healthy natives upon examination showed the presence of plague bacilli in 5 per cent. of the specimens. Under favourable conditions such infected persons and vermin become possible sources of danger, and sporadic outbreaks must be expected while they are present. It is difficult also to see what measures can be taken to eradicate the disease in these circumstances.

IN the course of the Harveian oration delivered before the Royal College of Physicians on Monday, Dr. W. H. Allchin referred to recent work on radio-activity and the constitution of matter, and its bearing on biological processes. He remarked that as the atomic and molecular theory was utilised to furnish an explanation of that flux of chemical activity which is denominated bioplasm, so have speculations on ionic action been pressed into the same service, and with some promise, wholly hypothetical as they may be. Nerve action is simply electrical action, negative ions being released where nerve blends with muscle or where systems of concatenated neurons come into connection. Ion after ion is precipitated, and thus neural conduction takes place. This play of ions is excited or inhibited by the character of the fluids with which the protoplasm is bathed—by the nature, that is, of the ions which these fluids contain. Most effective in stimulating protoplasmic action are such substances as sodium salts, as those of lime restrain it, and since such inorganic bodies are among the products of tissue waste, it may be that in the ions of metabolism are to be found the causes of that rhythmic tendency to activity which nerve cell and muscle fibre alike exhibit. If normal neuro-muscular action may be thus induced, the theory offers a clue to the comprehension of some of the most obscure morbid manifestations of these tissues. In many departments of physiology, notably in that concerned with nerve and muscle and with secretion, a large mass of information has been acquired as the result of experiments, whilst but little has been done towards ascertaining the ultimate structure of the tissues concerned —little, that is, beyond what was known a score of years ago or more. In respect to such tissues as these, microscopic examination would seem almost to have reached its limits, and for the complete comprehension of the physico-

chemical phenomena, more recently ascertained, the problem of the chemical and electrical constitution of the muscle or nerve fibre and of the gland cell awaits solution.

A REPORT on the photogrammetric measurement of the height of clouds at Simla during the twenty months June, 1900, to January, 1902, by Mr. W. L. Dallas, is published in the *Indian Meteorological Memoirs*, vol. xv. part ii. Only forty-seven good observations were secured, as it frequently happens that the lower clouds are ordinarily thick and below the level of the observatory (7224 feet). These observations give the mean height of cirrus 30,440 feet above Simla, and the maximum height 38,440 feet; of cumulus the mean and maximum heights are 7304 feet and 14,318 feet respectively.

WE have received from Mr. W. G. Davis a work on the climate of the Argentine Republic, compiled from observations made to the end of the year 1900. All the meteorological elements have been submitted to a careful and elaborate discussion, and the work is a most valuable contribution to the climatology of the South American Continent. In a general outline of the treatise, Mr. Davis points out that, in a country which embraces 33° of latitude, and the surface of which slopes from the Atlantic to the snow-clad Andes, great differences must prevail in the atmospheric conditions. In the narrow zone lying to the north of the Tropic of Capricorn, the mean annual temperature varies from 23° C. on the coast to less than 14° at the western limits, while the rainfall decreases from 1600 mm. to less than 50 mm. At 8° or 9° farther south, we find, in the Pampas, a mean temperature of 19°, which rapidly decreases towards the slopes of the Cordilleras; in the eastern part of Entre Rios the rainfall is 1000 to 1200 mm., and diminishes to less than 100 mm. in the province of San Juan. At 10° further south there is little difference in the isotherms (13° or 14°) between the Atlantic and the Andes, while the rainfall (200 to 400 mm.) is practically the same. At the extreme south of the Republic the climate is rigorous; in Tierra del Fuego the summer mean temperature is 8° to 9°, and the winter 2° to 3°. Rains are frequent, and no month is free from snow. At Staten Island the mean annual precipitation is 1400 mm., while in Tierra del Fuego less than half this quantity falls.

MR. R. W. PAUL has sent us his new catalogue of electrical testing instruments. The list, in addition to the usual resistance boxes, bridges, galvanometers, and other familiar testing instruments, includes several new pieces of apparatus and new patterns. Amongst these may be noticed the new pattern of Kelvin double bridge for the measurement of low resistances; there is also a new model Ayrton-Mather narrow-coil galvanometer having conveniently interchangeable coils. A new set of standard wattmeters, designed by Messrs. Duddell and Mather, is included in the list; these are constructed as much as possible from insulating materials, and range from 0·01 watt to 200 kilowatts. We hope to have an opportunity of describing them more in detail later. An interesting type of resistance has been designed for use with these wattmeters; it is made of silk-covered manganin wire, which is woven into a fabric with silk threads, thus giving a high resistance free from errors due to capacity or self-induction.

WE have received from Mr. C. E. Kelway a description of his system for warning ships at sea of approaching danger by equipping lighthouses with Hertzian signalling apparatus. The ships themselves would be fitted with a receiving apparatus which would respond when they came within the range of the wireless signals sent out from the lighthouse; these are to be sent out at regular intervals at the same times as the sound warnings. A ship, by observing the time that passes between receiving the wireless signal and the sound warning, is enabled at once to calculate its distance from the lighthouse; if it now continues on its course for a few miles and then makes a second observation, all the necessary data for ascertaining, trigonometrically, the exact position of the lighthouse are obtained. A special stop-watch reading directly in distances and a special position finder have been devised by Mr. Kelway for use with his system. The system was, we understand, submitted to the consideration of the recent Berlin Wireless Telegraphy Conference; it illustrates one of the many ways in which wireless telegraphy may be made of service to ships.

FROM the *Bulletin* of the Cracow Academy we have received reprints of several papers by Profs. Ladislaus Natanson and St. Zaremba dealing with certain points in the dynamical theory of viscosity.

MESSRS. TEUBNER, of Leipzig, announce the forthcoming publication of a new work entitled "Encyklopädie der Elementar-Mathematik," under the joint authorship of Profs. H. Weber (Strassburg) and J. Wellstein (Giessen). It is specially written for teachers, and will consist of three volumes dealing respectively with elementary algebra and analysis, elementary geometry, and applications of elementary mathematics.

THE *Proceedings* of the Edinburgh Mathematical Society for 1902–3 contain the reprint of some correspondence between Robert Simson (1687–1768, professor of mathematics at Glasgow, 1711–1761), Matthew Stewart (1717–1785, professor of mathematics at Edinburgh 1747–1772), and James Stirling, F.R.S. (1692–1770, author of works on Newton's cubic curves and on the calculus). The correspondence in question was bought at the Gibson Craig sale of manuscripts by Mr. J. S. Mackay in 1887.

THE *Bulletin* of the American Mathematical Society for October contains an English translation of Poincaré's review of Hilbert's "Foundations of Geometry." Hilbert's monograph is undoubtedly a classic, and Poincaré's comments upon it, as might be expected, are full of interest. One passage may be quoted as dealing with a misunderstanding which is too common. "Some people have gone so far as to . . . ask whether real space is plane, as Euclid assumed, or whether it may not present a slight *curvature*. They even supposed that experiment could give them an answer to this question. Needless to add that this was a total misconception of the nature of geometry, which is not an experimental science."

IN the *American Naturalist* for August, Dr. E. W. Doran emphasises the importance of the use of vernacular names for animals, and urges that, when these are of a composite nature, a uniform method in regard to the use of hyphens should be adopted in zoological literature. The rules he proposes with a view of attaining this desirable end will, we think, meet with the general approval of English writers.

MR. C. R. EASTMAN, on morphological grounds, expresses, in the *American Naturalist*, his disbelief in Dr. Patten's assertion that Cephalaspis was provided with a fringe of jointed and movable appendages along the ventral margin of the trunk. No such appendages exist in the allied Pterichthys, and it seems incredible that a vertebrate can possess more than two pairs of limbs. In these respects the writer has the support of Dr. Gaskell.

AT the conclusion of a paper on reptiles and amphibians from Arkansas and Texas, published in the *Proceedings* of the Philadelphia Academy for August, Mr. W. Stone discusses their bearing on previous views as to the zoogeographical zones of this part of the United States. He concludes that the boundary between the Austro-riparian and Sonoran areas, so far as reptiles are concerned, lies between the 96th and 98th meridians of longitude, that the Texan district of Prof. Cope should be referred to the Austro-riparian instead of to the Sonoran province, and that transcontinental zones of distribution are not indicated by reptilian evidence. The marked faunal division between the 96th and 98th meridians is due to this line marking the limits of the heavy rainfall of the Gulf coast.

A CURIOUS problem is presented by the hermit-crab. As is well known, these crustaceans present a marked asymmetry, which nearly always takes the form of a dextral spiral—in correlation with the circumstance that they generally inhabit dextral molluscan shells. Is, then, this asymmetry due to this habit, or was it pre-existent? In discussing this question in a paper on the metamorphoses of the hermit-crab, published in the *Proceedings* of the Boston (U.S.) Natural History Society, Mr. M. T. Thompson concludes that it cannot at present be definitely answered, owing to our imperfect knowledge of the relationships of the different generic representatives of the group. Nevertheless, the asymmetry is structurally adapted to the conditions imposed by the mode of life in question, and the presumption is accordingly very strong that it was from the first the result of a sojourn in dextrally spiral shells.

MR. M. J. NICOLL, who in 1902–3 accompanied the Earl of Crawford in his yacht, the *Valhalla*, round the world as naturalist, and made good collections in several branches of natural history, will again join the *Valhalla*, in the same capacity, next month for a winter tour in the West Indies. Mr. Nicoll's specimens collected during the last voyage are being examined and arranged at the British Museum, to which Lord Crawford has presented them. Mr. Nicoll's ornithological notes made during the voyage will be published in the next number of the *Ibis*.

IT has always seemed strange that so large and strongly marked an animal as the okapi (*Okapia johnstoni*) should have remained unknown to Europeans until its recent discovery on the Semliki by Sir Harry Johnston. But it would now appear, as is suggested by Herr Hesse, that a prior well-known African traveller, Wilhelm Junker, had obtained an imperfect skin of this animal at Zemio, in the Welle-basin, twenty years ago, although he did not recognise the nature of it, and was inclined to refer it to the water-chevrotain (*Hyomoschus aquaticus*). But as the animal was called by the natives "makapi," and was "of the size of a dwarf antelope," it seems more probable that the skin in question was that of a young okapi (see *Journ.* R.G.S., vol. xxii. p. 459).

IN the October number of *Climate* Dr. Louis Sambon continues his series of articles on the chief disease scourges of the tropics, dealing with malaria, yellow fever, cholera, plague and sleeping sickness. Another article of interest discusses the results obtained by the campaign against mosquitoes in various parts of the world.

THE Corporation of London has approved and adopted a series of regulations drafted by its Public Health Department for the sanitary control of the milk supply of the City. Some of these deal with the registration of the premises and their sanitary condition, contamination of milk, milk from diseased cows, &c. Others seek to secure the cleanliness of milk-shops and vessels, and the safeguarding of the milk-supply against infection from without.

THE health of the great armies of Europe is discussed by Dr. V. Lowenthal in an interesting statistical article in the *Revue générale des Sciences* (September 30). Of the armies of the six great Powers, France, Germany, Austria, Russia, Italy, and England, France heads the list both in the total mortality rate and in the attack rate. On the whole the German Army is the most healthy, then comes the Italian, and then the British. But for the enormous incidence of venereal affections, the latter, however, would in all probability appear as the most healthy.

"THE GEOLOGY OF THE COUNTRY AROUND TORQUAY" is the title of a memoir by Mr. W. A. E. Ussher that has just been issued by the Geological Survey. The author has for many years been engaged in a detailed examination of the Devonian rocks, and he gives full particulars of the complex structure of the area and of the several subdivisions of the strata, with lists of fossils. Useful tables are given showing the Continental equivalents. The terra-cotta clays of Watcombe, and the red sandstones and conglomerates that form portions of the picturesque cliffs, are grouped as Permian. Cavern-deposits, Raised Beaches, and other superficial deposits are described, and there is a short chapter on economics.

MESSRS. DAWBARN AND WARD, LTD., are publishing a series of penny pamphlets dealing with various subjects of interest to practical photographers. The first number in the series discusses the prevention and cure of halation, and the fourth number the camera and its movements.

THE ninth annual volume—that for the present year—of the *Reliquary and Illustrated Archaeologist* has been issued by Messrs. Bemrose and Sons, Ltd. The volume contains the four quarterly issues of the magazine which have been published this year, and most of the articles are excellently and profusely illustrated. The publication appeals preeminently to antiquarians, ethnologists and archæologists.

MR. JOHN MURRAY has published a cheap edition—five shillings net—of Nasmyth and Carpenter's classical work on "The Moon." The original work was published thirty years ago, and was reviewed in these columns on March 12, 1874 (vol. ix. p. 358). Three editions of the book were issued, but they have been out of print for several years, and the publication of the work in a popular and compact form will be welcomed by many students of astronomy.

A FIFTH edition of the "Manual of Pathology" by the late Prof. Joseph Coats has been published by Messrs. Longmans, Green and Co. The new edition has been revised throughout by Prof. L. R. Sutherland, and considerable alterations have been made without interfering materially with the original plan of the book. The chapter on bacteriology has been omitted, and the illustrations have been increased in number from 490 to 729. Two new coloured plates have also been added.

THE fourth revised edition of Prof. Max Verworn's "Allgemeine Physiologie" has been published by Mr. Gustav Fischer, Jena. The first edition of this well-known work was reviewed in NATURE in 1895 (vol. li. p. 529). A translation of the second edition, by Dr. F. S. Lee, was published in 1899, and was also noticed at length in these columns (vol. lx. p. 565). Since the third German edition was published in 1901, progress has been made in the

knowledge of the physiology of the cell, and the sections devoted to this subject have been carefully revised for the new edition now available.

WITH the advance of scientific education in this country scientific instrument makers are continuously bringing out improved forms of apparatus. We have recently received from Messrs. Brewster, Smith and Co. an improved form of a "double surface condenser." This is one of the most compact and efficient condensers which has come before our notice. We have tested it for condensing such volatile substances as ether, carbon disulphide, and acetone, and have found that even with rapid distillation the condensation is very complete. Generally speaking, in order to condense these substances satisfactorily, it is necessary to employ a very long condenser; of course, this means using a great amount of bench space. As the new condensers are used in a perpendicular position, the saving in space is very great.

MESSRS. BREWSTER, SMITH AND CO. have also sent us a "new Bunsen burner and midget furnace." It can hardly be said that the Bunsen burner is new, but the combination of furnace and burner is very convenient. The makers claim that marble is reduced to quicklime in ten minutes. This will, of course, to a large extent depend upon the quantity of marble taken in the first place—we find that from one to one and a half grms. is readily reduced to quicklime in twenty minutes. These little furnaces are not only useful for reducing calcium carbonate to lime, but also work very well in fusion experiments.

THE measurements by Biltz and Preuner of the density under different pressures of sulphur-vapour at 448° have usually been regarded as indicating that the vapour is composed of S_8 and S_2 molecules, and that the molecule S_6 does not exist. The application to the isothermal of the law of mass-action, discussed by Preuner in the *Zeitschrift für physikalische Chemie*, shows that this theory is inadequate, and that the vapour must contain molecules intermediate in complexity between S_8 and S_2. The proportions by volume of the constituents are calculated to be, under 10·4 mm. pressure, 29·2 per cent. S_8, 19·0 S_6, 19·7 S_4 and 32·1 S_2, and under 453·4 mm. pressure, 77·8 S_8, 15·1 S_6, 4·7 S_4 and 2·4 S_2.

SINCE Beckmann showed that iodine in all solvents has the molecular weight I_2, it has been suspected that the formation of violet or brown solutions is dependent upon the extent to which the iodine combines with the solvent. By means of comparative experiments on the solubility of iodine and the periodide $N(CH_3)_4I_9$, described in a recent number of the *Zeitschrift für physikalische Chemie*, Strömholm has obtained evidence that iodine actually combines with water, alcohol and ether, forming brown solutions, whilst the violet solutions in carbon disulphide, benzene and chloroform contain uncombined iodine; similarly it is shown that iodine has little tendency to combine with methyl iodide when dissolved in ether, or with sulphur dissolved in carbon disulphide.

THE additions to the Zoological Society's Gardens during the past week include a Black Lemur and young (*Lemur macaco*) from Madagascar, a Brazilian Hare (*Lepus brasiliensis*) from Brazil, eight Hamsters (*Cricetus frumentarius*), a Snow Bunting (*Plectrophenax nivalis*), four Lacertine Snakes (*Coelopeltis monspessulana*), two Dark-green Snakes (*Zamenis gemonensis*), a Vivacious Snake (*Tarbophis fallax*), European; three Cuban Snakes (*Liocephalus andreae*) from Cuba, two Garter Snakes (*Tropidonotus ordinatus*), a Prickly Trionyx (*Trionyx spinifer*) from North America, a South Albemarle Tortoise (*Testudo vicina*) from Galapagos, a Wrinkled Terrapin (*Chrysemys scripta rugosa*) from the West Indies, two Amboina Box Tortoises (*Cyclemys amboinensis*) from the East Indies, two Annulated Terrapins (*Nicoria annulata*) from Western South America, a Horned Lizard (*Phrynosoma cornutum*) from Mexico, a Carinated Lizard (*Liocephalus carinatus*) from the West Indies, two Hispid Lizards (*Agama hispida*) from South Africa, two Scoresby's Gulls (*Leucophoeus scorebii*) from Chili, deposited; a Tasmanian Devil (*Sarcophilus ursinus*) from Tasmania, received in exchange.

OUR ASTRONOMICAL COLUMN.

SEARCH-EPHEMERIS FOR COMET 1896 v.—A further portion of the search-ephemeris for Giacobini's comet (1896 v.), published by Herr M. Ebell in No. 3898 of the *Astronomische Nachrichten*, is given below. As will be seen from this ephemeris the computed brightness is now decreasing, although the comet should be in a favourable position for observers in the northern hemisphere:—

12*h*. *M.T. Berlin.*

1903	α h. m. s.	δ ° ′	log *r*	log Δ	Brightness.
Oct. 28	3 54 51	+ 8 6·5	0·2943	0·0130	2·21
Nov. 1	3 51 18	+ 7 23 8			
,, 5	3 47 33	+ 6 43·7	0·3055	0·0242	1·99
,, 9	3 43 40	+ 6 7·0			
,, 13	3 39 46	+ 5 34·0	0·3165	0·0410	1·75
,, 17	3 35 56	+ 5 5·3			
,, 21	3 32 15	+ 4 40·9	0·3274	0·0633	1·51
,, 25	3 28 50	+ 4 21·2			
,, 29	3 25 44	+ 4 6·0	0·3381	0·0901	1·27

A NOVEL FEATURE FOR GEODETICAL INSTRUMENTS.—In a paper contributed to No. 26, vol. iii., of the *British Optical Journal*, Sir Howard Grubb describes a novel feature in geodetical instruments which replaces the half-silvered, half-plain piece of glass generally used in such instruments by a piece of glass having a thin film of lead sulphide deposited on its surface. This film both reflects and transmits the incident light, and by varying its thickness the proportion of transmitted to reflected light may be varied.

Taking the case of the prismatic compass as an illustration, the rays of light from the object the position of which is to be determined are transmitted by the film of lead sulphide, and, at the same time, the previously collimated rays from the compass card are reflected by it. As both sets of rays are parallel, and the reflection of the card is superimposed on the image of the distant object, parallax does not interfere in the observations, and the position of the eye may therefore be changed without introducing any error into the reading, thereby rendering it possible to make the readings much more quickly and accurately than when using the older forms of reflecting-transmitting apparatus.

THE PATH OF COMET 1894 I. (DENNING).—No. 2 of the *Mitteilungen* of the Heidelberg Observatory contains a paper by Dr. P. Gast on the observations and calculations of the path of comet 1894 I.

The first part is devoted to a series of new observations of the comparison stars made during the year 1902, and is followed by a collection of the observations of the comet which were made at various observatories, then the various observations are compared among themselves and with the computed elements of this comet. The paper concludes with a discussion of the perturbations produced by Jupiter and the finally deduced elements. In a supplementary list the positions of eighty-eight reference stars for the year 1900 are given, the value of the precessional constant, the secular variation, and the star's proper motion being stated in each case.

OBSERVATIONS OF MARS.—In the October number of the *Bulletin* de la Société astronomique de France, MM. Flammarion and Benoit publish the results of their observations of Mars made at Juvisy during the last opposition of that planet. Although the planet was nearer to the earth during this opposition than it was in 1901, the unfavourable meteorological conditions prevented the making

of a complete record, but the set of fourteen drawings of the polar cap which accompany the paper show very clearly the diminution of the cap from October 15, 1902, to March 15, 1903, and its augmentation from then until July 1, the minimum apparently taking place at an earlier date than usual.

In addition to detailed descriptions of the most interesting observations, the paper contains reproductions of ten excellent drawings showing various features on the planet's surface.

NATAL GOVERNMENT OBSERVATORY.—The report of the Government Astronomer for Natal, Mr. E. Nevill, for 1902 is chiefly devoted to the various meteorological records of the colony, and forms a valuable addition to the meteorology of last year.

After giving brief descriptions of the staff, the instruments, the management of the time signals, the magnetic observations, and the tide records, the report gives a number of tables containing very complete records of the meteorological results obtained at the Durban Observatory and twenty-two inland stations, and the less complete records of twenty-six subsidiary stations which are scattered throughout the colony.

In dealing with this section of the report Mr. Nevill directs special attention to the importance of obtaining the fullest possible records of the meteorological conditions in Natal, because, in addition to their local importance, it has been shown that there is a very close connection between them and the conditions obtaining in Australia and India. In the latter case there are trustworthy indications that the meteorological conditions of Natal are those which are likely to prevail in India during the following season; this is especially marked in the case of the rainfall.

INHERITANCE OF PSYCHICAL AND PHYSICAL CHARACTERS IN MAN.[1]

THERE are probably few persons who would now deny the immense importance of ancestry in the case of any domestic animal. A majority of the community would probably admit also that the physical characters in man are inherited with practically the same intensity as the like characters in cattle and horses.

But the preeminence of man in the animal kingdom is justly attributed, not to his physical, but to his psychical character. The latter is seen developing apparently under the influences of home and of school, and we conclude, perhaps too rashly, that home and school are the chief sources of the psychical qualities. We are too apt to overlook the possibility that the home standard is itself a product of stock, and that the relative gain from education depends in a surprising degree on the raw material presented to the educator.

It is possible to hold this view and yet believe that moral and mental characters are inherited in either a qualitatively or a quantitatively different manner from the physical characters. Both may be influenced by environment, but one in a far more marked way than the other.

Some six or seven years ago, then, I set myself the following problem: What is the quantitative measure of the inheritance of the moral and mental characters in man, and how is it related to the corresponding measure of the inheritance of the physical characters?

The problem really resolved itself into three separate investigations:—

(*a*) A sufficiently wide inquiry into the actual values of inheritance of the physical characters in man.

For this investigation upwards of 1000 families were measured, giving ample means of determining the quantitative measure of resemblance for both parental and fraternal relationships.

(*b*) A comparison of the inheritance of the physical characters in man with those in other forms of life.

No substantial difference in this inheritance has been discovered.

(*c*) An inquiry into the inheritance of moral and mental characters in man.

Owing to the great difficulty of comparing the moral characters of a child with those of its adult parents, I confined my attention to *fraternal* resemblance, for if fraternal resemblance for moral and mental characters is less than, equal to, or greater than its value for physical characters, the same must be true for parental inheritance.

In the next place it seemed impossible to obtain moderately impartial estimates of the psychical characters of *adults*. The inquiry, therefore, was limited to *children*, so that the partial parent or relative could be replaced by the fairly impartial school teacher.

After much consideration and some experimenting, schedules were prepared in which teachers could briefly note the chief characteristics of the children under their charge. These schedules were white for a pair of brothers, pink for a pair of sisters, and blue for a brother and sister. With the schedules specially devised headspanners were distributed, directions for the use of the headspanner, and general directions as to the estimation of the physical and mental characters.

The material took upwards of five years to collect. Appeal was made through the columns of the educational journals to teachers of all kinds, and the observations were made not only in the great boys' public schools and the grammar schools of the country, but in modern mixed schools, in national and elementary schools of all kinds, in board schools, and private schools throughout the kingdom. Some 6000 schedules were distributed, and between 3000 and 4000 returned with more or less ample data. I have most heartily to thank the masters and mistresses of some 200 schools in which observations have been made for me. In the midst of arduous professional claims on their time and energy, they have, in many cases at considerable personal inconvenience, recorded and measured the children in their charge for a purpose only dimly foreshadowed for them.

Much of what I have to say upon the nature of the theory applied will not be new to those who have examined recent biometric work, and some of it will not be intelligible except to the trained mathematician. Still we must strive in broad lines to see how the work has been done, and, above all, to justify our treatment of the psychical character.

[To illustrate the method the lecturer examined the degree of resemblance between the cephalic indices of brothers, the cephalic index of a person being 100 × the ratio of breadth to length of head. This scarcely changes with growth after the first two years of life. A table was exhibited showing the cephalic index for 1982 pairs of brothers.]

Taking the boys, for example, with cephalic indices between 74 and 75, these boys had seventy-eight brothers who were distributed according to the column headed 74 to 75. Brothers are not alike in cephalic index, but distributed with a considerable range of variation. The arithmetic mean of the cephalic indices of this array of brothers is 77·45. Thus the average brother of a boy with cephalic index 74·5 has a cephalic index =77·45. This is the phenomenon of regression towards the general population mean (78·9) discovered by Francis Galton.

We now find by taking all the arrays that whatever the cephalic index of first brother be, cephalic index of mean second brother

$$= (1-\alpha)\{\text{mean cephalic index of whole population}\} + \alpha\{\text{cephalic index of first brother}\}$$

and that in the case of cephalic indices for two brothers the quantity α, defined as the "resemblance," has the value 0·5.

Now from this result we have learnt two great features about inheritance in man. Firstly, that part of the cephalic index of the second brother depends in the above linear manner on that of the mean of the whole population and part on that of the first brother; and, secondly, that these parts are about equal. Are these true for other characters than the cephalic index? Undoubtedly, for all physical characters. And further, the fraction α, which we have called the resemblance, is, for brethren, in all cases about 0·5.

This surprising uniformity in the inheritance of the measurable physical characters can be extended to physical characters not capable of accurate measurement, and to psychical characters provided we assume a certain distribution of frequency for such characters in human popu-

[1] Abstract of the Huxley Memorial Lecture for 1903. Delivered before the Anthropological Institute on October 16, by Prof. Karl Pearson, F.R.S.

lations. Suppose, then, we assume that the moral and mental qualities in man, like the physical, follow a normal law of distribution. What results shall we obtain by thus assuming perfect continuity between the physical and psychical? I cannot free myself from the conception that underlying every psychical state there is a physical state. Hence I put to myself the problem as follows :—

Assume the fundamental laws of distribution which we know hold for the physical characters in man, and see whither they lead us when applied to the psychical characters. They must (*a*) give us totally discordant results. If so, we shall conclude that they have no application to the mental and moral attributes. Or (*b*) they must give us accordant results. If so, we may go a stage further, and ask how these results compare with those for the inheritance of the physical characters; are they more or less or equally subject to the influence of environment? Here are the questions before us. Let us examine how they are to be answered. Taking as an example *ability in girls*, we find that the resemblance between sisters is 0.47. There can, I think, be no doubt that *intelligence* or *ability* follows precisely the same laws of inheritance as cephalic index or any other physical character.

I ask you to admit that I came to this inquiry without prejudice. I expected *a priori* to find that the home environment largely affected the resemblance in moral qualities of brothers and sisters. Putting any thought of prejudice on one side, accept for a moment the methods adopted, and look at the broad results of the inquiry. You have in the first table the mean resemblance of the physical characters of brothers and sisters from my records of family measurements. You have in the second table the mean of the physical measurements of our school records. These two series absolutely confirm each other, and give a mean resemblance of 0.5 nearly between children of the same parents for all physical characters. How much of that physical resemblance is due to home environment? You might at once assert that size of head and size of body are influenced by food and exercise. It is quite true. But can any possible home influence affect cephalic index or eye colour? I fancy not; and yet these characters are within broad lines inherited exactly like the qualities directly capable of being influenced by nurture and exercise. I am compelled to conclude that the environment influence on physical characters is to the first approximation not a great disturbing factor when we consider degrees of fraternal resemblance in man.

Now turn to the list of the degrees of resemblance in the mental and moral characters. We find, perhaps, slightly more irregularity than in the case of the physical characters. The judgment required is much finer, the classification much rougher, but the obvious conclusion is still that the values of the coefficient α giving the resemblance again cluster round 0.5.

We are forced, I think literally forced, to the general conclusion that the physical and psychical characters in man are inherited within broad lines in the same manner and with the same intensity.

This *sameness* surely involves something additional. *It involves a like heritage from parents.* So we inherit our parents' tempers, our parents' conscientiousness, shyness and ability, even as we inherit their stature, forearm and span.

At what rate is that? [A table was shown which represents our present knowledge of parental inheritance in man and in the lower forms of life, the resemblance of parent and offspring being again roughly 0.5.] So the psychical characters are not features which differentiate man from the lower types of life.

If the conclusion we have reached to-night be substantially a true one, and for my part I cannot for a moment doubt that it is so, then what is its lesson for us as a community? Why, simply that geniality and probity and ability, though they may be fostered by home environment and good schools, are nevertheless bred and not created. The education is of small value unless it be applied to an intelligent race of men.

Our traders tell us we are no match for the Germans or Americans. Our politicians catch the general apprehension and rush to heroic remedies. Looking round impassionately from the calm atmosphere of anthropology, I fear there really does exist a lack of leaders of the highest intelligence, in science, in the arts, in trade, even in politics. I do seem to see a want of intelligence in the British professional man and in the British workman. But I do not think the remedy lies in adopting foreign methods of instruction or in the spread of technical education. I believe we have a paucity just now of the better intelligences to guide us, and of the moderate intelligences to be guided. The only account we can give of this on the basis of the result we have reached to-night is that we are ceasing as a nation to breed intelligence as we did fifty to a hundred years ago. The only remedy, if one be possible at all, is to alter the relative fertility of the good and bad stocks in the community. We stand, I venture to think, at the commencement of an epoch which will be marked by a great dearth of ability. We have failed to realise that the psychical characters which are in the modern struggle of nations the backbone of a State are not manufactured by home and school and college; they are bred in the bone; and for the last forty years the intellectual classes of the nation, enervated by wealth or by love of pleasure, or following an erroneous standard of life, have ceased to give us the men we want to carry on the ever-growing work of our Empire, to battle in the fore rank of the ever-intensified struggle of nations.

The remedy lies in first getting the intellectual section of our nation to realise that intelligence can be aided and be trained, but no training or education can create it. You must breed it; that is the broad result for statecraft which flows from the equality in inheritance of the psychical and the physical characters.

THE APPLICATION OF LOW TEMPERATURES TO THE STUDY OF BIOLOGICAL PROBLEMS.[1]

THE cellular doctrine lies at the basis of modern biological research. Living matter in its simple and complex conditions consists essentially of protoplasm with a contained body or nucleus. The two elements plasma and nucleus constitute the elementary organism—the cell. The lowest individual forms of life are represented by a single cell, and such unicellular organisms may be either of a vegetable or animal type. The cells in each instance exist as free living and independent organisms. The higher forms of life are built up of parts in which the structural unit remains the cell, despite the modifications the cell necessarily undergoes as a fixed element in the various tissues and organs. All phases of animal and plant life are demonstrably of cellular origin and organisation, and their vital manifestations represent the summed up activities of cells. Every vital problem, therefore, is ultimately a cellular problem, and a direct study of the cell, in so far as may be possible, is the keynote of biological research. The methods to be adopted will depend upon the problem it is desired to investigate. A histological technique, aided by the microscope, will naturally be employed where it is desired to study the relations of parts and the structural organisation of the tissues and their cellular elements. The soluble products of the living cell spontaneously present themselves for examination by chemical and other means. It is otherwise with regard to the agencies acting and the processes occurring within the confines of the cell. These are naturally beyond the range of the ordinary methods of observation. The essential processes of life are intracellular and intimately bound up with the living substance of the cell, and of these but few data are possessed. The importance of the problems involved is as great as their investigation is difficult. The cell exercises its vital functions in virtue of a specific physical and chemical organisation of its molecular constituents. The ordinary methods of biological and chemical research modify or destroy this organisation, and do not admit of an intimate study of the normal cell constituents. For this purpose it is essential to eliminate or to reduce to a minimum the influence of external modifying agents on the cell or its immediate products. An intracellular physiology can only be based on a direct study of intracellular constituents apart from their secretions and products. This, in ordinary circumstances, is impossible with

1 By Dr. Allan Macfadyen. Communicated to Section B of the British Association at Southport, by Prof. J. Dewar, F.R.S.

respect to actively functionating and intact cells. It is obvious, therefore, that the first desideratum is a suitable method of obtaining the cell plasma for experimental purposes, and it is only recently that this has been successfully accomplished. The most feasible means of procedure appeared to be the use of *mechanical* agents which, whilst bringing the cell substance within the field of observation, would, at the same time, be least likely to affect its character and constitution. The method consists in a mechanical rupture of the cells and the release of their contents under conditions favouring the conservation of their properties. The first successful application of this description of method was made by Buchner in the particular instance of the yeast cell, and with brilliant results. The researches of Buchner were of wide biological significance, and were suggestive of much more than a cell-free alcoholic fermentation of sugars. They demonstrated the possibilities of the new methods with regard to more general vital problems. The Buchner process consisted in a mechanical trituration of the yeast cell with the aid of sand and a subsequent filtration of the resultant mass under pressure through Kieselguhr. The filtrate contained the expressed constituents of the yeast cell which were capable of passing through Kieselguhr, and the product, in virtue of its fermentative properties, was termed "zymase."

The author and his colleagues have, during the past four years, been engaged in investigating the application of cognate methods to biological research. The advice and help generously afforded by Prof. James Dewar materially forwarded the progress of the research.

It was considered that, by the employment of low temperatures, a disintegration of living cells might possibly be accomplished, and a wide field of inquiry opened to investigation in the biological laboratory. For this purpose the methods of mechanical trituration required refinement in several directions.

The conditions it was desired to fulfil were, a rapid disintegration of the fresh tissues and cells, an avoidance of heat and other modifying agents during the process, and an immediate manipulation of the cellular juices obtained.

It had likewise been noted that ordinary filter pressing through Kieselguhr removed physiologically active substances from the cell juices. Liquid air appeared to be the most convenient means of obtaining the necessary cold, and it presented the advantage of a fluid freezing medium in which the material to be manipulated could be directly immersed. The temperature of this reagent (about $-190°$ C.) would, in addition, prevent heat and chemical changes, whilst reducing the cells to a condition of brittleness favourable to their trituration without the addition of such substances as sand and Kieselguhr, which might modify the composition of the resultant product.

The method, if successful, would meet the conditions desired for the subsequent study of the intracellular juices. It may be briefly and generally stated that, by the application of low temperatures, a mechanical trituration of every variety of cell *per se* has been accomplished, and the fresh cell plasma obtained for the purpose of experiment. A number of control experiments have demonstrated that immersion in liquid air is not necessarily injurious to life—bacteria, for example, having survived a continuous exposure for six months to its influence. The actual trituration of the material is accomplished in a specially devised apparatus, which is kept immersed during the operation in liquid air.

The normal and diseased animal tissues have been treated in this manner, and their intracellular constituents obtained, *e.g.* epithelium, cancer tissues, &c.

Moulds, yeasts and bacteria have been rapidly triturated under the same conditions, and the respective cell juices submitted to examination.

The severest test of the capabilities of the method was furnished by the bacteria, an order of cells for which the standard of measurement is the *mikron*. The experiments proved successful in every instance tested. The typhoid bacillus, for example, is triturated in the short space of two to three hours, and the demonstration has been furnished that the typhoid organism contains within itself a toxin. From these and other researches it has become evident that there exists a distinct class of toxins and ferments which are contained and operate within the cell or bacterium, in contradistinction to the now well-known class of toxins which are extracellular, *i.e.* extruded during life from the cell into the surrounding medium. To this latter class belongs the diphtheria toxin, which has been so successfully used in the preparation of diphtheria antitoxin. A number of infective organisms do not produce appreciable extracellular toxins, and the search must therefore be made within the specific cells for the missing toxins to which the intoxication of the body in the course of the disease in question is probably due. The practical utility of investigating these intracellular toxins has already become evident in the preparation from the intracellular toxin of the typhoid bacillus of a serum having antitoxic value as regards this toxin.

The experiments made with the pus organisms have already shown that intracellular toxins exist in this important order of disease germs.

The cell juices of other types of pathogenic bacteria, such as the tubercle and diphtheria bacillus, present characteristics of equal interest.

The application of low temperatures has aided the investigation of certain other biological problems.

The photogenic bacteria preserve their normal luminous properties after exposure to the temperature of liquid air. The effect, however, of a trituration at the same temperature is to abolish the luminosity of the cells in question. This points to the luminosity being essentially a function of the living cell, and dependent for its production on the intact organisation of the cell.

The rabies virus has not yet been detected or isolated, although regarded as an organised entity. The seat of the unknown rabies virus is the nervous system. If the brain substance of a rabid animal be triturated for a given length of time at the temperature of liquid air, its infective properties as regards rabies are abolished. This result appears to be a further indication of the existence in rabies of an organised virus.

The method described admits of a fresh study of the question of immunity from an intracellular standpoint.

The intracellular juices of the white blood cells have been obtained, and tested with regard to bacteriolytic properties and the natural protection that may thus be afforded to the body against the invasions of microparasites.

The application of low temperatures to the study of biological problems has furnished a new and fruitful method of inquiry.

PHYSICS AT THE BRITISH ASSOCIATION.

THE meeting of the International Meteorological Committee at Southport during the week of the meeting of the Association resulted in an unusually large proportion of the papers presented to Section A dealing with cosmical problems, and these were taken in the department of the section devoted to astronomy and meteorology. Of the matters brought before the department devoted to physics, there seems little doubt that the most important were those involved in the discussions on the introduction of vectorial methods into physics, on the treatment of irreversible processes in thermodynamics, and on the nature of the emanations from radio-active substances respectively, and of these a short account follows.

In opening the discussion on the introduction of vectorial methods into physics, Prof. Henrici pointed out that, although vectors were invented for use in dynamics, the ideas involved were fully introduced into physics by Faraday's representation of the stresses in a medium by lines of force. Maxwell was aware of this, and devoted some sections of the opening chapter of his "Electricity and Magnetism" to an exposition of the properties of vectors, and expressed many of his later equations in vectorial form.

So long as we have to deal with quantities which involve magnitude and direction, but which are not specified as starting from a definite point, *i.e.* with non-localised vectors, a very simple algebra is all that is necessary, and when at any time it is required to extend our methods to localised vectors the methods of Grassmann's "Ausdehnungslehre" are available. The algebras which have been proposed for dealing with the simpler case agree in making addition follow the parallelogram law for compounding two forces, but they differ in the meanings they

attach to multiplication. In Prof. Henrici's algebra the products of two vectors α, β are:—$(\alpha\beta)$ a non-directional or "scalar," in magnitude equal to the product of one vector into the component of the other along the first, and $[\alpha\beta]$ a vector perpendicular to the plane drawn through α and β, and in magnitude equal to the area of the parallelogram of which α and β are concurrent sides. This algebra is evidently identical with those of Heaviside and Gibbs, and, like them, open to the objection that it does not discriminate between "polar" vectors, *e.g.* forces and "axial" vectors, *e.g.* couples. Its relation to that of quaternions is expressed by the equation $\alpha\beta = -(\alpha\beta)+[\alpha\beta]$, where $\alpha\beta$ is the quaternion product of α and β. If, now, u be a scalar function of the vector ρ of a point P, and P be displaced through a distance $d\rho$, the change du in the value of u will be proportional to $d\rho$, and may be denoted by $d\rho \,.\, \nabla u$, where ∇u is a vector such that for a given magnitude of $d\rho$, du is a maximum when $d\rho$ is parallel to ∇u. Hence the direction of ∇u is that of the greatest rate of change of u, and its magnitude that rate of change. Similarly for a vector function η of ρ $d_\rho\eta = (d\rho\nabla\cdot)\eta$, and ∇ follows quite generally the laws of combination of vectors. Thus we have $(\nabla\eta)$ the "divergence" of η and $[\nabla\eta]$ the "curl" of η, with their numerous applications. By the use of this operator ∇, theorems like those of Green and Stokes can be proved in a generalised form with great ease and elegance, and the equations for the electromagnetic field follow in a couple of lines of work.

With so powerful a calculus as this at command, Prof. Henrici considers it the height of folly, after using vectorial methods in those elementary parts of physics which deal with addition of forces or velocities, to drop them for Cartesian coordinates and direction cosines at the next step forward. He advocates the use of vectors throughout, and, like Heaviside, would make trigonometry follow and depend on vectors by the definitions $x = r\cos\theta$, $y = r\sin\theta$. Vectors would thus be introduced into school curricula previous to or along with the use of squared paper and the idea of coordinates.

In the discussion which followed, Sir Oliver Lodge, Dr. Sumpner and others spoke as to the usefulness of vectorial methods in physical work. Prof. Larmor said there could be no doubt as to the extreme elegance of vectorial methods, and attributed the slow progress they had made to the want of uniformity in definitions and notation, which rendered it necessary for each writer who used vectors to describe his notation and methods before his work could be understood by his readers. Mr. Swinburne also referred to this difficulty. Prof. Boltzmann pointed out that this confusion would have been avoided if Hamilton had accepted Grassmann's methods and notation. The writer suggested that the question of the possibility of introducing greater uniformity into the notation and methods of vector algebra was a suitable one to be considered by a committee of the British Association. Prof. Henrici thought there would be little difficulty in coming to some agreement between the advocates of the various systems now in existence. His communication was ordered to be printed *in extenso* in the reports, so that those interested in the subject might be able to consider the suggestions made in detail.

Mr. Swinburne opened the discussion on the treatment of irreversible processes in thermodynamics by pointing out that so much attention was devoted in books on thermodynamics to the consideration of the changes involved in reversible processes, and so little to irreversible ones, that there was a danger of the latter being overlooked, although they are the only ones which really occur in nature. His object was to bring them more prominently forward, and to suggest a method of introducing the subject which would not involve alteration or extension of fundamental ideas on passing from reversible to irreversible changes. The sketch of the method he proposed was necessarily brief, and it was not easy at the time to see to what the proposals made would eventually lead. This probably accounts for the unsatisfactory nature of the discussion, which consisted to a great extent of statements by the speakers that they had been unable to understand what was proposed, or of condemnation of any attempt to alter the definition of entropy. Fortunately, copies of Mr. Swinburne's communication were available, and a quiet perusal of his suggestions shows that they are by no means so drastic as was supposed.

He points out that, while the first law of thermodynamics asserts that heat is a form of energy, the second states that only a portion of a given supply of heat is available for conversion into work, although energy of other forms is wholly convertible. That part of a supply of heat which cannot be converted into work during a cyclic change of state of the body containing the heat he proposes to call the "waste heat." It depends on the temperature of the coldest available reservoir of heat of large capacity, say that of the sea. Any process which goes on in an isolated system involves in general an increase of this "waste," and the quotient of this increase by the temperature of the coldest available reservoir of heat Mr. Swinburne defines as the increase of entropy of the system during the process.

A part of the system may decrease in entropy, but the rest must increase by at least an equal amount. If the increase is equal to the decrease the increase is said to be "compensated," if it exceeds the decrease the excess is the "uncompensated" increase of entropy. A reversible change in an isolated system involves no increase of entropy of the system, and any change in the entropy of any part of the system must therefore be "compensated." When irreversible changes occur there is an increase of entropy of the system, and an uncompensated increase of entropy of some part of it. So far as reversible changes are concerned, it is evident that Mr. Swinburne's definition of entropy leads to the same result as the one commonly used, *i.e.* $\int \frac{d\mathrm{H}}{\theta} = d\phi$. For if in a Carnot cycle heat H_1 is taken in by the working substance at a temperature θ_1, the increase of entropy of the substance $= \mathrm{H}_1/\theta_1$, and if at the temperature of the coldest available reservoir θ_0, H_0 is given up by the substance, H_0 is Mr. Swinburne's waste heat, and H_0/θ_0, according to his definition, the increase of entropy of the substance when it took in H_1 from the reservoir θ_1. As temperatures are measured on the absolute scale, the two quantities are identical.

From this point onwards Mr. Swinburne's treatment of the equilibrium of isolated systems is much like those in use at present, except that he objects to the use of some of the names, *e.g.* "thermodynamic potential," now commonly used.

Prof. Perry, in the discussion which followed, stated that engineers, while using the definition of entropy which connected it with reversible changes, were quite aware that most of the processes with which they had to deal were irreversible, and that their theory was an approximation only.

Prof. Larmor thought Mr. Swinburne's method was a praiseworthy attempt to introduce simplification and precision into a part of the subject which had received little attention, and was still somewhat obscure, and Mr. Boys added that the ideas brought forward were well worthy of careful consideration.

Before stating his views as to the nature of the emanations from radio-active substances, Prof. Rutherford gave a short *résumé* of the known facts about radio-activity. Substances which possess the property throw off material which carries with it a positive electric charge. This charged material can penetrate to some extent through solids, is deviated in electric and magnetic fields, and appears to consist of particles of matter of about twice the weight of a hydrogen atom, moving with a velocity about one-tenth that of light. This is known as the α radiation, and accounts for about 99 per cent. of the energy sent out by a radio-active substance. Another kind of radiation, known as the β or kathode ray, is also emitted. It is negatively charged, more penetrative and more easily deviated than the α radiation, and appears to consist of particles of about one-thousandth the mass of the hydrogen atom. A third kind of radiation, known as the γ, is more penetrative still, but up to the present has not been sufficiently studied to enable its properties to be definitely stated. The matter which remains after the α radiation has been thrown off behaves in the case of thorium and radium like a gas of large molecular weight, diffuses, condenses at low temperatures, may deposit itself on bodies with which it comes into contact, and may again divide into a posi-

tively charged α radiation and a second emanation, and so on until the changes cease to produce the usual effect on an electrometer. Whatever the nature of the radio-active material, the amount of radiation it emits in unit time is equal to λ times the amount of radio-active element present, where λ is a constant for each type of matter, and is unaffected by chemical and physical agencies.

Prof. Rutherford regards the process which goes on in radio-active substances as a gradual breaking up of the atoms of the substance, and this gradual disintegration as the cause of the radio-active properties. The electrically neutral atom of a radio-active substance throws off a positively charged body which constitutes the α radiation; what remains of the atom constitutes the emanation. This again throws off a positively charged body, and the process repeats itself until the positively charged bodies are exhausted, and the substance no longer possesses radio-active properties.

This disintegration theory fits all the known facts, but it involves the existence in the atom of a radio-active substance of a store of energy hitherto unsuspected, amounting in the case of radium to at least 10^{16} ergs per gram. This energy exists, according to Prof. Rutherford, as kinetic energy of motion of the atoms in closed paths with velocities comparable with that of light, and disintegration is the moving off at a tangent of one or more of the particles of an atom. If this is the case it seems probable that the atomic energy of elements not yet found to be non-radio-active is of the same order of magnitude, and may be set free by methods of which we are not yet cognisant.

In the discussion which followed Sir Oliver Lodge said the theory put forward by Rutherford seemed to him to be a valuable working hypothesis, very near, if not absolutely, the truth. It was supported by Larmor's electrical theory, according to which the atoms of matter should be unstable.

Lord Kelvin, in a letter communicated to the section, put forward another theory as to the nature of the processes going on in radio-active materials. According to it each atom of matter has positive electricity distributed uniformly through its mass, and concentrated at one or more points, in general within it, atomic quantities of negative electricity, to which Lord Kelvin gives the name "electrions." A normal atom has the necessary number of electrions to neutralise the positive electricity associated with its matter. The α radiation consists of atoms of matter which have less than the normal number of electrions. When they move into matter they quickly pick up the negative charges necessary to render them neutral, and cease to be detected. The β radiation consists of electrions thrown off during violent oscillations of the atoms of matter, and are readily absorbed by matter. The γ radiation consists of vapour of the radio-active matter, *e.g.* radium, which would possess the penetrative power it is found to have if the Boscovichian forces between the atoms of radio-active matter and ordinary matter were small. The large amount of energy radiated is, according to this view, derived from without the atoms, where it exists in a form which we have not yet found a means of detecting.

Prof. Armstrong pointed out that, as the experiments of Rutherford and Soddy had been made on what was supposed to be radium bromide, the dissociation which they believed to be taking place might be of the compound and not of the element. He was disposed to regard Lord Kelvin's theory with favour.

Mr. Soddy thought ordinary chemical changes were excluded by the fact that the rate of production of the radiations was unaffected by chemical and physical conditions which greatly affected the former. The view Prof. Rutherford and he put forward was that at each stage of the process a new element was formed.

Prof. Dewar gave an account of the experiments on the effects of low temperature on the properties and spectrum of radium carried out partly in conjunction with Sir W. Crookes and recently communicated to the Royal Society.

Prof. Schuster thought the internal energy more probable than the absorption theory, and questioned whether the instability of the atoms predicted by electrical theory would account for the high velocities of the emanations. He was disposed to regard these high velocities as probably due to some cause not yet known.

Prof. Larmor agreed with Prof. Rutherford's theory, and pointed out that, just as atoms of matter must have size, or a half-size atom would still be an atom, so it may be that the atoms of electricity have size and configuration, and thus account for the complicated structure of the radium atom.

Mr. Whetham directed attention to the still unexplained fact that the negatively charged emanation seemed to deposit more readily on negatively than on positively charged bodies, and Dr. Lowry, after recounting some experiments on the flash of light seen when certain substances are crushed, suggested that the emanation might be a modification of a constituent of the atmosphere, *e.g.* helium.

C. H. LEES.

CHEMISTRY AT THE BRITISH ASSOCIATION.

THE Southport meeting of Section B proved to be one of the most successful held during recent years; the meetings were largely attended, and a keen interest was exhibited in the proceedings of the section. After the reading of the presidential address (NATURE, p. 472), Prof. J. Campbell Brown described an apparatus for determining latent heats of evaporation, in which a known quantity of heat, generated electrically in a platinum wire, is absorbed in converting a liquid at its boiling point into vapour at the same temperature; very concordant results are obtained.

In a paper on some derivatives of fluorene, Miss Ida Smedley showed that whilst fluorenone $\begin{matrix} C_6H \\ | \\ C_6H_4 \end{matrix}\!\!>\!C{=}O$, is orange-red in colour, the corresponding sulphur derivative, thiofluorenone, is intensely red; the radicle >CS has thus a greater tendency to produce colour than the carbonyl group. In a paper on the action of diastase on the starch granules of raw and malted barley, Mr. A. R. Ling showed that the starch derived from both raw and malted barley is dissolved and hydrolysed by diastase at a temperature below its gelatinising point, and that the optical and reduction constants differ according to the sample of grain from which the starch is derived. Evidence was adduced in two other papers on the action of malt diastase on potato starch paste, one by Mr. A. R. Ling and the other by Mr. A. R. Ling and Mr. B. F. Davis, that when diastase is heated in aqueous solution at 60°–70° for a short time, the molecule of the enzyme becomes so changed that it no longer yields the same products when it acts on potato starch paste.

Dr. H. C. White described the chemical and physical characteristics of the so-called mad-stone, which, in accordance with a superstition current in the southern States of America, is used to detect and cure the bites of venomous snakes or rabid animals; the mad-stone is found to be a concretionary calculus from the gullet of the male deer, and is devoid of discriminative or curative powers.

Prof. E. A. Letts, Mr. R. F. Blake, and Mr. J. S. Totton read a paper on the reduction of nitrates by sewage, in which it was shown that, when potassium nitrate is added to the effluent from a septic tank, practically all the nitrogen is evolved in the free state or as nitric oxide; the oxygen of the nitrate is evolved as carbon dioxide.

A method for the separation of cobalt from nickel and for the volumetric determination of cobalt was described by Mr. R. L. Taylor; it is based on the fact that cobalt is precipitated quantitatively as a black oxide from neutral solutions by barium or calcium carbonate in presence of bromine water. The black oxide has the composition Co_3O_{14} or Co_7O_{11}.

Prof. J. Dewar, F.R.S., contributed a description of the more recent results obtained from his investigations at low temperatures; he described the methods by which he has succeeded in determining the densities of solid hydrogen, nitrogen, and oxygen, the methods of producing solid hydrogen and nitrogen, and the methods by which he has been able to determine the latent heats, specific heats, and the coefficient of expansion of liquid hydrogen.

A paper on the application of low temperatures to the study of biological problems, by Dr. Allan Macfadyen, is printed in another part of the present issue (p. 608).

Mr. J. Hübner and Prof. W. J. Pope, F.R.S., gave a paper on the cause of the lustre produced on mercerising

cotton under tension, which was illustrated by photographs in natural colours; the lustre of mercerised cotton is proved to be due to a corkscrew-like structure of the mercerised fibre brought about by a simultaneous swelling, shrinking and untwisting which attends the immersion in caustic soda.

Sir H. Roscoe, F.R.S., in presenting the report of the committee on duty-free alcohol, explained the conditions under which the Board of Inland Revenue are now prepared to allow the use of duty-free alcohol for the purposes of research work.

Prof. G. von Georgievics, in a paper on the theory of dyeing, argued strongly in favour of the mechanical as opposed to the chemical theory of dyeing, and claimed that the experimental work upon which the chemical theory is based is erroneous.

In opening a discussion on the general subject of combustion by a paper on the slow combustion of methane and ethane, Dr. W. A. Bone pointed out that his own experimental work showed that, in the combustion of methane, a primary oxidation to formaldehyde and steam occurs, followed by rapid oxidation of the formaldehyde to carbon monoxide, carbon dioxide and steam; in the burning of ethane both acetaldehyde and formaldehyde are formed as intermediate products.

In a preliminary note on some electric furnace reactions under high gaseous pressures, Messrs. J. E. Petavel and R. S. Hutton gave an account of work carried out in an enclosed electric furnace constructed to work with gaseous pressures up to 200 atmospheres. The reactions at present under investigation include the direct reduction of alumina by carbon, the formation of calcium carbide and of graphite, and the production of nitric acid and of cyanogen compounds.

In a paper on the atomic latent heats of fusion of the metals considered from the kinetic standpoint, Mr. H. Crompton showed that, if in the solidification of a liquid energy is lost solely in bringing moving monatomic molecules to rest, a constant can be deduced in a very simple manner from the latent heat of fusion; approximately the theoretical value is obtained for this constant with many of the metals, but not with gallium and bismuth.

Dr. E. P. Perman brought forward a number of results which he has obtained concerning the influence of small quantities of water in bringing about chemical reaction between salts; he investigated more particularly the action of potassium iodide upon salts of lead and mercury. In a paper on the constitution of disaccharides, Prof. Purdie, F.R.S., and Dr. J. C. Irvine described the methylation of cane-sugar and maltose; from experiments on the hydrolysis of the products of methylation they deduced evidence substantiating the constitutions attributed by Fischer to these two disaccharides.

Amongst other papers read in the section may be noted the following:—Stead's recent experiments on the causes and prevention of brittleness in steel, by Prof. T. Turner; the colour of iodides, by Mr. W. Ackroyd; on essential oils, by Dr. O. Silberrad; the cholesterol group, by Dr. R. H. Pickard; on acridines, by Prof. A. Senier; sur le spectre de self-induction du silicium et ses comparaisons astronomiques, by M. le Comte A. de Gramont; fluorescence as related to the constitution of organic substances, by Dr. J. T. Hewitt; freezing point curves of binary mixtures, by Dr. J. C. Philip; mutarotation in relation to the lactonic structure of glucose, by Dr. E. F. Armstrong; the synthesis of glucosides, the preparation of oximido-compounds and the action of oxides of nitrogen on oximido-compounds, by Mr. W. S. Mills; further investigations of the approximate estimation of minute quantities of arsenic in food, by Mr. W. Thomson.

GEOLOGY AT THE BRITISH ASSOCIATION.

THE programme of the geological section of the British Association is usually more or less affected by the geological character of the country around the place of meeting, and this was the case in the present year, though the geology of Southport cannot compare in interest with that of Belfast, Glasgow, or other recent meeting places.

Mr. J. Lomas (Geology of the country around Southport) explained that the solid rock, Keuper and Bunter, is for the most part below sea-level, and only reaches the surface in a few places where it projects through the thick covering of Drift. The Drift is mainly Boulder-clay with an undulating surface, on which are found a number of lake-deposits, left by lakes or meres now partially or wholly drained.

One of these, Martin Mere, was visited by most of the geologists present, and was the subject of a paper by Mr. Harold Brodrick. Upon the Boulder-clay there is a bed of grey clay, which may be of either lacustrine or estuarine origin, and on it grew a forest of oak and Scotch fir. Numbers of trunks of the trees still remain, and Mr. Brodrick remarked that they have usually fallen in a north-east direction. These tree trunks are buried in a bed of peat, which is in places as much as 19 feet thick, and many dug-out canoes have been found in this peat.

The "submerged forest" at Leasowe, in Cheshire, is the remains of a similar mere which has been cut through by the sea, and the peat and tree trunks are now found on the coast below the level of high water. The question whether this points to a depression of the surface of the land was discussed, but the speakers hesitated to give any definite opinion.

Mr. Whitaker read the report of a committee appointed by the council of the Association to record observations on changes in the sea coast of the United Kingdom, and though there was no reference to Southport in the report, its reading was followed by considerable discussion. At Southport itself the land is gaining on the sea, and Mr. Lomas considers this to be due to the large amount of material brought down by the River Ribble. The sand dunes on the coast are, he believes, also due to material brought down by the river, which, drying at low water, is blown inland by the prevailing south-west wind. He remarked that sand dunes are usually found at and near the mouth of a fairly large river.

The question of coast changes was also discussed in a paper on a raised beach in County Cork by Messrs. Muff and Wright, of the Geological Survey. The beach deposits rest upon a platform of solid rock which is some 7 to 12 feet above the corresponding part of the present shore, and the beach deposits are covered by a thick bed of Boulder-clay, showing that they are of early Glacial, if not of pre-Glacial, age. This is almost an exact counterpart of the raised beach in Gower, South Wales, which was described by Mr. R. H. Tiddeman in a paper read before Section C of the British Association at Bradford in 1900.

Mr. Lamplugh (Land shells in the infra-Glacial chalk-rubble at Sewerby, near Bridlington) directed attention to the similarity of these raised beaches to that at Sewerby in Yorkshire. There we find (1) a beach deposit, a few feet above the present high-water mark, banked against an old chalk cliff; (2) a bed of land wash; (3) a bed of blown sand; and upon it (4) a bed of chalk-rubble, in which Mr. Lamplugh has found many specimens of *Pupa muscorum*, a land shell. Consequently the bed is a land wash corresponding to the "Head" of Cork and Gower. The author found this bed on the foreshore at Sewerby, showing that when it was formed the sea stood at a lower level than at the time of the beach deposits. This land wash is underneath all the Glacial Drifts of the Yorkshire coast.

In the discussion which followed the reading of these papers, it was suggested that the raised beaches may be due to an alteration in the level of the sea rather than to earth-movement. Mr. Clement Reid, however, remarked that, though the old sea beaches in Cork, Gower, and Yorkshire are about the same height above the present sea-level, there is at Penzance a well-marked notch in the rock at 65 feet above the sea, and in Sussex there is evidence of a sea-surface not only a few feet above the sea at Selsea, but also as much as 135 feet above the sea in Goodwood Park.

The relations of an estuarine deposit at Kirmington, in Lincolnshire, to the Glacial Drift was the subject of the report of a committee appointed at Belfast last year. The Kirmington Drift deposits are known to rest upon chalk, though the chalk has not yet been reached. A silty sand and chalk-rubble (1) is the lowest bed at present examined; upon it rests (2) a purple clay, no doubt a Boulder-clay, 12 feet thick; and above that (3) sand and chalky gravel 12 feet. Upon this (4) a thin fresh-water bed has now been found, and (5) a clay with estuarine shells, the whole being under (6) a second bed of Boulder-clay. The estuarine bed

with a fresh-water layer at its base is thus shown to be between two Boulder-clays, and the committee hopes to carry operations down to the Chalk before the meeting of the Association next year.

The report of the committee on Irish caves described explorations in some caves at Edenvale, near Ennis. Remains of man, associated with those of the bear, reindeer, &c., were recorded.

Implements, mainly Palæolithic, from the district between Reading and Maidenhead were dealt with in a paper by Mr. Llewellyn Treacher. He has obtained them in considerable numbers from gravels at levels of from 60 to 120 feet above the river Thames. The implements are usually of flint, but two examples of implements made from quartzite pebbles were described. The geological history of these pebbles is well known; they are from the Triassic pebble beds of the Birmingham district, and were brought into the Reading country by the River Thames in an early part of its history, when it drained an extensive tract now within the drainage area of the River Severn. Such pebbles are abundant in the old Thames Gravel, which caps much of the high ground north and north-west of Reading up to a level of about 500 feet above the sea, and no doubt the makers of the implements obtained the pebbles from the old Gravel.

The Swiss geologist, M. André Delebecque, read a short but very interesting paper on the lakes of the Upper Engadine. The lake of St. Moritz is, he said, obviously a rock basin, whilst the lakes of Sils, Silva Plana, and Campfer were, he believed, once a single lake also filling a rock basin. The torrents descending from side-valleys have now partially filled up this basin and divided it into the three lakes.

This paper led to a discussion on the origin of rock-basins. The author thought that, though Glacial erosion could hardly take place in very compact rocks, yet in many places even granite and gneiss become much decomposed, and glaciers may have swept away the decomposed rock and thus have produced hollows. Mr. Marr considered that every region containing rock-basins must be studied by itself, and that they are probably the result of many different causes.

Mr. Lamplugh said that, in regions of extreme Glacial erosion, we find true rock-basins near the gathering ground of ice, but as we approach the margin of the glaciated area we find lakes due to terminal moraines, kettle holes, &c.; thus in the marginal areas the lakes are not the result of direct ice-erosion, but are due to secondary causes.

Mr. Clement Reid said it was unfortunate that in north Europe the ice had so completely cleared away the soft deposits of the late pre-Glacial age that we have very little evidence as to the age of the lake or rock-basins.

In south Europe such evidence is often to be found, and he mentioned a case in Italy, near Florence, where there have been three lakes; the lowest, now silted up, is of about the age of our Cromer Forest Bed, the second, also filled up, is a Pleistocene lake, whilst the third, and highest, still exists as a lake. The speaker suggested that these lakes were due to earth-movements in a direction at right angles to the valley.

Passing to petrography, Mr. Teall contributed a most interesting paper on dedolomitisation. Taking a cherty dolomite, such as that of Durness, he showed that it has been dedolomitised by the formation of magnesian silicates, whereas in the case of the marbles formed of calcite and brucite it may be inferred that, under the conditions which prevailed during the intrusion of the plutonic rocks, the carbonic acid freed itself more readily from the magnesia than from the lime, thus in the absence of silica giving rise to the formation of periclase and converting the original dolomite into an aggregate of calcite and periclase, the periclase having been subsequently changed to brucite. The author instanced the predazzite of the Tyrol as a rock probably formed in this latter way. The history of the rock would then be as follows:—(1) formation of the limestone; (2) dolomitisation; (3) intrusion of igneous rock and dedolomitisation in consequence of the development of silicate or periclase; (4) hydration.

Mr. G. W. Lamplugh, whose name is well known in connection with the study of crush-breccias and conglomerates, read a paper on the disturbances of junction-beds from differential shrinkage and similar local causes during consolidation. He thought that in many cases rock was indurated before it became covered up by the succeeding strata, and that many of the curious structures we see in calcareous rocks may have been due to hardening before anything was laid on top of them. He instanced structures common in the Chalk and Lower Cretaceous rocks. He suggested that shrinkage during consolidation may account for the peculiar appearances which we sometimes see where a thin clay or shale is interbedded with thick sands, such as in the Hastings Sands, or at a junction such as that of the sand of the Lower Greensand with an underlying clay.

Mr. J. Lomas referred to a similar problem in a paper on Polyzoa as rock-cementing organisms.

The difficult question of the distinction between intrusive and contemporaneous igneous rocks was raised in papers by Mr. W. S. Boulton and by Messrs. T. H. Cope and J. Lomas, and was discussed at some length.

Mr. Boulton dealt with the basaltic rock associated with the Carboniferous Limestone at Spring Cove, Weston-super-Mare. The igneous rock shows a marked pillow-structure, contains tuff and agglomerate, and includes lumps and masses of the limestone.

The tuff within the sheet behaves like a lava showing flow structure, and is clearly not the result of sedimentation. The author believes the included limestone-fragments were derived from the underlying calcareous floor when it was a sea-bottom, the masses having been rolled and picked up by the lava, and thus become intercalated between its spheroidal masses. He thought the igneous rock was a submarine flow of lava. Messrs. Cope and Lomas dealt with the igneous rocks of the Berwyns. The district has a dome-like structure, shales and limestones of Llandeilo age being exposed on the top of the dome, whilst the newer Bala beds form a ring around. There are four thick sheets of rock which have hitherto been regarded as contemporaneous volcanic ashes. The authors, however, believe them to be intrusive igneous rocks.

Mr. J. G. Goodchild (Some facts bearing on the origin of eruptive rocks) contended that intrusive masses, as a rule, replace their own volume of the rocks which they invade, and do not cause displacement to any important extent. This paper gave rise to some discussion, for there were present many believers in the existence of laccolites. One speaker suggested that the presence of flow structure along the margins of intrusive igneous rocks was scarcely in harmony with the author's views. It was, however, admitted that there were difficulties when a dyke ends upwards or laterally against strata.

The palæontological papers were of considerable interest. Mr. A. C. Seward, president of the botanical section, read a paper before Section C on the fossil floras of South Africa. He considers that the plants from the Uitenhage series of Cape Colony are of Wealden age, and assigns those from the Stormberg Series to the Rhætic period. With regard to the Vereeniging plants, he describes them as belonging to a flora which flourished in South Africa, India, South America, and Australia during some portion of the Permo-Carboniferous epoch, perhaps that part nearly corresponding to the Upper Carboniferous of Europe. We have, he said, in South Africa as in South America, evidence of an overlapping or commingling of the northern and southern botanical provinces.

The Carboniferous flora of the Ardwick series of Manchester was the subject of a paper by Mr. Newell Arber, and some additional details as to the Carboniferous Mollusca were furnished in the report of the committee on life-zones in the rocks of that period.

Dr. Smith Woodward described an Acanthodian fish, Gyracanthides, from the Carboniferous of Victoria, Australia, and in illustration of another paper he exhibited some fragments of bone from Brazil. They were from a Red Sandstone formation, probably of Triassic age, and it had been suggested that they belong to an Anomodont reptile.

Mr. W. G. Fearnsides (on the Lower Ordovician rocks in the neighbourhood of Snowdon and Llanberis) gave an account of his discovery of fossils round the south-west and north-west flanks of Snowdon, from Criccieth to Llanberis. They are in beds corresponding to the well-known South Wales Llanvirn series, and are the first fossils recorded from beds on Snowdon older than the fossiliferous Bala ash of the summit.

Finally, the committee appointed last year to investigate the fauna and flora of the Trias of the British Isles made its first report. It was written by Mr. H. C. Beasley, and deals with cheirotheroid foot-prints. The attendance at the meetings of the section was good, and on several occasions the papers led to animated and interesting discussions. H. W. M.

ZOOLOGY AT THE BRITISH ASSOCIATION.

THE president's address—which was postponed until Friday, September 11, in order to avoid the hours fixed for the opening addresses in the other biological sections—dealt first with the inadequacy of the public provision made for the advancement of zoology and its applications in this country, and secondly with some considerations bearing on the problems of variation and heredity, more especially as seen in the Cœlenterata. In fact, influenced no doubt by the personal work of the president, a considerable number of the communications brought before the section this year dealt with the Cœlenterata, especially with corals and coral reefs.

Thursday, September 10.—The forenoon was given up to coral papers, and the afternoon mainly to reports of committees. Dr. J. E. Duerden (from the United States) gave two papers, "Septal Sequence in the Coral Siderastræa" and "Morphology and Development of Recent and Fossil Corals"—these being some of the results of the author's studies of living West Indian corals while he served as curator of the museum at Jamaica. He directed attention to the general occurrence of boring filamentous Algæ, and to the fact that the colours of West Indian corals are mainly due to the presence of symbiotic yellow cells (zooxanthellæ) in the endoderm. Mr. C. Crossland had a paper describing the coral formations he met with on the east coast of Africa, near Zanzibar, and Mr. Stanley Gardiner gave a general account of the coral reefs of the Indian Ocean. In connection with this, Prof. Herdman directed attention to the fact that, in the Gulf of Manaar, calcareous masses ("calcretes") of great extent are formed *in situ* on the sea-bottom by the cementing of sand and other loose material by calcareous incrusting Polyzoa. Miss Edith Pratt had a paper on the assimilation and distribution of nutriment in *Alcyonium digitatum*. The polypes exercise choice, and feed mainly on small Crustacea. Miss Pratt regards the so-called nerve-plexus as part of a system of amœboid endoderm cells conveying nutriment throughout the colony. Prof. Hickson described a case of polymorphism in a *Pennatula murrayi* from eastern seas. Dr. J. Cameron gave a lantern demonstration on the origin of the epiphysis in Amphibia as a bilateral structure.

The reports of committees were as follows:—(1) On bird migration in Great Britain and Ireland. This is the final report, and consists chiefly of Mr. Eagle Clarke's observations on the starling and the rook. (2) Naples Zoological Station. This includes a detailed account, by Mr. W. Wallace, of his investigations on the oocyte of Tomopteris. (3) "Index Animalium." The first volume, dealing with the period 1758–1800, has been issued, and the indexing of 1801–1900 is now being continued by Mr. Sherborn. (4) Zoology of the Sandwich Islands. This is the thirteenth report, and the work is still in progress. (5) Coral reefs of the Indian region. (6) Plymouth Marine Laboratory. (7) Millport Marine Laboratory. As on this occasion the physiological section did not meet separately, the physiological papers were taken in Section D. These included two reports:—(1) The microchemistry of cells. This dealt chiefly with the localisation of potassium in the living cell, and was drawn up by Prof. A. B. Macallum. (2) The state of solution of proteids.

Friday, September 11.—After the presidential address came a paper by Dr. Gamble and Mr. Keeble on the bionomics of *Convoluta roscoffensis*, with special reference to its green cells. This was followed by three short notes by Prof. R. J. Anderson—the skull of *Ursus ornatus*, the skull of *Grampus griseus*, and the peritoneum in *Meles taxus*. The section did not meet on Saturday.

Monday, September 14.—The morning was devoted to a joint discussion with botanists on fertilisation, in which the president, Prof. Hartog, Prof. Bretland Farmer, Mr. W. Bateson, Mr. M. D. Hill, and Mr. Jenkinson took part. The following papers were then read:—M. D. Hill, on nuclear changes in the egg of Alcyonium; Prof. Hartog, on the function of chromatin in cell division, and on the tentacles of Suctoria; Prof. Hickson, on conjugation in Dendrocometes (demonstrated with slides); J. W. Jenkinson, on some experiments on the development of the frog; Dr. Leighton, on British reptiles; N. Annandale, on the coloration of Malayan reptiles; H. C. Robinson, on the walking fish of the Malay Peninsula, and also an exhibition of convergent series of Malayan butterflies.

Tuesday, September 15.—Prof. Herdman gave a short account of a remarkable phosphorescence phenomenon observed in the Indian Ocean, which led to descriptions of other similar occurrences by the president, Mr. Stanley Gardiner, Mr. Bateson, and others. Prof. Herdman then read a joint note by Mr. James Hornell and himself on pearl-formation in the Ceylon pearl oyster, giving a biological classification of pearls into (1) ampullary, (2) muscle pearls, and (3) cyst pearls. The remaining papers were mainly physiological in their bearing, viz. Captain Barrett-Hamilton, on a physiological theory of the winter whitening of animals; Prof. B. Moore, on a new form of osmometer for direct determinations of osmotic pressure of colloids, and also experiments on the permeability of lipoid membranes; Prof. Sherrington and Dr. Grünbaum, on the cerebrum of apes; Mr. J. Barcroft, on the origin of water in saliva; Dr. Greaves, demonstration of visual combination of complementary colours; Mr. C. V. Hughes, note on two rare birds; Dr. Rennie, on epithelial islets in the pancreas of Teleosteans; Mr. D. C. McIntosh, on variation in *Ophiocoma nigra*; and Prof. W. C. M'Intosh, on the eggs of the shanny. Dr. Rennie suggests that his epithelial islets are blood-glands which have entered into a secondary relation to the pancreas, and that they maintain their primitive function of producing an internal secretion.

The section did not meet on Wednesday, but on Thursday, September 17, there was a dredging expedition, in which the president and a number of the members of Section D took part. The expedition was in the Lancashire Sea-Fisheries steamer, *John Fell*, kindly lent for the purpose by the committee, and was under the leadership of Mr. Dawson (Superintendent of Fisheries), Mr. Isaac Thompson (of the Liverpool Marine Biology Committee), and Prof. Herdman. The first hauls of the fish and shrimp trawls were taken in the shallow waters off Southport and the estuary of the Mersey, in order to show the fauna of the characteristic Lancashire small-fish "nurseries"; a visit was paid to the local shrimping fleet, a fishing boat was overhauled and boarded and its nets examined, and the other routine operations of the fisheries steamer in policing and inspecting the district were fully explained to the party. The processes of taking the physical observations, and of examining, counting, and recording a haul of the trawl were also gone through. Later in the day dredging and tow-netting took place further out to sea on harder ground with a more varied fauna. Although not strictly part of the work of the section, this dredging expedition made an interesting and appropriate finish to a very successful zoological meeting.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

DR. SYDNEY YOUNG, F.R.S., professor of chemistry in University College, Bristol, has been appointed to the chair of chemistry in Trinity College, Dublin, vacant by the resignation of Prof. Emerson Reynolds.

ONE of the two open entrance scholarships which were recently founded at the Victoria University of Manchester, each of the value of 100*l*., has been awarded to Mr. W. C. Denniston.

DR. JOHN WHITE, of the University of Nebraska, has been appointed head of the department of chemistry at the Rose Polytechnic Institute, succeeding Prof. W. A. Noyes, who was recently appointed chief chemist of the American National Bureau of Standards.

THE course of Saturday morning lectures on the teaching of mathematics, which the London Technical Education

Board announced would be commenced by Prof. Hudson at King's College, Strand, on October 17, has been postponed until next term, and will begin on January 23, 1904.

AT a special convocation of the University of Toronto on October 2, the following honorary degrees were conferred in connection with the opening ceremonies of the new physiological and medical laboratories:—LL.D. (*honoris causa*), Prof. W. W. Keen, Jefferson Medical College, Philadelphia; Prof. W. H. Welch, Johns Hopkins University; Prof. William Osler, F.R.S., Johns Hopkins University; Prof. R. H. Chittenden, Yale University; Prof. Charles S. Sherrington, F.R.S., University of Liverpool. *In absentia*, Prof. H. P. Bowditch, Harvard University. The inaugural address at the opening of the laboratories was delivered by Prof. Sherrington.

THE new buildings of the Essex County Technical Laboratories, Chelmsford, will be opened by the Earl of Onslow, President of the Board of Agriculture, on Friday afternoon, October 30. The buildings, which have just been completed at a cost of nearly 12,000*l.*, comprise chemical, physical and biological laboratories and classrooms, together with agricultural and horticultural museums and libraries, and provide facilities for systematic instruction in agriculture and horticulture, as well as in pure science. The laboratories are intended to be a centre for agricultural and horticultural information for the whole county, and they include rooms for the analysis of soils, manures, foods, seeds, &c., and for other scientific work carried on in the interest of these industries.

IN reply to a memorial to the Board of Agriculture, asking that ordnance maps might be sold at reduced prices for teaching purposes, the Geographical Association has been informed that the Board is prepared to authorise the Ordnance Survey Department to produce and supply to educational authorities a special edition of the outline 1-inch maps, printed on cheap but reasonably strong paper, at the following prices:—200 copies, 1*l.* 5*s.*; 500 copies, 2*l.*; 1000 copies, 3*l.*; 5000 copies, 12*l.* For larger numbers the estimated price would be 2*l.* per 1000 copies. The Board has stipulated that any maps thus supplied should not be sold, and a heading is to be printed on the maps to this effect. Referring to the educational advantages of the Board's decision, Dr. Herbertson, secretary of the Geographical Association, remarks:—"It is universally agreed that all sound geographical teaching must begin in a study of the home region, and it is therefore to be hoped that most teachers will avail themselves of the facilities so generously granted, either individually or by making application through the local education authority."

MUCH of the success of the Glasgow and West of Scotland Technical College could probably be traced to the widespread interest in its work shown by the Corporation of Glasgow, by Scottish manufacturers and merchants, and by the associations both of professional men and of artisans. The most recent annual report of the governors of the college provides many indications of the belief in the value of higher technical education by the inhabitants of Glasgow and its neighbourhood. The Corporation of Glasgow has made a grant of 5000*l.*, of which 4500*l.* was towards working expenses and 500*l.* towards the building fund; many manufacturers and others have given facilities for visits to their works by parties of students, and many merchants have made additions to the college equipment or have supplied laboratory material. It is of interest to note that the total expenditure involved by the erection of the new buildings, the foundation stone of which was laid last May by the King, exclusive of equipment, will be not less than 210,000*l.* Of this sum the governors are able to announce promises of donations and grants amounting to 182,382*l.*

SOCIETIES AND ACADEMIES.

LONDON.

Entomological Society, October 7.—Prof. E. B. Poulton, F.R.S., president, in the chair.—Mr. G. C. **Champion** exhibited on behalf of Prof. Hudson **Beare** some specimens of a Ptinus new to the British list, captured in a granary at Strood on May 11, 1901.—Mr. C. O. **Waterhouse** exhibited on behalf of Mr. Charles **Pool** specimens of a beetle of the genus Niphus, closely resembling *N. crenatus*, but with distinct shoulders, and more parallel elytra which are less strongly striated. They were found in large numbers in a corn chandler's at Edmonton.—Mr. H. St. J. **Donisthorpe** exhibited specimens of *Aphanisticus emarginatus* from the Isle of Wight, a beetle new to the British list, and a Scymnus, new to science, from the same locality.—Mr. M. **Burr** exhibited a living adult male earwig, *Labidura riparia*, Pall., captured near Boscombe at the end of August. He said that the very noticeable pale coloration becomes darker after death, sometimes nearly black, which might account for some of the numerous "colour-varieties."—Dr. Norman **Joy** exhibited a specimen of *Argynnis selene*, taken last year in Berkshire, showing a remarkable tendency to melanism, and rare Coleoptera taken in the same county during 1903.—Sir George **Hampson** exhibited a collection of Norwegian butterflies made by him on the Dorsefjeld, on the Alten fiord, at Bossekop, and other localities this year, including series of *Colias hecla*, Lef., *Chrysophanus hippothöe*, and var. *stieberi*, Gerh., *Œneis norna*, Thnb., *Melitaea*, var. *Norvegica*, Auriv., the Norwegian form of *M. aurelia*, *Argynnis freiga*, and *A. frigga*, a Labrador, Arctic, and North American species, now found further south, at Kongsvold, for the first time.—Mr. A. H. **Jones** exhibited examples of *Erebia christi*, taken this summer in the Laquinthal, and of the species of Erebia, to which it is allied; a local form of *Satyrus actaea*, var. *cordula*, from Sierre; and a short series of *Chrysophanus dorilis* (type) and *C.* var. *subalpina* from the Laquinthal, with *P. hippothöe*, var. *eurybia*, showing the strong resemblance on the upper surface which the ♀ of this latter species bears to the ♀ *subalpina*.—Mr. A. J. **Chitty** exhibited specimens of *Procto trupid*, which he said approached *Poncra constricta* in appearance, but might be an Isobrachium. If so, it was new to the British list.—Mr. H. Willoughby **Ellis** exhibited *Criocephalus polonicus*, Motsch, a longicorn beetle new to Great Britain, from the New Forest, and also specimens of all stages, from the egg to the imago, to illustrate the life-history of the species. He also exhibited specimens of *Asemum striatum*, L., with larva and pupa, accounted heretofore rare in the New Forest, but this year occurring in abundance.—Mr. Ambrose **Quail** exhibited cases showing the life-history of some Australian Hepialidæ.—Dr. D. **Sharp**, F.R.S., exhibited specimens illustrative of the egg-cases and life-histories of eight species of South African Cassididæ, as described in a paper by Mr. F. Muir and himself.—Mr. W. L. **Distant** also showed the pupa cases of some African species of Aspidomorpha, with the cast heads of the larvæ.—Mr. Roland **Trimen**, F.R.S., exhibited some cases of mimicry between butterflies inhabiting the Kavirondo-Nandi district of the Uganda British Protectorate, particularly that in which *Planema poggei*, Dewitz, is imitated by an apparent variety of *Pseudacraea künowii*, Dewitz, and also by a hitherto undescribed form of the polymorphic ♀ *Papilio merope*, Cram. He mentioned that both *Planema poggei* and *Pseudacraea künowii* were described and figured by Dewitz in 1879 from single specimens taken by Dr. Pogge in Angola, and added the interesting fact that the only other example of the undescribed mimicking form of the ♀ *Papilio merope* known to him—in the Hope Department of the Oxford University Museum—is ticketed "Angola; Rogers, 1873." The president referred to the special interest attaching to an interpretation of this remarkable form of the female *merope*; at the same time he pointed out that the interpretation so convincingly illustrated that evening had been made out last spring by Mr. S. A. Neave, who exhibited this form of the female *merope*, together with *Planema poggei* as its model, at both *soirées* of the Royal Society in May and June, a time when Mr. Trimen's absence from England unfortunately prevented him from seeing them.—Dr. T. A. **Chapman** exhibited *Coenonympha oedipus*, *Satyrus dryas*, and *Heteropterus morpheus*, taken last summer near Biarritz, and *Erebia crias* and *E. stygne*, from the Logroño Sierra, Spain. These he suggested were probably examples of homœochromatism. Little attention has been directed to homœochromatism in European butterflies, and these were certainly not examples of the detailed mimetism we are now familiar with in Müllerian groups from the African

and neotropical regions.—Dr. **Chapman** also exhibited living imagines of *Crinopteryx familiella*. These had just emerged at Reigate, where they and their parents, descended from pupæ brought from Cannes in March, 1901, had lived out of doors during their active existence, being brought into the house only during their pupal æstivation. This seemed noteworthy in so southern (Mediterranean) a species. The experiment seemed quite likely to continue successful for the next generation.—Mr. Ambrose **Quail** read papers on the antennæ of the Hepialidæ and on *Epalxiphora axenana*, Theyr.—Mr. Gilbert J. **Arrow** read a paper on the laparostict lamelicorn Coleoptera of Grenada and St. Vincent, West Indies.—Mr. T. H. **Taylor** communicated notes on the habits of *Chironomus* (*orthocladius*) *sordidellus*.—Mr. F. Du Cane **Godman**, F.R.S., communicated descriptions of some new species of Erycinidæ.—Mr. W. L. **Distant** communicated additions to the rhynchotal fauna of Central America.—Dr. D. **Sharp**, F.R.S., read a paper on the egg-cases and early stages of some Cassididæ.

PARIS.

Academy of Sciences, October 12.—M. Albert Gaudry in the chair.—The perpetual secretary announced to the Academy the death of Prof. Rudolf Lipschitz, correspondant for the section of geometry.—On the relations between the theory of double integrals of the second species and that of the integrals of total differentials, by M. Émile **Picard**.—On the temperature of inflammation and on the slow combustion of sulphur in oxygen and in air, by M. Henri **Moissan**. The temperature of inflammation of sulphur is 282° C. in oxygen and 363° in air, at atmospheric pressure. Sulphur dioxide can be detected after twelve hours at 100° C., giving a distinct quantity of solid at −186°.—Palæontological observations in Alaska, by M. Albert **Gaudry**. The abundance of mammoth remains near Yukon leads to the conclusion that at a far distant epoch the climate was far less severe than at present.—On the new function $E_\alpha(x)$, by M. G. **Mittag-Leffler**.—The detection and estimation of urea in the tissues and in the blood of vertebrate animals, by M. Nestor **Gréhant**. The alcohol extract is evaporated at 50° C., the residue treated with nitrous acid, and the gases pumped out, the carbon dioxide being measured. Both the blood and muscles of mammals were found to contain urea, of birds, none.—On linear equations of finite differences, by M. Alf. **Guldberg**.—On the working of coherers, by M. Albert **Turpain**.—Contact electrification and the theory of colloid solutions, by M. Jean **Perrin**. If a substance in contact with water takes a strong electrification and small surface tension, the stable state of the system will be realised by an emulsion of granules of fixed diameter, dispersed in the water.—The action of carbonic acid under pressure on metallic phosphates, by M. A. **Barillé**.—On a series of bismuth compounds, by MM. G. **Urbain** and H. **Lacombe**. From an examination of the double nitrates, the author concludes that bismuth stands in the same relation to the rare earths as zinc does to magnesium.—On the estimation of vanadium in metallurgical products, by M. Em. **Campagne**. The metal is converted into chloride, the bulk of the ferric chloride removed by ether, and the vanadium converted into $VOCl_3$ by evaporation with hydrochloric acid. This is converted into sulphate, and titrated with permanganate.—On the nitric esters of the alcohol-acids, by M. H. **Duval**. The preparation and properties of the nitrates of glycollic, malic, and glyceric acids are described.—The abnormal fixation of trioxymethylene on certain organo-magnesium derivatives, by MM. M. **Tiffenau** and R. **Delange**. The compound obtained by the action of magnesium upon benzyl chloride behaves abnormally with trioxymethylene, giving orthotolyl alcohol, $CH_3.C_6H_4.CH_2OH$, instead of the phenyl-ethyl alcohol, $C_6H_5.CH_2.CH_2OH$, which might have been expected. The magnesium compound, however, possesses the normal constitution, $C_6H_5.CH_2.Mg.Cl$, as is shown by the production of phenylacetic acid by the action of carbon dioxide.—The action of mixed organo-magnesium compounds upon amides: a new method for the preparation of ketones, by M. Constantin **Béis**. When an amide is heated on the water bath with an excess of an organo-magnesium compound, and the product treated with water, ketones are produced. Methyl-ethyl-ketone, diethyl-ketone, methyl-propyl-ketone, isobutyl-ethyl-ketone, acetophenone, and phenyl-ethyl-ketone have been prepared by this method, which appears to be of general application.—On the oscillatory movements of *Convoluta roscoffensis*, by M. Georges **Bohn**.—On the vegetative apparatus of the yellow rust of cereals, by M. Jakob **Eriksson**.—The necessity of a microbial symbiosis for obtaining a culture of the Myxomycetes, by M. **Pinoy**.—On a new mineral species, by M. A. **Lacroix**. The mineral, which is named grandidierite, has the composition

$$7SiO_2.11(Al,Fe)_2O_3.7(Mg,Fe,Ca)O.2(Na,K,H)_2O,$$

and is one of the most basic silicates known. It was found in South Madagascar.—On the Turonian of Abou Roach (Egypt), by M. R. **Fourtau**.

DIARY OF SOCIETIES.

FRIDAY, OCTOBER 23.

PHYSICAL SOCIETY, at 5.—The Bending of Magnetometer Deflection-Bars: Dr C. Chree, F.R.S.—On the Magnetism of Basalt and the Magnetic Behaviour of Basaltic Bars when Heated in Air: Dr. G. E. Allen.—Some Experiments with Electrical Oscillations: Dr. W. Watson.

SATURDAY, OCTOBER 24.

ESSEX FIELD CLUB.—Annual Cryptogamic Meeting at High Beech, Epping Forest; Referees: Dr. M. C. Cooke and Mr. George Massee.

SATURDAY, OCTOBER 31.

ESSEX FIELD CLUB, at 6.30.—Exhibition of a Series of Photographs of Fungi, by means of the Lantern: Mr. Somerville Hastings.—Seed Dispersal: Prof. G. S. Boulger.

CONTENTS.