THURSDAY, FEBRUARY 1, 1906.

THE PHILOSOPHIC FOUNDATIONS OF SCIENCE.

Science and Hypothesis. By Prof. H. Poincaré. Pp. xxvii+244. (London: The Walter Scott Publishing Co., 1905.) Price 3*s.* 6*d.*

Wissenschaft und Hypothese. By Prof. H. Poincaré. Autorisierte deutsche Ausgabe. Translated by F. and L. Lindemann. Pp. xvi+342. (Leipzig: Teubner, 1904.) Price 4.80 marks.

A SCIENTIFIC man, while actively engaged in work of research, must have faith in the solidity of the foundations on which he builds his reasoning in order to preserve the persistent patience which is necessary if his work is to be successful. Were he to doubt that there are laws which cannot be broken, were he to examine critically every brick in his foundation in order to discover some secret flaw which might endanger the safety of his edifice, he would become a philosopher, but as a man of science he would go to swell the ranks of the unemployed. Nevertheless, we must assign a proper place in the history of scientific thought to the spirit of scepticism which throws doubt on the premises, has no faith in the reasoning, and only grudgingly concedes the conclusions. If I have qualified the statement contained in the opening sentence and confined its application to the time a man is actively engaged in scientific work, it is because there are periods in every man's life when it is good for him to dig down to the bottom of his beliefs. Nor will the critical examination of axioms and definitions be without profit; for it will tend to loosen the ties of preconceived notions which keep men of science, like other mortals, in bondage.

The special difficulty of inquiring into the laws which form the basis of our scientific beliefs consists in the fact that it is apt to lead us round in a circle. When we have tried to formulate a law of nature, we often discover that we have only defined a scientific term. A superficial mind, satisfied with this discovery, would proclaim that all science resolves itself into definitions and conventions, but a closer examination exposes the shallowness of such a conclusion. If among a number of possible definitions we choose a particular one, there must be a deeper meaning in the propriety of the choice. Even though a law may be of our own making, to use Prof. Poincaré's descriptive language, "our decrees are those of an absolute but wise ruler who consults his Council of State." The inquiry into a law of nature resolves itself, therefore, into an inquiry why that particular law is more convenient than others that can be imagined, but this conclusion only brings us back to our starting point, the question as to the truth of a law and its convenience being identical.

Prof. Poincaré's volume will come as a revelation to many who have thought but little about these matters, and as a relief to others who have attempted without success to arrive unaided at a conclusion satisfactory to themselves. But the book requires close and careful study, and a superficial gleaning of its contents would probably lead to mental disaster. For, even following Prof. Poincaré's guidance, we feel ourselves all the time walking along a precipice, at the bottom of which is written, "You shall never know anything of the real construction of the material universe." The author seems to enjoy taking us very near the edge of that pit, and when he whispers into our ears, "what you cannot know is not worth knowing," we feel as if he intended to throw us over. But he has a sense of humour which saves him and us, and there is always a solution which we should perhaps have rejected at first sight, but which we are glad to accept after a contemplation of the less cheerful alternatives which have been brought into our view. There is certainly no one with the same intimate knowledge of mathematical and physical science who could have written with the same authority and produced a volume in which so much charm and originality are condensed. The wealth of his store of illustration is boundless, and the stringency of his logic leaves us without answer. Even in cases when our instincts rebel, we are carried away by the fascination of the language, which in each subdivision of the subject takes us with dramatic power to its artistic *dénouement*.

Could and should such a book be translated? The fascination of the original can certainly never be reached, but translation is allowable where the main argument can be reproduced without loss of clearness, though the delicacies of meaning to which the French language peculiarly adapts itself will undoubtedly be lost.

The English translation errs, perhaps, on the side of following too literally every sentence, and sometimes even every word in the sentences, of the French original. The meaning of the text is carefully though often awkwardly preserved. While the reader is not carried away by the incisive character of expression which belongs to the original, he will in most cases be able to re-construct the dominant idea. The German translation is more successful. We must ascribe this in the first place to the fact that one of the translators has himself made important contributions to certain parts of the subject, and, feeling himself secure in apprehending the meaning, has been able to reproduce the sense without putting any strain on the language. The result is that, while no one could read a few pages of the English edition without recognising the fact that it is a translation, the German carries with it much more of the freshness of an original book. The German translator is also to be commended for the addition of a good index. A series of notes is added, which take up a considerable fraction of the whole volume. Many of these notes will be useful, as they supply references to writings where the readers can study in greater detail important points on which Prof. Poincaré only touches with a passing allusion. But I cannot refrain from criticising the introduction of controversial matter. Differences of opinion between Sophus Lie and Prof. Lindeman are surely out of place in the translation of a book of this nature.

It is time to refer more particularly to the contents of the book. The volume opens with a chapter on the nature of mathematical reasoning, which is shown to be contained in a power of generalisation dependent on recurrent reasoning. When we have proved a theorem for one number, and show that if true for any number a, it is also true for a number $a+1$, we may assert it to be true for *all* numbers. This is the generalisation which, according to Poincaré, lies at the bottom of all mathematical argument, and allows us to pass from the finite to the infinite. The second chapter brings mathematical quantities into relationship with experiment, and treats, among other things, of incommensurable quantities and the creation of the physical and mathematical continuum. We are made to understand how, adopting a certain definition of a line which would satisfy most of us, the diagonal and inscribed circle of a square have no point in common, and we are then asked to admit the possibility of a curve which has no tangent. But a greater surprise is in store for us in the second portion of the book, where, in the course of an admirable discussion of the geometries of Lowatchewski and Riemann, we are introduced to the possibility of a fourth geometry, in which a right line may be at right angles to itself. This part of the book will probably be the one most valued by the student of experimental science, because it deals with an aspect of the subject which, though foreign to his customary plane of thought, must be of the highest interest if he desires to dip a little below the surface.

The conception of space and the relation of geometry to experiment are discussed briefly, but with great precision and clearness. The foundations of geometry are shown to be experimental. "If there were no solid bodies in nature, there would be no geometry." Yet, though founded on experiment, the laws of Euclidean geometry can never be upset by experiment:

"If, then, to contemplate the impossible, one were to discover negative parallaxes, or to find that all parallaxes lie above a certain limit, one would have the choice between two conclusions: We might reject the Euclidean geometry or, on the other hand, we might modify the laws of optics by admitting that light is not accurately propagated in straight lines. It is unnecessary to add that everybody would choose the latter alternative as most convenient."

The final conclusion is that "geometry is not true: it is convenient."

More than one-third of the book having been taken up with the discussion of the fundamental notions of mathematics, we are fully equipped to enter into the discussions of the laws more particularly associated with physics. All those who care to think of these matters at all must have given some attention to the nature of the so-called laws of motion. They will find much in Prof. Poincaré's reflections that has been familiar to them, and something, perhaps, that they have vaguely felt, but not been able to put into definite form. One point which is brought out clearly, which, speaking for myself, I had not sufficiently realised, consists in the difficulty of finding independent measures of both force and mass unless the third law of motion is treated as an axiom. The discussion of the third law will be found to be full of interest. Too little importance, perhaps, is attached to what the author calls "anthropomorphic mechanics." This is surprising, as anthropomorphic ideas are used by him so freely and convincingly in his foundation of geometrical laws. It is true enough that no one has yet been able to find a scientific basis of mechanics in an anthropomorphic conception of force, but at the same time I do not believe that anyone has ever truly reasoned about force without such idea forming the real moving spring of his thoughts. "One could not maintain," Prof. Poincaré says, "that the sun is conscious of a muscular effort when he attracts the earth." That is true enough, but we are able in our imagination to attach the idea of muscular effort to every effect of force in the same way as we can feel sympathetic pain for a friend who lies on the operating table, though our reason tells us that he himself is quite unconscious of pain. In that case we project our own sensitive and conscious mind into his unsensitive body, and to some extent feel the operator's knife. There are probably great differences in the way different brains work, but I could not myself form an idea of the mechanics of the solar system without imagining myself at its centre and consciously pulling the planets towards me. In the same way, if I imagine myself freely placed in space, I at once become conscious of a pull towards the sun. That anthropomorphism has played an important part in the history of mechanics is admitted by the author, but he restricts the philosophy of science to the discussion of the symbols which can be reduced to measurement.

Prof. Poincaré's discussion of the principles of the conservation of energy will be read with interest. That principle has been abused by energy specialists in a manner which could not fail to call forth a wholesome reaction. The weak point which Prof. Poincaré specially exposes seems, however, to me to touch not so much the enunciation of the principle as the difficulty of identifying potential and kinetic energies in cases where the mechanism of the phenomena is unknown to us. This only means that science is not sufficiently advanced to specify completely the different forms of energy. This most of us admit, while the Energetiker deliberately uses the principle of energy for the purpose of hiding his ignorance. Thermodynamics is briefly dwelt upon, but we should have liked to hear more of the author's views on the dissipation of energy. The far-reaching consequences of the gradual decay of regular motion assign to the second law of thermodynamics a predominant place, and put the importance of the first law completely into shade. Lord Kelvin's principle of dissipation of energy has opened out a common ground lying on the borderland between physics and metaphysics which has not been cultivated so much as it deserves to be.

It is not possible to follow Prof. Poincaré in his discussions of selected questions of modern theories of physics. They will be read with interest, though

many of us will not agree that "a day will come when the ether will be rejected as useless."

The reader will place the book—if possible the original, but *faute de mieux* its translation—on his shelves with the intention of frequently spending an instructive quarter of an hour with it. Each time he carries out his intention he will realise more the truth of the author's remark: "To doubt everything or to believe everything are equally convenient solutions: both absolve us from the necessity of thinking."

ARTHUR SCHUSTER.

THE INTELLIGENCE OF ANIMALS.

Comparative Studies in the Psychology of Ants and of Higher Animals. By E. Wassmann, S.J. Pp. x+200. (St. Louis, Mo., and Freiburg: B. Herder; London: Sands and Co., 1905.) Price 4*s.* 6*d.* net.

AMONG those who have most carefully and successfully studied the habits and psychology of ants, Father Wassmann occupies a place in the front rank. He has especially devoted his attention to the curious and complicated relations which exist between ants and their domestic animals. Of these, he gives a list comprising no less than 1246 species! Father Wassmann is an accurate and careful observer, and his writings are most interesting.

To show how conscientiously he has studied the ants of his own district I may mention that he made a census of the ants' nests round his home. Many communities have more than one nest. Of *Formica sanguinea*, which he regards as the most gifted of European ants, he records 2000 nests belonging to 410 communities! Most of them have separate summer and winter nests, or rather nests for warm and dry, or cold and wet seasons.

Father Wassmann is by no means one of those who regard ants as exquisite automatons, "devoid even of the simplest sensitive perception and cognition." I quite concur with him—indeed, I expressed the same opinion nearly fifty years ago—that "the life of ants is the climax of development in instinctive life throughout the animal kingdom"; and that "the chasm between the psychic life of animals and that of man, is, in many respects, wider between ape and man, than between ant and man."

Father Wassmann is also, I believe, quite correct in alleging that Buechner and Brehm, and even Romanes, have accepted many statements implying intelligence on the part of animals for which there was no sufficient evidence, some of which, indeed, were quite absurd; and, secondly, that they have in some cases built upon them conclusions for which there is no foundation, and which will not stand the test of critical examination.

On the other hand, I am unable to follow him when he altogether denies to ants any, even the most exiguous, rudiments of intelligence. As in the cases of Darwin and Forel, the conclusion forced upon me has been that animals, and especially ants, do possess some elements of intelligence. In that we agree with the vast majority of those who have studied dogs, elephants, &c.

Father Wassmann defines intelligence as "the power of acting with deliberation and self-consciousness, of inventing new means for attaining various purposes and thus making progress in civilisation." But if ants are descended from an original common stock in bygone times, no one will deny that they have "invented new means for attaining various purposes and thus making progress in civilisation." Moreover, even now we see them adapting themselves to the circumstances of their complex life in a manner which it is surely an abuse of terms to call "instinctive." He admits that the observations of all who have studied ants conclusively demonstrate that ants are not mere reflex machines, but beings endowed with sensitive cognition and appetite, and with the power of employing in the most various manner their innate, instinctive faculties and abilities under the influence of different sense-perceptions. Surely, then, under his definition it is impossible to deny that they have some intelligence.

For instance, in constructing their nests, as Father Wassmann admits, ants do not "cooperate with the regularity of a machine or according to a rigid pattern, but each ant with evident liberty follows her own impulse and her own plan. . . ."

"As a rule the most zealous and skilful worker is imitated most; her zeal is catching, so that she directs the activity of the others into the same channel."

Indeed, Father Wassmann's fairness and love of truth compel him to make several candid admissions which seem fatal to his position. For instance, an Algerian ant (*Myrmecocystus altisquamis*) has wide open entrances to the nest. A colony, however, which Forel brought to Switzerland, being much annoyed by the attacks of *Tetramorium caespitum*, gradually contracted the doorways. On this Father Wassmann admits that, "as Forel says, these facts afford irrefutable evidence of the great plasticity of ant instinct. For, this instinct is not merely a nervous mechanism forced to operate along uniform lines; it includes sensitive cognition and appetite, which are not only of an organic but also of a psychic nature."

Again, "within these limits, however, we find a wonderful adaptation of means to the end, and at times a marvellous sagacity of animal instinct, which appears nowhere else to such advantage."

"This phenomenon manifests the marvellous sagacity and quasi-intelligent plasticity of animal instinct, which can hardly be styled 'automatism.' Neither can it be identified with intelligence properly so-called, for this would suppose rational knowledge of the internal laws governing the growth of the ant organism, a knowledge far surpassing even the intelligence of man and entirely beyond the reflections and experience of ants."

Surely, however, if ants have sagacity they must have intelligence. Nor is the attribution to them of "sagacity" an isolated case. Again on p. 157 he says:—

"Their sagacity is instinctive, essentially different from intelligence and reflection. Ants are in their every action guided directly by sensitive perceptions, not by intellectual ideas. The enigma, therefore, is

satisfactorily explained by the innate adaptation of their sensitive cognition and appetite, whereas the hypothesis of animal intelligence is unable to offer any solution."

"Instinctive sagacity" seems to me, I confess, a contradiction in terms.

I admit that the subject is one of much difficulty, but if an ant applied Father Wassmann's rigorous criticism to man himself, I am not sure that our boasted gift of reason could be absolutely proved.

No doubt animals do stupid things, but so do we.

Father Wassmann describes what he justly calls the "lovely scenes" in an ant's nest—the care of the young, the "motherly tenderness" shown to the delicate pupæ—but denies that this is any evidence of affection, and contrasts it with the love of a woman or a man for their children. This, he maintains, "is a *rational* love, *conscious of duty* (the italics are his), therefore it is the highest and noblest love existing in Nature." Far be it from me to say a word against either reason or duty. They are amongst the highest qualities of our nature; but surely they have nothing to do with the love we feel for our children, which rests on even nobler feelings.

While fully recognising, then, the accuracy and interest of Father Wassmann's observations, and after carefully considering his arguments, I cannot but recognise in animals some vestiges and glimmerings of intelligence, and maintain, as I did thirty years ago, that "when we see an ant-hill, tenanted by thousands of industrious inhabitants, excavating chambers, forming tunnels, making roads, guarding their home, gathering food, feeding the young, tending their domestic animals—each one fulfilling its duties industriously, and without confusion—it is difficult altogether to deny to them the gift of reason; and the preceding observations tend to confirm the opinion that their mental powers differ from those of men, not so much in kind as in degree."

AVEBURY.

MAXWELL'S THEORY OF LIGHT.

The Electromagnetic Theory of Light. By Dr. C. E. Curry. Part i. Pp. xv+400. (London: Macmillan and Co., Ltd., 1905.) Price 12*s.* net.

DR. CURRY bases his work, which is almost entirely analytical, on Maxwell's equations of the electromagnetic field. These equations suffice to account for the phenomena of electromagnetism, and the book is a discussion of the properties of electromagnetic waves in which the condition that the wavelength is short is generally, but by no means always, introduced. In these equations four vectors are concerned, the electric and magnetic forces, and the electric and magnetic displacements, or, as Dr. Curry prefers to call them, the electric and magnetic moments. The type of equation satisfied by each of these vectors is the same, and it is not necessary for Dr. Curry's purpose to identify the light vector definitely with either. It is another vector satisfying an equation of the same type.

No attempt is made to give a mechanical account of the properties of the ether; it is a medium in which transverse waves of electric and magnetic force are propagated according to the laws indicated by Maxwell's equations; in a crystal, however, of course the direction of the electric force does not lie in the wave-front; the same is true of the magnetic force if the permeability be a function of the direction.

Working on these lines, Dr. Curry has put together a large amount of information as to the analytical properties of such waves. The earlier chapters are entirely taken up with the discussion of the forms defined by certain particular solutions of the equations of motion, for if $\phi \equiv f(r \pm vt)/r$ be a solution, so is $d^n\phi/dx^\lambda dy^\mu dz^\nu$, where $n=\lambda+\mu+\nu$. Some of the solutions thus obtained are of importance in the theory of light, but, as the author states, their interest is chiefly theoretical; and one of his "chief reasons for the elaborate treatment of this particular class of waves has been to indicate another fertile field of research offered by Maxwell's equations."

In chapter iv. we are introduced to the phenomena of interference, treated at first in a simple manner, but applied later to the various kinds of waves the properties of which have already been discussed. The more usual problems of optics first become prominent in chapter v., which deals in the ordinary way with Huyghens's principle and its application to the rectilinear propagation of light. The first difficulty occurs in the attempt to find an expression for the secondary disturbance transmitted from a given element of a primary wave. Such expression may clearly involve the angle ϕ between the normal to the wave and the direction in which the secondary disturbance is being estimated, but the statement that "it is natural to assume that the law of variation of the light vector . . . be according to the cosine of the obliquity of the angle ϕ" is not very convincing, and there seems no reason for calling this law the "natural law of obliquity." The law is, of course, a simple one, and it allows of the analytical solution of various problems which are hardly tractable when a more complex law is assumed; but this is its sole merit. Stokes showed that the true factor is $(1+\cos\phi)$, and this law is utilised later on; but the physical reason for the change of phase in consequence of which the secondary disturbance from a wave $\sin k(vt-r)$ becomes proportional to $\cos k(vt-r)$ is not discussed as fully as its importance deserves. On these points, reference might with advantage have been made to Prof. Schuster's article in the *Philosophical Magazine*, vol. xxxi.—it is quoted later on another point—or to Lord Rayleigh's article in the "Encyclopædia Britannica." Following this a rigorous proof of Huyghens's principle is given in the usual way from the consideration of the relations existing between certain volume and surface integrals, and the result is applied to optical problems; but the fact that this rigorous analysis leads to Stokes's law of obliquity is not definitely stated, though it follows at once from the formulæ on p. 176.

Diffraction phenomena are explained by the use of the same principles, employing the most general formula for the secondary disturbance, and assuming

that the disturbance is zero over the opaque portion of the diffracting screen, while over the transparent portion it has the same value as though the screen were absent. The results are applied to the problem of diffraction by a straight edge leading to Fresnel's integrals and the properties of Cornu's spiral. These might have been obtained more simply, though the rigorous method has its advantages in enabling one to see the meaning of the various simplifications introduced in the process. Later on in the discussion an interesting account of Sommerfeld's theory is given.

The latter part of the book is taken up with the usual theory of reflection and refraction and of double refraction. The surface conditions are deduced from the electromagnetic equations, and the relations between the incident reflected and refracted vectors follow readily. Attention is directed to the fact that the laws thus deduced do not hold for light, and the effect of a transition layer is considered in a satisfactory manner.

In the last chapter we have the equations relating to the propagation, reflection, and refraction of electromagnetic waves by crystals.

At present, part i. only of the whole treatise is under consideration. This deals, as will have been observed, with the analytical portions of the subject for which Maxwell's theory gives a satisfactory explanation. In part ii. the author hopes to consider the really more interesting portions where the simple Maxwell theory needs modifications before it will fit the facts. Readers will await with interest Dr. Curry's treatment of the phenomena of the rotation of the plane of polarisation, absorption, metallic reflection, the Zeeman effect, and the relations generally between magnetism and light.

INDIAN HERMIT CRABS.

Catalogue of the Indian Decapod Crustacea in the Collection of the Indian Museum. Part ii., *Anomura.* Fasciculus i., *Pagurides.* By A. Alcock, M.B., LL.D., F.R.S., C.I.E. (Calcutta: Indian Museum, 1905.) Price 14 rupees.

THE second instalment of Dr. Alcock's fine "Catalogue of the Indian Decapod Crustacea" is now before us. It deals with the hermit crabs (Paguridea or Pagurides), and forms the first fascicule of the second part, which is devoted to the Anomura. Dr. Alcock is thus making use of the old classification of the Decapoda into Brachyura, Anomura, and Macrura, a course to which modern opinion seems to incline—and, as we think, rightly—in spite of the many merits of Boas's arrangement of the group under the suborders Reptantia and Natantia. In the hands of different authors, the limits of the Anomura have varied considerably, and Dr. Alcock takes the term in the sense of Boas's Anomura, including under it the Paguridea, Galatheidea, and Hippidea only. Now there can be no question that Boas was right in excluding the sponge crabs (Dromiacea) and sand crabs (Oxystomata) from the Anomura when he formed his tribe Anomala, but we believe that the group thus constituted is still an imperfect one, in that it is not true to genealogy, since it omits the Thalassinidea, which are certainly more nearly akin to the primitive hermit crabs than they are to the lobsters, near which they are generally placed. This is not denied by Dr. Alcock, but he gives as his reason for taking the old course with the Thalassinidea that to include them with the Anomura "is going too far, as being likely to confuse the systematist"—a poor compliment to the systematist! A zoological classification must be one of two things—either purely empirical, or based on genealogical facts so far as we can ascertain them, though no one is likely to choose the former alternative at this time of day—but in either case illogical concessions to supposed infirmities of the human intellect do not seem to us to be admissible. However, authorities will never agree on questions of classification, and we do not regard the author's decision as a serious blemish on this otherwise wholly admirable work.

In this volume, as in that on the Indian crabs, Dr. Alcock starts with an introduction on the group as a whole, in which he has condensed into a few pages a great deal of very interesting and useful information. In the tables of distribution which follow it appears that the littoral forms are generally Indo-Pacific in range, but that the more primitive sublittoral genera have a very distinct circumtropical distribution. The bearing of this fact on geographical problems is, of course, an important one. The bulk of the work is taken up with systematic descriptions, which are as excellent as is all Dr. Alcock's work in this line, and deal with some ninety species of twenty-eight genera. At the end of the volume is a "table of the genera and species of Pagurides," with bibliographical references, which must have been extremely laborious to compile, but will now be correspondingly helpful to systematists. The illustrations are excellent. L. A. B.

OUR BOOK SHELF.

Traditions of the Caddo. Collected under the auspices of the Carnegie Institution of Washington by George A. Dorsey, Curator of Anthropology, Field Columbian Museum. Pp. 136. (Washington, D.C.: Carnegie Institution, 1905.)

THE make-up of this volume is somewhat curious. It contains one hundred and one pages of texts, followed by twenty-eight pages of abstracts of the same in small type; there is no index, and the only notes are almost monosyllabic, for they merely indicate by whom the story was told—a fact of little value, inasmuch as we learn absolutely nothing of the narrator beyond his (or her) name. This is the more regrettable, as the Caddo, a tribe allied to the Pawnee and Arikara and associated more especially with the Wichita, has retained none of its ancient culture, and we must therefore know the history of the tribe and of the individual narrators before we can judge of the influences that have gone to shape their stock of folk-tales. Equally regrettable is the absence of notes on the stories themselves; it is true that native names are translated, but there are many points on which the editor could throw light with advantage; for example, in tale 35 we find a dead man cannot get into Spirit Land because he cannot fit his arrows to his bow-string, which has a knot in it; a living man puts in

a new bow-string; the ghost shoots arrows in the air and goes up with them.

For those who are interested in these *märchen*, less for the light they may throw on the problem of diffusion than for the evidence they contain of the beliefs and customs of the Caddo, the usefulness of the work is diminished both by the absence of notes and the lack of an index. For European readers, at any rate, there is a further desideratum, viz. some account of the tribe the tales of which are here collected; the American Folklore Society has set a good example in this respect in the volume of Skide Pawnee tales.

The seventy tales in the present volume, which is to be followed by others on the allied tribes, are largely concerned with the adventures of Coyote and other animals. The first ten are either cosmogonic or deal with origins of various kinds; we have the familiar story of the way in which death was introduced into the world, in this case by Coyote; the deluge legend is probably late, as the flood is sent as a punishment; in a parallel story the destructive animals, which lived at the beginning of the world, are destroyed by fire, mankind being saved by climbing up a rope made on earth and made fast to the sky by Crow. More familiar is the tale of the hare and the tortoise, here told by Coyote and Turtle; in these tales the distinguishing characteristic of the former is his stupidity.

Meccanica Razionale. By Roberto Marcolongo. Vol. i., Kinematics—Statics, pp. xii+270; vol. ii., Dynamics—Principles of Hydromechanics, pp. vi+126. (Milan: Ulrico Hoepli, 1905.) Price 3 lire each volume.

No better proof could be adduced of the general and popular interest taken in higher mathematics in countries outside Great Britain than the excellent series of manuals emanating from the firm of Hoepli in Milan. One great difficulty in acquiring a *general* knowledge of such subjects as analytical statics, particle and rigid dynamics, and hydrodynamics arises from the voluminous character of the principal treatises available as text-books. Most of the English standard works on such subjects were originally smallish single volumes, but they have in the course of various editions grown in size until they have reached to two large and bulky volumes. Anyone who can read Italian can now, at a cost of five shillings, obtain in Prof. Marcolongo's two little manuals a survey of such subjects as vector analysis, polhodes and herpolhodes, the ordinary and spherical catenary, planetary motion, Lagrange's equations, the theory of least action, cycloidal and compound pendulums, attractions of ellipsoids, Lagrange's and Euler's equations of hydrodynamics, and the principles of vortex motion.

Die Vererbungslehre in der Biologie. By Dr. H. E. Ziegler. Pp. 74; with 59 figures in the text and 2 plates. (Jena: Gustav Fischer, 1905.)

THIS little work represents a fairly successful effort to put in simple language the complex problems of heredity so far as they have yet been analysed. The author discusses the evidence that cytology has been able to furnish in connection with the theories of variation, and he especially deals with the views of Weismann and of De Vries as to the meaning of variation as expressed in terms of the cell. His attitude towards the mutation theory of De Vries is rendered clear by the following sentence from p. 69, "Wenn man nicht auf dem Standpunkt der 'intracellularen Pangenesis' steht, so kann man nicht einsehen, warum zwischen kleinen und grossen Abänderungen, also zwischen allmählicher und stossweiser Veränderung, eine strenge grenze gezogen werden soll." But the question here raised is not one dependent on theory or hypothesis; it is a question of fact, and the existence of opposite opinions merely demands a more thorough investigation at the hands of persons unbiased by prejudice. Perhaps, as was formerly the case with the inheritance of the so-called "acquired characters," much of the prevalent opposition to the theory of mutation rests on a misunderstanding of the main idea embodied in the word itself.

An Analysis of Human Motive. By F. Carrel. Pp. viii+222. (London: Simpkin, Marshall, Hamilton, Kent and Co., Ltd., 1905.) Price 5s. net.

THIS volume discusses the six predominant motives which influence man, viz., those of sustenance, sex, pleasure, sympathy, self-love, and religion; examines slightly the conflicts of motives, the relation of motives to moral systems, and the like; and sums up the matter in a series of conclusions which is not entirely destitute of merit.

But the work as a whole is disappointing. The sentences are lumbering and long, sometimes twelve lines long; there are no indications that the author has read very widely, nor is any remarkable insight displayed. Felicitous illustration would have lightened many a page; but of illustration there is almost nothing. The obvious has no terrors for our author, and so the satirical rogue frequently indulges in slanders like the following:—"The pleasure motive may lead persons to pass time in witnessing theatrical performances, and when the taste has been formed and the habit acquired, to spend more of their resources upon such amusements than their means justify." Split infinitives and the use of "practise" as a noun do not lead one to rank the writer as an authority on English. One statement seems defective in mathematical accuracy:—"In provincial towns the proportion of men to women (among church-goers) is twelve to a hundred. In London the proportion is *two-thirds women to one-half men.*" It is difficult to avoid seeing a *non sequitur* in the following:—"The grief experienced at the death of a beloved relative cannot be long continued without interfering with the normal course of life and coming into conflict with its essential motives, and therefore we see that the violent acts of despair to which it tends, are not resorted to as long as the mind has not completely lost its rationality."

We gather that the author thinks much of Epicurus and of Spencer, but little of Aristotle's "Nicomachean Morals," which are, it would seem, of little more than historical interest. The writer continues:—"It was their want of precision that enabled them to be adopted by the schoolmen of the middle ages, as a basis for their ethical dialectics." That Aristotle and this author have very different views of what constitutes precision is true and obvious, but not a circumstance on which this author is to be congratulated.

Deutscher Kamera Almanach, 1906. Second year. Jahrbuch der Amateur-Photographie. By Fritz Loescher. Pp. viii+280. (Berlin: Gustav Schmidt, 1905.) Price 3·50 marks.

THIS is the second issue of this annual, and from its appearance it seems to be very hardy. The first-named title does not seem very befitting to the volume before us, as the "Almanack" portion is more conspicuous by its absence than presence. As a "Year Book" containing an excellent series of well written articles on numerous photographic subjects by recognised workers in Germany, England, France, &c.; novelties of the year; progress; exhibitions; list of German amateur photographers' societies; most important recent photographic literature, and other useful information, the book will be found of interest to those who are able to read German. The illustrations are good and numerous, and include a frontispiece, 47 full page pictures, and 107 others distributed throughout the text.

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.*]

Fresnel's Theory of Double Refraction.

THERE is a point in connection with the ordinary expositions of Fresnel's theory of double refraction to which, on account of its frequent occurrence, it is perhaps worth while to direct attention. It is found in Aldis's "Tract on Double Refraction," p. 7, in Preston's "Theory of Light," third edition, p. 328, and in Basset's "Treatise on Physical Optics," p. 115.

Having shown that when a molecule receives a displacement ρ, the other molecules of the system remaining fixed, the restoring force along the line of displacement is $F=\rho/r^2$, where r is the parallel radius-vector of a certain quadric, Preston, for instance, proceeds as follows:—"Hence, if we consider only the component F as effective, the equation of motion of the particle will be

$$d^2\rho/dt^2=-\rho/r^2 \quad . \quad . \quad . \quad . \quad . \quad . \quad (10),$$

and the time of vibration will consequently be given by the equation

$$T=2\pi r \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (11).$$

But the velocity of propagation is connected with the wave-length and the periodic time, by the equation $\lambda=vT$, therefore

$$v=\lambda/2\pi r \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (12)."$$

Now if equation (10) refer to the motion of a particle when the others remain fixed, there is no question of a wave at all, and the deduction of a propagational speed is without meaning; if, on the other hand, we are to regard (10) as giving the motion of a particle in the front of a luminous wave, then equation (11) expresses the bizarre result that the frequency, that is the colour, of the light is dependent upon the direction of vibration.

Fresnel's method was quite different; having determined the value of the restoring force on the supposition of absolute displacements, he employed it for the case of relative displacements, and regarding the component parallel to the wave as alone effective, he *assumed*, on the analogy of the transversal vibrations of a stretched string, that the propagational speed is proportional to the square root of the effective force. Hence, taking the azis of z in the direction of propagation, and making a suitable choice of the unit of mass, we should have in place of (10)

$$\partial^2\rho/\partial t^2=1/r^2\ \partial^2\rho/\partial z^2,$$

giving in place of (12) $v=1/r$.

One other point may be mentioned. Preston and Basset, quoting from Verdet, state that one of the hypotheses on which Fresnel founded his theory is that the vibrations of polarised light are at right-angles to the plane of polarisation. This is not strictly correct. There is no doubt that this assumption played its part among the ideas that led Fresnel to formulate his theory: in the theory, however, as finally presented, it does not appear as a fundamental hypothesis; it follows, in fact, as a direct *consequence*. On the other hand, the postulate that the ether is incompressible should be included among the hypotheses of Fresnel; indeed, if this be not assumed, the effective component of the force of restitution would have, as Sir G. Stokes has pointed out ("Math. and Phys. Papers," iv., 158), a value quite different from that given by Fresnel. JAMES WALKER.

Oxford, January 19.

On an Alleged New Monkey from the Cameroons.

I MUCH regret that in describing, in NATURE for October 26 last, the monkey on which I bestowed the name *Cercopithecus crossi*, I overlooked the description of *C. preussi* by Matschie. Dr. Lönnberg, of Stockholm, was kind enough to write me early in November to say that he had "a strong suspicion that your guenon may prove identical with *C. preussi*," described in *Sitz. Ber. Naturforsch. Freunde Berlin* in 1898. Only last week, however, was I able to consult this volume, and there is no doubt that, as Mr. Pocock has now also pointed out, Matschie's name has priority over *C. crossi*. HENRY O. FORBES.

The Museums, Liverpool, January 27.

FORESTS AND RIVERS.

AT the recent meeting of the International Navigation Congress at Milan, one of the questions taken into consideration was "the influence which the destruction of forests and desiccation of marshes has upon the *régime* and discharge of rivers," and seven papers bearing on the subject were read and discussed. Of these, three were from Austria, and the others from Germany, France, and Russia. The problem as to the effect of forests on the water supply of rivers and on climate is of great social importance on account of the agricultural and commercial interests which are so closely connected with the use of timber, and with the utilisation of running water.

It is allowed by all the authors of these papers that, due to the improvident way in which the forests have been dealt with, there has been a marked change in the water supply of the neighbouring rivers; that where forests have been cut down brooks have disappeared, and many small rivers that at one time were useful as sources of power are so no longer for want of water; that in the larger rivers torrents have become more impetuous, and flooding more frequent; while, on the other hand, navigation suffers at times for want of water.

The greatest harm has been done in the mountain districts, where the steep slopes allow the rain-water to run off too rapidly, carrying away the surface soil and transporting pebbles and boulders into the rivers, causing shoals, and thus decreasing their capacity to discharge the flood water.

The extent to which forests, both on the Continent and in America, are being cut down and destroyed, and large areas of land, which at one time were covered with primæval forest, have become barren waste by fire or the lumberman's axe without any attempt at re-afforestation, was one of the subjects dealt with in the presidential address of Mr. J. C. Hawkshaw at the Institution of Civil Engineers in 1902. Mr. Hawkshaw pointed out that, notwithstanding the displacement of wood in building structures by iron, yet large quantities of timber are still required, not only for building purposes, but for temporary structures, such as coffer dams and scaffolding; pit props for mining; sleepers required for the railways, which, in this country, he estimated at an annual value of 18 million pounds, and those required for renewals at three-quarters of a million pounds; while for the railway service of the United States there are required 15 millions of acres of forest land to maintain a supply of sleepers.

The question for consideration at the Congress was whether the wholesale destruction of forest land for cultivation or for timber supply is having any material effect on the rainfall and consequent water supply; and the effect of forest destruction on the rivers of the country from which the trees are removed was also considered.

The physical conditions of forest land are that, owing to the shelter from sun and wind, the atmosphere is generally colder and damper than in the open country, and evaporation consequently less. It is calculated that a hectare of forest land (2½ acres) gives off every day 37 cubic metres of oxygen and 37 metres of carbonic acid, leading to a great expenditure of heat; and that from every hectare of forest land sufficient heat is abstracted to melt 316 cubic metres of ice. Ligneous plants also withdraw from the ground and discharge as vapour more than 40,000 gallons of water per hectare per day, which causes a sensible reduction of temperature. When clouds pass over a forest they encounter a cool, damp atmosphere, the point of saturation comes closer, and

rain is caused. This condition of forest land has been remarked on by aëronauts, who find that a balloon is invariably affected, and drops when passing over forests.

The advantages claimed for forests with regard to water supply are that the trees act as regulators of the rainfall; that the average quantity of rain falling on land covered with forests is greater than in the open ground to the extent of about one-sixth; that it holds up the water for a time and discharges it later on when water is most required in river basins, the rain being held back by the leaves of the trees and coming to the ground more gradually; the rain that falls on the surface is also taken up by the layer of dead leaves on the ground, which permits of a gradual percolation to the subsoil. Observations show that in summer the ground of the forest is damper than that of the adjacent cleared land, and snow remains for a much longer period in forest land before melting than in cleared land.

On the other hand, it has been contended by some of those who have made a study of sylviculture that forests do not increase the quantity of water flowing to the springs and rivers, but reduce it. The numerous striking facts quoted do not bear out this contention, which is mainly based on the fact that the substratum water stands at a lower level on forest land than in the adjacent cleared ground. This fact is generally admitted to be the case at one period of the year. As the result of many years' observations, it has been found that the maximum level of underground water is reached in May, that the water accumulates in the ground from August to January; and that the rivers are supplied by this reserve, and were it not for this accumulation many brooks and river feeders would cease to flow in summer.

Several very striking examples are given by the authors of the papers as to the deleterious effect of cutting down forests, especially in hilly districts. In the commune of La Bruguière, the forests on the slopes of the Black Mountain were cut down; the consequence of this removal of the trees was that a brook which ran at the foot, and the water from which was used for driving some fulling mills, became so dried up in summer as no longer to be of any use, while in winter the sudden floods caused very great damage in the valley. The forests were re-planted, and as the trees grew up the water coming to the brook was so regulated as to serve its former useful purpose in driving the mills, and the torrents in winter were moderated. Several other examples of a similar character are given.

In Switzerland, amongst other examples is quoted one that occurred in the canton of Berne, where, owing to the re-planting of the mountain-side with fir trees, the water again appeared at a spring which had ceased to flow. After a period the trees were cut down and the land converted into pasturage, since when the spring has almost disappeared, only opening out at occasional intervals.

In the Kazan district of Russia, once celebrated for its forests of oaks and linden, which are now nearly all cut down, there were formerly seventy water-mills constantly at work. Less than half now can be worked, and even they only run half time, and are idle in summer for want of water; while in winter the little rivers that worked these mills are converted into impetuous torrents, breaking up the mill dams and doing other damage. These abandoned water-mills stand out as a striking proof of the consequences of the destruction of forests.

In Sardinia, where the surface consists of plutonic rocks covered with a thin layer of earth, all the streams have a rapid slope. The woods, which occupied in 1870 an area of more than 2½ million acres, or about 43 per cent. of the whole surface of the island, now are reduced to about one-sixteenth of this area. Since the removal of the trees the floods in the rivers rise with a rapidity and flow with a velocity never known before, and a great number of bridges have been destroyed by the floods. The beds of the channels have been raised in some places above the surface of the land, owing to the detritus brought down in floods.

In Wisconsin, U.S.A., the settlers cut down the forests and converted the land into tillage and pasture. During a period of about seventy years nearly the whole of the forest land was thus cleared, with the result that, as the forest disappeared, the water in the river became lower; finally thirty miles of the channel entirely dried up, and many water-mills that were formerly worked by the stream are now deserted and useless, owing to the want of water to run them.

In Sicily, owing to the cutting down of the forests on a vast scale in the province of Messina, the bed of the river has been raised by the stones and earth carried down by the torrents so as to stop all drainage from the land, and great damage has been done by the floods. Several other examples are given to the same effect where forests have been cleared in the same district, and these are compared with other streams where the forests still exist and their condition remains unaltered. In the former case, landslides from the mountains have become very frequent.

VARIATION OF GLACIERS.[1]

THIS interesting report of the Commission internationale des Glaciers shows that these ice-streams still continue to diminish in those parts of the world which it has been possible to examine. In the Swiss Alps, of ninety glaciers observed, not one shows an advance, which fully confirms the general results of the last seven years, and indicates that any slight variation is now at an end; the same is true of the Italian Alps, though some of them give signs of increase in their upper parts. In the French Alps (Pelvoux district), the Glacier Noir has steadily decreased since 1860; the Glacier Blanc, after decreasing from 1865 to 1886, advanced from about 1889 to 1896, but is now again retiring. It is noteworthy that the average elevation of the supply basin of the former is from 2500 to 2800 metres, and of the latter from 3000 to 3300 metres. In the Savoy Alps the shrinkage continues, some small glaciers having disappeared. The same is true in the Pyrenees.

In Norway both snowfall and temperature were rather variable in 1904, but the glaciers, with a few exceptions, have retreated; and in Greenland the Jakobshavn Glacier has shrunk, sometimes rather considerably. In the Caucasus (central) the glaciers continue to retreat; less is known of the eastern district, but the same apparently is true of it. During the past year M. Fedtchenko visited more than 110 glaciers in the Pamir, and has stated that all appeared to be diminishing. The same is true, with a few exceptions, of the north-western part of the United States, as well as of the mountain region of western Canada. In Africa, though the rainfall had been unusually heavy in the Kilimanjaro district, the amount of snow in the crater of Kibo had not, according to

[1] "Les Variations périodiques des Glaciers." Dixième Rapport, 1904. Rédigé par H. F. Reid et E. Muret (Extrait des *Archives des Sciences physiques et naturelles*, t. xx., juillet et août.) Pp. 34. (Genève: Georg et Cie, 1905.)

Dr. Uhlig, increased since 1901. Thus the report indicates that the retreat of glaciers, which began about forty-five years ago, still continues, having overpowered the slight rally which has been occasionally perceptible during the last decade. T. G. B.

THE REVOLUTION OF THE CORPUSCLE.[1]

Air: "The Interfering Parrot." (*Geisha.*)

A corpuscle once did oscillate so quickly to and fro,
He always raised disturbances wherever he did go.
He struggled hard for freedom against a powerful foe—
An atom—who would not let him go.
The æther trembled at his agitations
In a manner so familiar that I only need to say,
In accordance with Clerk Maxwell's six equations
It tickled people's optics far away.
You can feel the way it's done,
You may trace them as they run—
$d\gamma$ by dy less $d\beta$ by dz is equal $K.dX/dt$.
. . . . . .
. . . . . .
While the curl of (X,Y,Z) is the minus d/dt of the vector (a,b,c).

Some professional agitators only holler till they're hoarse,
But this plucky little corpuscle pursued another course,
And finally resorted to electromotive force,
Resorted to electromotive force.
The medium quaked in dread anticipation,
It feared that its equations might be somewhat too abstruse,
And not admit of finite integration
In case the little corpuscle got loose.
For there was a lot of gas
Through which he had to pass,
And in case he was too rash,
There was sure to be a smash,
Resulting in a flash.
Then $d\gamma$ by dy less $d\beta$ by dz would equal $K.dX/dt$.
. . . . . .
. . . . . .
While the curl of (X,Y,Z) would be minus d/dt of the vector (a,b,c).

The corpuscle radiated until he had conceived
A plan by which his freedom might be easily achieved,
I'll not go into details for I might not be believed,
Indeed I'm sure I should not be believed.
However, there was one decisive action,
The atom and the corpuscle each made a single charge,
But the atom could not hold him in subjection
Though something like a thousand times as large.
The corpuscle won the day
And in freedom went away
And became a kathode ray.
But his life was rather gay,
And he went at such a rate,
That he ran against a plate;
When the æther saw his fate
Its pulse did palpitate,
And $d\gamma$ by dy less $d\beta$ by dz was equal $K.dX/dt$.
. . . . . .
. . . . . .
While the curl of (X,Y,Z) was the minus d/dt of the vector (a,b,c).

[1] Composed by Mr. A. A. Robb and sung at the annual dinner of the research students of the Cavendish Laboratory, Cambridge, on December 6, 1905.

NOTES.

DR. N. L. BRITTON, director of the New York Botanical Garden, has been elected president of the New York Academy of Sciences.

DURING the meeting of the French Association for the Advancement of Science, to be held at Lyons next August, it is proposed, if the suggestion arouses sufficient interest, to arrange an exhibition of urban hygiene.

THE Brussels correspondent of the *Daily Telegraph* states that at the last meeting of the Academy of Science it was announced that Dr. Jacobs had conclusively proved cancer to have a bacterial origin. This is not the first time that similar positive statements have been made which subsequent research has proved to be fallacious, and all such reports must be received with the greatest reserve.

THE Morrison lectures of the Royal College of Surgeons, Edinburgh, have this year been delivered by Dr. Ford Robertson on the pathology of general paralysis of the insane. The main theme of Dr. Robertson's lectures is that general paralysis is an infective or germ disease caused by certain diphtheroid bacilli, which can be isolated from the blood and cerebro-spinal fluid of the patient, and the toxins of which by their action on the central nervous system induce the paralysis and other symptoms.

THE Milroy lectures of the Royal College of Physicians of London will be delivered by Dr. W. H. Hamer on March 1, 6, and 8, the subject being "Epidemic Disease in England: the Evidence of Variability and of Persistency of Type." The Goulstonian lectures will be delivered by Dr. H. Batty Shaw, on the subject of "Autointoxication," on March 13, 15, and 20; the Lumleian lectures by Dr. Ferrier, the subject being "On Tabes Dorsalis," on March 22, 27, and 29; and the Oliver-Sharpey lectures by Dr. E. J. Spriggs on April 3 and 5, the subject being "The Bearing of Metabolism Experiments upon the Treatment of some Diseases." Prof. W. Osler will deliver the Harveian oration on St. Luke's Day, October 18, and Dr. S. J. Sharkey the Bradshaw lecture in November.

THE annual general meeting of the Iron and Steel Institute will be held on Thursday and Friday, May 10–11. The council will shortly proceed to award Carnegie research scholarships, and candidates must apply before February 28. The awards will be announced at the general meeting. In place of the ordinary autumn meeting, a joint meeting of the American Institute of Mining Engineers and of the Iron and Steel Institute will be held in London on July 23–29. The Lord Mayor of London has consented to act as chairman of the London reception committee, and will give a conversazione at the Mansion House on the evening of July 24. The annual dinner will be held at the Hotel Cecil on Friday, July 27. A programme of the visits and excursions to be made during the meeting will be issued when the arrangements are sufficiently matured.

THE death is announced, at the age of eighty-three, of M. Jules Despecher, who for more than half a century played a prominent part in organising and arranging submarine cable services.

THE commission for the methods of examining and methylating alcohol, appointed by the French Government, has decided to offer the following prizes for open competition, irrespective of the nationality of the competitors:—(1) a prize of 20,000 francs for a method of methylating alcohol, which shall be preferable to that now in vogue in France, and which at the same time shall prevent any

defrauding of the revenue; and (2) a prize of 50,000 francs for a system which shall permit of the use of alcohol for illuminating purposes under the same conditions as those for the use of petroleum. Further details and particulars may be obtained from the commission (though not before April), which body will itself decide to whom the awards shall be made.

THE programme of the sixth International Congress for Applied Chemistry has recently been issued. The congress will be held in Rome from April 26 to May 3. On April 25 there will be a social gathering of those taking part in the congress, preparatory to the official opening on the following day; on the afternoon of the same there will be the first full committee meeting for the election of next year's officers. On April 27 the sittings of the various sections will begin, and will be continued on April 28 and 30, and on May 1 and 2. For Sunday, April 29, an excursion into the outskirts of Rome has been arranged. On May 3, after the final committee meeting, there will be two excursions, the one to the Island of Elba, and the other to Sicily. During the first, visits will be paid to the iron mines and works of Elba, whilst for the second arrangements have been made for visits to the saltworks of Erapani, the wine factories of Marsala, and the sulphur mines of Messina; but since the two excursions are taking place simultaneously, members of the congress may only participate in one of the two. All members will be entitled to reductions of from 40 per cent. to 60 per cent. on tickets issued by the State railways, according to the distances travelled.

THE Philosophical Institute of Canterbury, Christchurch, N.Z., has opened a fund with the object of establishing a memorial to the late Captain F. W. Hutton, F.R.S., president of the New Zealand Institute. It is proposed to devote the fund to the encouragement of original research in natural science in New Zealand by making grants from time to time to persons engaged in original research, and by the award of a bronze medal, to be called the "Hutton medal," for original contributions of special value. In the appeal for support, the memorial committee remarks:—"The influence and importance of research are becoming more and more fully recognised in all parts of the world, but New Zealand has as yet taken no steps for its encouragement, and no financial assistance has so far been given to private workers in any department of science. It is hoped, therefore, that advantage will be widely taken of the present opportunity of contributing to a fund which will encourage research, and will at the same time perpetuate the memory of Captain Hutton, who so unselfishly devoted himself throughout his lifetime to the advancement of natural science in New Zealand." Though the Philosophical Society has taken the matter in hand in order to save time, and has subscribed 50*l.*, the board of governors of the New Zealand Institute will probably be asked to take over the work of collecting the funds required. Meanwhile, subscriptions may be sent to Dr. Chilton, Canterbury College, Christchurch, N.Z., who is acting as hon. treasurer of the fund.

FROM the *British Journal of Photography* (January 26) we read that an international exhibition of photography is to be held this summer at Paris at the Petit Palais, in the Champs Elysées, and will be open from July 16 to October 10. Judging even by the brief statement given, the exhibition will be on a very large scale, there being thirteen groups of exhibits, comprising altogether sixty-three classes. A list of the groups is as follows:—History of photography; applications of photography to science; educational; amateur and pictorial photography; photographic periodicals; professional photography; photographic publications; photographic materials; apparatus and accessories; photo-mechanical processes; industries related to photography; leather dressing; photographic illustrations; and the photographic trade. Such a comprehensive programme will, we hope, bring together workers in all sections, and include a strong British exhibit. In the second group the exhibition is assured the support of a large number of scientific institutions in France and other countries, including the Collège de France, the Museum of Natural History (Paris), the Paris National Observatory, the physiological station at the Parc du Princes, the Marey Institute, the Institute Pasteur, the Faculté de Médecine, the Sorbonne, the School of Pharmacy, the School of Mines, the Smithsonian Institution (Washington), the meteorological observatories of France, and many others. It is stated that the last day for receiving applications for space is fixed for February 25 next, and that an English (?British) committee is in formation. It may finally be stated that no charge is made for exhibits coming under the head of the first three groups.

AMONG the contents of Nos. 24–27 of the *Sitzungsberichte* of the Royal Academy of Vienna for last year is a notice of Hymenoptera obtained during an expedition to south Arabia, and a summary of the zoological results of another expedition to the Sudan and Gondokoro. In a third paper Mr. A. Handlirsch discusses the phylogeny of the Arthropoda.

IN the course of a paper on the natural history of the Warburton district, published in the December (1905) number of the *Victorian Naturalist*, the author mentions that frigate-birds are used in the South Sea Islands as letter-carriers. If captured young, they will return, like homing pigeons, to the island of their birth, and, taking advantage of this trait, the missionaries forward such birds to islands with which they desire to hold communication. When released from their new domicile they fly straight to their old home, where they alight on the identical perches on which they were accustomed to be fed. Later on it is mentioned that diamond-tailed geckos (*Phyllurus platurus*) are always found head-downwards on the rocks they frequent. They assume this position, according to the author, in order to make hawks believe that their heads are their tails; consequently, when seized by one of these birds, which invariably pounce upon what they regard as the head, the brittle tail snaps off, and the gecko wriggles away little or none the worse for the encounter.

WE are glad to welcome the volume of the *Zoological Record* for 1904, which from its bulk bears testimony to the energy with which natural history studies are being carried on both in this country and abroad. A few changes have been made in the staff, but in the main the old contributors have remained at their posts. Errors, as usual, appear to be comparatively few, and in many cases are excusable. We notice, however, that the genus Lohmannella (spelt with a single *n*) appears among the mites, as well as (in its proper place) among the Vermes. In the myriopod section, which is written by a foreigner, the editor might well have amended the style of such names as Kaukasus, Wladiwostok, and Eastromelia, while in the Bryozoa he might have noticed that Miss Embleton gives "Memoirs of the Geological Survey of India" as the title of a paper. Again, in the bird section (p. 30) we find the same paper quoted twice over, on account of the fact that it appeared in two different journals. In congratulating the editor and his staff on their successful

labours, we may refer to the fact that they record the appalling total of no less than 2095 new generic and subgeneric names as the result of a single year's work!

IN the *Scientific Reports* of the Imperial Cancer Research Fund (No. 2, 1905) a valuable series of experiments and observations on the growth of cancer under natural and experimental conditions is detailed by Dr. Bashford and his co-workers. The statistical investigation of cancer has also been pursued, and a valuable report is presented. The provisional conclusion is arrived at that there is nothing in the statistical investigations of the Imperial Cancer Research Fund which points to an actual increase in the death-rate from cancer.

IN an interesting article in the *Quarterly Review* (January) Dr. George Pernet reviews the light-treatment of disease, with which the honoured name of the late Dr. Finsen, of Copenhagen, will always be associated. The action of the various rays of the visible and invisible spectrum on the lower forms of life is first detailed, and it is shown that the violet and ultra-violet rays are the active ones, and it is these which are employed for the treatment of lupus. At the same time, it must be recognised that light-treatment has its drawbacks; it is costly, slow in action, and does not influence all forms of the disease, particularly if at all below the surface, since the active rays have little power of penetration. It has recently been observed, however, that if the tissues be first treated with some fluorescent substance, such as eosin, the penetrative powers of the active rays are increased, and this fact may prove to be of practical value. Lastly Dr. Pernet points out that as lupus is a form of tuberculosis, the eradication of the disease is intimately connected with the larger question of the eradication of tuberculosis in general.

A LIST of pyrenomycetous fungi collected in Orleans County, New York, has been prepared by Mr. C. E. Fairman, and is published in vol. iv. of the *Proceedings of the Rochester Academy of Science, U.S.* A number of species are recorded for the first time for the State, and five are new to science.

UNDER the title of "Mesozoic Plants from Korea," Mr. H. Yabe contributes to vol. xx. of the *Journal of the College of Science*, Tokio University, a paper on fossil botany dealing with the collections obtained from a bed of coal shale in the vicinity of Naktong, a village near Sengchu. Twenty-one species, mostly ferns, but including a few cycads and conifers, are distinguished. From the similarity of several of these with species recorded from the Japanese Tetori series, the writer judges that the beds were formed contemporaneously; he also suggests that the plant-bed of Naktong was deposited as a beach formation in shallow brackish water.

IN connection with the fine avenues of trees at Quetta referred to in NATURE of January 11, p. 253, Mr. E. P. Stebbing has been investigating the ravages of a beetle, *Æolesthes sartus*, that has locally received the name of the "borer." In a pamphlet printed by the Government of India, Mr. Stebbing sketches the salient points in the life-history of the insect. The damage is caused principally by the larvæ, that feed first in the phloem and sap-wood of the tree, and subsequently penetrate during the winter into the heart-wood. The trees that have suffered most have been the Kabul willow, the reamer poplar, and the elm; the walnut, horse-chestnut, ash, and robinia have escaped entirely or nearly so, and, curious to relate, the mulberry has not been attacked.

THE members of the Botanical Society of Edinburgh receive from time to time at their meetings interesting announcements of the discovery of rare plants found during summer excursions. Mr. J. G. Nicolson publishes in vol. xxiii., part i., of the *Transactions and Proceedings* of the Society a list of some rare Caithness plants, that includes *Arctostaphylos alpina*, collected on Mt. Morven, *Hierochloe borealis* from Thurso, and a strange alien, *Hymenaea Courbaril*, known as the West Indian locust, washed up by the Gulf Stream near John-o'-Groats. Mr. W. Young, writing on the plants of the Glenshee district, Perthshire, reports the occurrence of *Gentiana nivalis*, *Veronica alpina*, and *Cochlearia Groenlandica* among flowering plants on or near Glas Maol; among the liverworts gathered in the district were *Cephaloziella Jackii*, *Lophozia socia*, and *Harpanthus Flotowianus*. The volume contains the latest of many papers by Mr. W. West and Prof. G. W. West on algæ, in which they describe the fresh-water algæ collected in the Orkneys and Shetlands; their list enumerates more than four hundred species—a large number being desmids and diatoms—of which several are new species or varieties.

THE order Bombacaceæ, united by Hooker with Malvaceæ, includes, besides the baobab, several remarkable trees, of which the "silk-cotton" trees are a prominent feature in the tropics. Two genera pass by this name, Bombax and Ceiba, or, as it is known in this country, Eriodendron. At Nassau, in the Bahamas, there is a historic giant silk-cotton tree that is assigned to *Eriodendron anfractuosum* in an enumeration of the plants of the Bahamas. The illustration here reproduced is taken from *Forest and Stream*, January 13, and shows the remarkable formation of plank-like outgrowths, produced from the base of the trunk and the uppermost roots, that have received the name of plank-buttresses. The plank-buttress is a peculiarity of trees growing in a tropical climate with abundant rainfall.

FIG. 1.—The Giant Ceiba Tree of Nassau—one of the famous trees of the World.

MR. AUDOIN contributes an interesting paper on the hydrography of Lake Tchad to *La Géographie* (vol. xii., No. 5). Recent observations of the volume of tributary streams and the area of the lake are analysed and applied to the examination of the question of the gradual desiccation of the region.

MR. MARQUARDSEN contributes a valuable and complete summary of the history of geographical exploration in the Lake Tchad region down to the year 1905 to the new number of the *Mitteilungen aus den deutschen*

Schutzgebieten (vol. xviii., part iv.). With this number is issued a new map of the region, and also a map of Togoland on a scale of 1 : 200,000.

PROF. H. FISCHER and Prof. F. Guillotel write in the *Zeitschrift* of the Berlin Gesellschaft für Erdkunde (No. 10, 1905) and in *La Géographie* (vol. xii., No. 4) on the position of geography, and the teaching of geography, in the United States. In both papers there is much to interest and stimulate teachers of the subject in this country. We note with pleasure the well deserved tribute which both writers pay to the work of Prof. W. M. Davis.

WE have received the annual number for 1905 of *Mazama*, the publication of the well known American mountaineering club. Mr. Henry Gannett contributes a paper on Lake Chelan and its glacier, and Mr. H. F. Reid describes the glaciers of Mount Hood and Mount Adams. The rest of the number is chiefly devoted to accounts of the work of the club during the year. Some of the photographs illustrating the "Rainier outing" are of great excellence.

THE director of the new Japanese Meteorological Service of Corea, Mr. Y. Wada, has lost no time in searching for and publishing the results of observations existing in that country. The Journal of the Meteorological Society of Japan for November last contains summaries of rainfall observations for the years 1896–1904 discovered at Seoul, and compiled in the Chinese language by a Mr. Li. The mean annual rainfall is about 35·4 inches, of which nearly 25 inches fall in the three summer months; July has an average fall of 11·3 inches, and December only 2·8 inches. The greatest daily falls occur in June and July, and exceed 5 inches on rare occasions. Rain falls, on an average, on 94 days in the year, and snow on 19 days.

MR. J. R. SUTTON has communicated to the *Transactions of the South African Philosophical Society* (vol. xvi., part ii.) a useful paper entitled "Some Results of Observations made with a Black Bulb Thermometer *in vacuo*." Mr. Sutton states that the object of the investigation was chiefly to ascertain some of the effects of various meteorological influences upon the indications of the instrument, not to discuss its suitability for the purposes of physical research. We are glad to see, however, that he does not share the opinion that has been sometimes expressed by high authorities of the untrustworthiness of the black bulb thermometer. We think it has been recently shown that good instruments, after use for some years, give fairly accurate comparative results, and, this being the case, their indications afford useful observations which cannot otherwise be obtained at ordinary meteorological stations. The author's observations show *inter alia* that at Kimberley the differences between the maxima in sun and shade increase with fair uniformity from winter to summer, the temperature in the sun increasing faster than that in the shade. A monthly comparison of various elements for four years shows that there is not any very obvious relation between the solar temperature and either the state of the sky or the hygrometric condition of the air, except, roughly, that the amount of cloud is least and the temperature of the dew-point lowest in winter, when the black bulb temperatures are lowest and the difference of maxima least. The elements arranged in a sequence of cloud percentages show that the temperature in the sun is at its highest when the sky is half clouded. Mr. Sutton thinks this seems to indicate that when the sky is more than half covered the clouds are as likely to shut off the solar heat as to impede radiation from the thermometer. We are unable in this brief notice to refer to various other points of interest in the paper.

THE paper on worm contact read by Mr. Robert A. Bruce before the Institution of Mechanical Engineers on January 19 throws much light on the actions involved with worm gearing. Many writers have contributed to the theory of the subject, but hitherto experimental investigation has been singularly incomplete. Some of the most interesting aspects of the question are dealt with by the author, but further research work is necessary before a complete account of the action of worm-gearing can be drawn up. The author's paper will prove a valuable guide to students of applied mechanics, and forms a welcome addition to the proceedings of the Institution of Mechanical Engineers.

THE presidential address of Prof. J. F. Kemp to the New York Academy of Sciences is printed in full in *Science* of January 5. It deals in a popular manner with the genesis of mineral veins. Ores, he shows, gather along subterranean waterways. They may fill clean-cut fissures; they may impregnate porous rocks on either side; or they may replace entirely soluble rocks. As to the source of the water that accomplishes these results there has been much discussion, the crucial point relating to the relative importance of the two kinds of ground-waters, those from the molten igneous rocks and those derived from the rains. The author inclines to regard the latter, if not as the sole vehicle of introduction, as the preponderating one.

IN the current issue of the *Engineering Magazine* (January) there is an interesting account of the first attempt of the United States Government to develop a source of fuel supply in the Philippines, where the economic conditions are favourable, inasmuch as nothing in the shape of a competing private coal-mining industry is established there. Owing to the high calorific power of the coal available, and to the fact that there is an ideal harbour adapted for a coaling station, the small island of Batan was selected as the site for the Government coal mines. The coal is of Eocene age, and the greatest normal thickness of any seam on the island is 8 feet. The coal yields 40 per cent. of volatile constituents and 4 per cent. to 7 per cent. of ash, whilst the fixed carbon in several cases exceeds 50 per cent. The author of the paper, Mr. O. H. Reinholt, was in charge of the development, and the numerous illustrations he gives are reproduced from photographs taken by himself.

MR. CONSUL STEVENS, in his report on agriculture in the Trans-Caucasus for the year 1905, refers, writes a contributor to the *Journal of the Society of Arts*, to the ravages of locusts. The fields situated along the stretch of land north and south of the river Kura are often visited by this insect at a season of the year when, in view of the forward state of the crops, their presence proves most disastrous to the population. The Government has for some years been paying much attention to the destruction of locusts, and with this object in view has endeavoured to encourage the peasants to destroy locusts' eggs, or the larvæ. Accordingly the peasants dig holes or trenches, and during the months of June and July the villagers go out into the fields and drive the larvæ into the trenches. This measure has been crowned with a certain amount of success during the present season, and the havoc done to the crops by locusts has thereby been reduced to a minimum. No fewer than 13,905,276 days' *corvée* work was done between the years 1898 and 1904 in destroying locusts in the Sir.

Darya, Samarkand, Ferghana, Semirechi, and Trans-Caspian districts. This in itself shows the immense sacrifices the natives are called upon by the authorities to make in connection with the destruction of locust eggs. Between the years 1900 and 1905 the rural authorities of those localities paid away sums to the amount of 80,000*l.* for the destruction of locusts, and yet during this period the crops in Central Asia were damaged to the extent of 150,000*l.* by this insect.

THE publication in NATURE of December 7, 1905 (p. 132), of some verses on the passing of the atom, sung at the chemical laboratory dinner at University College, London, has induced Mr. F. Horton, St. John's College, Cambridge, to send us a copy of the post-prandial proceedings of the Cavendish Society, containing several metrical compositions inspired by recent work on ions and radio-activity. Songs of this kind are sung at the Cavendish research students' annual dinner, which is held at the end of each Michaelmas term; and the one by Mr. A. A. Robb reprinted elsewhere in this issue is a good example of versification in science.

IN two recent papers, the one by Mr. D. Himstedt and Mr. G. Meyer, published in the *Berichte* of the Freiburg Scientific Society (1905, vol. xvi., p. 13), and reprinted in *Le Radium* (vol. ii., No. 12), the other by Prof. B. Walter and Mr. R. Pohl (*Annalen der Physik*, iv., 18, 406), experimental evidence is brought forward to show that the light ordinarily emitted by radium bromide is principally due to the impact of the Becquerel rays on the particles of nitrogen in the immediate vicinity. The probability of this being the case was suggested by Sir William and Lady Huggins in 1903, although the latter were unable then to obtain direct evidence in support of their view.

AN important paper by Prof. A. W. Witkowski on the thermal dilatation of compressed hydrogen is published in the *Bulletin International* of the Cracow Academy of Sciences (1905, No. 6). Full details are given of the methods employed in determining the values, already published in a brief report to the British Association in 1904, of the volume coefficient of dilatation of hydrogen at temperatures ranging from +100° to −190° C. under pressures of 1–60 atmospheres. The results are used in discussing Wroblewski's calculation of the critical temperature and pressure of hydrogen, a subject which is also dealt with experimentally by Prof. Olszewski in the following number of the Bulletin (1905, No. 7). The critical pressure was found in a new determination to be 13·4–15 atmospheres, the critical temperature being −240°·8 C. Prof. Olszewski also describes in No. 7 an unsuccessful attempt to liquefy helium by allowing it to expand suddenly, after cooling to −259° C. by means of solid hydrogen, from a pressure of 180 atmospheres. Not a trace of liquefaction could be observed at the temperature obtained in this way, which is calculated to be as low as −271°·3 C., or 1°·7 absolute.

AT the last meeting of the physical-mathematical section of the Berlin Academy of Science, held under the presidency of Prof. Waldeyer, Prof. Landolt epitomised the results of his extensive experiments on the question of the possible change of weight caused by chemical action, and stated that he had obtained confirmation of many previous observations of a decrease in weight as a result of certain reactions, and that he had started further experiments with the view of discovering the cause of such changes. Prof. van 't Hoff gave a further contribution to his series of papers on natural salt formations, xlv., the occurrence of tincal and octahedral borax. In collaboration with Blasdale he had observed that the appearance of octahedral borax in Italy was dependent upon a minimum temperature of about 35°·5 C. Prof. Waldeyer read a communication from Dr. A. Sachs, of Breslau, on kleinite, a hexagonal mercury oxychloride from Terlingua, in Texas. This mineral, to which the formula $Hg_4Cl_2O_3$ is given, is a third addition to the other two mercury oxychlorides previously found in this district, namely, eglestonite, $Hg_6Cl_3O_2$, belonging to the regular system, and the monoclinic terlinguaite, Hg_2ClO.

THE real existence of the *n*-rays, discovered by M. Blondlot, has been the subject of much discussion, there being a general consensus of opinion outside France that the effects produced are physiological. The *Comptes rendus* for January 15 contain two papers of considerable interest on this subject. The first of these, by M. Mascart, gives details of a series of measurements of the points of maximum intensity in the spectrum produced by the refraction of the *n*-rays through an aluminium prism, by a number of independent observers. The phosphorescent screen was mounted on the carriage of a dividing engine, and each of four observers (Messrs. Blondlot, Gutton, Virtz, and Mascart) made independent measurements of the points of maximum intensity. The most concordant figures were those obtained by M. Blondlot, but the general agreement of the results left no doubt as to the position of the lines. M. Mascart gives the results without comment. The second paper, by M. Gutton, is an attempt to prove the objective existence of the *n*-rays. It had been noted that if these rays are allowed to fall on the primary spark of a Hertzian oscillator, the lustre of the secondary spark diminishes. This effect has been secured photographically, the difference being clearly marked in the whole of the thirty-seven experiments. The apparatus is described in detail, and the precautions necessary for success pointed out. These two papers certainly provide material for consideration by those who maintain that the whole phenomenon is a physiological illusion.

PROF. HENRI MOISSAN has continued his experiments on the fusion and volatilisation of the more refractory metals in the electric furnace, and gives an account of his results in the current number of the *Comptes rendus* (January 22). In the first experiment, made with osmium, the temperature obtained by using a current of 500 amperes at 110 volts, although sufficient to distil 16 per cent. of the metal in four minutes, was not sufficient to melt the metal, except at the edges. Osmium was entirely fused with a current of 700 amperes at 110 volts in five minutes, but the fused metal contained nearly 4 per cent. of graphite. Under the same conditions of current and voltage as in the second experiment above mentioned, 150 grams of ruthenium were completely melted in three minutes, about 11 per cent. being distilled during the fusion. The fused ingot of ruthenium also contained graphite. Platinum could be distilled in the same furnace with great ease, and, indeed, Prof. Moissan remarks:—"The liquid metal distils with the same facility as water carried to 100° C." Palladium, iridium, and rhodium were also fused and distilled without difficulty, palladium being the easiest metal to fuse of all those examined in this group.

A SUMMARY of the weather for 1905 at Sevenoaks has been received from Mr. W. W. Wagstaffe.

MR. H. K. LEWIS'S quarterly list of new books and new editions added to his Medical and Scientific Library (136 Gower Street, W.C.) during the last three months of 1905

includes more than 150 titles of books, above 30 of which are in the chemical, engineering, and electrical departments of the library.

THE "Writers' and Artists' Year-book" for 1906 has now been published by Messrs. A. and C. Black. It contains much information likely to be of assistance to writers on all subjects. The list of papers and magazines, good though it is, is by no means complete; for though details concerning *Science Siftings* are supplied, we have been unable to find any mention of the *Chemical News*, the *Entomologist*, the *Irish Naturalist*, and the *Zoologist*. The price of the year-book is 1s. net.

MESSRS. ARCHIBALD CONSTABLE AND CO., LTD., have ready for publication immediately the following books of scientific interest:—"Motor Vehicles and Motors," vol. ii., by W. Worby Beaumont; "Tunnel Shields and the Use of Compressed Air in Subaqueous Works," by W. C. Copperthwaite; "Modern Turbine Practice and Water Power Plant," by J. W. Thurso; "The Seven Follies of Science," by J. Phin; "Experimental Electrochemistry," by N. Monroe Hopkins; "Gas, Gasolene, and Oil Engines" (new edition), by G. D. Hiscox; and "Practical Electro-chemistry" (second edition), by B. Blount.

THE twenty-sixth issue of the "Englishwoman's Year-book and Directory," that for 1906, has been published by Messrs. A. and C. Black. It maintains the high level of usefulness to which attention has on previous occasions been directed in these columns. Englishwomen anxious to take part in the useful work of the world owe a debt of gratitude to Miss Emily Janes, who edits the volume. Great prominence is, as usual, given to education, and the information given concerning the higher education of women is exhaustive and interesting. An alphabetical list of some distinguished women with their contributions to science and education should serve to encourage others to assist in the spread of knowledge.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN FEBRUARY:—

Feb. 2. 5h. Jupiter in conjunction with the Moon. Jupiter 4° 39′ N.
,, 3. 5h. 23m. to 6h. 28m. Moon occults α Tauri (mag. 1·1).
,, 4. 10h. 6m. to 12h. 6m. Transit of Jupiter's Sat. III. (Ganymede).
,, 5. Juno (mag. 8·7) in opposition to the Sun.
,, 7. 7h. 7m. to 8h. 4m. Moon occults ζ Cancri (mag. 4·7).
,, 7. 9h. 33m. Minimum of Algol (β Persei).
,, 8. Total eclipse of the Moon.
17h. 57m. First contact with the shadow.
18h. 58m. Beginning of total phase.
19h. 47m. Middle of the eclipse.
20h. 36m. End of total phase.
21h. 37m. Last contact with the shadow.
19h. 30m. Moon sets at Greenwich.
Magnitude of the eclipse = 1·632.
,, 10. 6h. 22m. Minimum of Algol (β Persei).
,, 10. 11h. 7m. to 12h. 12m. Moon occults χ Leonis (mag. 4·7).
,, 14. Venus. Illuminated portion of disc = 1·000. Of Mars = 0·944.
,, 16. Juno ½° S. of ζ Hydræ (mag. 3·3).
,, 22. 19h. 43m. Partial eclipse of the Sun, invisible at Greenwich.
,, 24. 11h. Saturn in conjunction with the Sun.
,, 28. 7h. 0m. to 8h. 9m. Moon occults μ Ceti (mag. 4·4).

DISCOVERY OF A NEW COMET.—A telegram from the Kiel Centralstelle announces the discovery of a new comet by M. Brooks at Geneva on January 26. Its position at 10h. (Geneva M.T.) on that date was

R.A. = 16h. 19m. 28s., dec. = +47° 10′,

which is near to τ Herculis.

The object is said to be a bright one, and to be moving in a north-westerly direction. Being the first comet to be discovered during the year, it will take the designation 1906*a*. At 9 p.m. τ Herculis is fairly low down, near to the N.N.E. horizon, and does not "south" until about 7·30 a.m.

A second telegram from Kiel states that the comet was observed by Dr. Palisa at Vienna on January 28. Its position at 15h. 13·3m. (Vienna M.T.) was

R.A. = 16h. 18m. 16·4s., dec. = +50° 4′ 45″.

From this it appears that the comet is at present travelling nearly due north towards the constellations Draco and Ursa Minor.

COMET 1905*c* (GIACOBINI).—As comet 1905*c* is now emerging from the immediate neighbourhood of the sun and is fairly bright, it should soon become visible in the evening sky, immediately after sunset, and in the south-west. The following is an extract from a daily ephemeris published by Herr A. Wedemeyer in No. 4067 of the *Astronomische Nachrichten*:—

Ephemeris 12h. M.T. Berlin.

1906	α (true) h. m. s.	δ (true) ° ′	log r	log Δ
Feb 1	22 18 6	−25 9	9·6110	0·0616
3	22 40 39	−24 17	9·6634	0·0616
5	23 1 53	−23 9	9·7099	0·0633
7	23 21 49	−21 50	—	—
9	23 40 24	−20 25	—	—

OBSERVATIONS OF STANDARD VELOCITY STARS.—In accordance with the international cooperative scheme for the regular determination of the radial velocities of ten standard stars, Mr. Slipher, using the Lowell spectrograph, observed the following stars during the summer and autumn of 1905. γ Cephei was substituted for α Crateris—the tenth star of the standard list—because the latter was too near the sun during the period covered by the observations. The mean velocity obtained by Mr. Slipher for each star is also given below:—

Star	No. of plates	Velocity
α Arietis	3	−14·3 km.
α Persei	5	− 2·5 ,,
β Leporis	3	−13·0 ,,
β Geminorum	3	+ 3·3 ,,
α Boötis	5	− 4·7 ,,
β Ophiuchi	3	−11·3 ,,
γ Aquilæ	3	− 2·1 ,,
ε Pegasi	4	+ 6·1 ,,
γ Piscium	3	−11·3 ,,
γ Cephei	3	−41·9 ,,

Mr. Slipher describes the equipment and the method of working, and directs attention to the fact that the high altitude of the Lowell Observatory and the prevalent transparency of the sky contribute greatly to the light-power of the equipment. Satisfactory spectrograms of α Persei were obtained in 15 minutes, whereas with the Yerkes equipment the shortest exposure on this star was 30 minutes (*Astrophysical Journal*, No. 5, vol. xxii.).

A FIRE NEAR THE MOUNT WILSON OBSERVATORY.—From No. 1, vol. xiv., of *Popular Astronomy*, we learn that a serious fire took place on Mount Lowe, near to Mount Wilson, on December 9, 1905. Fortunately, no damage appears to have been done to the observatory equipment, but the heat was so intense that Prof. Hale, fearing that some of the more delicate parts of the apparatus might be injured thereby, had them removed and sunk in the observatory reservoir until the danger was past.

MEMOIRS OF THE ROYAL SOCIETY OF NAPLES.[1]

THE greater number of the papers published in the last volume of the *Atti* of the Royal Society of Naples deal with geological and palæontological subjects connected with southern Italy. Dr. Maria Pasquale has prepared a catalogue of the fossil remains of Selachians, preserved with the University collections in Naples, and in various other museums in Italy. The majority of the species were already known through the writings of Prof. O. G. Costa,

FIG. 1.—*Hippocampus antiquorum*. From the Pleistocene Clay of Taranto.

who had originally formed the Neapolitan collection, and of Prof. Bassani, in whose custody the specimens now are. With the exception of one possibly Cretaceous species, all are Cainozoic, and no less than twenty-two species come from the *pietra leccese* (Middle Miocene).

The fish fauna of the Pleistocene Clays of Taranto is described by Prof. F. Bassani (No. 3, 59 pp., 3 pls.), principally from a collection of 700 specimens obtained by Dr. Marchesetti during the excavation of a new dry dock at Taranto in 1886. From beds of clay varying from 10 metres to 73 metres in thickness come 9 species of algæ, including the new *Grateloupia bassanii*, which form the subject of a special memoir by Dr. A. de Gasparis (No. 4, 8 pp., 1 pl.), and 29 species of fish, all of which are found living in the Mediterranean at the present day, and many of which may be seen on the stalls of the fish market in Taranto. Certain genera, Hippocampus, Scopelus, Maurolicus, Heliastes, Mullus, and Trachypterus, do not appear to have been recorded in the fossil state before these Tarantine discoveries. The occurrence of many individuals belonging to near-shore-living genera, like Solea, suggests that the fauna was essentially a littoral one, and the presence of such deep-sea types as Nyctophus (=Scopelus) or Maurolicus is hardly to be regarded in any other light than the occasional upheaval of the *dead* bodies of abyssal forms in the Straits of Messina at the present day. Bones of a dolphin are recorded from the same deposits.

[1] "Atti della Reale Accademia delle scienze fisiche e matematiche di Napoli." Vol. xii. (1905.)

Dr. M. Pasquale also contributes a short illustrated description of another fish, *Palaeorhynchus deshayesi*, Agassiz, from the Eocene deposits near Barberino di Mugello, Florence (No. 8, 7 pp., 1 pl.).

Two important contributions to the palæontology of the Gulf of Naples deal with the corals of Capri and with the Triassic shells of Giffoni, near Salerno. Prof. de Angelis d'Ossat has proved that the Capri limestones of Venassino, which have hitherto been generally believed to be of Tithonic age, in accordance with the view of Oppenheim (1889), are far more nearly related in their coral-fauna to the Urgonian rocks. Out of a total of 25 species of corals, 18 are shared with the Urgonian, only 1 with Tithonic deposits. Several species of Amphiastræid and Astræid corals are described and figured as new to science, and an Acanthocœnia is named after Dr. Cerio, the discoverer of this rich deposit, who has devoted so much of his life to the study of the natural history of Capri. The dolomitic limestone of Giffoni has already been made known by the work of Costa and Bassani on the fish-fauna. In Dr. Galdieri's memoir (No. 16, 30 pp., 1 pl., 21 figs.), which is in the main a revision of O. G. Costa's work of forty years ago, an attempt has been made to determine the exact chronological position of the Giffoni beds with respect to others both in Italy and the Alps. More material will be required before certain conclusions can be drawn, but at the present state of knowledge there is fair evidence of contemporaneity with the well known Triassic strata at St. Cassian.

An interesting note bearing on the same general subject of the limestones of the Bay of Naples is on the Scoglio di Revigliano, by Prof. de Lorenzo (No. 12, 4 pp., 2 pls.). Revigliano Island is a tiny islet rock of Cretaceous, perhaps of Urgonian, age, which, were the sea to be removed, would be seen to rise by itself from a gently sloping plain of volcanic deposits, among which pumice, like that which buried Pompeii in the year 79, would be conspicuous, as well as the products of other Vesuvian and Campanian eruptions. The strata of the little rock dip in the same direction as those of the Sorrentine peninsula, viz. to the north-west, and they indicate by their trend the existence of a great fault, all other trace of which is buried beneath the alluvial and volcanic deposits of the Sarno-Castellamare plain.

The granitoid and Filonian Rocks of Sardinia form the subject of a posthumous memoir of Carlo Riva (No. 9, 108 pp., 7 pls.), which has been prepared for the press by his friend and colleague Prof. de Lorenzo. After describing the petrographical characteristics of the chief varieties of rock in detail, the author gives a valuable account of seventeen localities in Sardinia where zones of contact between the granites and schists and calcareous rocks may be well studied, together with an appreciation of the metamorphic changes that have taken place at each locality. The memoir concludes with a discussion of the theories of the probable age of the granitoid rocks of Sardinia.

FIG. 2.—Revigliano from the south-east.

Dr. V. Bianchi has re-investigated certain parts of the brain of *Delphinus delphis* (No. 14, 16 pp., 3 pls.), and has compiled an interesting table setting forth his estimates of the relative numbers of neuroglœal corpuscles and of nerve cells in various regions of the cerebral cortex.

Although the cerebral hemispheres resemble those of the carnivorous type, yet the frontal lobes are so singularly under-developed that the author finds therein an explanation of the relative stupidity of the dolphin.

"Bidder's Organ" (Spengel) was discovered in 1758 by Rösel von Rosenhof upon the testes of *Bufo calamita*. Dr. Attilio Cerruti, by means of material captured in the volcanic crater of Archiagnano, near Naples, has been able to demonstrate a highly interesting cytological process which occurs in the male individuals of *Bufo vulgaris* during the early months of the year. Certain of the cells, named ovules, of the organ of Bidder are so strongly attracted by some of their neighbours that they actually penetrate their enveloping membranes, and their cytoplasm and nuclei flow into the invaded cells. In the majority of cases the penetration is simple, *i.e.* only one ovule invades a second, but multiple penetration has also been observed; and then in the case of ovules, say, *a*, *b*, *c*, *d*, ovule *a* will penetrate into *b*, *b* into *c*, *c* into *d*, &c. In all cases of penetration, degeneration ensues. Generally speaking, the invading ovule is the younger, and is one which has developed on the periphery of the organ, the invaded ovules lying nearer the centre. The author draws a suggestive comparison between this phenomenon and that of the fusion of Ascaris ova described by O. zur Strassen, which, if they develop at all, give rise to monsters.

There are also four mathematical memoirs. Signor D. de Francesco contributes a paper on the motion of a cord and on the equilibrium of a flexible but non-extensible surface (Nos. 5 and 6, 5 pp., 9 pp.), and Prof. E. Cesàro investigates the intrinsic representation of a surface (No. 7, 20 pp.) and the curve of von Koch (No. 15, 12 pp.). A lengthy contribution to the theory of ternary biquadratic form and its resolution into factors (No. 13, 102 pp.) is by the hand of Ernesto Pascal.

R. T. G.

PHYSIOLOGICAL ECONOMY IN NUTRITION.

ONE of the most remarkable points in the recent history of physiological research is the small amount of attention bestowed upon the important question of nitrogenous metabolism until within the last few years. The older work of Voit and of Pflüger has for long been regarded as authoritative, in spite of the fact that these two observers are not at one on many essential facts. They, however, agree that proteid food is a most essential constituent of our diet, and that a minimum allowance per diem of about 100 grams, corresponding to 16 to 18 grams of nitrogen, is necessary for the well-being and equilibrium of the average adult human individual. A dietary containing this amount of proteid or albuminous material would not be regarded by the average meat-eating Englishman to be a very liberal one, and is frequently exceeded.

So firmly rooted has this idea of a proteid minimum intake of 100 grams become that not only is it stated as an axiom in the majority of text-books, but it forms the basis of dietaries prescribed by responsible Governments for use on military service, &c. The doctrine that proteid food is the most necessary of all foods is so thoroughly ingrained, even upon the lay public, that in popular parlance the words nutritious and nitrogenous are almost synonymous. This is a very dangerous mistake, for the non-nitrogenous constituents of diet, the carbohydrates and the fats, are equally necessary for the maintenance of bodily heat and energy, and so are equally, though in a somewhat different sense, to be regarded as nutritious. An example of this erroneous way of regarding food is to be seen in advertisements that meet the eye everywhere; preparations of milk, for instance, are sold which contain mainly the proteid matter of that fluid, and are vaunted as containing all the nutritious elements, the other constituents being looked upon as useless. As a matter of fact, milk is of special value on account of the admixture of the non-proteid with proteid material. In the concentration camps which were established during the later phases of the South African War, such hardships as occurred there were mainly due, not to lack of proteid nutriment, for the standard of nitrogen was fully maintained, but to lack or scarcity of vegetables and other sources of carbohydrate food.

For some considerable time, certain experimenters in Germany have striven to demolish the fetish of the irreducible minimum of the 16 or 18 daily grams of nitrogen, but their work has not attracted world-wide acknowledgment; the experiments they recorded were either made for too short a time or on too few people to be regarded as epoch-making.

It has been left to America to make the question one of immediate and urgent attention, and I propose in this article to bring the conclusions of these American investigators before the readers of NATURE.

Prof. R. H. Chittenden, of Yale University, and Dr. Otto Folin, of Waverley, Massachusetts, are the two principal exponents of the new doctrine, and I propose to deal with them in that order.

The Work of Chittenden.

Chittenden has been working at the subject for some years, and the results of his labours are given in a volume which will amply repay perusal entitled "Physiological Economy in Nutrition" (New York: F. A. Stokes Co., 1904). A more popular exposition of his ideas has been published in a recent number of the *Century Illustrated Monthly Magazine* (October, 1905, p. 859 *et seq.*).

The question was first brought to the notice of Prof. Chittenden by Mr. Horace Fletcher, who states that he cured himself of dyspeptic troubles by lessening his proteid nutriment below what was regarded as the physiological standard. He has started a propaganda on the subject from the economic point of view, for proteid is the most expensive of the articles of diet. One at once sees that the question is not merely one for the student of science, but is most important for the man in the street as well. Owing, no doubt, to his lack of physiological knowledge, Mr. Fletcher attributed the benefits he derived to a thorough mastication of the comparatively small amount of food he took. Mastication is, of course, of importance, but it does not possess the superlative importance attributed to it by Mr. Fletcher, and will not explain the results of the experiments made by Chittenden and his fellow-workers.

The number to which I have already alluded (16 to 18 grams of nitrogen a day) is based roughly on the usual diet of the meat-eating nations, and it is argued that habit and instinct alike are safe guides in determining such a number, and the effects of such a diet in the maintenance of health and bodily equilibrium have been abundantly proved through centuries of experience. It forms, as already stated, the basis of the usually accepted dietaries of Ranke and of Voit.

In other nationalities, it is true, a different figure has been arrived at, and the same argument of habit and experience might equally well be used in its favour. Thus in certain semi-civilised races the proportion of flesh food is much larger, and in other races, again—and this is the commoner variation—the proteid intake is less. We need, however, only consider the second alternative, for one can hardly suppose anyone will advocate a return to more carnivorous habits. It is alleged that in such nationalities as the Japanese, or in groups of people like vegetarians, and in certain rural populations, health and equilibrium are as well maintained as in the ordinary meat-eating inhabitants of our large cities. Those who hold that the number 16 to 18 is the correct one have explained the different number arrived at by the nations of the Far East as a racial difference propagated by long centuries of inheritance, or have tried, more or less successfully, to show that such people come nearer to Voit's standard than had been supposed, or else that they are not properly nourished.

Such explanations will not hold water when applied to the experiments conducted by Prof. Chittenden upon himself, his colleagues, his students, and upon a considerable number of athletes and soldiers. These experiments lasted in all cases for months, and in some for more than a year. The proteid intake was reduced to half, and in some cases to less than half the number hitherto regarded as normal. After a variable initial drop in body-weight, the deprivation was apparently followed by no untoward results. Equilibrium was maintained; the health remained

perfect or improved; the muscular power of athletes was increased; mental acuity was undiminished; and desire of richer food disappeared.

Chittenden argues from such results (and daily observations were diligently maintained throughout each experiment) that his scanty proteid diet is the normal, and that the average meat-eater is the man who is abnormal. He says:—"When we recollect that these eighteen grams or more of nitrogen in the urine reach the final stage of urea, &c., only by passing through a series of stages each one of which means the using up of a certain amount of energy to say nothing of the energy made use of in digestion, absorption, &c., we can easily picture to ourselves the amount of physiological labour which the daily handling by the body of such amounts of proteid food entails. It needs very little imagination to see that a large amount of energy is used up in passing on these nitrogenous waste products from organ to organ or from tissue to tissue, on the way to elimination, and we can fancy that liver and kidneys must at times rebel at the excessive labour they are called upon to perform." He then goes on to point out that many of these waste products, like uric acid, are toxic, and the evil results that ensue from their accumulation.

It is on such grounds that Chittenden advocates a revolution in our ordinary dietary, and his arguments for temperance in proteid intake are entitled to careful attention. He is no crank or faddist, and his conclusions have been arrived at by the true scientific method, that of experiment.

There will be many who will pay no attention to them at all. The *bon vivant*, for instance, will resent any interference with his habits, gout and other evils notwithstanding; and certainly some of the meals Chittenden describes do not appear very appetising; for instance, a banana and a cup of coffee for breakfast; bean soup, bread (1 oz.), bacon ($\frac{1}{2}$ oz.), fried potato, salad, prunes, and another banana for supper. But no doubt variations in the way in which the nutriment can be obtained are possible of introduction.

The honest inquirer after truth may also have his doubts, and it cannot be disputed that there are difficulties, and serious ones, which will have to be answered before the advocacy of the new idea will meet with success.

One would like to know, for instance, whether the numerous subjects of the experiments are still keeping up their reduced diet, or whether they have returned to the flesh-pots after a period of enforced abstinence. If they are still maintaining their new habits, one would like to know how they fare in a few years' time, if they have the reserve force to enable them to withstand a severe disease, great fatigue, or privation during a siege, and whether the initial briskness they felt when they dropped their large (probably too large) proteid intake is maintained, or whether, on the other hand, they present the appearance and symptoms of underfed persons.

A cautious and conservative person would point to the danger of a sudden change in the habits of years and generations, even though it may ultimately be necessary. Most physiologists will recall the analogy of metabolic changes to commercial undertakings which they employ when presenting balance-sheets of intake and output in the body, and say, just as in a business enterprise, a large turnover implies healthy activity, so in the body a frequent exchange of the old for the new is within certain limits an indication of vigour, and a necessary accompaniment of healthy action. The liver, the function of which it is to turn nitrogenous metabolites, which may be harmful, into urea, which is harmless and easily disposed of, is adequately large and active in health to deal with considerable quantities of material.

Then we may point to the stunted and feeble inhabitants among the poor and ask why they are so. Unhealthy dwellings, excess of alcohol, insufficiency of light and pure air will explain a good deal of their condition; but is it not underfeeding, especially in early life, which is at the root of the matter? They have had *nolens volens* to subsist on a diet very like Chittenden's, but their nutritive condition is not such as to make people who can afford a more liberal table inclined to follow their example.

Further, one may inquire, why is it that, with a few exceptions, the meat-eating nations have risen to the front? and why is it that in countries like India, where the native population is diluted with the white races, it is the former who are more readily attacked by disease, and more easily succumb to its effects?

A question intimately related to that of a suitable diet for the healthy adult is that of the feeding of children. The diet of the growing infant is relatively far richer in proteid than that of the adult. Must we also reduce the intake of proteid food in the child? This is a question that Chittenden has not touched, but clinical experience does not point, so far as I can ascertain, to an affirmative answer, either with regard to the feeding of infants or of certain classes of invalids.

These questions and difficulties cannot be answered offhand. There is a wide field still open to investigators, and not until such difficulties are removed will it be possible for physiologists to state that Prof. Chittenden has convinced them.

The Work of Folin.

Whether Dr. Otto Folin has seen these difficulties or not, he certainly does not mention them, and he appears as an advocate of the new doctrine, not only from a study of Chittenden's investigations, but also as a result of his own researches. Nitrogen enters the body in the complex compounds known as proteids; it leaves the body mainly by the urine in the shape of certain simpler substances of which urea is the most abundant. Folin has approached the subject from the aspect of nitrogenous discharge, and has published his investigations on the urine in a series of three interesting papers in the *American Journal of Physiology* (vol. xiii., 1905, pp. 45–65, 66–115, 117–138). Although it is possible that some of his conclusions may not stand the test of time, all of them are most suggestive, and his theory of proteid-metabolism will stand out as one of the most important contributions to physiological literature that has appeared within recent times.

The question, what is a normal diet? is intimately bound up with another, and that is, what is a normal urine? The text-book statements on the composition of this fluid are all derived from the examination of the urine of people accustomed to the Voit dietary; but if the diet of the future is to contain only half as much proteid, the urine of the future will naturally show a nitrogenous output of half that which is now regarded as normal. In people on such reduced diets, Folin shows that the decrease in urinary nitrogen falls mainly on the urea fraction, and in some cases the urea accounted for only 66 per cent. of the total nitrogen eliminated. The other nitrogenous waste products alter but little in absolute amount, but relatively their amount rises; in particular, the creatinine remains remarkably constant in absolute amount in spite of the great reduction in the proteid ingested. He goes on to point out that the laws governing the composition of urine are the effect of more fundamental laws governing proteid katabolism. Voit's well known theory on this question states that katabolism, *i.e.* the breaking down stage, occurs only in "circulating proteid"; the small amount of "living proteid" which dies is dissolved, and is then added to the "circulating proteid," where the final breakdown into waste products takes place. Pflüger, on the other hand, believes that all proteid taken in as food is first assimilated and becomes a corporate part of living cells before it undergoes the katabolic change. This view has met with more general acceptance than Voit's. The opinion held by Folin is that neither of these extreme views is correct, but that nitrogenous katabolism is of two kinds: one is inconstant and immediate, varies with the food, and leads to formation of urea and inorganic sulphates, but not of creatinine and "neutral sulphur." The other is smaller in amount, constant in quantity, and is largely represented by creatinine, "neutral sulphur," and to a less extent by uric acid and ethereal sulphates. This latter form of metabolism, representing the breakdown of actual living substance, may be termed tissue or *endogenous* metabolism, whilst the other is *exogenous*. Exogenous metabolism therefore represents an immediate discharge of the nitrogenous constituent of proteid matter, leaving the non-nitrogenous moiety available for use in heat and energy production, fulfilling, in other words, the same func-

tion as carbohydrate and fat. Endogenous metabolism sets a limit to the lowest level of nitrogenous equilibrium attainable, and the proteid necessary to balance this part of the nitrogenous waste is indispensable for the repair of the tissues. Whether the amount exogenously katabolised can be entirely dispensed with is at present questionable. I fancy most physiologists would agree that it cannot with safety be wholly dispensed with; the body would then be working too dangerously near the margin, and in any case where an excess of nitrogenous waste is necessary the call would have then to be made on the tissue proteids.

Recent researches on digestion of proteids in the alimentary canal have shown that they are largely broken down into simple substances like ammonia, leucine, tyrosine, and other amino-acids. This is regarded by Folin as a preliminary means of getting rid of the excess of proteid matter usually ingested; these waste products, according to this view, are taken to the liver, rapidly transformed into urea, and so got rid of. The evidence that they are synthesised by the cells of the body into "living proteid" is regarded by him as inconclusive and largely teleological. An extensive formation of Voit's "circulating proteid," to be followed immediately by decomposition into urea, is quite as improbable as the corresponding formation and decomposition of Pflüger's organised protoplasm. The organism requires in its food only the small amount of nitrogen necessary for endogenous metabolism; the nitrogen of the extra proteid is unnecessary, and the organism has at hand an active mechanism for casting it out.

To attempt to summarise all the points of detail into which Folin enters is beyond the scope of this article: all I desire to do is to bring forward the main principle of the new idea. There is, however, one further point of sufficient importance to warrant specific mention, and that is the one related to muscular work. The fact that muscular work does not increase proteid katabolism may be accepted as an approximate truth; it is not absolutely true; there is a certain increase of nitrogenous waste, but it is insignificant as compared with the enormous and immediate increase of waste carbonaceous products like carbon dioxide that are discharged when muscles are thrown into action.

If current views on the nature of proteid katabolism are correct, this fact is very difficult to explain, but it becomes intelligible if proteid katabolism, in so far as its nitrogen is concerned, is independent of the oxidations which give rise to heat or to the energy which is converted into work. "Whether severe work will have an effect on the endogenous metabolism cannot be shown by investigating urea excretion; determinations of creatinine and 'neutral sulphur' are necessary for a study of that question" (Folin).

One of the benefits such papers as those of Folin confer is that new ideas of this kind suggest fresh work to others, and it can hardly be doubted that in the future physiological literature will contain many papers criticising and supplementing the theories and facts which Folin has brought forward. Already one of these has appeared in the current issue of the *Journal of Physiology* (Noël Paton, vol. xxxiii., p. 1, 1905). In this Dr. Noël Paton on the whole agrees with Folin concerning the dual nature of proteid metabolism. He, however, differs from him in certain points of detail. He finds in the dog, for instance, that creatinine excretion is not so constant a quantity as in man. He also doubts whether it is possible to draw any hard and fast line between endogenous and exogenous metabolism, and that urea may be a final product of both. He explains some of Folin's results by variations in the activity of the liver, for it is in this organ that ammonia compounds and the like are transformed into urea. A study of various diets upon the flow of bile (which may be taken as an index of hepatic activity) shows that proteid diet specially stimulates the metabolic processes in the liver. Hence on a diet which is poor in proteid the hepatic action may be sluggish, and will therefore fail to convert a large quantity of waste nitrogen into urea, while on a diet rich in proteid the conversion must be much more complete. As with the nitrogen, so with the sulphur, the amount of which is completely oxidised must be determined by the activity of the changes in the liver.

Such, then, is a brief summary of some of the recent work in connection with these most important problems. We can hardly doubt that the steps made are in the direction of progress of knowledge, but it is as yet too early to prophesy where they will ultimately lead us.

W. D. H.

PHOTOGRAPHY IN NATURAL COLOURS.

AN exhibition of photographs in which the aim of the photographer has been to imitate the colours of the objects represented is now open at the offices of the *British Journal of Photography*, 24 Wellington Street, Strand, and will remain open until the beginning of March. The specimens are all direct photographs in the sense that they have been produced by photographic printing, and not in printing presses from blocks or plates. The editors of the *British Journal of Photography* must be congratulated in that they have succeeded in bringing together a more representative collection than has ever been on view before.

The first glance that one instinctively takes round a room immediately on entering it produces a feeling quite different from that experienced on giving a momentary and general look round in a small gallery of paintings. In the latter case there is an impression of completeness in the work that gives satisfaction, whether or not this is maintained when the pictures are more carefully examined; but here there is a sense of a want of finish, an impression of experiment or incompleteness, as if those who made the pictures had left off before they had got the effect they sought to get. Perhaps others will not experience the same feeling, but it was very marked in the case of the writer, and, so far as the origin of it could be traced, it appeared to be due to a general crudeness of colour, or the predominance of one certain colour over the whole picture, or an indecision of outline that was evidently not intentional. Some examples suffer in one way and some in another; a few are quite satisfying, and must be very excellent if not perfect, but they are not in a sufficient proportion to affect the general impression.

It will hardly require technical knowledge to convince the visitor that the personality of the photographer has a great deal to do with the result. The more skilful the worker the better the photograph, that is, the more true are the colours and the fewer the errors of manipulation in all ways. As the skill of the worker has so much to do with the result, it is impossible to decide as to the merits of the various methods. Strictly speaking, it is not possible to determine the value of any of the photographs, for in no case is the original put by the side of it. Who would ever dream of attempting to judge the merits of a copy except by comparing it with the thing copied? Yet the writer has never seen or heard of a demonstration of the possibilities of a method of colour photography by an exhibition of a coloured object and its photograph side by side.

The effect of the personal element, or, in other words, the varying skill (or perhaps the varying luck) of different workers, is very clearly shown in the examples of the same process by different persons, or where an optically inferior method gives a better result. As an example of this last we would refer to Nos. 12 and 33, both apparently from the same group of fruit, &c., and both made of three superimposed films. In No. 33 the films are not cemented together, yet this picture is brighter than the other.

The only example of the immediate production of the colour of the incident light, and in this case the colour is not pigmentary but due to interference and visible only at a certain angle, is a very successful spectrum by the Lippmann process contributed by Mr. E. Senior. With two or three exceptions, the rest of the exhibits are three-colour prints. The fundamental principles are the same in all. Three-colour records are made by photographing the object through coloured media, getting the red, green, and blue of the object separately recorded. From these three negatives suitably coloured prints are made and brought together. In the Joly process, two specimens of which are lent by Mr. E. J. Wall, the three colours are arranged in series of fine parallel lines, and it is necessary to get so far away that these lines are indistinguishable, otherwise they are annoying to the spectator. The starch-grain method of

Messrs. Lumière gets over this difficulty of the lines by coating a plate with a single layer of starch granules which have been previously suitably coloured in three batches and then well mixed. The disposition of the three required colours is thus irregular, and the separate points of colour are too small to be discriminated by the naked eye. Unfortunately, no example of this method is on view; probably the inventors do not care to show their results until they have perfected the process. But this is the only notable process not represented.

In the rest of the exhibits the three coloured prints are superimposed, the variations being in the methods of their production and assembling. In the Sanger-Shepherd process three separate films are prepared, stained, and cemented together. Several exhibitors have adopted this process, chiefly in the production of transparencies, but there are a few prints on paper, and of these a portrait, No. 11, is worthy of special commendation. Dr. B. Jumeaux's modification consists in getting the blue element as a toned bromide print, and then superimposing the red and yellow films. Captain Lascelles Davidson and Mr. O. Pfenninger show specimens in which the films are superimposed but not cemented together, and there are other modifications that are not described.

Instead of three stained films, the prints may be prepared from pigmented tissue by the ordinary carbon process. The Autotype Company, the Rotary Photographic Company, Mr. W. E. Brewerton, M. Leon Vidal, the Lumière N.A. Company, and Dr. A. Hesekiel and Co. exhibit prints by various modifications of this method of working, the last named adopting the Selle process introduced several years ago. Mr. W. E. Brewerton shows how the gum bichromate process may be adapted for the purpose, each of the three coloured elements being produced in turn on the same sheet, with no transferring. The two "winter landscapes" by Dr. H. Bachmann are stated to be three-colour prints in gum bichromate, but the colours are scarcely, if at all, perceptible. The "pinatype" process has recently been described in these columns. In this case three colours are absorbed in turn into a single gelatin film from prepared gelatin films previously soaked in the colour solutions. Messrs. Fuerst Bros. show specimens of it, and Dr. E. F. Grün some results of undescribed modifications.

One of the most interesting exhibits is the group numbered from 52 to 56, examples of coloured prints obtained by a single exposure of a piece of coated paper under the coloured original, the colours being reproduced in the print. The sensitive material has the necessary three colours, each in its own film, superimposed, so that it appears black. By exposure to white light the dyes are all bleached, but if the light is coloured the corresponding colour is not bleached, because the dye does not absorb light of its own colour. This process has been worked at for many years by several investigators, the fundamental difficulties being to find the colours of the right tints that shall be sufficiently sensitive, that is fugitive to light, and can be made sufficiently stable when the print has been produced. These examples are by Szczepanik's method, and show surprisingly bright and clean colours. It is a pity that the original "lithophanes" are not shown as well as the copies, as many will doubtless consider that they are withheld because the comparison would not be to the advantage of the prints. Whether this is so or not, the results are wonderfully good considering the difficulty inherent in such work.

Of the three negatives exhibited by Dr. J. H. Smith and Co., obtained by one exposure in an ordinary camera, the plate used having superimposed on it three sensitive films with the necessary colour screens, there is nothing to be said, as there is no example of the plate used or of the print that the negatives might give. The results on "multico" tissue, which has several layers of pigmented tissue and is used as in carbon printing, the "mars star" prints which are produced by applying colours to bleached bromide prints, and the two portraits by Mr. Burgess can hardly be regarded as serious attempts to reproduce mechanically the colours of the originals until more is known about them. They are better described as colour effects, and there might be some interest attaching to them if the methods of their production were known. C. J.

THE INTERNATIONAL METEOROLOGICAL CONFERENCE AT INNSBRUCK.

Fourth Meeting, September 14, 1905.[1]

THE president, Prof. J. M. Pernter, announced that after the discussion of a proposition made by Father Froc the meeting would proceed to elect the International Committee. By accepting Father Froc's proposition, the committee recommended the observation of the zodiacal light whenever possible, and assigned a definite symbol for use in reports.

On the proposition of Prof. von Bezold, the following committee was re-elected:—Messrs. Chaves, Davis, Eliot, Hellmann, Hepites, Hildebrandsson, Lancaster, Mascart, Mohn, Moore, Palazzo, Paulsen, Pernter, Russell, Rykatcheff, and Shaw.

Also, on the proposition of Prof. von Bezold, Prof. Nakamura, of Japan, was elected in succession to the late Dr. Billwiller.

Prof. Pernter proposed that the presidents of the commissions should be added to the committee, but it was decided that six months' notice should be given of any propositions which would affect the constitution of the committee.

Prof. Hildebrandsson presented the report of the commission on squalls. It was arranged that the question of the study of squalls should be left in the hands of Messrs. Durand-Greville, Hildebrandsson, and Shaw, and that meteorological institutions, including aëronautical stations, should be asked to send to these gentlemen, upon demand, for a certain number of days, about ten per year, the necessary observations for the construction of accurate charts of isobars, with the diagrams of pressure, temperature, and wind for the purposes of this special study.

Prof. Hellmann reported on behalf of the commission on the international code and on the comparison of barometers. The conference considered the publication of the international code, of the resolutions passed by, and of the papers presented to, the international conferences to be a valuable and powerful means of facilitating and developing international meteorological research, and expressed a hope that the meteorological institutions in Berlin, Paris, and London would undertake the publication in German, French, and English. Thanks were voted to Father Algué, who proposed to publish them in Spanish, and to Profs. Hellman and Hildebrandsson for their preparation of the code.

After some discussion as to the best means of comparing the barometers in different countries, it was decided to put into operation the decision of the conference at Vienna relating to the inspection of the stations in the control of each country. The comparison, wherever possible, was to be extended to extra-European countries. This work was left to Prof. Hellmann and General Rykatcheff.

General Rykatcheff presented propositions from the magnetic commission dealing with the necessity of bringing the magnetic instruments in the various observatories into agreement, and with the desirability of an early exchange of diagrams after days of magnetic storms, or whenever the records may be specially interesting.

Fifth Meeting, September 15, 1905.

The president of the solar commission, Sir Norman Lockyer, presented the report of the meetings of that commission during the preceding days, and also the report of the meeting at Cambridge in 1904. The committee approved of all the resolutions contained in the report, and re-elected the commission, with Sir Norman Lockyer again as president.

The commission expressed the opinion that permanent meteorological observatories should be established in the north of Siberia and America, at least two or three in each country. It also desired to obtain all the observations that may have been made in a large number of islands scattered over the globe, the names of which were given, and insisted on the necessity of continuing these observations, asking that the attention of the Governments concerned should be directed to this matter. Directors of

[1] Reports of the proceedings of the first three meetings appeared in NATURE of September 21 and October 5, 1905 (vol. lxxii., pp. 510 and 562).

meteorological services were asked to furnish data of the heights and flow of rivers and lakes whenever possible.

M. Teisserenc de Bort reported from the commission on the atlas of clouds, and gave particulars of certain alterations in the plates in that atlas and in the definition of stratus cloud.

M. Teisserenc de Bort and Dr. Rotch gave an account of an expedition through the regions of the trade wind and equatorial calms in the North Atlantic. M. de Bort gave the history of the expedition and the results of the observations obtained by means of captive balloons, and Dr. Rotch gave those obtained by kites. Prof. Hergesell followed with the results similarly obtained in the Mediterranean on board the yacht belonging to the Prince of Monaco.

Dr. Köppen announced that the German hydrographical expedition to the Bismarck Archipelago would similarly use balloons and kites during the voyage.

Prof. Mohn reported from the commission on meteorological telegraphy.

M. Polis directed attention to the fact that the *Daily Telegraph* already announces the coming of storms from the Atlantic, using observations sent by means of wireless telegraphy from ships at sea. The conference then passed the following resolution:—"This conference is convinced that wireless telegraphy is chosen to render in the future great service in the forecasting of the weather in the Atlantic, but before introducing it into the current service of the meteorological institutions it is indispensable to take satisfactory precautions for the control of the observations transmitted. The conference asks the Meteorological Office in London to prepare as quickly as possible a report on this question, and communicate with the other meteorological institutions that may be specially interested in the matter."

During this meeting it was announced that M. Mascart had been elected president, and Prof. Hildebrandsson secretary, to the committee, and that the following commissions had been renewed:—Magnetic commission, president, General Rykatcheff (St. Petersburg); aëronautical commission, president, Prof. Hergesell (Strasburg); solar commission, president, Sir Norman Lockyer (London); commission on radiation, president, Prof. Ångström (Upsala). After thanking the reporters of the various commissions for their reports, the president declared the session at Innsbruck to be at an end.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The Vice-Chancellor has appointed Lord Curzon of Kedleston to be Romanes lecturer for 1906.

The following elections have been made to the University mathematical scholarships:—to the senior scholarship, A. Holden (Balliol College); to the junior scholarship, A. V. Billen (University College); to the exhibition, J. Hodgkinson (Jesus College).

G. E. Beaumont (Magdalen College School) has been elected to a natural science scholarship at University College.

Scholarship examinations in natural science will take place on March 13 at Keble College, and on April 24 at Merton College, New College, and Corpus Christi College.

CAMBRIDGE.—The board of biology and geology has reported to the Senate on the disposition of its share of the Gordon Wigan fund, which amounts to about 150*l*. The following assignment has been made for 1905 and following years:—(*a*) A grant of 50*l*. a year to Dr. D. Sharp, for a period of five years (1905–9), or such part of it during which he holds the curatorship in zoology; (*b*) a grant of 50*l*. out of the income for 1905 to Prof. Hughes, to enable Mr. E. A. Arber to continue his researches into the stratigraphical and geographical distribution of fossil plants; (*c*) the balance of the fund for 1905, and a grant of 50*l*. for each of the years 1906 and 1907, to Mr. A. C. Seward, to enable the botanic garden syndicate to offer greater facilities for plant-breeding experiments. The same board strongly recommends that the agreement between the University and Dr. Dohrn, director of the zoological station at Naples, be renewed for a further period of five years, by the payment to him of 100*l*. per annum out of the Worts travelling bachelors' fund, such period to date from Michaelmas, 1906.

Mr. D. G. Hogarth will lecture on "Geographical Conditions affecting Population in the East Mediterranean Lands" in the Sedgwick Museum on Tuesday, February 20, for the board of geographical studies, and Dr. Hans Gadow is to lecture to-day before the Antiquarian Society on "Aztec Civilisation and its Origin."

THE council of the University of Liverpool at a meeting held on January 23 passed the following resolution:—"That on the recommendation of the Senate a readership in ethnography be instituted in recognition of the scholarship of H. O. Forbes, LL.D., director of the Public Museums of Liverpool, and that Dr. Forbes be appointed to the said readership."

IT is announced in *Science* that Mr. N. W. Harris, of Chicago, has presented 500*l*. to North-western University, to be used as an endowment for an annual series of lectures to be delivered by some distinguished man, not a professor of the university, upon the results of his own investigations in scientific, literary, economical, or theological problems. From the same source we learn that by the will of Andrew J. Dotger, of South Orange, N.J., the Tuskegee Normal and Industrial Institute will, at the death of the testator's wife, receive the residuary estate, said to be about 100,000*l*.

IN an address delivered to the Manchester section of the Society of Chemical Industry, Dr. G. H. Bailey, as chairman of the section, dealt with the question of higher education and chemical industry, pleading for more cooperation between manufacturers and teachers. If success is to be achieved in the chemical industries of this country, Dr. Bailey considers that there must be a great change in the curriculum hitherto adopted in our universities and colleges; moreover, "a satisfactory curriculum can only be assured by a more intimate association of the teaching authorities, whoever they may be, and the leaders of industry." In considering the present state of English industry and the methods necessary to ensure its prosperity, Dr. Bailey remarks:—"progress in manufacture must indeed be regarded as a safeguard to stability, far more potent than any political or economic device for the protection of interests, and that nation must succeed in industry, which keeps this clearly in view and possesses the talent wherewith to meet the ever changing demands made upon it."

VISCOUNT HAYASHI, the Japanese Ambassador, distributed the prizes to the successful students of the Northern Polytechnic Institute, Holloway, on January 25. In the course of a subsequent address, he said that scientific research made such strides in the past century that it is no exaggeration to assert that the present is the age of practical application in every phase of modern life. Therefore there is nothing more important in a national system of secular education than institutions which keep abreast with the stride of science. Viscount Hayashi explained then that he took part in the administration of the technical college in Tokio. That college was established some thirty years ago with the help of many British professors and men of science whose names are well known in Europe, and from it thousands of students have been sent out to take part in engineering and other works necessitating the scientific application of the mechanical arts. Japan owes very much to that great educational work, and Viscount Hayashi said his people felt grateful for the assistance which Great Britain had given in this department.

THE London County Council School of Marine Engineering at Poplar, which was described in NATURE for October 19, 1905 (vol. lxxii. p. 623), was opened on January 24 by Sir William Collins, M.P. An address was delivered by Sir William White, K.C.B., who expressed a favourable opinion of the arrangements, equipment, and course of study provided in the new institute. He went on to describe the remarkable results attained during the last twenty years by a modest educational scheme which he

had conducted on behalf of the Shipwrights' Company of the City of London. Before 1888 there was no evening class in the Port of London where young men could obtain instruction in the science of shipbuilding. The Shipwrights' Company then undertook to establish and assist evening classes, which have been since carried out successfully and without a break in various parts of the East End. In these classes hundreds of young men have received valuable teaching, and the results have surpassed expectation; many of the students of the evening classes have proved themselves capable of taking the highest training in naval architecture at the Royal Naval College at Greenwich, and elsewhere, and not a few have secured positions of importance and responsibility in the Admiralty service, under the Board of Trade, Lloyd's Register of Shipping, and in private shipbuilding establishments. This object-lesson of what can be done with moderate expenditure, under careful and personal supervision, gives every reason for anticipating much greater benefits from the new institute with its ample means and adequate provision. Sir William White concluded by remarking that technical education for the rank and file as well as for the leaders and captains of industry is of great importance, and in providing the new school and equipping it on so generous a scale the London County Council has shown great wisdom as well as great liberality.

MEN of science have long urged the necessity for the introduction of scientific methods of inquiry and procedure into national administration, and their consistent advocacy culminated recently in the inauguration of the British Science Guild with the primary object of familiarising statesmen and others with the scientific spirit. The first president of the new guild, Mr. Haldane, is the Secretary of State for War in the new Government, and his speech on January 27 at a banquet of the Edinburgh University Liberal Association may well fill men of science with hope that a new era is near in which ideas and the results of scientific research will be taken into account in legislation and administration. Mr. Haldane insisted that national prosperity is not wholly a matter of fiscal policy. Answering the question, Is all well with us? he replied in the negative, because we are lacking in the ideas which science alone can give us, and consequently are lacking in the organisation of our industries. Knowledge, the expert, the spirit of science and organisation to permeate our people, our manufacturers, and workmen alike are all wanted. One of the ways in which the universities can assist the nation is in this direction. Mr. Haldane said his impression is that the Army would be the better for more help from the universities than it had been able to take from them. There are too few officers of the right sort, the thinking sort, like the men in the Engineers and in the Artillery, but of whom there are too few in the Cavalry and the Line. Mr. Haldane thinks he sees the beginning of a movement of this kind; and he hopes the university men will play a distinguished part in the future in obtaining that which is absolutely essential in making the Army an efficient army—a supply of scientifically minded officers and soldiers. The splendid fighting quality in the field which has distinguished the Army in the past, the quickness of eye that is born and that does not come is needed; but with it and behind it, whether in the hands of the general staff or of the commander himself, there must be a knowledge that can only come of the hard and patient discipline of the spirit.

THE cooperation of employers in the technical training of apprentices was a subject of discussion at the annual meeting of the Association of Technical Institutions held last week. A report upon this subject was issued recently by the association, and some of the results of the inquiry were stated in NATURE of December 21, 1905 (p. 188). In a contribution to the discussion, Prof. W. Ripper remarked that his own observation and experience has led him to believe that the unsympathetic attitude towards technical education which used to be so common among foremen and employers in this country is undergoing a change. The apathy and indifference towards educational improvement so general among apprentices and young people will be largely removed when they are made to realise that there is, as a rule, no promotion for them unless they are able to show that they possess educational as well as practical fitness for such promotion. This method of promotion is the one exclusively adopted in the Government dockyards, and the results of it have without doubt been highly satisfactory. In the race for commercial supremacy England, America, and Germany are each, probably, equally well equipped with the most up-to-date machinery and appliances. But these are tools merely. For the real element of success, for the intelligence and virility behind the tools, we depend alone upon the quality of the individual men from top to bottom of the industrial army; and especially do we depend upon the quality of the men at the top—the leaders—whose character, ability, foresight, judgment, power of organisation, and power of inspiration must ultimately determine the degree of success of the efforts of the whole. At present there is too often no connection whatever between the works and the technical school, no knowledge on the part of the employer of the quality of the youths in the colleges, who are available for suitable employment, and, on the other hand, no opportunity on the part of the youths to show possible employers what qualifications they possess, and what claim they have to recognition over the youth who has received no training. A closer relationship between employers and the teachers in technical institutions is therefore demanded in the interests both of public efficiency and of private well-being. In the discussion which followed the reading of Prof. Ripper's paper, Prof. Wertheimer said there is no doubt a steady, if not rapid, improvement taking place year by year. Firms—and the best firms, too—are recognising the desirability of getting into their employ young people whose intelligence has already been trained.

SIR WILLIAM ANSON delivered an address as president of the Association of Technical Institutions, at the annual meeting of the association held last week. In the course of his remarks, he said that the subject which most exercises both the local authorities and the Board of Education is the coordination of the studies which make up our system of education, and especially coordination in such a manner as to give to our technical institutions their proper place and to secure for them their utmost utility. There is no subject more intimately connected with the welfare of the people and the prosperity of our industries. We have paid somewhat dearly for our neglect of science in the past, and not merely for neglect of science, but of any conception of education which can be regarded as scientific or even as systematic. There is one form of error which touches more nearly the elementary schools. We have founded technical institutes, have multiplied libraries and laboratories, but have not taken pains to ensure that those to whom this instruction is offered are capable of taking advantage of it. Time and money are wasted in endeavouring to impart technical instruction to students who have forgotten such elementary mathematics as they ever knew, and who are unable to express their knowledge in their own language in an intelligible form. Everyone ought to know something of science, and everyone would be the better for learning the practical application of some branch of science. But we want the students in technical institutions to come to them able to take advantage of the opportunities which they afford, and not only this, but able to carry forward knowledge which they acquire; not merely to learn something and go away with no idea or intention of following up the instruction which they have received. An educational system may be devised in which all the parts are symmetrically fitted together, in which science pure, and science applied, language, literature, and history are all given their due place, and every arrangement made for the student to pass through courses appropriate to him under teachers fully qualified for their work. But even if these educational ideals are realised, it may be doubted whether we shall get what is wanted until there comes into existence a more widely diffused belief in education, in the value of a trained intelligence as well as of particular information, a belief that experience acquired with knowledge, and knowledge applied with intelligence, are better than that mere experience which is described in the common phrase "rule of thumb." As Sir John Wolfe Barry had said, "We want to see in Great Britain the

man of science installed in his laboratory in all important manufactories and encouraged to help in their development." Great employers have it in their power to advance the education of the people all along the line. Technical instruction in all its stages is a practical thing; and when it is realised that employers appreciate the instructed and intelligent student, then parents will begin to see that education has a practical value. The educational gospel should be "Believe, believe," not only or chiefly in machinery, in a curriculum, a laboratory, a library, but in the value of knowledge, of intelligence, of training, and when we have made this belief widespread an important step will have been taken toward the education of our people.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 14, 1905.—"Report on the Psychology and Sociology of the Todas and other Indian Tribes." By Dr. W. H. R. **Rivers.** Communicated by the Secretaries of the Royal Society.

An abstract of observations made chiefly on the Todas of the Nilgiri Hills. The psychological work deals chiefly with the senses, in only two of which is there evidence of decided difference between Todas and Englishmen. The former were less sensitive to pain, and showed certain deficiencies in the colour-sense, especially in the degree of relative sensibility to red and blue, a low degree of sensibility for blue being associated with defective nomenclature for that colour. Definite colour-blindness was found in 12 per cent. of the males, a frequency higher than has been recorded in any other race. Quantitative observations were made on two visual illusions, one of which, that of compared horizontal and vertical lines, was distinctly more pronounced in the Todas, while the other, the Müller-Lyer illusion, was present in a slighter degree. This difference is believed to depend on the difference in nature of the two illusions. Especial attention was paid to the variability of the individuals subjected to the tests, and it is shown that there is some evidence of correlation between the degree of general intellectual development and certain simple mental activities which can be tested by experimental methods.

The sociology of the Todas was studied by means of the genealogical method, and was found to have many points of resemblance with that of Malabar, and the view is advanced that the Todas at one time inhabited that district and are probably of the same race as the present inhabitants of Malabar, the Nairs and Nambutiris. A detailed record was obtained of the elaborate religious ritual of the Todas, and evidence is given that this religion has undergone degenerative changes. It is suggested that this is part of the general disappearance of a higher culture which the Todas brought with them to the Nilgiri Hills.

"On the Spectrum of the Spontaneous Luminous Radiation of Radium. Part IV.—Extension of the Glow." By Sir William **Huggins,** K.C.B., O.M., F.R.S., and Lady **Huggins.**

In our second paper [1] we suggest "whether the β rays, which are analogous to the kathode corpuscles, may not be mainly operative in exciting the radium glow. On this surmise it would be reasonable to expect some little extension of the glow outside the limit of the solid radium itself. We are unable to detect any halo of luminosity outside the limit of the solid radium bromide; the glow appears to end with sudden abruptness at the boundary surface of the radium." We omitted to state that this conclusion was arrived at by eye observations. The radium was observed in the dark with a lens, and with a low-power microscope.

The earlier photographs of the spectrum of the glow were taken, for the purpose of comparison spectra, with the height of the slit reduced by shutters so as to be within the width of the exposed radium bromide, and, therefore, these photographs would not show whether the bright bands of nitrogen extend into the air beyond the radium. Subsequently photographs were taken with the whole height of the slit, and on these we find that all the bands of nitrogen do extend to some little distance outside the radium salt. Our attention at the time being directed to other phenomena of the glow, we did not examine the photographs to see if the nitrogen bands extended beyond the radium.

In a paper, dated August 22, 1905, F. Himstedt and G. Meyer [1] state that in their photographs of the spectrum of $RaBr_2$, the four nitrogen bands, 3577, 3371, about 3300, and 3159, extend beyond the radium salt, while the other less refrangible bands are not traceable outside the radium. In our photographs all the nitrogen bands project beyond the radium salt, the relative distance to which the extension can be detected in the case of each band being, as might be expected, in proportion to the strength of the impression of that band upon the photographic plate.

B. Walter and R. Pohl, in a paper dated September, 1905,[2] give an account of experiments made with the help of screens, which show that for a distance of up to about 2 cm. the air surrounding radium bromide has an action on a photographic plate.

On re-examining an early photograph, taken in 1903 for another purpose, which is described in our second paper,[3] in which the $RaBr_2$ was enclosed in a very narrow tube of thin glass, we find that the bands of nitrogen, which are strong within the tube, show no trace of extension on the plate beyond the tube. The exposure of this plate was seven days.

This experiment, which we have repeated recently with an exposure of fourteen days, shows that the luminosity of nitrogen in the near neighbourhood of radium bromide is not due to the kathode-like β radiation, for this passes freely through glass.

Two explanations may be suggested: first, that the active cause is the α rays;[4] or secondly, that the nitrogen molecules which encounter those molecules of the radium which are undergoing active changes are broken up into ions, which are projected outwards, and give rise to the glow of luminous nitrogen.[5]

Royal Astronomical Society, January 12.—Mr. W. H Maw, president, in the chair.—Photograph of comet *c*, 1905, taken at the Royal Observatory, Greenwich, on January 8: **Astronomer Royal.** The photograph showed the comet with a bright nucleus and a faint, straight tail extending about 2°. It was hoped that further photographs would be obtained after the comet had passed the sun.—The ring nebula in Lyra: E. E. **Barnard.** A careful series of measures of the positions of the stars about the nebula appeared to show that the star in the centre of the ring had neither proper motion nor parallax.—Mean areas and heliographic latitudes of sun-spots in the year 1904: **Astronomer Royal.**—Photographic reproduction of *réseaux* for star photography: H. **Bourget.** Specimens of the *réseaux* were shown on the screen.—Report on observations of Jupiter at Trincomali, Ceylon, 1904–5: Major P. B. **Molesworth.** Special attention was directed to the remarkable movement of the south tropical dark area in the neighbourhood of the great red spot. The motion of the area across the red spot bay was so rapid that it seemed necessary to assign some cause other than the actual transference of matter.—Measures of wide double stars: Rev. T. E. **Espin.**—Action of the wood of the dark slide upon photographic plates: Prof. H. H. **Turner.** The plates were negatives of the solar eclipse taken at Aswan by Mr. J. H. Reynolds, which were greatly injured by strong impressions of the grain of the wood of the dark slides in which they were placed after exposure. The same had occurred to Dr. Copeland's plates taken in 1898. It was stated that the wood of Mr. Reynolds's slides was very old, and various suggestions were made, but the real cause of this effect upon the plates still appeared obscure.—Lunar nomenclature: W. **Goodacre.**—Measures of the lunar crater Mösting A made at the Royal Observatory, Greenwich: **Astronomer Royal.**

[1] *Roy. Soc. Proc.*, vol. lxxii., p. 410-(1903).

[1] F. Himsted and G. Meyer, *Ber. d. Nat. Gesells. Freiberg*, vol. xvi. pp. 13–17.

[2] B Walter and R. Pohl, *Ann. de Phys.*, vol. xviii., p. 406.

[3] *Roy. Soc. Proc.*, vol. lxxii., p. 412.

[4] B. Walter, July, 1905, showed by means of absorption screens that the radiation from radio-tellurium can produce the ultra-violet light of nitrogen (*Ann. d. Phys.*, vol. xvii., p. 367).

[5] The experiments described in our last paper showed that probably the β rays are not the operative cause of the nitrogen glow (*Roy. Soc. Proc.*, vol. lxxvi., p. 488).

PARIS.

Academy of Sciences, January 15.—M. H. Poincaré in the chair.—The landing of aëroplanes: Bouquet **de la Grye.** A plan of arresting an aëroplane, and capable of keeping it horizontal during its descent, is described. It has been found to work in experiments on the small scale.—The *n*-rays: M. **Mascart** (see p. 325).—The influence of the reaction of the medium on the activity of amylase and on the composition of saccharified starch: L. **Maquenne** and Eug. **Roux.** The effect of the acidity or alkalinity of the solution on the hydrolysis of starch by malt has been recognised by other workers, without, however, the effect being quantitatively determined. The author shows that phenolphthalein is an unsuitable indicator to use for these experiments, methyl orange being better. He has found that for a rapid hydrolysis it is first necessary to neutralise the alkali of the starch, then to add to the malt a quantity of sulphuric acid equal to about 0·4 of that which would be required to neutralise it completely. Not only can the rate of hydrolysis be greatly increased by this treatment, but the proportion of maltose formed is also raised about 10 per cent. to 15 per cent.—Observations on the subject of the group C(OH) of the tertiary alcohols: Louis **Henry.** Tertiary butyl alcohol is converted by aqueous fuming hydrochloric acid into the corresponding chloride with great ease; by the substitution of the hydrogen atoms of the methyl groups by other elements the action of the hydrochloric acid is modified, the velocity of the reaction and amount of the ester formed being reduced, or the action altogether prevented. In the present paper the effects produced by the introduction of chlorine, cyanogen, and oxygen are discussed.—Some integrals of partial differential equations: E. **Goursat.**—A family of conjugated networks with the same congruence: E. **Merlin.**—The impossibility of negative waves of shock in gases: Gyözö **Zemplén.** A reply to the criticisms of P. Duhem on a former note on the same subject.—The conditions of establishment and application of progressive damping for the oscillations of road vehicles: A. **Krebs.** It is shown by a theoretical analysis of the problem that the friction of ordinary carriage springs ceases to be efficient when the sudden change of level is more than 2 cm. A new arrangement is described which satisfies the theoretical conditions for greater oscillations, and which has been found to work well in practice.—Photographic experiments on the action of the *n*-rays on an oscillating spark: C. **Gutton.** If the *n*-rays are allowed to fall on the primary spark of a Hertzian oscillator, the secondary spark diminishes. The present paper deals with the photographic registration of this effect.—The density of ice: A. **Leduc.** About 108 grams of water were frozen in each of the author's experiments. Well boiled distilled water gave a density of 0·9172, but it was clear that this number was too small, since in the upper part of the density flask small strings of separated air bubbles were visible. By repeatedly melting and freezing in a vacuum, the density was raised to 0·9176, and even in this case there was some evidence of traces of dissolved air. It is pointed out that the usual method of analysing the gases dissolved by water must be inexact, since all gas is not expelled by boiling.—The distribution of electric currents in a network: I. **Révilliod.**—A parhydric valve: J. de Rohan **Chabot.** A description of a new form of valve for preventing the return of water into the vacuum of a filter pump.—Correction to a note on the saline oxide of nickel: H. **Baubigny.**—The silicide of copper, and a new mode of formation of silicon soluble in hydrofluoric acid: Paul **Lebeau.** When the amount of silicon in a copper silicon mixture is raised above 10 per cent., a metallographic examination shows the presence of free silicon.—A silicide of thorium: O. **Hönigschmid.** This has been prepared by heating together a mixture of aluminium, potassium fluosilicate, and the double fluoride of thorium and potassium; the excess of aluminium is removed by treatment with potash solutions. The compound isolated, the chemical and physical properties of which are given, has the composition $ThSi_2$.—The diazo-derivatives of the diamines: Léo **Vignon.**—The estimation of carbon monoxide in air by iodic anhydride: Albert **Lévy** and A. **Pécoul.** Although acetylene reacts with iodic anhydride, it does not interfere with the estimation of minute amounts of carbon monoxide in air, since a mixture of 1 part of acetylene in 10,000 parts of air gives no iodine.—The estimation of small quantities of chloroform in air and in blood or in aqueous solution: Maurice **Nicloux.** A combination of the methods of Dumas (the action of alcoholic potash on chloroform) and Mohr (chlorine titration in presence of a chromate).—The combustion of acetylene by oxygen: Paul **Maurícheau-Beaupré.** An examination of the products of combustion of the oxy-acetylenic blow-pipe flame showed that oxides of nitrogen and ozone were present, but no trace of carbon monoxide.—The direct proportionality between the cryoscopic point of a mineral water of the bicarbonate class and the composition of this water expressed as anhydrous monocarbonate: Lucien **Graux.** The half-bound carbonic acid is without effect on the freezing point.—Mixed crystals of alkaline nitrates: Fréd. **Wallerant.**—The alkaline rocks in the neighbourhood of Evisa, Corsica: M. **Deprat.**—The yield of urine: Henri **Lamy** and André **Mayer.**—The vitelline of the egg: L. **Hugounenq.**—New researches on the oxidations produced by animal tissues in the presence of ferrous salts: F. **Battelli** and Mlle. L. **Stern.** Examples of the analogy between the oxidations produced by hydrogen peroxide in presence of ferrous sulphate and by animal extracts in presence of the same salt.—The anomalous behaviour of the proteolysis produced by papaine: C. **Delezenne,** H. **Mouton,** and E. **Pozerski.**—The whitening of wheaten flour: E. **Fleurent.** The oxides of nitrogen are more favourable than ozone, the latter giving an objectionable smell to the flour.—Geology of the Peloponnesus: Ph. **Négris.**—An ancient volcanic chain to the N.W. of the Puys chain: Ph. **Glangeaud.**—Magnetic observations made at Sfax, Tunis, on the occasion of the total eclipse of the sun of August 30, 1905: M. **Dehalu.**

January 22.—M. H. Poincaré in the chair.—The boiling of osmium, ruthenium, platinum, palladium, iridium, and rhodium: Henri **Moissan** (see p. 325).—The origin of the idea of solid solutions: Lecoq **de Boisbaudran.** A claim for priority in the idea of solid solution.—Glycuronic acid in the blood corpuscles: R. **Lépine** and M. **Boulud.** The authors point out the liability of changes in the glycuronic acid contents of the blood after it has left the blood-vessel, and the precautions necessary to avoid such change.—A theorem relating to the second differentials of the potential of an attracting volume: A. **Korn.**—Elliptical polarisation produced by mixed liquids: J. **Chaudier.**—Some new magneto-optical properties of colloidal solutions of oxide of iron: A. **Cotton** and H. **Mouton.**—The kathodic phosphorescence of europium: G. **Urbain.** Certain differences in the spectra observed might be interpreted as being due to two elements in europium, or possibly to purely physical causes independent of the elementary complexity. Further experiments will be made to elucidate this point.—Mixtures of antimony and tellurium, antimony and selenium, and the cryoscopic constant of antimony: H. **Pélabon.**—Methoxytrichloropentanol 1 : 5 : 4 and α-trichloromethyltetrahydrofurfurane: J. L. **Hamonet.**—Acetylenic amides and nitriles: Ch. **Moureu** and I. **Lazennec.** A general method for preparing the amide $R—C\equiv C—CONH_2$ and the corresponding nitriles is given.—Glycidic condensation of the aldehydes with α-chloropropionic ester: Georges **Darzens.**—The acyclic vinyl and β-chloroethyl ketones: E. E. **Blaise** and M. **Maire.**—A crystalline modification stable in two intervals of temperature: Fréd. **Wallerant.**—The influence of the colouring matters in a mother liquid on the form of the crystals deposited: P. **Gaubert.** During their growth, crystals of phthalic acid can absorb a certain quantity of foreign material which exercises an influence on their form and size. The different faces are not penetrated by the foreign substance with the same facility. The actual amounts of the colouring matters included were small, 1/170th for methylene blue and less for other substances.—The mechanism of the fall of certain terminal buds: A. **Tison.**—A new genus of fungus from British East Africa: P. **Hariot** and N. **Patouillard.**—The variations of phosphoric acid and nitrogen in the juices of the leaves of certain plants: G. **André.** In an annual plant, a

part of the phosphoric acid leaves the leaf and goes towards the ovule in the state of a soluble mineral phosphate, whilst another part is displaced from its state of combination with nitrogenous material.—The properties of colloids and the dynamic interpretation of cell division: Angel **Gallardo.**—On *Leposphilus labrei* and on the family of the Philichthydæ: A. **Quidor.**—The action of extract of the interstitial gland of the testicle on the development of the skeleton and on the genital organs: P. **Bouin** and P. **Ancel.**—Experimental researches on the proportions of chloroform contained in the organism during chloroform anæsthesia: J. **Tissot.**—The action of sulphate of hordenine on the circulation. L. **Camus.** With large doses there is an increase of the blood pressure accompanied with modifications in the rhythm and amplitude of the pulsations; small doses have little effect on the blood pressure, but give rise to important changes in the number and amplitude of the pulsations.—The reconstitution of an ancient Oligocene lake on the north side of the massif of Mont Doré: Ph. **Glangeaud.**—New observations on the geology of the Sahara: René **Chudeau.**—On the formation of the network of the reticulated Nummulites: Jean **Boussac.**—The oceanic circulation: MM. **Thoulet** and **Chevallier.**

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 1.

ROYAL SOCIETY, at 4.30.—On the Filtration of Crystalloids and Colloids through Gelatin, with Special Reference to the Behaviour of Hæmolysins: J. A. Craw.—Chemical Action of *Bacillus lactis aerogenes* (Escherich) on Glucose and Mannitol: Production of 2: 3-Butyleneglycol and Acetylmethylcarbinol: Dr. A. Harden and G. S. Walpole.—On Voges and Proskauer's Reaction for Certain Bacteria: Dr. A. Harden.—The Quantitative Estimation of Small Quantities of Nickel in Organic Substances: H. W. Armit and Dr. A. Harden.—The Alcoholic Ferment of Yeast Juice: Dr. A. Harden and W. J. Young.—On the Function of Silica in the Nutrition of Cereals. Part I.: A. D. Hall and C. G. T. Morison.—On the Origin of the Sertoli or Foot Cells of the Testis: C. E. Walker and Miss A. L. Embleton.—Studies on Enzyme Action—Lipase: Maurice Nicloux.—A Further Communication on the Specificity and Action in Vitro of Gastrotoxin: Dr. C. Bolton.

CHEMICAL SOCIETY, at 8.30.—Hydroxylamine-αβ-disulphonates (Structural Isomerides of Hydroxyamino-sul, hates or Hydroxylamine-ββ-disulphonates): T. Haga.—Studies in the Camphane Series. Part XXI. Benzenediazo-ψ-Semicarbazino-camphor and its Derivatives: M. O. Forster.—The Relation between Absorption Spectra and Chemical Constitution. Part I. The Chemical Reactivity of the Carbonyl Group: A. W. Stewart and E. C. C. Baly.—(1) The Relation between Absorption Spectra and Chemical Constitution. Part II. The Quinones and α-Diketones; (2) The Relation between Absorption Spectra and Chemical Constitution. Part III. The Nitranilines and the Nitrophenols: E. C. C. Baly and A. W. Stewart.—The Action of Light on Benzylidenephenylhydrazine: F. D. Chattaway.—The Union of Chlorine and Hydrogen: D. L. Chapman and C. H. Burgess.—Note on the Molecular Weight of Adrenaline: G. Barger and A. J. Ewins.—The Critical Temperature and Value of ML/O of Some Carbon Compounds: J. Campbell Brown.

ROYAL INSTITUTION, at 5.—The Significance of the Future in the Theory of Evolution: Benjamin Kidd.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY, at 8.—Destructor Byeproducts: F. L. Watson.

LINNEAN SOCIETY, at 8.—The Percy Sladen Trust Expedition to the Indian Ocean in H.M.S. *Sealark*: J. Stanley Gardiner.

SOCIETY OF ARTS, at 8.—Howard Lecture: High Speed Electric Machinery, with Special Reference to Steam-Turbine Machines: Prof. S. P. Thompson, F.R.S.

FRIDAY, FEBRUARY 2.

ROYAL INSTITUTION, at 9.—The Electric Production of Nitrates from the Atmosphere: Prof. S. P. Thompson, F.R.S.

GEOLOGISTS' ASSOCIATION, at 7.30.—Annual General Meeting. Presidential Address: The Study of Fossil Fishes: Dr. A. Smith Woodward, F.R.S.

SATURDAY, FEBRUARY 3.

ROYAL INSTITUTION, at 3.—Advances in Microscopy: J. W. Gordon.

MONDAY, FEBRUARY 5.

ROYAL INSTITUTION, at 5.—General Monthly Meeting.

SOCIETY OF ARTS, at 8.—Modern Warships: Sir William White, K.C.B., F.R.S.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—The Loss of Nitre in the Chamber Process. Part II.: J. K. H. Inglis.

VICTORIA INSTITUTE, at 4.30.—On Biological Changes in Geological Time: Prof. J. Logan Lobley.

TUESDAY, FEBRUARY 6.

ROYAL INSTITUTION, at 5.—Food and Nutrition: Prof. W. Stirling.

SOCIETY OF ARTS, at 4.30.—Imperial Immigration: O. C. Beale.

ZOOLOGICAL SOCIETY, at 8.30.—On Trichorhiza, a New Hydroid Genus: E. S. Russell.—Notes on the Histology and Physiology of the Placenta in Ungulata; Dr. J. W. Jenkinson.—Description of a New Fly of the Family Tabanidæ: Miss G. Ricardo.—A List of the Mammals obtained by Messrs. R. B. Woosnam and R. E. Dent in Bechuanaland: H. Schwann.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Adjourned Discussion*: The Railway-Gauges of India: F. R. Upcott.

WEDNESDAY, FEBRUARY 7.

SOCIETY OF PUBLIC ANALYSTS, at 8.—President's Annual Address, followed by Ordinary Meeting.—Note on Dutch Cheese: C. H. Cribb.—The Assay of Mercury Ores: G. T. Holloway.—The Purification of Zinc and Hydrochloric Acid: Dr. L. T. Thorne and E. H. Jeffers.—The Facing of Rice: C. H. Cribb and P. A. E. Richards.

GEOLOGICAL SOCIETY, at 8.—On the Carboniferous Limestone (Avonian) of the Mendip Area (Somerset), with Especial Reference to the Palæontological Sequence: T. F. Sibley.—The Igneous Rocks Associated with the Old Red Sandstone of the Mendips: Prof. S. H. Reynolds.

SOCIETY OF ARTS, at 8.—Progress in Electric Lighting: Leon Gaster.

THURSDAY, FEBRUARY 8.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: On Roche's Ellipsoids and on Allied Problems Relating to Satellites: Sir George H. Darwin, K.C.B., F.R.S.—On Periodicities in Sun-spots: Prof. A. Schuster, F.R.S.—Explosions of Coal-Gas and Air: Prof. B. Hopkinson.—Polarisation in Secondary Röntgen Radiation: C. G. Barkla.—Constants of Explosion of Cordite and of Modified Cordite: Robert Robertson.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Technical Considerations in Electric Railway Engineering: F. W. Carter (*Conclusion of Discussion*).—Crane Motors and Controllers: C. W. Hill.

ROYAL INSTITUTION, at 5.—The Significance of the Future in the Theory of Evolution: Benjamin Kidd.

FRIDAY, FEBRUARY 9.

ROYAL INSTITUTION, at 9.—Eclipse Problems and Observations: H. F. Newall, F.R.S.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Anniversary Meeting.

PHYSICAL SOCIETY, at 8.—Annual General Meeting.

ROYAL GEOGRAPHICAL SOCIETY, at 5.30 (Research Department).—The Ruins of Rhodesia and the Probable Date of Outside Intrusions in East Africa: Discussion to be opened by D. Randall MacIver.

MALACOLOGICAL SOCIETY, at 8.—Annual Meeting.—On Pearl-Oyster Culture and Pearl Fishing: T. H. Haynes.—Irish Molluscs and their Habitats: R. J. Welch.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Electric Driving at the Locomotive Works of the North London Railway: R. H. Mackie.

SATURDAY, FEBRUARY 10.

ROYAL INSTITUTION, at 3.—Advances in Microscopy; J. W. Gordon.

MONDAY, FEBRUARY 12.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Geography of the Spanish Armada: Rev. W. Spotswood Green.

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