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MECHANISM, IDEA, OR—NATURE?

Naturalism and Agnosticism. By James Ward, Sc.D. 2 vols. Pp. xviii+302 and xiii+291. (London: A. and C. Black, 1899.)

THE distinguished writer of the well-known article on psychology in the "Encyclopædia Britannica" could not but be sure of a welcome for any contribution towards the establishment of a world-formula that he found it in him to offer. Prof. James Ward displays analytical power of quite first rate quality, even when he uses it perversely. He has an insight more than common into the bearings of scientific methods and naturalistic speculations, even when he is disputing their competency or restricting their range. If his lucidity is that of the successful teacher, his earnestness and his often eloquence mark the great one. Finally, in meeting the apostles of naturalism within the jurisdiction of their own categories, and without the mystification of an alien esotericism, he has set an example of hopeful augury. "Naturalism and Agnosticism" is for these reasons one of the books that must count.

On the other hand, while future attempts at construction cannot neglect the reasonings of this very considerable work, Prof. Ward's is not a mind "to nestle in." His attack upon Naturalism with Agnosticism must, we venture to think, be held to have failed, his conclusion to Spiritualistic Monism to be illicit.

Prof. Ward's book embodies his Gifford lectures, in defence of theism, delivered at Aberdeen in the years 1896 to 1898. As they "take it for granted that till an idealistic (*i.e.* spiritualistic) view of the world can be sustained, any exposition of theism is but wasted labour," they are in effect a critique of Naturalism and Agnosticism singly and together, followed by a brief development of a Monism of Spirit, in whose interests they are assailed. Their "demurrer" to theistic inquiries is ruled out, because they themselves, it is claimed, have failed.

We may pass the question whether a Naturalism that dares to say that it sees no way of access to knowledge of a certain kind, "demurs" to theism in any manner in which "spiritualistic monism," with its implicit pantheism, does not, and consider rather the development of Dr. Ward's attack on Naturalism. He tries a fall with it in three fields—Mechanism, Evolution taken as the working of Mechanism, and Psychophysical Parallelism as the device by which the mechanical view disposes of the importunate facts of consciousness. It seems to follow that unless Naturalism must be identified with Mechanism our author's thesis fails.

As regards Mechanism, Dr. Ward disclaims any pretensions to specialism in physics, but he shows such intellectual communion with the studies that are the great glory of his university, that he fully sustains his right to be heard. His fundamental point is the abstractness and hypothetical character of modern physics. He shows how they pass from the perceptual and actual into what has been happily called "conceptual shorthand." He finds mathematical physics "idealistic" in their procedure—epistemologically, we presume, not ontologically—and he claims that they do not set before us "what verily is and happens." Matter, mass, energy—what are these? We seem driven to modify our ideas of them again and again, till we end either in Nihilism, with, for instance, Kirchhoff, or in some highly artificial formula, such as, *e.g.* the "hydrokinetic ideal" of Lord Kelvin. From the point of view of logic, the inverse methods of abstract physics are such that our ultimate principle will not necessarily be a *vera causa* in the sense of one who can say *hypotheses non fingo*. If, then, we accept it as ultimate reality, we are simply Neopythagoreans. Can we construct from it a cosmos of qualitative variety? much less an organic world.

Yet, starting from mechanism, such an attempt at edification has been made by Mr. Herbert Spencer. To him the sciences in their evolutionary gradation appear to offer a closed system, a polity, a synthesis which is philosophy. The absence of the two volumes essential for the bridging of the gap from inorganic to organic, and especially of that famous chapter in which, "were it written," the transition is actually made, puts Mr. Spencer's high claims out of court. But further, by playing off dissipation of energy against conservation, the doctrine of "First Principles" can be shown to be inadequate. And Mr. Spencer's demand for instability of the homogeneous at the start, instability of the heterogeneous at the finish, shows his construction to be arbitrary. To get evolution to the point of a working process, we need, says Dr. Ward, a teleology—"evolution with guidance," or plan, or purpose. And this to our author implies something incompatible with mechanism, mind in some transcendental sense, god. There is perhaps a lacun in the inference, but so comes the god into the mechanism

But if mind is thus to be, at the very least, the predominant partner in the world-system—it is to be much more—Dr. Ward must get rid of Psychophysical Parallelism. Psychosis cannot be epiphenomenon, nor, to use Huxley's unfortunately loose phrase, a "collateral product." Nor can man—though this is not the same thing—be a conscious automaton. We cannot have any implication of "the impotence of mind to influence matter." We must admit "interaction," because "invariable concomitance and absolute causal independence are incompatible positions."

But if there is not only room for god, as Brahma so to speak, at the beginning, but also both room for and need of, as it were, Vishnu, throughout the working of the mechanism, to save it from nihilism, to supply "guidance" to the evolutionary process, to infuse new energy, or, as "the sorting demon of Maxwell," restore wasted energy, to account for life, to work as immanent sustaining force throughout, we need only to refute dualism in favour of a "duality of subject and object," and the way is clear for idealism.

But is this so? Is naturalism really refuted? Is neutral agnosticism illicit, or, in the alternative, so unstable, as to be necessarily materialist or mechanical in bias? Or has Dr. Ward haply shown that certain physicists, like certain idealists, have no right to their creed? Those, namely, who fail to take their symbols as formulæ, abstractions, averages, or to see that where explanatory, the range of their power of explanation is limited. Or has he perhaps overthrown much in the hasty constructions of Huxley and Mr. Spencer, made in the first flush of the reconnaissance in force of militant science, but left Naturalism the while untouched?

Dr. Ward's polemic against Mechanism is, we take it, justified with some qualifications, as against those who hold that the synthesis of naturalism is complete, and that the law of its continuity implies the resolution of all phenomenal realities into terms of the modern substitutes for matter in motion, conceived of as having no qualitative but only quantitative determinations. Again, the unnecessarily contemptuous criticism of Evolution as the working of mechanism is valid against Mr. Spencer's "First Principles." Mr. Spencer's mastership happily does not rest upon the soundness of the too early stereotyped foundation, nor on the claim that the edifice is complete to its coping-stone. Further, if "science" is at the standpoint of the materialism of Laplace, or even if it has taken the Huxley of the early sixties, with his undoubted materialist bias, as guide in all things, it will have to retrace the steps it has taken in its advance towards a creed. If it abstracts the known from the knower, and maintains that the act of abstraction makes no difference, it can be convicted of positing a phenomenal world *per se*. If, in the faith of continuity, it says that the inorganic, as it is conceived by mathematical physics, not only conditions but also constitutes the organic, in the sense that we must not, in order to explain the organic, look for anything in the inorganic other than those mathematical determinations of which alone abstract physics take account, then it is against that long patience which is the chief of discoverers, and is attempting an "anticipation" of experience. If it treats regulative as constitutive principles, and attributes agency to formulæ, it is guilty of what we had thought was specifically the idealist's fallacy. But must Naturalism do these things?

We might instance Dr. Hodgson's experientialism and Prof. Münsterberg's transformism among types of naturalism able to "let the galled jade wince." Surely, too, the specialist, finding in his own department, recognised as partial and abstract, the immanence of law, and learning that his colleagues in other departments find law there too, and so throughout, is justified in believing that out of nature—human nature, and specifically the nature of human thought included—the solution must come. Unable to find a mediating term between his "non-matter in motion" or what not, and psychic process, he accepts the "parallelism," with hypothetical connection as co-aspects or, since Prof. Ward, despite of Kant and Mr. Bradley, prefers the causal relation, co-effects of a unitary system. And if to the knowledge of this he sees no road from the human standpoint, wherein lies the illicitness of the union, always stigmatised by Dr. Ward as an evil *liaison*, between his positive treatment of his facts of science and his agnostic neutral attitude, without bias either materialist or spiritualist, towards the ultimate real?

Dr. Ward thinks, in terms of the quotation on his title-page, that law implies teleology, and that teleology implies spiritualistic monism. We do not see the steps by which he establishes this latter point. And he thinks neutral agnosticism unstable in the direction of one bias or other. We do not see why.

Surely in taking Naturalism "to designate the doctrine that separates Nature from God, subordinates Spirit to Matter, and sets up unchangeable law as supreme," Dr. Ward has imposed upon it three characters—the first an ambiguity, the second a mechanical bias which is not essential to it, the third its pride, or what it would repudiate, according to the meanings attached to the words "law" and "supreme." It is he who has conjured up what, by a curious slip, he calls "a novel Frankenstein."

We cannot accept Dr. Ward's criticism of psychophysical parallelism. Mr. Stout, who also "carried Cambridge to Aberdeen," is to the point here. He treats it as the best mode of formulating the facts, but needing for explanation something beyond itself. That he finds this something in an idealist metaphysic makes his witness the more impartial. Prof. Ward hankers after "interaction," or at least "activity of mind." The first, in the form in which he demands it, involves him, to our thinking, in a dualism, which is not a duality of subject and object, and for which his own "refutation of dualism" is enough. The second is spiritualism, which, if monistic, precisely inverts material monism and makes man a conscious automaton from the other point of view.

We may note in this connection a sceptical argument of Dr. Ward's. In what seems to be a misapplication of the formula of "introjection," which he applies elsewhere with signal success, he insists that my *psychoses* are experience only for me, my *neuroses* experience only for the physiologist. The inference surely must be to solipsism or to nothing. Does Dr. Ward mean to deny the accompaniment of my psychical phantasmagoria with brain change?

The quality of Dr. Ward's idealism is perhaps to be doubted. Where does he get the "voluntary movement" which is essential to our perception of space? We are not quite sure that his "intellective synthesis" gives him a right to a world of "intersubjective intercourse" at all. It is, to use an illustration of his own, a case of genii each hermetically sealed in his bottle, but collectively at large. Or it is natural realism. Again, his mental "activity" is in collision with the teaching of Mr. Bradley.

Dr. Ward must have creative agency for thought if "nature is spirit" (though if this be so in a plain, straightforward sense, then why naturalism is wrong from the point of view of spirit is hard to see). But all thought that we know is accompanied with body, and does not create. Huxley "quite rightly refuses to convert invariable concomitance into necessary conjunction." If that is so, what becomes of Dr. Ward's formula as to parallelism and causal independence, apart from his fallacious use of it to establish interaction, when the "community" need not imply more than that they are aspects or, if Dr. Ward will have it so, co-effects of the same real?

Prof. Ward declines to allow analysis to be adequate unless you can find your way back to complete synthesis. Judged by this test, what becomes of Spiritualistic Monism? Indeed, the double edge of Dr. Ward's arguments is one of the marked characteristics of his book. What is good for "non-matter in motion" is good for Green's "relations without *relata*." What is good for Lord Kelvin's Plenum is good for Mr. Bradley's Reality. A dialectical process, which must take place in a time considered to be riddled with self-contradictions and *aufgehoben*, is analogous to the form of evolution that

Dr. Ward eviscerates. In truth, mechanism inverted is spiritualistic monism. The naturalism not yet fully formulated, which has allied itself provisionally and in no way illegitimately with neutral agnosticism, is happily neither materialism nor idealism. H. W. B.

THE EVOLUTION OF EUROPEAN PEOPLES.

The Races of Europe: a Sociological Study. By William Z. Ripley, Ph.D. Pp. 624; and bibliography, pp. 160. 222 portrait types; 86 maps and diagrams, and other illustrations. (London: Kegan Paul, Trench, Trübner and Co., Ltd., 1900.)

IT has been reserved for an American anthropologist to give us the first comprehensive work on the races of Europe, a subject which is as fascinating as it is important.

The first two chapters of this comprehensive work deal with general questions, among others the problem of environment *versus* race in determining ethnic characters is touched upon, and the error of confusing community of language with identity of race is pointed out; nationality may often follow linguistic boundaries, but race bears no necessary relation to them.

As the main arguments in the book are derived from a consideration of three main sets of comparative data—the head-form, hair- and eye-colour, and stature—it was necessary to discuss their value, and in doing so the author has passed in brief review various races of man in all parts of the world. As the shape of the head, that is the length-breadth, or cephalic index, is not liable to be affected by environment as pigmentation appears to be, and stature certainly is, it takes the first rank as a criterion of race, the colour of the hair and eyes comes second, while stature is relegated to the third rank.

Dr. Ripley states as a proposition that is "fairly susceptible of proof":

"The European races, as a whole, show signs of a secondary or derived origin; certain characteristics, especially the texture of the hair, lead us to class them as intermediate between the extreme primary types of the Asiatic and the negro races respectively."

Surely the wavy-haired group of mankind has as much a claim to be considered primitive as are the frizzly- or the straight-haired groups. That certain characters are intermediate does not imply that a mixture has taken place. In some respects each of these three main groups of mankind is nearer to, and in others further from, the higher apes than the other two groups; the wavy character of the hair of the Europeans, for example, is probably an ancestral feature that has been retained by them and the other Cymotrichi.

The earliest and lowest strata of population in Europe were extremely long-headed, and the author regards the living Mediterranean race as most nearly representative of them. He considers it highly probable that the Teutonic race of Northern Europe is merely a variety of the primitive long-headed type of the Stone Age; both its distinctive blondness and its remarkable stature having been acquired in the relative isolation of Scandinavia, through the modifying influence of environment and artificial selection. It is certain that, after the partial occupation of Western Europe by a dolichocephalic type in the Stone Age, an invasion by a broad-headed race of decidedly Asiatic affinities took place. This intrusive element is represented to-day by the Alpine type of Central Europe.

It is the play of these three groups, Teutonic or Nordic, Alpine and Mediterranean, upon one another, together with the effect of environment, the potency of which varies locally, occasional isolation and sexual selection, which has resulted in the complexity of the ethnology of modern Europe.

Dr. Ripley deals with the various countries of Europe, and endeavours to unravel the anthropological history of each. It is a humiliating fact how often political or religious bias has crept into ethnological arguments; but our author approaches the subject with an unprejudiced mind, and looks at the problem from a broad point of view.

The most remarkable trait of the population of the British Isles is the uniformity of its head-form; the prevailing type is that of the long and narrow cranium, accompanied by an oval rather than broad or round face. The length-breadth indices all lie between 77 and 79, with the possible exception of the middle and western parts of Scotland, where they fall to 76. This index alone proves little in the present instance, and recourse must be made to other characters, such as hair-colour and stature.

These distinctly prove a dual element in the population, one of which is the persistent Neolithic stock, a branch of the Mediterranean race; the other is the northern race, composed of Saxon, Danish and Norwegian elements. Immigrants belonging to the Alpine race, not pure, but as a mixed people, overran all England and part of Scotland, bringing with them bronze implements, the art of pottery-making, and other cultural advantages; but their physical influence was transitory, for at the opening of the historic period the earlier types had considerably absorbed the new-comers, and the Teutonic invasion completed their submergence. Dr. Ripley, however, is scarcely correct in stating that the Alpine immigrant type never reached Ireland, as traces of them have been recorded (*cf. Proc. Roy. Irish Acad.* (3), iv. 1898, p. 570). The distribution of stature bears out a distinction between the Goidels and the Brythons; but the high stature found in South-west Scotland is anomalous, and requires further study.

It is impossible to deal with all the controversial problems in the book, but an author can generally be gauged by his treatment of critical cases, and of these it is no exaggeration to say that Dr. Ripley always takes a sane position. The origin of the Etruscans is a case in point. The different views of various authors are briefly stated, but the author inclines to Sergi's theory that the Etruscans were really compounded of two ethnic elements, one from the north bringing the Hallstatt civilisation of the Danube Valley; the other Mediterranean, both by race and culture. The sudden outburst of a notable civilisation being the result of the meeting of these two streams of human life, the author appears to have overlooked the probability of a similar history for early Greece.

A whole chapter is given to a discussion of the Basques, and Collignon's deductions are adopted. The French

Basques of to-day are more pure than the Spanish; but they originally came from Spain. Although the Basque face is extraordinarily narrow, the head is broad; but this is not due to a mixture with the Alpine race, as the Basque head is essentially dolichocephalic, the breadth occurring pretty far forwards near the temples. We have here, in fact, an example of a local modification (a sub-species of the Mediterranean stock) evolved by long-continued and complete isolation, in-and-in breeding primarily engendered by peculiarity of language, and perhaps intensified by artificial selection.

After having analysed the various European groups, Dr. Ripley devotes a couple of chapters to European origins and others to social problems, such as environment *versus* race, acclimatisation, and urban selection; in the latter he discusses the tendency to long-headedness, shortness of stature and brunetness that characterises most large towns.

Dr. Ripley has presented us with a very valuable and most interesting study of the origins and physical characteristics of various European peoples, which is as indispensable to students of history and sociology as it is to anthropologists. The clearness with which he states and illustrates his facts leaves nothing to be desired, and we offer him our congratulations on having coped so successfully with an intricate problem, and on having brought his laborious researches to such a satisfactory conclusion.

The book is handsomely "got up," and is sumptuously illustrated. There are 222 carefully-selected portrait types, and 86 maps and diagrams. The selection of the portraits could have been no easy task, and the construction of the distributional maps must have entailed an infinitude of labour. The volume concludes with a bibliography on the anthropology and ethnology of Europe, which is as appalling as it is invaluable.

A. C. Haddon.

A REVISION OF CERTAIN CELL PROBLEMS.

Histologische Beiträge, Heft VI.: Ueber Reduktionstheilung, Spindelbildung, Centrosomen und Cilienbildner im Pflazenreich. Von E. Strasburger, o.ö. Professor an der Universität Bonn. Pp. xx + 224. Mit. vier litho. Tafeln. (Jena: Gustav Fischer, 1900.)

It is with no small degree of pleasure that we have perused this, the latest, addition to the five series of "Histologische Beiträge," by Prof. Strasburger. The new volume, like some of its predecessors, deals almost exclusively with cell problems, and anything which its author may have to say on such matters must always command special respect. Breadth of treatment and open-mindedness, no less than thoroughness, have always characterised the work of this great investigator, and perhaps few who are not familiarly acquainted with the cell literature up to the early seventies can realise the extent to which our modern knowledge of cytological phenomena is indebted to the pioneer researches of the author of "Zellbildung und Zelltheilung."

In the volume before us, amongst other topics, the whole subject of what are now familiarly known as "Reduction-divisions" is treated afresh, and emphasis is laid on the need for a wider basis of comparison before we can return a satisfactory answer to the question as to whether the reduction is only *quantitative*, or whether as Weismann and his followers have supposed, it is *qualitative* also.

The majority of English and German botanical cytologists have decided in favour of the former view, and the researches of Flemming, Brauer, Meves and others on the animal side have shown that the opposite view is, at least, not always tenable. The case of the Salamander especially appears to be impossible of interpretation from the standpoint of the "Qualitative" hypothesis, and now Strasburger shows that the vitally important feature in the Salamander mitosis, viz. the *longitudinal* fission of the retreating chromosomes during the diaster stage of the first reduction division, is closely paralleled by the behaviour of the nucleus in the pollen mother cells of *Tradescantia*. Such a discovery is of the highest value as supporting the evidence already accumulated in favour of the merely quantitative character of these mitoses. The explanation which Strasburger gives of the structure of the ordinary V-shaped chromosome in the first reduction diaster will not, perhaps, gain general acceptance till it has been tested afresh. He believes that the original rod-shaped chromosome, divided longitudinally in two planes cutting each other at right angles, first splits completely into two daughter-chromosomes upon the spindle, and then that each of them opens out along the second plane of cleavage, only cohering at one end thus giving rise to the V-shaped chromosomes of the diaster. During the second division, the latter finish their longitudinal fission by complete separation of the limbs at the apex of the V, and thus what would appear to be a transverse fission proves to be merely the finish of a longitudinal splitting incepted at a much earlier period.

The author also discusses the nature of the causes which have brought about the difference of sex, and dismisses the "hunger" and autophagy hypothesis of Dangeard, which is, perhaps, a rather crude form of the less tangible but familiar theories of rejuvenescence. The view is supported that one important factor lies in the comparative absence of kinoplasm from the female, and of trophoplasm from the male, gamete. But it may, perhaps, be questioned whether the study of the evolution of sex in such forms as the green algæ does not favour the conclusion that such a difference is a result rather than a cause of sex-difference.

Incidentally, the view recently advocated by Němec, that the reproductive mitoses, in their early multipolar character, contrast with the universally bipolar vegetative divisions, is shown to be without foundation. Multipolar spindles occur both in pollen mother cells and in those of the root apex in *Vicia*, and the present writer has also observed them in the apical meristem of *Equisetum*.

The frequent connection of spindle fibres with extranuclear nucleoli is admitted, and is utilised to support the contention that these enigmatical bodies stand in a close relation to the kinoplasm which they are regarded as "activating." Many of the bodies which have, by different writers, been described as centrosomes are certainly nothing else than these escaped nucleoli, and in the example of *Nymphaea*, in which the presence of centrosomes has recently been insisted on, Strasburger shows that not only can the occasional granules not be identified as centrosomes, but that the spindle often reaches to and ends on the peripheral layer of the cytoplasm in a multipolar fashion.

Naturally the bodies known as blepharoplasts are also brought under discussion. These structures have by some been identified with centrosomes, but they seem really to be but remotely related to them. The fact that, as was shown by Webber, the true spindle often becomes multipolar, notwithstanding the presence of blepharoplasts, tells strongly against their centrosomic character, whilst the fact that in the earliest stages radiations start from them proves absolutely nothing at all. Fischer has shown how heterogeneous bodies may serve as starting-points for radiations in fixed specimens of albumin; and Guignard has described and figured, in the case of the lily, similar radiations having the entire nucleus as their common centre. Much more definite is the relationship existing between the blepharoplasts and cilia. Strasburger, who regards them as essentially consisting of kinoplasm, adduces a series of observations in support of the view that they, or bodies like them, are constantly associated with cilia. Certainly it is a fact of no small significance that whilst, in ferns and cycads, they should be absent from all the other nuclear divisions, they are constantly present in those which directly lead to the formation of the motile antherozoids. Moreover, R. Hertwig has found an analogous relation to hold good for Actinospherium, stating that "centrosomes" only occur in connection with the polar (*Richtungs*) mitoses, whilst they are quite absent from the somatic divisions.

It is not possible to touch, even briefly, on all the points raised and illustrated in Prof. Strasburger's book; it is hoped, however, that enough has been said to indicate its importance as embodying, not only a considerable number of new facts, but also many new and suggestive points of view.

And throughout the volume one is struck, not only by the full recognition accorded to the work of other investigators in the same field, but by the invariable courtesy which characterises the author's criticism of their results even when these do not accord with those obtained by himself.

J. B. FARMER.

MODERN POWER LOOMS.

Mechanism of Weaving. By T. W. Fox. Pp. xxii + 514. (London: Macmillan and Co., Ltd., 1900.)

THE second edition of this excellent book, on the construction and working of the power loom, has been carefully revised by the author. It has justly been recognised as a standard text-book on the subject of loom mechanism. The work treats of tappet, dobbie, and Jacquard or harness looms. In the first place, a full exposition is given of the tappet shedding motion, reference being made to the Yorkshire tappet loom, Woodcroft and segment tappets, and also to the different under motions for the depression of the heald shafts. Proceeding, Mr. Fox deals with some of the principal types of dobbies, such as the Blackburn, Keighley, Burnley and American. By means of sectional drawings, the somewhat intricate mechanism of these dobbies is clearly described. The work would have been enhanced to the manufacturer of heavy fabrics, such as linen, woollen and worsted textures, if fuller descriptions had been given of the dobbies employed in the weaving of these fabrics. Still, to the student of cotton weaving and the manufacturer of light fabrics, the information supplied will be found invaluable, and even the makers of heavier cloths might consult the pages on dobbies with profit. It is open to dispute whether the best method of treatment has been adopted, from a student's standpoint, in dealing fully with shedding motions, including the Jacquard, and card stamping, and the methods of tieing up the harness, before reference is made to other essential motions of the loom; but the plan of the author is evident on only a casual examination of the book, namely, to treat of each distinct motion in all its various forms in succession, excluding the possibility of affording the reader at the outset even a general notion of the combination of movements in power-loom weaving. This explains why some 280 pages, or more than half the book, should be devoted to the principles of shedding, card stamping and harness mounting, prior to any descriptive reference being made to the picking, the warp let-off, fabric take-up, shuttle, and other motions.

In dealing with the Jacquard loom, the single-lift machine—the basis on which all Jacquards are constructed—is first treated of; then follow descriptions of the double-lift, centre-shed, open-shed, twilling, Bessbrooke and cross-border machines. The doup and gauze harness are very clearly explained. Other systems of tie-up, more elaborately illustrated, might have been advantageously incorporated into this section of the work; but sufficient data is afforded to enable the student to grasp the principles on which the complex mountings are effected, necessary in the weaving of tapestry and decorative silk fabrics.

Lappet weaving receives adequate attention, especially as worked by means of lappet wheels and the Scotch method; but only brief details are given on other forms of this motion, in which lags are used and pegs of different lengths, and also in which the frames for carrying the lappet threads operate on the upper side of the fabric.

In regard to picking, Mr. Fox gives some interesting information on the magnitude of the force expended in propelling the shuttle from side to side of the loom. Perhaps there is no motion in weaving in which improvement is so desirable as in picking. This is more obvious in heavy looms, where large shuttles have to be used, travelling at a high speed. Under the head of "Warp Protectors," fast and loose reeds are considered, as well as shuttle guards. Many attempts have been made at automatic warp-stop motions, such as those applied to the Northrop and Poyser looms, but probably the author has not mentioned these on account of their not having come into general use in this country; still, there are principles in both interesting to the student of "Mechanism of Weaving."

The chapter on "Multiple Box Motions" is one very typical of the author's skill in the exposition of difficult mechanical problems. Revolving, as well as drop-box motions, with suitable illustrations, are fully explained. On "beating-up," the author has some instructive information respecting the movement of the crank for carrying the batten or going part against the fell of the fabric. He supplies a table showing the motion of the crank, and treats of the length of the crank-arm and the eccentricity of movement. The concluding portions of the book are devoted to weft-stop motions, mechanism for governing the warp and taking-up of the fabric, the construction of temples and selvage motions. There is also a chapter on the arrangement of weaving-rooms or sheds, with a plate illustrative of the positions of the looms and other machinery. The book should be in the possession of all those interested in the construction of power looms.

OUR BOOK SHELF.

Leçons d'Optique géométrique à l'Usage des Élèves de Mathématiques spéciales. Par E. Wallon, Professeur au Lycée Janson-de-Sailly. Pp. 343. (Paris : Gauthier-Villars, 1900.)

THIS book has been written at the desire of Prof. Wallon's students, to whom a graceful tribute is paid, in the preface, for the assistance which their questions, doubts and objections have rendered in developing the author's methods of teaching. To look on one's students as collaborators, that is certainly the secret of successful teaching ; and, as here presented, Prof. Wallon's lectures are certainly successful in giving a systematic and clearly defined outline to the science of geometrical optics. The diagrams are well drawn and numerous, and the mathematical proofs are simple and yet sufficient. There is, however, little that is novel to be found in the course of these lectures ; indeed, in a few cases it might be objected that there was a tendency to lag behind the times. Thus, in discussing refraction equivalents, Newton's law, that $\frac{n^2 - 1}{d}$ = constant, and Gladstone and Dale's law, that $\frac{n - 1}{d}$ = constant, are alone mentioned (n being the refractive index, and d the density of the substance). Lorenz's law, that $\frac{n^2 - 1}{(n^2 + 2)d}$ = constant, is now most generally accepted. For gases, in which n is nearly equal to unity, all three laws hold with about equal accuracy. But Lorenz's law appears to hold in passing from the gaseous to the liquid state, and must therefore be accepted as the most general.

An interesting chapter is devoted to the subject of the human eye, in which the most well known optical properties of that organ are discussed. In the ensuing chapter, on optical instruments, a particularly good account is given of the optical systems comprised in telescopes and microscopes of various patterns. It is surprising, however, that the ophthalmoscope and ophthalmometer are not mentioned, and are in fact so seldom found described in works on geometrical optics. Both instruments involve interesting optical arrangements, and their practical usefulness would render a description of their details still more interesting. E. E.

Therapeutic Electricity and Practical Muscle Testing. By W. S. Hedley, M.D., M.R.C.S. England. Pp. ix + 278 ; 3 plates ; 99 illustrations. (London : J. and A. Churchill, 1899.)

THE increased use of electro-therapeutic methods renders the appearance of Dr. Hedley's book welcome. The profession have for some time looked somewhat askance at this departure in therapeutics, and are, in many branches of this practice, rather inclined to regard the good effect of the treatment as moral and not actual. The work before us considers the whole subject from a scientific standpoint, and any one interested in it will gain considerable profit from its perusal.

The reader must be warned at once that the book contains no mention of radiography or the application of the Röntgen rays to the healing art, either from a diagnostic or therapeutic standpoint. The author, in his preface, admits that the work is a therapeutical one, and to some extent apologises for the description of such instruments as the cystoscope, &c. No doubt he thinks the profession is in possession of sufficient literature upon the subject of radiography, which may or may not be true ; the sphere of usefulness of the book would, however, certainly have been increased by the inclusion of this subject.

The work is divided into three parts. The reason for this classification is not quite evident ; a part as a classification unit seems, in the author's hands, to differ to no material extent from a chapter. Further, each part is chaptered separately, which, without some very special object is to be gained, is a bad plan ; from this it follows that the book contains three Chapters i., &c.

The first part is mostly concerned with those general physical considerations which have a special bearing upon what the author in the first chapter of Part ii. calls the electro-therapeutic outfit. A good account is given in Chapter vii. (p. 65) of currents of great frequency and high potential, which, as has been frequently shown, are of great therapeutic value. Much technical detail is given, both of a purely electrical and electro-physiological character.

One of the most useful chapters from the standpoint of the general physician is Chapter v. Part ii., upon the action of muscles and the consequences of their paralysis. In Chapter x. Part iii., an interesting account of cataphoresis is given. Very frequent mention is made of authors' names and no reference added, nor is there an index of authors at the end, or anything in the shape of a bibliography. Mere chance or whim has apparently guided the author in giving or omitting the full reference of a work cited ; in some cases the full reference of important monographs is withheld, in others that of trivial ones given. This method cannot be too severely deprecated.

To sum up our remarks, it is with the manner and not the matter of the book we find fault. It is full of useful and, indeed, essential information to those working in this field ; the author has spared no pains to collect fact bearing upon and elucidating his subject.

Lessons in Botany. By Prof. George F. Atkinson, Ph.B. Pp. xv + 365. (New York : Henry Holt and Co., 1900.)

THE present volume is, in a sense, an abridged edition of an excellent text-book by the same author, which appeared a year or two ago. The subject-matter is carefully arranged to suit the convenience of teacher and pupil, and altogether the book is one which should prove useful in this country as well as in America. Naturally, from the British point of view, the difficulty of obtaining the needful specimens occasionally may turn up, though this would not recur very often. We can confidently recommend Prof. Atkinson's book to the notice of teachers.

Outlines of Plant Life, with special reference to Form and Function. By Prof. Charles Reid Barnes. Pp. vi + 308. (New York : Henry Holt and Co., 1900.)

THIS is a work intended for school use. It has some points of merit, especially the special part on ecology, in which the examples are well chosen and fully illustrated. The illustrations, though almost all are (with due acknowledgment) borrowed from other works, are distinctly good. We think the book a useful one, and the exercises which are interspersed through the volume add to its value.

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.*]

Note on some Red and Blue Pigments.

THE following data are placed on record because interesting in themselves, and in the hope that they may be useful to others who have the opportunity to make further investigations.

(1) A little boraginaceous plant called *Eremocarya micrantha* (Torrey) is common in sandy places at Mesilla Park, New Mexico, flowering in April. A few days ago, Prof. E. O. Wooton called my attention to the fact that its roots are deep red, and stain herbarium paper. Curious to learn more about this peculiar coloration, I made some tests, with the following results:—The pigment is not soluble in water, but it readily dissolves in cold alcohol, forming a beautiful red solution. The roots, after being treated with alcohol, become white, showing that the pigment is entirely superficial, and is apparently an excretion from the root. The red colour is that of the normal or acid state of the pigment, but on adding enough liquor potassæ to make the solution alkaline, the colour immediately becomes a beautiful blue. An excess of strong caustic potash does not destroy the pigment until after a considerable time. Prof. A. Goss tested the delicacy of the colour-reaction in the presence of acids and alkalis, and found that a very small excess of one or the other would give the characteristic colour. The pigment is, of course, an anthocyan, very similar, at least, to litmus; and it may be that it can be utilised for the same purposes.

(2) It has been remarked more than once that whereas the hind wings of Acridiidæ (grasshoppers) are sometimes blue, sometimes red, and sometimes yellow, species living in the same locality, though of very diverse genera, will often have similarly coloured wings. In the Mesilla Valley we have common species with red and with yellow wings; but in the Organ Mountains, not far away, I found two species very abundant, both having blue wings, and otherwise coloured much alike, though of totally different genera. These were *Leprus wheeleri* and a *Trimerotropis* which I took for *T. cyaneipennis*, but which Mr. S. H. Scudder tells me is distinct and apparently undescribed. As the blue of the wings appeared to be certainly a pigmentary colour, and much resembled the vegetable anthocyans, I detached one of the wings of *Leprus wheeleri*, and boiled it in dilute hydrochloric acid. As I had hoped, but hardly ventured to expect, the blue at once became red. Heating the thus reddened wing in liquor potassæ did not change it back to blue, but caused it to turn yellow. I infer that the blue pigment has a red (acid) phase, but that strong alkali will destroy it altogether, leaving a yellow coloration which is of a different character. It is difficult to avoid the conclusion that the redness or blueness of the wings in these grasshoppers may result from the action of some environmental factor (*e.g.* the juices of plants eaten) upon the pigment, and that this accounts for the colour-similarity of diverse species living at the same place. Of course, this is not supposed to account for the similarity of the colours of the tegmina and thorax, of which the various shades of grey, red and brown resemble those of the rocks and ground.

T. D. A. COCKERELL.

Mesilla Park, New Mexico, U.S.A., April 17.

Valve Motions of Engines.

IN your number of December 14, 1899, Prof. John Perry mentions a diagram by Mr. Harrison. This diagram is the same as "Das bizentrische polare Exzenterschieberdiagramm" of F. A. Brix in the *Zeitschrift des Vereins Deutscher Ingenieure*, April 10, 1897.

There is only a small difference, as Mr. Harrison finds the distance OC by means of a circle with radius = length of connecting-rod, and Mr. Brix finds that distance by calculating it out of $\frac{R^2}{2L}$, (R = length of crank, L = length of connecting-rod). Now OC has not exactly that value, but the fault made therewith is much smaller than the fault made by describing the circle. Therefore the method of Mr. Brix is preferable to that of Mr. Harrison.

F. J. VAES.

Rotterdam, April 14.

MR. BRIX seems to have solved only the simple case of a valve worked by an ordinary eccentric. There are other good graphical solutions—for example, by Coste and Maniquet in a modified form of the Reauleaux diagram, which gave accurate results. Mr. Harrison's diagram is more general and is applicable to link and radial valve-gears and to all motions which are composed of a simple harmonic vibration with a small octave superposed. It may be used for velocities and accelerations as well as mere displacements. As to calculating the distance OC by the formula $\frac{R^2}{2L}$, instead of using the construction of the circular arc, this is a matter of no importance because there is no appreciable difference in the answers.

April 28. JOHN PERRY.

Drunkenness and the Weather.

I NOTICE in your issue of March 15 a communication from Mr. R. C. T. Evans, of Gray's Inn-road, W.C., calling attention to a probable error in my deductions in the paper which appeared in your issue of February 15, under the title "Drunkenness and the Weather." He says, "When a man is intoxicated and commits an assault, the result is entered in the police reports as 'assault,' the more serious offence overshadowing the less; so that in all probability many of the cases of assault referred to in the statement were also cases of drunkenness, but were not tabulated as such. Studying Prof. Dexter's curves in this light, we may reasonably conclude that the number of those arrested for drunkenness or its results, varies but little throughout the year."

Although his supposition seems a reasonable one, a fuller statement of the conditions of the study will show that the fluctuations of the "drunkenness" curve cannot be so easily accounted for.

First, the monthly occurrence of arrests for drunkenness for New York City is more than twice that for assault, even in the summer, when the former are at the minimum and the latter at the maximum for the year, and if we suppose that every person arrested for assault in the summer was also intoxicated and would have come into the hands of the law for that crime if he had not for the other, even this would not bring the drunkenness curve up to its normal for the winter months.

Second, the method of recording crime by the New York City Department of Police makes this practically impossible. Misdemeanours are there classified and recorded under 183 different headings. The two which I have compared are "assault and battery" and "intoxication." There are, however, four other classes of assault besides, one for "intoxication and disorderly conduct," equalling that of "assault and battery" in the annual number of arrests, besides one for "fighting." A letter just received from the Clerk of Police says, "The crime of intoxication and fighting—a drunken brawl—would be classified in the statistics as 'intoxication and disorderly conduct.'" A careful analysis of all the conditions would make it seem that only occasionally would arrests for "assault and battery" encroach upon the data of drunkenness. I believe they might sometimes do so, but not sufficiently often to materially influence the curve.

EDWIN G. DEXTER.

Greeley, Colo., April 17.

SOME SPECULATIONS AS TO THE PART PLAYED BY CORPUSCLES IN PHYSICAL PHENOMENA.

IN some experiments described in the *Phil. Mag.* October 1897, I showed that in the kathode rays there were present bodies whose mass was exceedingly small compared with the masses of ordinary atoms; these masses, which carry a charge of negative electricity, I called "corpuscles." Ever since then I have indulged in speculations as to the possibility of these corpuscles existing in a free state in ordinary matter not under the influence of the very intense electric field which are associated with the kathode rays. As recent work has produced some evidence of the free existence of these corpuscles, I have thought that these speculations might be of some interest to a wider circle than that to which they have hitherto been addressed. In the *Phil. Mag.*

(February 1900), I showed that these corpuscles existed in the neighbourhood of a hot wire and of a metal plate illuminated by ultra-violet light, and recently the discovery by Giesel, Curie and Becquerel of the magnetic deflection and electric charge carried by part of the radium radiation may be interpreted as indicating the existence of corpuscles in this substance.

I suppose, then, that there is a certain amount of what may be called corpuscular dissociation taking place in bodies; that some of the molecules of the substance are continually breaking up by the detachment of a corpuscle, and are being reformed by the arrival of another corpuscle; the result of this is that at each instant there are a certain number of free corpuscles with negative charges distributed throughout the body, while the corresponding positive charges are on the molecules of the body, the corpuscles are much more mobile than the molecules; indeed, in solids and liquids, the latter may be regarded as almost fixed in comparison with the former. We thus get the conception of a body permeated with corpuscles which are able under forces to move from one part of the body to another. We must remember that, as the particles are charged, any movement will be accompanied by electrical effects and, in general, a volume density of electrification.

The actual number of corpuscles free at any instant is the result of an equilibrium between the number of corpuscles produced by dissociation and the number which recombine. Thus if q is the number of corpuscles produced by dissociation in unit volume in one second, τ the time during which a corpuscle is free (*i.e.* the time which elapses between its departure from one molecule and its entry into another), n the number of free corpuscles in unit volumes, then when there is equilibrium $q=n/\tau$ or $n=\tau q=\lambda q/u$, if λ is the mean free path of the corpuscle and u its velocity of translation. In non-conductors we suppose that there are very few corpuscles, but that they are abundant in metallic conductors. Let us now trace some of the consequences of the existence of these corpuscles in a solid, and suppose for the moment that the positively charged molecules are fixed; if the corpuscles are acted upon by gravity (of which point we have no evidence), then in a vertical bar of metal the number of corpuscles in unit volume will be greater at the bottom of the bar than at the top, for just the same reason as the density of the air gets less as we go higher; thus in this case gravity would produce a displacement of electricity, the bottom of the bar being negatively and the top positively electrified. Again, in a rotating mass of metal the centrifugal force would tend to drive the corpuscles towards the surface; there would thus from this effect be an excess of the corpuscles near the surface and a deficit near the axis. Thus the outer parts of the metal would be negatively and the inner parts positively electrified, the rotation of the negatively electrified corpuscles being no longer completely balanced by that of the positively electrified molecules would give rise to a magnetic field; thus a large mass of rotating metal would act as a magnet. Again, suppose we place a piece of metal in a magnetic field, the action of the magnet on the moving corpuscles will make them describe curved paths, and we can easily see that the magnetic effect due to the particles moving in this way is in the opposite direction to that of the external magnetic field. Thus a metal containing these corpuscles would tend to act like a diamagnetic substance. Again, suppose the metal is exposed to an electric force X, the corpuscles will acquire an average velocity along x equal to $X\tau e/2m$, where m is the mass of a corpuscle and e its charge. Let us call this velocity vX, then the electric current across unit area is $nevX$; thus nev or $qe^2\lambda^2/2mu^2$ is the specific conductivity of the substance. If we suppose that u, the mean velocity of translation of the corpuscles, varies with the temperature in the same way as the velocity of translation of the molecules of a gas, mu^2 would be proportional to the absolute temperature, and the specific resistance would, considered as a function of the absolute temperature θ, vary as θ/q; if q, the amount of ionisation increases as the temperature increases, the resistance will vary more slowly than the absolute temperature; if q diminishes as the temperature increases, the resistance would vary more rapidly than the temperature. These corpuscles moving from place to place would carry not merely electric charges, but energy from one part to another; and since the coefficient of diffusion of these corpuscles is proportional to v, the thermal and electric conductivities would be proportional to each other. Again, when we have conduction of heat we have unequal streams of these corpuscles in opposite directions; thus the unequal deflection of their paths produced by a magnet would give rise to an electric displacement, and we should have an electromotive force at right angles to the magnetic force and to the temperature gradient, an effect discovered by v. Ettinghausen and Nernst. From the conductivity of the gas we can deduce the value of nev. We know the value of e, and hence another equation would enable us to determine n and v; for this purpose we turn to the Hall effect, but here the results are disappointing, for we can easily prove that when E^1 and E are the tranversal and longitudinal electric forces and H the magnetic force, $E^1/EH = \frac{v_1k_2 - v_2k_1}{k_1 + k_1}$, where v_1 and v_2 are respectively the velocities of the negative corpuscles and positive molecules under unit electric force, and k_1 and k_2 the values of k for these ions where k = pressure ÷ number of systems in unit volume. If both the negative corpuscles and the positive molecules behave like perfect gases, $k_1 = k_2$ and $E^1/EH = \frac{1}{2}v_1$, since v_2 is very small; thus, on this supposition, the Hall effect would give us the value of v; but there seems no reason to suppose that the positively electrified molecules in the solid would produce the same pressure as an equal number of molecules in the gaseous state, and thus though v_2 is small compared with v_1, k_2 may be so small compared with k_1 that k_1v_2 cannot be neglected in comparison with k_2v_1, and in this case the Hall effect would not be sufficient to determine v. The fact that the Hall effect is of different signs for different substances shows that we have to take into account both terms in the expression for E^1/EH.

Again, if different parts of a metal bar were at different temperatures, the "pressure" as it were of these corpuscles would be different at different parts of the bar, so that the corpuscles would tend to flow from one part of the bar to the other, and cause an electric displacement; thus difference of temperature would cause an electric displacement. This is the Thomson effect, measured by the "specific heat of electricity." The value of the "specific heat of electricity" will on this theory depend not only on the variation with temperature of the kinetic energy of a single corpuscle, but also on the way the dissociation constant q varies with the temperature. There are many other phenomena which can be interpreted in terms of these corpuscles, but these I must leave for another occasion.

J. J. THOMSON.

Cavendish Laboratory, Cambridge, April 30.

SCIENCE IN RELATION TO ART AND INDUSTRY.

AT the annual banquet of the Royal Academy on Saturday evening, Sir Norman Lockyer, in replying on behalf of science, made the following remarks upon the intimate relation between intellectual progress and the study of nature, and also upon the necessity for a more liberal provision for scientific work if England wishes to compete successfully with other nations struggling for industrial supremacy. Though the public mind may be disturbed by the statement of the principle that the provision made for scientific and technical study and research should be as great as that given by any two other nations, the comparison will serve a useful purpose in directing attention to a view of the claims of science worthy of consideration.

It is a very great honour for a student of science to be called upon in such an august assembly as this to say a few words; but if I am to be accepted as the representative of science I do not wish to be fettered by your suggestion, Sir, that I should refer to the dependence of art on science. I am sure that I may frankly say for every man of science that we acknowledge freely the firm brotherhood between art and science—a brotherhood founded upon a common object, the study of Nature, "the mistress of all the masters," and carried on by a common method, the proper co-ordination of brain, hand and eye. In every case with which a man of science or a man of art has to deal, imagination is required, and so science and art meet upon terms of mutual helpfulness. I think I may also say that this feeling is thoroughly reciprocated by men of art, for many of them honour me with their friendship, and therefore I know their sentiments. I am the more anxious to say this because some twenty years ago, when I was privileged to attend this anniversary dinner, I heard a distinguished representative of literature express a totally different sentiment. He told us that "before their sister, Science, now so full of promise and pride, was born, there were Art and Literature like twins together," and it was suggested that the sooner art and literature formed an alliance offensive and defensive against the interloper, the better it would be for them. I do not believe in this. For me science is as old as art. They have both advanced together. Let us take the position of things 6000 years ago, to begin at the beginning of things, if we can. Then the priest-mummifiers of Memphis had to be profound anatomists. If you go to the Gizeh Museum you find magnificent specimens in those statues of Chepren in diorite, other statues in wood, and the plaques, veritable Memlings in stone, which clearly show that this knowledge was also possessed by their sculptors. If you come down to a comparatively modern period, something like 600 B.C., and compare those wonderful metopes of Solinunto with the marbles of the Parthenon, which are of a later date, you will find an enormous advance in the latter. You will find that Hippocrates had lived in the interval, and, indeed, that he and Phidias were contemporaries and fellow-townsmen. Carrying the matter down to the introduction of Universities into Northern Italy in the thirteenth century, we find that the difference between the art of Cimabue and Giotto depends on the fact that anatomy had been introduced in the meantime. Science, then, is no new interloper, seeking to detract from the importance of art and literature. What was new twenty years ago was that the work of the late Prince Consort, whose name will always be revered by those who know the benefits he conferred on our country, was then beginning to tell. He showed us that in order to secure industrial progress we must have, above all things, instruction and practice in science and art. In war, being well assured of the valour and endurance of our sailors and soldiers, the chief thing we have to do is to see that they are properly supplied with the engines and munitions of war, and, more than these, the scientific spirit. In peace, for the beauty of a nation's life and a perfect record of it, we must look chiefly to the sweetening and ennobling influences of art and the enduring works of its masters; but for a nation's continued welfare and progress both science and art are necessary. We are in face of industrial struggles, and we must utilise both science and art to supply the wants of our own and other countries, and to provide commodities made in England, besides handling

> "Things of beauty, things of use,
> That one fair planet can produce,
> Brought from under every star."

We are in face of a struggle for existence in which we know full well that only the fittest will survive. How are we going to carry on the struggle? What are our weapons? Our first line of defence in this direction can only consist of our Universities and our teaching centres. Have we enough of them? We know already that we have not enough of them, because we have already lost several important engagements in these industrial battles. Are there no means by which we can judge of their sufficiency? In relation to non-peaceful international struggles in which also defeat has to be guarded against, a clear and universally approved policy has been enunciated; this is, that the future of our empire, an empire the real unity and strength of which are developing under our eyes at this moment, can be secured if we see to it that our first line of defence, our fleet, shall be equal in strength to the fleets of two other possibly contending powers. The second answer then, I think, is that this principle should be applied to our first line of defence in those industrial conflicts the results of which are much more enduring. Do our teaching and research centres at present outnumber in the same proportion, as do our ships, those of any two nations which are actually contending with us in peaceful enterprise? And, also, are they equally efficient in every respect? I believe, and I know that this view is held by many representative men of science, that until our Universities, our science schools, our art schools, and our technical institutions bear the same relation both in number and efficiency to those of other nations as do our battleships, cruisers, and small craft, we shall not be justified in regarding the future of the empire with that freedom from care which is the attribute of a strong man armed.

NOTES.

PROF. E. SUESS, professor of geology in the University of Vienna, has been elected a Foreign Associate of the Paris Academy of Sciences, in succession to the late Sir Edward Frankland. Sir John Burdon-Sanderson, Bart., has been elected a Correspondant of the Academy, in succession to the late Sir James Paget.

DR. S. L. TÖRNQUIST, of Lund (Sweden), has been elected a Foreign Member of the Geological Society, and Prof. F. Sacco, of Turin, has been elected a Foreign Correspondent.

WE much regret to see the announcement of the death of Lieut.-General Pitt-Rivers, F.R.S., the distinguished anthropologist, on Friday last.

THE annual conversazione of the Society of Arts will be held at the Natural History Museum, South Kensington, on Wednesday evening, June 20.

THE adjourned debate on the Sea Fisheries Bill was resumed in the House of Commons on Monday. After a long discussion, a division was taken, and a majority was obtained in favour of the second reading. The Bill was then referred to a Select Committee.

IT is reported that Vesuvius has shown signs of increased activity during the past few days. Explosions have taken place in the crater of the volcano, and masses of rock and lava have been ejected. The huts of the guides and the topmost station of the funicular railway are threatened. Reuter reported that four Englishmen who ascended Vesuvius on Tuesday went beyond the limit indicated as dangerous by the guides and gendarmes, and were seriously injured by a mass of ejected material striking them. This however has since been denied by Reuter's Naples Correspondent.

THE U.S. National Academy of Sciences has decided to award the Barnard medal to Prof. Röntgen for his discovery of the X-rays. This medal is awarded at the close of every quinquennial period for a discovery in physical or astronomical science, or novel application of science to purposes beneficial to the human race. The first presentation of the medal was to Lord Rayleigh and Prof. Ramsay for their joint discovery of argon.

REUTER'S AGENCY learns that Dr. Louis Sambon and Dr. G. C. Low, who has been awarded the Craggs research scholarship of 300*l.* per annum, are about to experiment with a view to proving that malaria is spread by mosquito bites, and expect to begin work seriously on June 1, by which time they will have all their arrangements completed. A suitable spot has been chosen for the erection of their mosquito-proof house in the Campagna, on the line of the railway running from Rome to Tivoli.

A MEETING of the International Association for the Advancement of Science, Arts and Education will be held at the Society of Arts to-morrow (May 11), at 4 p.m. Sir Archibald Geikie, F.R.S., vice-president of the British Committee, will preside. The secretary, Prof. Patrick Geddes, will deliver an address on the nature and aims of the Association and its forthcoming assembly at the Paris Exhibition.

IN connection with the International Congress of Physics to be held in Paris from August 6 to 12, a preliminary programme of papers has been issued. Over sixty reports have already been promised, and among the names of contributors we notice those of Amagat, Arrhenius, d'Arsonval, Battelli, Becquerel, Blondlot, Bouty, Boys, Branly, Brillouin, Broca, Cornu, Curie, Exner, Griffiths, Hurmuzescu, Lippmann, Lorenz, Poincaré, Potier, Poynting, Pringsheim, Righi, Spring, J. J. Thomson, Villard, Warburg and Wien.

THE next meeting of the Comité International des Poids et Mesures is fixed for September 10, 1900. Owing to the death of M. Joseph Bertrand, and the resignation of Prof. Thalen, two of the original members of the Comité, the number of members is now limited to eleven. Great Britain will be represented at the forthcoming meeting by Mr. H. J. Chaney, a member of the Comité.

THE death of M. Edouard Grimaux, at the age of sixty-five, occurred during the past week. M. Grimaux succeeded Cahours as professor in the École Polytechnique at Paris, and also held a chair at the Agronomic Institute. He made numerous and valuable contributions to organic chemistry, and was the author of several chemical treatises. He will be gratefully remembered by chemists for an admirable biography of Lavoisier, which he published in 1884. M. Grimaux lately became prominent in connection with the Dreyfus case. At the Zola trial he expressed his belief in the innocence of Dreyfus. For this he was deprived of his professorship by General Billot, notwithstanding the fact that he had rendered devoted service to the army in 1870. In 1894 M. Grimaux was elected to the Academy in the place of Frémy.

REPLYING to a question in the House of Commons on Monday, Mr. Akers-Douglas stated that the new National Physical Laboratory is not to be erected, as has been reported, in the Queen's Cottage grounds, or in any other grounds attached to Kew Gardens. It will stand quite outside those Gardens on Crown land. The only part of the scheme which might possibly be supposed to affect the amenities of the Gardens is a small building which will not, at the outside, cover a quarter of an acre. This building will be so placed as not to interfere with the views from the Gardens over the Old Deer Park, and it will not be opposite to that part of the Gardens round the Queen's Cottage which is reserved in a wild state. The building will only be used for delicate scientific work which will not disturb the seclusion of the neighbourhood of the Queen's Cottage, and which, in fact, itself requires as much quiet and privacy as can be obtained.

THE Paris correspondent of the *Chemist and Druggist* states that science is represented at the Salon by several portraits of average merit. The best is that of Dr. Vaillard, head army surgeon and professor at the Val de Grace Military Hospital, where he is known to two or three generations of army pharmacists who have followed his lectures. Dr. Vaillard is of middle age, and is shown standing, in regimental dress, with the Cross of the Legion of Honour on his tunic. His left hand is leaning on a laboratory-bench, on which are a microscope and a variety of analytical appliances. To his right is a lecture-blackboard, and one can dimly see his written demonstration. The artist is M. Paul Bourdier. The portrait of M. Hautefeuille, chemist, and member of the French Institute, is the work of a lady artist. She shows him in everyday attire in a corner of his laboratory, sitting at a table, with a collection of scientific apparatus near at hand; in the background is a furnace, at which an assistant in a white blouse is working. M. Tisserand, of the French Institute, is another portrait of fair merit. One would like to see more of this class of picture, but must suppose artists find no market for them.

THE death of Dr. Edmund Atkinson on the 4th inst., after a very short illness, will be a matter of deep regret to his large circle of friends. He was born at Lancaster in 1831, and was a student of Owens College, Manchester, in the early days of that institution. There he became assistant to the late Sir Edward Frankland, the first professor of chemistry in the College, and was associated with him in organising the laboratory which has since become so well known. About 1854 he went abroad for some years and continued his scientific studies at the Universities of Marburg, Göttingen and Heidelburg, and at the École de Médecine in Paris under Wurtz. On his return to England he became private assistant to Sir Benjamin Brodie at Oxford, then science master at Cheltenham College, and afterwards professor of experimental science at the Royal Military College, Sandhurst, and at the Staff College. He was several times elected upon the council of the Chemical Society, and was one of the founders of the Physical Society, of which Society he was treasurer from the beginning until the last anniversary meeting, with the exception of a short interval a few years ago. Dr. Atkinson rendered great service to science by his numerous translations into English of foreign scientific works; among these the best known are Ganot's "Elements of Physics," von Helmholtz's "Popular Scientific Lectures" and Mascart's "Treatise on Electricity and Magnetism." He was a man of excellent judgment in practical affairs, and of late years he gave much time as a magistrate to the local affairs of his neighbourhood. He was always ready to undertake onerous duties for those in need of help, and was a most generous and steadfast friend.

THE council of the Royal Geographical Society have awarded the two Royal medals for this year to Captain H. H. P. Deasy and Mr. James McCarthy. The Founders' medal has been awarded to Captain Deasy for the exploring and survey work accomplished by him in Central Asia. Mr. McCarthy is the Government surveyor of Siam, and the Patron's medal has been awarded to him for his great services to geographical science in exploring all parts of the kingdom of Siam, for his laborious work during twelve years in collecting materials for a map, to form the basis of a survey system, and for his admirable map of Siam just completed. The other awards have been made as follows:—The Murchison award to M. Henryk Arctowski for the valuable oceanographical and meteorological work which he performed on the Belgian Antarctic expedition; the Gill memorial to Mr. Vaughan Cornish for his researches, extending over several years, on sea-beaches, sand-dunes, and on wave-forms in water; the Back grant to Mr. Robert Codrington for his journeys in the region between Lakes Nyassa and Tanganyika, during which he removed, on behalf of the Society, the section containing the inscription from the tree under which Livingstone's heart was buried; and the Cuthbert Peek grant to Mr. T. J. Alldridge for his journeys during the past ten years in the interior of Sierra Leone, during which he has done valuable geographical work.

THE following opportunities for the study of botany during the ensuing summer season in the United States are mentioned in the *Journal* of the New York Botanic Garden for April :—Columbia University, New York, has instituted a summer session, beginning July 2 and ending August 10. The department of botany will be under the charge of Prof. Lloyd, who will offer courses in ecology, general botany, and research work in select subjects. Students in these courses will have access to the museum and collections of the Botanic Garden. The Woods Holl Laboratories will be open from July 5 to August 16, and the botanical staff includes Dr. B. M. Davis, Mr. G. T. Moore, Dr. R. H. True, Miss Rhoda A. Esten, and Miss Lillian G. MacRae. Courses in cryptogamic botany, plant physiology, and plant cytology will be offered. The biological laboratory at Cold Spring Harbour will be open from July 2 to August 25, the botanical staff including Dr. D. S. Johnson, Dr. H. C. Cowles, and Mr. W. C. Coker. Courses of lectures will be offered in cryptogamic botany, ecology, and bacteriology.

THE Annual Summary of the *U.S. Monthly Weather Review* for 1899 contains a very interesting account of the climate of St. Christopher, by Mr. W. B. Alexander. The island lies in latitude 17° 20′ N. and longitude 65° 45′ W.; its length is 23 miles, and the breadth of the main body is about 5 miles. The central part is occupied by a range of mountains, the highest of which, Mount Misery, rises to a height of about 4100 feet. Tables and diagrams are given showing the barometric pressure for 35 years, and the rainfall for 44 years at Basseterre, which is situated in a spacious and fertile valley. The climate, generally speaking, is dry and healthy, being tempered and purified by frequent thunderstorms. The mornings and evenings of the hottest days, which occur in August, are agreeably cool; the coldest months are January and February. The mean annual temperature is about 81°, of August, 83°, and February, 78°. The mean annual rainfall is about 51·6 inches; 37 per cent. of the amount occurs during the first half of the year, and 63 per cent. during the last half. The rainfall is more frequent than heavy; it has only reached or exceeded 5 inches in 24 hours eleven times in 44 years.

IN the *Proceedings* of the South African Philosophical Society, vol. xi., Mr. J. R. Sutton publishes an important discussion of the winds of Kimberley. The results are obtained from three years' hourly observations with Osler and Robinson anemometers. The period is admittedly short; but the excellence of the position and the scarcity of hourly observations in South Africa are quoted as reasons for not delaying the appearance of the paper. The observatory is situated at Kenilworth, about three miles N.N.E. of Kimberley, at an altitude of nearly 4000 feet. It has been supposed that there was an overwhelming excess of northerly winds, and theories have been propounded why this is the case; but the conclusion to be drawn from the paper is that while sometimes one and sometimes another direction may preponderate from year to year, a definite prevailing wind does not exist. Of the 25,898 hours of wind analysed throughout the three years, the final resultant contains the small components of only 50 hours to the north and 100 hours to the west. The diurnal curve of wind velocity contains two maxima (2h. p.m. and 10h. 45m. p.m.) and two minima (5h. a.m. and 7h. 30m. p.m.). The mean hourly velocity is 6·6 miles per hour.

AN interesting illustration of Doppler's principle is noted by Prof. F. Richarz, of Greifswald. The writer was standing by the Brenner Pass near a curve where a railway train was approaching him, the line being backed by a wall of mountain. On the engine giving a short whistle, an echo was heard, the pitch of which was at least half a tone lower than the original sound.

THE American Museum of Natural History, New York, as we learn from a note recently published by Mr. J. A. Allen, has recently obtained a specimen of the head of the wood-bison (*Bison americanus athabascae*), which is still in existence in the forests near Great Slave Lake. Compared with the bison of the plains (now extinct in a wild state) the woodland bison is stated to be rather larger than the former, and to have the bases of the horn-cores relatively thicker. In 1894 the herd of wood-bisons in the Great Slave Lake district was estimated to be some hundreds in number, but in 1899 it was reduced to about fifty. A very few years more will probably witness the complete extinction of this animal.

AT a recent meeting of the Geographical Society of France, the well-known naturalist, M. Grandidier, the author of the great work upon the natural history of Madagascar, gave an account of his last expedition to that Island, in 1898–99. M. Grandidier landed at Tuléar, on the south-western coast of the Island, and thence made an adventurous journey through the interior to Fianarantsoa, in the Betsileo country, in the south-eastern district. M. Grandidier on his way visited the well-known deposits of Ambolisatra, about 35 kilometres north of Tuléar, where numberless fragments of *Aepyornis*, and almost entire skeletons of the small Madagascar hippopotamus, besides remains of many lemurs of gigantic size and other extinct animals were obtained. From Fianarantsoa, M. Grandidier proceeded north through a well-known country to Antananarivo, the capital of the Island.

As in the case of other larger mammals, the process of dividing the giraffe (*Giraffa camelopardalis*) into "sub-species" is now proceeding apace. Mr. de Winton (*P.Z.S.* 1897, p. 273) first showed, on good grounds, that the giraffe of South Africa was, in certain points of structure, different from the giraffe of the Sahara and Nubia, and proposed to call the former *Giraffa capensis*, leaving the old name *Giraffa camelopardalis* for the northern form. Since then, Mr. O. Thomas (*P.Z.S.* 1898, p. 40) has separated the giraffe of Upper Nigeria from the northern form under the title *Giraffa camelopardalis peralta.* Still more recently, Herr Matschie, of Berlin (*Sitzb. ges. Nat. Fr.* Berlin, 1898, p. 75), has added two new names to the list of giraffes, and called them after their discoverers, *G. tippelskirchi* and *G. schillingsi*, the former being from German East Africa, and the latter from British East Africa. It is curious that these two closely adjoining districts should not agree even in having the same form of giraffe!

THE *Quart. Journ. Micr. Science* for April contains an account by Monsieur P. Bouvier of the results of his examination of the specimens of the primitive Arthropods, commonly known as *Peripatus*, in the collection of the British Museum. The author, who adopts the generic divisions proposed by Mr. Pocock, names one new Andean form after the Director of the Museum, and shows that, with the exception of one from the Congo and a second from Sumatra, all the representatives of the typical genus *Peripatus* are American. To the same journal Mr. E. Warren communicates a paper on the individual differences exhibited by one of the water-fleas (*Daphnia magna*) in its power of withstanding the introduction of salt into the water in which it lives. The physiological condition of the individual is found to have a great effect on it salt-resisting powers.

IN the last issue of the *Zeitschr. Wiss. Zool.*, Dr. R. Gast relates the life-history of a rotifer of the genus *Apsilus*, specimens of which were recently found in an aquarium at Leipzig. This paper is followed by one on the development of a sponge of the group Sycones by Dr. O. Maas, which is worthy of special notice on account of the beauty of the illustrations.

MENTION has already been made in these columns of the description in the *Notes* from the Leyden Museum of the crustaceans collected during the Dutch Expedition to Central Borneo. In the March issue of the same serial this is followed by an account of the birds, which have been worked out by Dr. Büttikofer. Although expectations were entertained that many new forms would be obtained, out of 269 species collected all were previously known, and only two were new to Borneo.

THE April number of the *Journal of the Quekett Microscopical Club* contains the description, by Mr. J. G. Waller, of a new marine British sponge, obtained some twenty years ago at Torbay, for which the name *Raphiodesma affinis* is suggested. Another addition to the British fauna is a new species of Hymenoptera (*Prosopis palustris*), from Wicken Fen, Cambridgeshire, described by Mr. R. C. L. Perkins, in the *Entomologist's Monthly Magazine* for March. This discovery should strengthen naturalists in their opposition to the proposed draining of the fen in question.

MANY strange objects are worn by savage peoples, and for various reasons, also, as with us, rarity usually enhances value. In the Pelew Islands the rubbed-down first vertebra (atlas) of the dugong is worn as a bracelet by the more important men, for it is not often that the vertebra in question is large enough to be so worn. The "klilt," as it is called, has recently been fully described and figured by Dr. O. Finsch (*Globus*, lxxvii. 1900, p. 153). In the Timor Group a wooden imitation is employed; but in Timorlaut the second vertebra (axis) of the dugong is employed; but, although the dugong is greatly hunted in Torres Straits and in South-eastern New Guinea, no ornaments are made from its bones or tusks.

DR. HERMANN MEYER gives an account of a second journey to explore the head waters of the Xingu, in the *Verhandlungen* of the Berlin Gesellschaft für Erdkunde. The route taken was from Cuyaba, reached by ascending the Parana–Paraguay from Buenos Ayres, over the watershed and down the Ronuro to its junction with the main stream, and back to Cuyaba up the course of the Kulischu; practically the same as the former journey of 1896–97, except that the Ronuro was followed throughout its length instead of the Jatoba, a tributary joining it in its lower course. Dr. Meyer concludes that later expeditions will avoid the Ronuro; the Kulischu gives the best access to the region, an exploration of which as far as the Paranayuba would give valuable scientific results.

THE new number of the *Mittheilungen von Forschungsreisenden und Gelehrten aus den deutschen Schützgebieten* contains some interesting papers from the German East African region. Captain Kannenberg gives the first part of an account of a journey through the Marénga Makāli region, with a map. The pendulum expedition under Dr. Fulleborn and Lieut. Glanning reports progress. A summary of the results of the geological expedition in the region north of Lake Nyassa under Dr. Danz is given, and Lieut. Baumstark contributes a paper on the Warangi.

DR. H. NAGAOKA has contributed a valuable paper on the elastic constants of rocks and the velocity of seismic waves to the *Publications* of the Japanese Earthquake Investigation Committee (No. 4 in Foreign Languages). His experiments were made on about eighty specimens of different rocks, cut into prisms 15 cm. long and nearly 1 cm. square in section. They showed at once that Hooke's law does not hold even for very small flexure and torsion, the deviation being prominent in certain specimens of sandstone, and more marked in torsion than in flexure experiments. On releasing the rocks from stress, the return to the original state is extremely small. The elastic constants of archæan and palæozoic rocks (whether of igneous origin or otherwise) are far higher than those of cainozoic rocks, though the velocity of elastic waves in them is not higher in the same proportion. So far as the experiments go, the elastic constants increase more rapidly than the density, so that the velocity must be greater in the interior than at the surface of the earth's crust.

WE have received the Twenty-fourth Annual Report of the Geological and Natural History Survey of Minnesota for the years 1895–98; a report which is stated by Mr. N. H. Winchell, the State Geologist, to be his final one. As he remarks: "It ought not to be supposed that by the closing of active work by the present survey, and the publication of its final report, the geology of the State is a finished thing. Geology is a progressive science, and requires continual work." Other States have had surveys which have been hurried to "completion," and have naturally had to enter upon re-surveys, more careful and elaborate. Our own Geological Survey has experienced this as much as any of those abroad; where impatience to see the work "completed" and smallness of revenue have hampered and retarded real progress. The report before us contains a synopsis of the field-work done in Minnesota since 1894, and a useful alphabetical index to the entire series of annual reports of the Survey. Mr. Winchell also notes some of the more important economic and scientific researches which should be carried on in a future survey of the State.

IN the "Palæontologia Indica" for 1899. there is a description of the Cambrian fauna of the Eastern Salt-range, by Dr. K. Redlich, who has supplemented the work of Waagen with more detailed information. A new genus, *Hoeferia*, is now established for the specimens previously referred to *Olenellus*. Among other fossils described are *Hyolithes*, *Lingulella* and *Pseudotheca*. The name *Cylindrites* is applied to "long cylinders, which are often arranged in a fan-shaped aggregate," and appear to be worm-tracks; but it may be pointed out that the name was long ago applied to a genus of Gasteropods. None of the Cambrian fossils from the Salt-range can, in the author's opinion, be referred to a later horizon than the *Paradoxides*-zone. Dr. F. Noetling contributes notes on the morphology of the Pelecypoda, dealing with the hinge of some Miocene and recent bivalves. He endeavours to show that the shape and the delicate and minute variations in the shells can to some degree be expressed better by figures than by words. Dr. C. Diener describes the Anthracolithic fossils of Kashmir and Spiti. In studying the collections made by the Geological Survey of India, he came to the conclusion that fossils both of Permian and Carboniferous ages were included in the series; and he uses the term Anthracolithic as a convenient one for a Permo-Carboniferous group, which appears to be intimately connected stratigraphically and palæontologically. Among the specimens described, the presence of many European types of Carboniferous Brachiopoda is noted, and there are also affinities with the Australian Carboniferous fauna.

IN the form of "Appendix No. 2" for 1900 to the *Kew Bulletin*, we have the usual list of new species of plants brought into cultivation for the first time during last year, or re-introduced after having been lost from cultivation.

THREE of the photographs in natural colours, taken by Mr. H. J. Mackinder in his journey to the summit of Mount Kenya, are reproduced by a three-colour process in the May number of the *Geographical Journal*. Colour photography has thus been brought into the service of geographical exploration, and we may expect to see further developments of its use.

THE May number of the *Journal* of the Chemical Society, which now appears with a regularity worthy of emulation by the publications of other scientific societies, contains Sir Henry Roscoe's memorial lecture on Bunsen, accompanied by a photogravure of the lamented chemist, and Prof. Thorpe's presidential address on some characteristics of the study and progress of chemistry in Great Britain during the present century.

THE current number of *The Builder* (May 5) contains reproductions of Mr. Aston Webb's drawings of the proposed buildings to be erected in the Imperial Institute Road, South Kensington, to accommodate the physics and chemistry departments of the Royal College of Science. The original drawings are on view at the Royal Academy.

THE "Statesman's Year-book," edited by Dr. J. Scott Keltie, with the assistance of Mr. I. P. A. Renwick (Macmillan), has been accepted as a trustworthy authority upon all matters of political geography for so many years, that people familiar with its pages, and therefore conscious of the extent and accuracy of the information contained in them, regard it as one of the few essential annuals. The volume for 1900, which has just been published, is larger than any previous edition, and the numerous rearrangements of territories which were made last year have necessitated many changes in the text, several of the sections having been almost rewritten. Four specially prepared coloured maps are included, dealing with (1) the partition of North-east Africa; (2) the reorganisation of British Nigeria and the French West African territories; (3) the political partition of the Pacific; (4) the final arrangement of the boundary between British Guiana and Venezula. The "Year-book" is thus an epitome of recent geographical events as well as a manual of statistical and historical information concerning the states of the world. So long as the volume is kept so completely up to date as it is at present, it is not likely to be superseded.

IN a short note in the current number of the *Berichte*, Dr. Marckwald discusses some peculiarities shown by picric acid and its solutions, in the light of the ionic hypothesis. Picric acid, as usually obtained, has an intense yellow colour, but on recrystallising from strong hydrochloric acid it becomes nearly colourless. If this white crystalline mass is sucked nearly dry at the filter pump and washed with a little water to remove the adhering hydrochloric acid, the yellow colour at once returns. The mother liquor, which at first has only a pale yellow colour, also becomes more intensely coloured as water is added. Dr. Marckwald shows that if it be assumed that picric acid is itself colourless, but that the ions, $C_6H_2(NO_2)_3O$, are coloured, all these somewhat perplexing phenomena find an immediate explanation in terms of the theory of electrolytic dissociation.

THE confirmation of the relations deducible by thermodynamics as existing between the freezing-point and vapour pressures of a very dilute solution, although of considerable importance for the electrolytic theory of solution, presents great experimental difficulties, especially as regards the vapour pressure determinations. An ingenious method attacking this problem is described in the current *Zeitschrift für physikalische Chemie*, by Dr. R. Gahl. A measured volume of air is drawn through the solution, such as hydrochloric acid, and this is passed through pure water, the change of electrical conductivity of which is measured. The number of cases in which such a method can be applied is obviously restricted, but the accuracy attainable appears to be of the order of ·001 mm. of mercury.

THE additions to the Zoological Society's Gardens during the past week include a Grys-bok (*Raphiceros melanotis*) from South Africa, a Yellow-whiskered Lemur (*Lemur xanthomystax*) from Madagascar, presented by Mr. J. E. Matcham; a Violet-necked Lory (*Eos riciniata*) from Molluccas, presented by Mr. H. R. Filliner; two Australian Rails (*Rallus pectoralis*) from New Holland, presented by Mr. C. J. Fox; a Common Boa (*Boa constrictor*) from South America, an Egyptian Eryx (*Eryx jaculus*) from Egypt, presented by Mr. C. W. Lilley; two Eyed Lizards (*Lacerta ocellata*), European, presented respectively by Miss Robinson and Miss Ash; two Edible Frogs (*Rana esculenta*) from Biskra, presented by the Hon. Mrs. A. Cadogan; a Crowned Lemur (*Lemur coronatus*), a Black Lemur (*Lemur macaco*), two Blackish Sternotheres (*Sternothoerus nigricans*), a Radiated Tortoise (*Testudo radiata*) from Madagascar, a Slender Loris (*Loris gracilis*) from Ceylon, two Amherst's Pheasants (*Thaumalea picta*, ♂ ♀), ten Reeve's Terrapins (*Damonia reevesi*), a Three-banded Terrapin (*Cyclemmys trifasciata*) from China, a Grooved Tortoise (*Testudo calcarata*) from Khartoum, too Roofed Terrapins (*Kachuga tectum*), a Hamilton's Terrapin (*Damonia hamiltoni*) from India, a Derbian Sternothere (*Sternothoerus derbianus*), two Black Sternotheres (*Sternothoerus niger*) from West Africa, three Chequered Elaps (*Elaps lemniscatus*) from South America, a Glass Snake (*Ophiosaurus apus*), European; six Kentucky Blind Fish (*Amblyopsis speloea*) from Kentucky, deposited; a Brazilian Tapir (*Tapirus americanus*, ♂) from South America, a Cape Hunting Dog (*Lycaon pictus*, ♀) from South Africa, two Siamese Pheasants (*Euplocamus proelatus*, ♂ ♀) from Siam, two Rufous-tailed Pheasants (*Euplocamus erythropthalmus*, ♂ ♀) from Malacca, purchased; a Crowned Lemur (*Lemur coronatus*), an English Wild Cow (*Bos taurus*), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

COMET GIACOBINI (1900 *a*).—This comet has been in an unfavourable position for observation during the past few weeks, but is now rapidly leaving the sun, and may be searched for in the early morning. The following ephemeris is an abridgment from one given by Herr A. Berberich, of Berlin, in the *Astronomische Nachrichten* (Bd. 152, No. 3636):—

Ephemeris for 12h. Berlin Mean Time.

1900.	R.A. h. m. s.	Decl. ° ′
May 21	1 17 22	+24 21·8
22	16 27	24 41·4
23	15 30	25 1·2
24	14 31	25 21·4
25	13 29	25 41·8
26	12 26	26 2·6
27	11 21	26 23·6
28	10 13	26 44·9
29	9 3	27 6·5
30	7 50	27 28·4
31	1 6 34	+27 50·6

At present the comet is moving slowly in a north-westerly direction through the constellation Pisces, almost in a line between β Arietes and α Andromedæ.

COLOUR SCREENS FOR REFRACTING TELESCOPES.—The *Astronomische Nachrichten* (Bd. 152, No. 3636) contains a description of some experiments undertaken by Messrs. T. J. J. See and G. H. Peters, at the United States Naval Observatory, to determine the utility of viewing celestial objects through variously coloured screens. It was thought that if a suitable screen was chosen which would cut off the violet light of the secondary spectrum shown by the lens, that a considerable improvement of the definition might be expected, and after trial of several types of light filter, several were found which did materially improve the seeing. The screen specially recommended consists of a solution of picric acid and chloride of copper in alcohol. This is applied in a small cell made to fit as a cap outside the eyepiece of the telescope. It is thought that the method may improve meridan work by furnishing better defined star-discs, and also planetary micrometer measurements on account of the diminution of irradiation.

PHOTOMETRIC REVISION OF HARVARD PHOTOMETRY.—The Harvard Photometry, showing the brightnesses of stars north of declination −30°, and of the sixth magnitude or brighter, was compiled from observations made during the period 1879–82. In 1891, on the return of the photometer to Cambridge from Peru, it was decided to redetermine the magnitudes of these stars, and by the end of 1894 the work was almost completed. Nearly all the observations were made by Prof. E. C. Pickering, the Director of the Observatory of Harvard College, and the results of the revision now form Part i. of the last issue of the *Annals of Harvard College Observatory*, vol. xliv.

FITZ GERALD'S "HIGHEST ANDES."[1]

IN the book entitled "The Highest Andes," Mr. E. A. Fitz Gerald relates the experiences of himself and his party upon the journey which he made in 1896-97 in the neighbourhood of Aconcagua, the highest mountain at present known in South America, which it was his aim to map and to ascend. He describes in considerable detail the various operations of the expedition, and recounts with rare frankness the sensations of himself and of his assistants at low atmospheric pressures. Various other matters of considerable public interest are introduced incidentally in his volume, such as the Trans-Andine Railway and the Boundary dispute between Chili and the Argentine Republic; but the attention of the reader will be mainly engrossed by his history of the attacks upon the two great mountains Aconcagua and Tupungato, neither of which was conquered easily.

Although it is visible from Valparaiso, Aconcagua can scarcely be said to have been known at the beginning of the nineteenth century. Humboldt was certainly unacquainted with its name when he was travelling in Peru. He said many years afterwards that, at that time, Chimborazo was everywhere accounted to be the loftiest mountain in the world. But in his "Aspects of Nature," published in England in 1849, he knew differently, and referred to the Great Andes of Peru and Bolivia which were brought to light by Mr. Pentland; and to Aconcagua, which had been found by the officers of the *Adventure* and *Beagle* on Fitzroy's expedition to be between 23,000 and 24,000 feet in elevation. Since then the mountain has had its ups and downs; or, to employ the language of the geologist, it has had its periods of elevation and subsidence. It got to its lowest level about twenty-seven years ago at a meeting of the Royal Geographical Society. After the reading of a paper by Mr. R. Crawford, C.E., upon a projected railway route across the Andes, Mr. J. W. Miers, another Civil Engineer, got up and said of Aconcagua that "he believed it to be little less than 15,000 feet high. Admiral Fitzroy had described it as being higher than any of the Himalayan peaks; but he must have been mistaken in his calculations, no doubt in conseqence of the difficulty in getting a suitable base for a trigonometrical measurement. He (Mr. Miers) had often seen it void of snow, and as the snow-line in that latitude is about 15,000 feet, *it is manifest that the mountain cannot much exceed that height.*" Though Sir Clements Markham (the present President of the Royal Geographical Society) was at the meeting, it does not appear that either he or any one else entered a protest against this startling statement (see *Proc.* R. Geog. Soc., December 9, 1872, pp. 66-7). Subsequently, Aconcagua rose to a height exceeding 24,000 feet in the pages of the *Daily Chronicle* (January 18, 1897), and it has now, according to Mr. Fitz Gerald, dropped to 23,080 feet, or to almost exactly the height assigned to it by Admiral Fitzroy. This appears to be the greatest elevation that any one has hitherto reached upon a mountain.

FIG. 1.—Looking down Horcones Valley from glacier.

Mr. Fitz Gerald's Expedition sailed from Southampton on October 15, 1896; left Buenos Aires November 29; and on December 7 arrived at Punta de las Vacas (7858 feet), the terminal station in Argentina of the Trans-Andine Railway.[1] This terminus is only a little more than twenty miles to the south-east of the summit of Aconcagua. No other mountain in the world of anything like its magnitude is approached so closely by railway.[2] An abortive attempt to get to it was first of all made *via* the Vacas Valley, which runs a little west of north from the Terminus and leads to the eastern side of the mountain; and it was subsequently found that the true way towards the summit was by the Horcones Valley, the upper part of which lies to the *west* of the main peak. After some pre-

[1] "The Highest Andes: a Record of the First Ascent of Aconcagua and Tupungato in Argentina, and the Exploration of the Surrounding Valleys." By E. A. Fitz Gerald. 8vo, pp. 390. (London: Methuen and Co., 1899.)

[1] This line is intended to connect Buenos Aires and Valparaiso. Its construction has been suspended for several years, but it has been quite recently stated that progress will shortly be resumed. About 44 miles remain to be made.

[2] The railway which is being constructed towards Chamonix terminates at present at the village le Fayet, which is less than *ten* miles distant from the summit of Mont Blanc. The summit of Mont Blanc is 13,875 feet above le Fayet, and that of Aconcagua is 16,222 feet above Punta de las Vacas.

liminary exploration, a camp was established at the head of this valley, at a height of about 14,000 feet. "The lack of pasturage," it is said, "made it impossible to take the mules any farther," and thenceforward all transport had to effected by men.

Besides Mr. Fitz Gerald, the Expedition at this time consisted of Messrs. Vines, de Trafford and Gosse; Zurbriggen, the brothers Joseph and Louis Pollinger, Lanti and Weibel. Matthias Zurbriggen, who was born in Switzerland and lives in Italy, is termed guide, and the rest of the men are called porters; although the two Pollingers and Lochmatter are actually guides, and amongst the best of the younger ones of the Zermatt district. Lanti, who is also called a porter, appears to have been a miner. Mr. Lightbody, an engineer of the Trans-Andine Railway, joined the party at a later date.

On the first day (December 23), Fitz Gerald and Zurbriggen, with four porters and twelve horses or mules, started from the mouth of the Horcones Valley (8948 feet), and went to the spot at its head that has been already mentioned, which was about 14,000 feet above the sea; and, leaving the animals there, some of the party pushed on, with the view of arriving at a depression upon the ridge which leads from the summit towards the north-west; but when an altitude of 16,000 feet is supposed to have been reached, a halt was called on account of the lateness of the hour. "Being much fatigued, we decided not to pitch our tent, but simply to crawl into our sleeping-bags. No one had the energy even to make for himself a smooth place. . . . During the night, one of my Swiss porters, a tall, powerfully-built man, Lochmatter by name, fell ill. He suffered terribly from nausea and faintness." Next day they progressed upwards, but still did not reach the spot for which they were aiming, and passed the night at some elevation that is not mentioned. It was now Mr. Fitz Gerald's turn to feel the effects of diminution in atmospheric pressure.

"I had suffered acutely," he says, "during the afternoon from nausea, and from inability to catch my breath, my throat having become dry from continual breathing through my mouth. . . I was unable to sleep at all, partly because of the difficulty I had in breathing, and partly on account of the dreadful snoring of the men. They would begin breathing heavily, and continue on in an ascending scale till they almost choked. This would usually wake them up, and they were quiet for ten minutes or so, till gradually the whole performance recommenced" (pp. 55-6).

On the following day (December 25) they continued the ascent; and, although the distance that they mounted was small, the effects became more marked. Mr. Fitz Gerald says of himself and also of Zurbriggen: "We were feeling distinctly weak about the knees, and were obliged to pause every dozen steps or so to catch our breath, and frequently we sat down for about ten minutes to recover" (p. 56). On the next night they encamped on the desired spot, which is said to have been 18,700 feet above the sea. During the day, Zurbriggen advanced (according to his estimate, 2000 feet above the camp), and returned "late in the evening, completely exhausted." On the 27th Mr. Fitz Gerald and the rest retreated to 12,000 feet in the Horcones Valley, in doing which, it seems to me, they made a mistake, and sacrificed some of the advantages which had been gained by considerable labour.

FIG. 2.—Saddle on which the 18,700 ft. camp was situated.

On December 30 they re-started, reached the 18,700 feet camp at the end of the day, and left at 5.45 the next morning with the view of reaching the summit. "At that time we little knew what lay before us; the summit looked so very near that we even talked of five or six hours as a possible time in which to reach it. We set out towards our peak over the loose, crumbling rocks that covered the north-west face; the steepness was too great for a direct line of march, and we were obliged to twist and zigzag."

"I noticed Zurbriggen was going very fast; I was obliged to call to him several times, and ask him to wait for me, as I did not wish to exhaust myself by pressing the pace so early. I was surprised at his hurrying in this way, as it is generally Zurbriggen who urges me to go slowly at first. However, I soon discovered the reason for this; he was suffering bitterly from cold. Seeing that his face was very white, I asked him if he felt quite well. He answered that he felt perfectly well, but that he was so cold he had no sensation whatever left in his feet; for a few moments he tried dancing about, and kicking his feet against the rocks, to get back his circulation. I began to get alarmed, for frozen feet are one of the greatest dangers one has to contend against in Alpine climbing. The porters who had been lagging behind now came up to us; I at once told Zurbriggen to take his boots off, and we all set to work to rub his feet. To my horror I discovered that the circulation had practically stopped. We continued working hard upon him, but he said that he felt nothing. We took off his stockings, and tried rubbing first with snow and then with brandy; we were getting more and more alarmed, and were even beginning to fear that the case might be hopeless, and might even necessitate amputation. At last we observed that his face was becoming pallid, and slowly and gradually he began to feel a little pain. We hailed this sign with joy, for it meant, of course, that vitality was returning to the injured parts, and we renewed our efforts; the pain now came on more and more severely; he writhed and shrieked and begged us to stop, as he was well-nigh maddened with suffering. Knowing, however, that this treatment was the one hope for him, we continued to rub, in spite of his cries, literally holding him down, for the pain was getting so great that he could no longer control himself, and tried to fight us off. The sun now rose over the brow of the mountain, and the air became slightly warm; I gave him a strong dose of brandy, and after a great deal of trouble induced him to stand up. We slipped on his boots without lacing them, and supporting him between two of us, we began slowly to get him down the mountain side. At intervals we stopped to repeat the rubbing operation, he expostulating with us vainly the while. After about an hour and a half, we succeeded in getting him back to our tent, where he threw himself down, and begged to be allowed to go to sleep. We would not permit this, however, and taking off his boots again we continued the rubbing operations, during which he shouted in agony, cursing us volubly in some seven different languages. We then prepared some very hot soup, and made him drink it, wrapping him up warmly in all the blankets we could find and letting him sleep in the sun. In the afternoon he seemed quite right again, and was able to walk about a little" (pp. 61-2).

This episode brought that day's attempt to an end, but the next morning (January 1) they started again at 8 a.m., with temperature at 26° F., passed the place where they had turned back on December 31, and then encountered great and steep slopes of loose, rolling stones; which, so far as the mountain itself was concerned, seem to have formed the greatest difficulty on the ascent. "The first few steps we took caused us to pause and look at one another with dismay. Every step we made, we slipped back, sometimes the whole way, sometimes more. . . . We continued plodding on for some time, our breath getting shorter and shorter as we struggled and fought with the rolling stones in our desperate attempts not to lose the steps we gained. . . . There was nothing to fix our attention upon except the terrible, loose, round stones, that kept rolling, rolling as if to engulf us." Now another one became ill. "Louis Pollinger" (who is an unusually sturdy and powerful young fellow) "was turning a sickly, greenish hue. All the colour had left his lips, and he began to complain of sickness and dizziness." They went on until 2.15 p.m., and then turned back. "Zurbriggen, I think, could have gone a little farther, but even he admitted that he did not think he would be capable of reaching the summit. . . . The temperature had now dropped to 17° F., and the sun gave us no warmth to speak of. Coming down was almost worse than going up. Fatigued as we were, and chilled and numb to the bone, we constantly fell down, and it was four o'clock before we reached our encampment. . . . We were all of us suffering from splitting headaches."

Although Mr. Fitz Gerald speaks frequently of heat and cold, he does not often quote actual temperatures; but at this point he remarks that the temperature fell to 5° F. during the night, that the maximum in the sun had only been 47° F. during the previous three days, and that it had barely reached 29° F. in the shade. Though the cold which was experienced was not at all lower than might have been expected, they found it trying. "The cold at this altitude seems absolutely unendurable after sunset. I have seen the men actually sit down and cry like children, so discouraged were they by this intense cold" (p. 57); and he says, truly, at another place, that "with the barometer standing at fifteen inches, the rarefied atmosphere lowers all the vital organs to such an extent that 20° of frost feels more like 60°" below freezing-point (p. 63). There were four of them in their miserable little tent, packed so close that each time one turned over he was obliged to wake the rest." "A terrible and stunning depression had taken hold upon us all, and none of us cared even to speak. At times I felt almost as if I should go out of my mind. . . . All ambition to accomplish anything had left us, and our one desire was to get down to our lower camp, and breathe once more like human beings" (p. 67); and so down they went, this time to Puente del Inca, 8948 feet, at the mouth of the Horcones Valley, and waited there a week.

On January 9 they started again, passed that night half-way up the Horcones Valley, and on the next day went up to the 18,700 feet camp, ascending from 14,000 feet at the rate of 854 feet per hour! "We all seemed so well that I thought it better not to make an attempt on the mountain next day, but to see what a few days of rest and good food would do for us. My hope was that the system would accustom itself to the rarefied air." The minimum of that night was 1° F., which is the lowest temperature recorded in the volume. At 9 a.m. on January 12, Mr. Fitz Gerald set out once more for the summit, accompanied by Zurbriggen and Joseph Pollinger. "For my own part I knew, after the first quarter of an hour, that the attempt would be fruitless. However, I pushed along, hoping against hope that by some chance I might feel better as we went on. I had barely reached 20,000 feet, when I was obliged to throw myself on the ground, overcome by acute pains and nausea," and he returned to the tent, while Zurbriggen pushed on alone. He did not, however, reach the summit; and, when he was returning, was watched through a field-glass.

"He was apparently quite exhausted; he could only take a few steps at a time, and then seemed to stumble forward helplessly. We watched him thus slowly descend for about an hour and a half; first he sat down for four or five minutes, then he slowly plodded onward again. At last he reached a large patch of snow, where, by sliding, he was able to make better time. He did not reach the tent till after sunset, and then he was speechless with thirst and fatigue" (p. 78).

On January 13, another attempt gave a similar result; but at night preparations were made for a renewed assault on the morrow; and on the 14th, Zurbriggen, Joseph Pollinger, Lanti and Mr. Fitz Gerald started at 7 a.m., "all in excellent spirits—so far as it is possible to be cheerful at 19,000 feet." Things went well until 12.30, when they had reached an elevation which was estimated to be about 22,000 feet, and then Mr. Fitz Gerald collapsed. It is to the credit of the head of the Expedition that he writes so frankly, and one cannot but regret that his perseverance did not meet with success. This is his own description:

"I got up, and tried once more to go on, but I was only able to advance from two to three steps at a time, and then I had to stop, panting for breath, my struggles alternating with violent fits of nausea. At times I would fall down, and each time had greater difficulty in rising; black specks swam across my sight; I was like one walking in a dream, so dizzy and sick that the whole mountain seemed whirling round with me. The time went on; it was growing late, and I had now got into such a helpless condition that I was no longer able to raise myself, but had to call on Lanti to help me. . . . Lanti was in good condition, and could, I feel sure, have reached the summit. He was one of the strongest men we had with us. For a long time past he had been begging me to turn back, assuring me that our progress was so slow, that even should I keep it up I could not reach the top before sunset. I was right under the great wall of the peak, and not more than a few hundred yards from the great couloir that leads up between the two summits. I do not know the exact height of this spot, but I judge it to be about a thousand feet below the top. Here I gave up the fight and started to go down.

"I shall never forget the descent that followed. I was so weak that my legs seemed to fold up under me at every step, and I kept falling forward and cutting myself on the shattered stones that covered the sides of the mountain. I do not know how long I crawled in this miserable plight, steering for a big patch of snow that lay in a sheltered spot, but I should imagine that it was about an hour and a half. On reaching the snow I lay down, and finally rolled down a great portion of the mountain side. As I got lower my strength revived, and the nausea that I had been suffering from so acutely disappeared, leaving me with a splitting headache. Soon after five o'clock I reached our tent. My headache was now so bad that it was with great difficulty I could see at all.

"Zurbriggen arrived at the tent about an hour and a half later. He had succeeded in gaining the summit, and had planted an ice-axe there; but he was so weak and tired that he could scarcely talk, and lay almost stupefied by fatigue. Though naturally and justifiably elated by his triumph, at that moment he did not seem to care what happened to him. At night, in fact, all hope and ambition seemed to depart, after four days spent at this height, and that night we got little sleep, every one making extraordinary noises during his short snatches of unconsciousness—struggling, panting, and choking for breath, until at last obliged to wake up and moisten his throat with a drop of water" (pp. 82-3).

affected by the diminution in the atmospheric pressure which they experienced, and they were sometimes rendered almost incapable. Upon the map, Tupungato is credited with a height of 21,550 feet, but I have not been able to find in the volume the data from which this elevation has been derived. If it has no better foundation than readings of an aneroid barometer, it is probable that the height has been considerably over-estimated. The elevation assigned to Aconcagua is obtained from the railway-levels as far as the terminus at Punta de las Vacas (7858 feet), carried on by levelling and triangulation up the Horcones Valley, and may be considered authoritative. Notwithstanding its great height, the mountain bears little snow in the middle of the summer; and in this respect the observations by Mr. Miers which are quoted at the beginning of this article are supported. Mr. Fitz Gerald, indeed, says that "when Zurbriggen made the ascent of Aconcagua, he went to the summit of the mountain without placing his foot upon snow; the side of the mountain was bare to the top on the north-west slopes" (p 34). The apex of Tupungato was also bare rock. From the absence of great snow-fields and large glaciers in this elevated region, it would appear that the annual snow-fall there is inconsiderable.

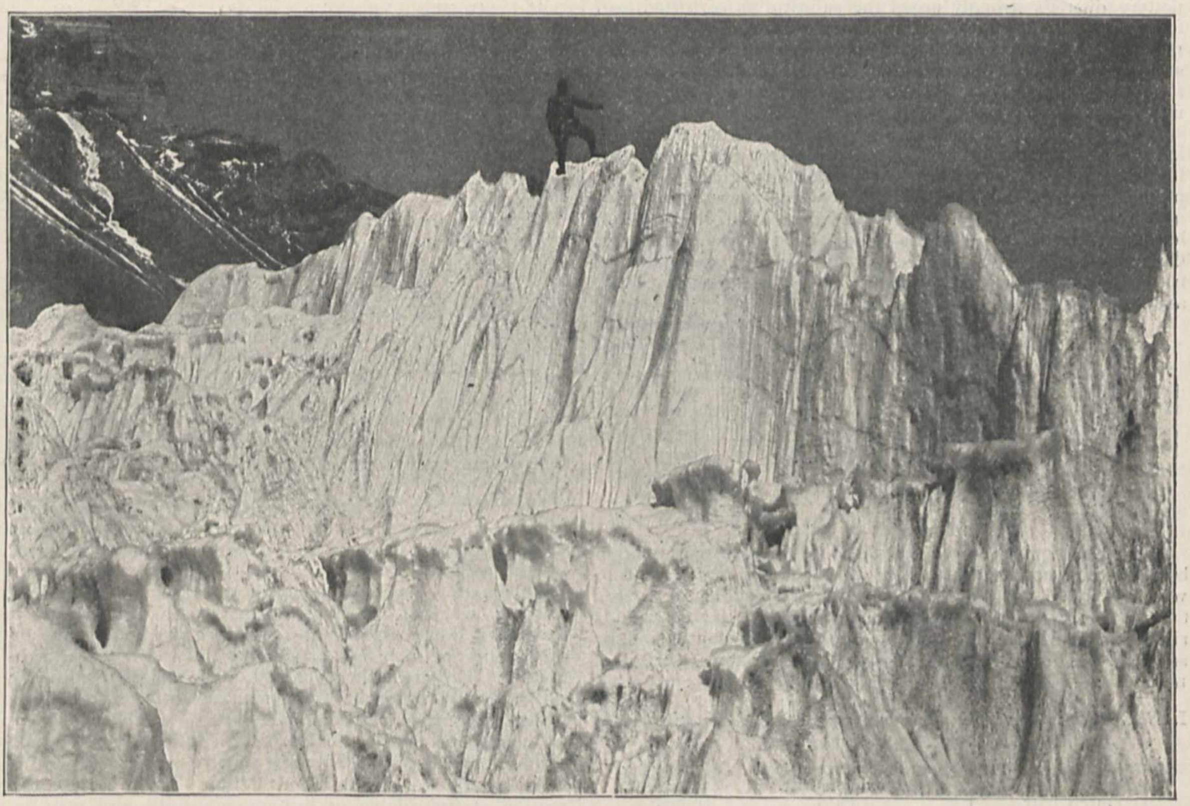

FIG. 3.—Seracs of the Horcones Glacier.

Thus, Zurbriggen alone reached the highest point in the world which has hitherto been ascended; and it is not the least curious fact in this interesting journey that he should have done so, for he was not the most nimble of the party, and in appearance and gait is not the one who might have been expected to be the most successful. That he did succeed was proved on the following 13th of February, when Mr. Vines and Lanti again ascended the mountain, and found an ice-axe on the summit and a substantial pyramid of stones which he had built. The cairn might have been erected by any one, but the axe could have been put there only by himself.

The position assigned to Aconcagua on the map which accompanies Mr. Fitz Gerald's volume is long. 69° 59′ west of Greenwich, 32° 39′ south latitude, and Tupungato is placed about 57 miles to its south. This latter mountain was ascended by Mr. Vines and Zurbriggen on April 12, 1897, but only after three attempts which ended in failure. Upon it, as on Aconcagua, all those who got to considerable elevations were strongly

Mr. Fitz Gerald's book will give abundant food for reflection to those who think that the loftiest mountains in the world can be scaled, and scaled easily. He confirms the observations of others, that the greatest heights are reached painfully and laboriously, and that there is a pretty constant diminution in pace the higher one ascends. The illustrations in the volume are reproductions of photographs, and out of the forty-five views of scenery which are given, thirty-three are by Mr. Lightbody. The appendix contains notices of the rocks, by Prof. T. G. Bonney; of the reptiles, scorpions and spiders, by Messrs. Boulenger and Pocock; and of the plants, by Mr. Burkill. The collections seem meagre, and nothing except a few rock specimens appears to have been brought from the greatest heights.

EDWARD WHYMPER.

POTTERY AND PLUMBISM.

DR. T. E. THORPE, F.R.S., gave a lecture on Friday evening, May 4, at the Royal Institution, on the results of an experimental inquiry which he has made, at the instance of the Home Office, on the hygienic questions involved in the use of lead compounds in the manufacture of pottery.

After explaining how lead poisoning occurs in connection with pottery manufacture, he described the conditions which a perfect glaze must fulfil, and named the various forms in which lead compounds enter into the composition of the glazing material as ordinarily employed. He pointed out that experience amply demonstrated, both in this country and on the Continent, that "raw" lead is more generally mischievous in its action than "fritted" lead, that is, lead in the form of a complex silicate associated with alumina, lime, &c. This depends on the more ready solubility of the various modifications of raw lead in the animal secretions, and more particularly in the gastric juice. This fact, indeed, is now generally recognised, and in the inquiry which was instituted by the Home Office in 1893, manufacturers whose names deservedly carry authority in the pottery districts strongly urged the substitution of fritted lead for raw lead in all glazes. Unfortunately, however, this recommendation was not enforced. This may have been due, partly at least, to the circumstance that cases of plumbism occurred from time to time in works where fritted lead was exclusively used. The fact is there is fritted lead and fritted lead.

Dr. Thorpe then proceeded to explain the results of a recent inquiry into the conditions which determine the ease with which lead may be dissolved out from a fritt by dilute acids such as are present in gastric juice. In the first place, it was found that, speaking generally, English fritts yielded a far larger amount of lead to solvents than those made in Holland, Belgium, Germany or Sweden. Indeed, some English specimens of fritted lead were found to be hardly less soluble than raw lead, as shown by the following numbers:—

	Lead oxide dissolved, expressed as percentage of total lead oxide present.
Lead silicate, Specimen I.	99·6
" " " II.	99·6
Glaze A, made with lead silicate	99·2
" B, " " "	99·2
Various forms of "raw" lead: Litharge	100·0
Various forms of "raw" lead: Red lead	100·0
Various forms of "raw" lead: White lead	100·0

Next, the inquiry showed that there was no necessary relation between the amount of lead oxide in a fritt and the extent to which it would yield lead to solvents comparable, as regards their action, with animal secretions. Some of the compounds richest in lead were, in fact, among those least attacked by solvents. This is illustrated by the following series of numbers:—

I. *Solubilities practically the same, amounts of lead oxide in the fritt very different.*

	Percentage of lead oxide in fritt.	Solubility per cent. on fritt.
Dutch fritt	18·0	traces
English fritt, A	40·4	0·2
Belgian fritt	22·4	0·7
English fritt, B	41·3	0·7
" " C	52·3	·0·4

II. *Solubilities very different, amounts of lead oxide in fritt practically the same.*

English fritt, D	37·9	28·0
" " E	36·2	1·4
" " F	45·8	10·8
Swedish fritt	44·1	2·1

Further inquiry elicited the fact that the extent to which the fritt gave up lead to the solvent depended upon two conditions:—

(1) The existence of a definite numerical relation between the basic and acidic oxides in the fritt, and

(2) Complete chemical union.

The definite numerical relation thus alluded to may be stated in the following terms:—If the sum of the equivalent percentages of basic oxides, expressed as lead oxide, is not more than double the sum of the equivalent percentages of acidic oxides, expressed as silica, the solubility of the fritt, as regards lead, is rarely more than 2 per cent. Any increase in this ratio is attended by an increase in the amount of lead dissolved, and the amount of soluble lead increases very rapidly with even a slight increase in the ratio. The following figures serve to illustrate this fact:—

	Percentage of lead oxide.	Solubility per cent. on fritt.	Ratio.
Dutch fritt, No. 1	18·0	traces	1·34
Belgian fritt, No. 1	21·8	"	1·44
Dutch fritt, No. 2	19·0	1·2	1·50
Belgian fritt, No. 2	22·4	0·7	1·52
Swedish fritt	44·1	2·1	1·56
English fritt	24·0	0·2	1·57
" "	40·4	0·2	1·68
" "	24·5	0·6	1·70
" "	36·2	1·4	1·79
" "	36·4	2·3	1·87
" "	45·8	10·8	2·61
" "	37·9	28·0	2·92
" "	70·4	67·3	3·26

It was further found that, provided the ratio of acids to bases is below 2, the nature of the basic oxides has little or no effect upon the amount of the lead oxide dissolved. This may be illustrated by the following numbers:—

	Lead oxide.	Alumina.	Lime.	Alkalis.	Solubility per cent. on fritt.
Dutch fritt	19·0	8·1	9·0	4·9	1·2
English fritt	16·2	10·3	8·5	9·2	1·7
Swedish fritt	44·1	5·5	0·9	3·4	2·1

Further evidence of the fact that the insolubility of a complex silicate is determined by the ratio of acids to bases, and is independent of the specific nature of the bases, is afforded by the case of flint glass, which consists essentially of a silicate of alkali united with a silicate of lead. Separately, these silicates are readily attacked by dilute acids. When united, as in flint glass, the compound is only very sparingly soluble. Merely to flux together the ingredients of a fritt, with no regard to its composition as a definite chemical compound, and with no regard to the time or temperature needed to complete the chemical changes, is not the proper way to make a fritt.

In the course of the inquiry it was found that the Continental fritts, which conformed to the above ratio, and were distinguished by their comparative solubility, were very difficult to break up by the action of acids, and yielded only minute portions of soluble matter (much of which, however, consisted of lead) to solvents, whereas the English fritts were, for the most part, very easily decomposed by the same treatment, and gave up the greater part of their lead to solution. This led to the surmise that the Continental fritts consisted, in the main, of comparatively stable chemical compounds, the minute quantity of lead dissolved being due to some lead compound—oxide or silicate—in a state of incomplete chemical union. Experiment showed that this surmise was correct. By treating a fritt, compounded so as to be within the limiting ratio, with dilute acid, by far the greater portion of the soluble or incompletely fixed lead may be removed, and a highly insoluble complex lead silicate is obtained. A fritt, for example, containing upwards of 53 per cent. of oxide of lead, and of which the limiting ratio of acids and bases was about 2, had this ratio lowered to 1·8 and the solubility diminished from 2 per cent. to four-tenths of a per cent., the amount of lead oxide in the product so treated being upwards of 52 per cent.

A number of manufacturers and professional fritt makers, acting in conformity with the suggestions which have been put forward, and in response to the invitation of the Home Secretary to have their glazes tested in the Government Laboratory, are now producing lead fritts having a solubility which is even below the standard provisionally suggested in the Home Office Circular of December last.

Although measures based upon the above facts will no doubt largely minimise the evil of lead poisoning, Dr. Thorpe stated that he was not sufficiently sanguine to suppose that they would altogether stamp out plumbism in the Potteries. It must be clearly understood that complete immunity from lead poisoning can never be obtained so long as lead compounds continue to be used. The true solution is to be found in the more general adoption of leadless glazes. That leadless glazes of a high brilliancy, covering power and durability, and adapted to all kinds of table, domestic and sanitary ware, to china furniture, to tiles, insulators and electric fittings of the most varied kind, are perfectly practicable, was illustrated by reference to the numerous examples of leadless glazed ware which, thanks to the liberality of a number of the manufacturers, were exhibited to the audience. Among them were specimens from Mintons, from the Worcester Royal Porcelain Company, Burgess and Leigh, Barker and Read, Bernard Moore, the Crystal Glaze Company, Hawley Brothers, Defries, and others. Telegraph insulators of Doulton's and Buller's make were exhibited by the Post Office.

Dr. Thorpe stated that leadless glazed ware was now being supplied to a number of the Government Departments and to certain of the London Clubs. He further stated that the London School Board had resolved to insert a clause in all specifications for new works strictly prohibiting the use of any pottery goods involving lead glaze wherever practicable.

The fact that the application of leadless glazes has passed beyond the experimental stage is so obvious that the Secretary of State now proposes to relax the Special Rules, issued by the Factory Department, in regard to the pottery industry in the case of factories or processes in which no compounds of lead are used.

Dr. Thorpe concluded by remarking that every intelligent potter must concede that there is an ample field for investigation by modern methods of attack into problems connected even with the first principles of his art. The craft of the potter largely depends upon the intelligent application of scientific principles. Whether, however, modern science enters into it to the extent that might be desired is perhaps open to question.

There is probably no industry in the world, certainly none in England, so conservative in its operations as that of the potter. The best of English earthenware still enjoys, no doubt, the pre-eminence which the skill and aptitude of Wedgwood and his immediate followers imparted to it. The great potter was fully abreast of the physical science of his day, and was quick to test or take advantage of any discovery which seemed to promise to be of service to his art. But perhaps it may be doubted whether the spirit of Wedgwood actuates his successors to the extent that might be desired. It is at least certain that the exercise of this spirit, that is, the intelligent application of simple chemical principles, would years ago have obviated, to a large extent at least, this evil of plumbism among the pottery workers.

APPLICATIONS OF ELECTRICAL SCIENCE.[1]

I FEEL very much honoured by having been placed in the position I now occupy, and by having to deliver this opening address to the Dublin Branch of the Institution of Electrical Engineers. I believe that we are one of the first branches that has developed into the meeting stage of our existence, and may congratulate ourselves on having passed through our larval transformations safely and rapidly, and on our having been the first to emerge into an imago.

The action of the parent Institution in founding these local branches is worthy of our grateful commendation. We are left perfectly free to develop our own life untrammelled by any rules except such as we would ourselves have necessarily chosen to govern our actions. We have the great advantage of being a branch of a most distinguished Institution of world-wide reputation, and that without paying any extra subscription. I hope that we will add to the life and work of that Institution, and thereby promote both our own interests and the welfare of mankind. Papers and discussions here will be taken as delivered to the Institution of Electrical Engineers, and, if of sufficient merit, will be published in its *Proceedings*, thus securing to us a world-wide publication, while at the same time ensuring that Ireland is credited with the work done.

The history of electricity in the nineteenth century is far too large a subject for an occasion like the present one, but certain aspects of this history convey valuable lessons for the future and may well engage our attention in this last year of the century, and may help us to lay the foundations for further advance in the next. The aspect of the history of electricity during the nineteenth century to which I desire to direct your attention is an object-lesson of how to apply science to further the well-being of mankind. The history of any applied science might be considered in this aspect, but the history of applied electricity is particularly appropriate for being thus considered, for several reasons. The history is condensed within a few years; the discoveries of science have followed one another with extraordinary rapidity, and within a few years after the discoveries were made they have been applied to the use of man. It is just a hundred years since Volta discovered how to make continuous electric currents. Within a few years of that discovery their chemical actions were discovered and electric lights produced, both arc and incandescent. Twenty years afterwards the magnetic effect of an electric current was discovered by Œrsted, its mathematical theory evolved by Ampère, and the law of its intensity worked out by Ohm. Some fifteen years afterwards, Faraday discovered how to produce electric currents by magnetism. Immediately after the discovery of the principle of the conservation of energy it was applied to electro-magnetism, and the foundation of our whole system of electro-magnetic measurement was laid. Faraday's belief in the correlation of electricity and light, following lines suggested by Lord Kelvin, was forged into a consistent theory by Clerk Maxwell, and this theory confirmed experimentally by Hertz. Such, in brief, is the scientific history of electro-magnetism during the expiring century, and on this science practically all the applications of electricity depend.

I may pause for an instant to consider where this theory now lands us. The all-pervading ether has been realised as the means of transmitting light, electricity and magnetism, and we are looking forward to its properties explaining chemical actions and gravitation. We are still looking for a theory of its structure which will give a dynamical explanation of its properties. We know how to express these properties by quantities we call electric and magnetic force, whose laws we know, but whose laws we are, as yet, unable to explain by any structure working on dynamical principles. So far as we know, the properties of electric and magnetic force are explicable upon dynamical principles; so far there is no known necessity for seeking for adynamical properties in the ether; so far we may hope to explain electro-magnetism upon the dynamical principles of Newton's laws without invoking any other principles than those of force and inertia, as expounded in these laws. Until, however, a satisfactory theory of the nature of the ether has been actually invented, there will remain some doubt as to the adequacy of these fundamental dynamical laws to explain all its properties. The direction in which it is most probable that an explanation will be found is in the hypothesis that the ether is of the nature of a perfect liquid full of the most energetic motion. We know that a gas consists of separate molecules in intensely energetic irregular motion. I expect that the ether is a perfect liquid in intensely energetic irregular motion: much more rapid than that of any gas: with a rapidity of internal motion comparable with the speed of light: maybe with enough energy in each cubic centimetre to keep hundreds of horse-power going for a year, if only we could get at it. So far as this hypothesis has been worked at there seems nothing impossible about it, but, on the contrary, much possibility in it, and, to my mind, its inherent simplicity confers on it a great probability.

Be that as it may, we now know that in the electric lighting of our cities, in electric tramways and railways, in electric furnaces and electrolytic vats, and in the other innumerable applications of electricity, we are harnessing the all-pervading ether to the chariot of human progress, and using the thunderbolt of Jove to advance the material welfare of mankind.

Having thus shortly considered the progress of electrical science, the history of the *applications* of electricity may be thus summarised. Shortly after Œrsted discovered the magnetic effect of an electric current this discovery was applied to telegraphy, and Faraday's discovery of how to generate electric currents by magnetism was almost immediately applied to the same use. Telegraphy developed rapidly, and many subsequent discoveries were due to the observations made in the practical application of electricity to telegraphy. This has been developing ever since, accumulating knowledge and applying the accumulations to produce more knowledge and more applications, till all this has resulted in the perfection of the multiplex telegraph and the wonders of the telephone and wireless telegraphy. No other department of applied electricity has had such a continuous development, hardly any interval elapsing between discovery and application in its case, while in almost

[1] Inaugural address to the Dublin Section of the Institution of Electrical Engineers, delivered by Prof. G. F. Fitzgerald, F.R.S. Abridged from the *Journal* of the Institution, April.

every other case years have elapsed between discoveries and their application. It is especially the object of this address to call attention to the cause of this and to the lessons to be learnt from it.

Within the first decade of the century, electrolysis and the electric light were discovered; but, except on a small scale in electro-plating, it was reserved for the last quarter of the century to see their application to the general use of mankind. Before her Majesty began to reign, Faraday had discovered how to generate electric currents by magnetic actions; but, except to generate currents to light a couple of lighthouses, no applications of Faraday's discovery to generate electric currents on a large scale was made till Wilde, Gramme and Siemens worked at it, more than thirty years after its discovery. The application of electric currents to transmit power on a small scale was made in the electric telegraph years before any applications were made on a large scale. Except for a few experiments by Jacobi and others, the transmission of power by electric currents on a large scale is the work of the last twenty—one might almost say of the last ten—years.

Consider now what are the characteristics of the applications which developed continuously, and what were those of the applications which lay dormant for years. Maybe we can learn from this consideration how to arrange that, in the future, our discoveries may not lie for years dormant.

The most noticeable difference between the applications of electricity that developed and those that lay dormant is that those that developed were useful on a small scale, while those that lay dormant were not useful until developed on a large scale. Electro-plating and telegraphy were useful on quite a small scale. Experiments as to their efficiency could be conducted on the laboratory scale with quite cheap apparatus, and thus they were actually developed.

A recognised authority, who is fond of poking paradoxical fun at professors, has recently stated that "the progress of telegraphy and telephony owes nothing to the abstract scientific man." I do not know exactly what he means by the abstract scientific man, but I do know that telegraphy owes a great deal to Euclid and other pure geometers, to the Greek and Arabian mathematicians who invented our scale of numeration and algebra, to Galileo and Newton who founded dynamics, to Newton and Leibnitz who invented the calculus, to Volta who discovered the galvanic cell, to Œrsted who discovered the magnetic action of currents, to Ampère who found out the laws of their action, to Ohm who discovered the law of the resistance of wires, to Wheatstone, to Faraday, to Lord Kelvin, to Clerk Maxwell, to Hertz. Without the discoveries, inventions and theories of these abstract scientific men, telegraphy as it now is would be impossible.

We have seen that electro-plating and telegraphy were capable of development on a small scale, and were consequently largely developed by laboratory research. The development of dynamos from Faraday's discovery required expensive experiments, and to test their efficiency on a large scale required very expensive experiments indeed. It was not possible to conduct experiments that would be of much practical use on the small scale on which laboratory experiments have to be conducted, on account of the miserable pittance that is at the command of scientific laboratories. The only opportunity of conducting experiments on a large scale is when an inventor can control capital, as, for example, if he himself is in the position of an engineer to some wealthy body whose money he can employ on experiments. Jacobi and others spent a good deal of money, no doubt, on experiments in power distribution by electro-magnetic engines, but their expenditure, though quite considerable as compared with the usual run of laboratory experiments, was as nothing compared with the enormous sums spent by the pioneers of modern electromagnetic machinery on *their* experiments.

What we have found, then, is that development depended on whether or no people experimented energetically upon how to render each discovery of practical utility; where experimenting was energetic, development was rapid; where experimenting was not energetic, development was slow. We have further found that the energy of experimenting depended on the money available; where little money was required, development was rapid; but it was slow where large sums of money were required in order to perform valuable experiments.

We may further inquire how it happened that money and time became available for costly experiments. Money is available for laboratory experiments by the beneficence of private and public endowment, and time is available by the devotion of scientific men to the advancement of natural knowledge. These have been available because some few men have had faith in the desirability of knowledge both for its own sake and for the material and moral advantage of mankind. Money has been available in England on a large scale in the past because of the enthusiastic faith of some very few men in the possibilities of scientific discoveries. One of the most remarkable instances of this faith was in the case of the great experiment of laying the Atlantic cable. A few men with strong faith impressed their belief on a few capitalists, and after years of most expensive experimental work they at last brought their great undertaking to a successful issue; the general body of capitalists meanwhile looking on with amused incredulity. The development of the dynamo depended similarly upon the strong faith of individuals, who spent immense sums of money and much time and energy on the subject because they had faith in its possibilities. It is remarkable how many of the developments of scientific discoveries of the latter years of the century have been due to foreigners or firms with foreign leaders, such as Siemens Brothers. This has been largely due to the fact that foreigners are far in advance of us over here in their faith in the possibility of using scientific discoveries. The rapid advance of the applications of science in the last quarter of this century has been very largely due to the growth of this faith. It has grown to a strong conviction in the ordinary public of America and the Continent, and is growing daily stronger over here, but is still far weaker here than in other parts of the civilised world. The result of this has been that while the germs of many of the greatest inventions have been made within the British Isles, we have not been pioneers in any great advance in the applications of electricity since the development of submarine telegraphy. Possibly another cause has been our obstinate retention of our abominable series—one cannot call it system—of weights and measures. It is with great hopefulness that I see public opinion gradually growing in favour of the metric system.

How does it happen that one of the foremost countries in advancing science has been one of the last to appreciate the possibilities of applied science? This has been due partly, no doubt, to our great success as manufacturers and as mere mechanical inventors. No doubt Watt was a truly scientific inventor, and even mere mechanical inventors are appliers of scientific knowledge that was discovered, in the most part, by scientific men centuries ago; but most of our success as manufacturers has been due to mechanical inventions and to our well-trained and expert artisans, and not to the useful application of recent scientific discoveries. This great success, and the absence of scientific training in our schools, and the want of contact between manufacturing and scientific society, have all contributed to prevent a due appreciation of the value of scientific discovery and experiment as a means of advancing the material wealth of society.

When can we expect the country or generous benefactors to learn that science on a large scale is at the basis of the material prosperity of the country, and that science on a large scale is very expensive. Of what use is 200*l*. a year in making experiments on a commercial scale? Ten thousand pounds a year would be more like the figure required; and 10,000*l*. a year could be most profitably spent on experimental work here in Ireland, on the one subject of utilising our bogs. It is most probable that the energy of their combustion could be transmitted to our towns to provide them with light and power; but the preliminary experiments are far beyond the capabilities of a scientific laboratory.

Then there are the questions of three-wire tramways, leaky telegraph lines, submarine relays, sun engines, of flying machines which Lord Rayleigh considers can be constructed if money enough were forthcoming, and of vacuum tubes as a means of illumination, and of numberless other matters already ripe for application, to say nothing of the innumerable scientific discoveries that have not yet been even suggested as having practical applications.

Besides these industrial laboratories, all our Government departments, such as the army and navy, should have large experimental organisations where any invention that promised success would be developed and seriously tried. The decision of what to try should not be left to mere officials, however distinguished, but should be referred to independent scientific advisers—persons who were not trammelled by official traditions, but were in touch with scientific advance and enthusiastic believers in it. If the country spent a couple of millions per annum on experimental work of this kind it would bear much fruit, and we should not find ourselves out-shot by semi-barbarous farmers.

Hope is the great incentive to exertion. Without it a nation is dead. Without it we lose all belief in the possibility of improvement, and improvement at once becomes impossible. The history of electrical engineering, the utilisation of the all-pervading ether for the service of man, should strenghen our hope and our belief in the possibility of improvement. For has it not revolutionised society and enabled high and low, rich and poor, to lead better lives, by making life less hard and grimy, and thus improved the well-being of man both materially and, what is far more important, morally as well?

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Oxford.—The following are the principal lectures announced for this term:—Prof. Clifton, practical physics: Mr. Baynes, elementary electricity and magnetism; Mr. Jervis-Smith, dynamo and motor machinery, with electrical testing; Prof. Odling, silicon compounds; Dr. Fisher, metals and organic chemistry; Mr. Watts, organic chemistry; Mr. Marsh, practice of organic chemistry; Mr. Hartridge, aromatic compounds; Mr. Vernon Harcourt, subjects of the preliminary examination; Mr. Elford, the elements treated in the periodic order; Mendeleef's periodic system, Groups vii. and viii.; great chemists and their work; Mr. Walden, synthetical methods in organic chemistry; Mr. Wilderman, equilibrium and velocity of physical and chemical reactions in heterogeneous systems; Prof. Miers, the new theories of crystal structure; Mr. Bowman, the crystallography of optically active substances; Prof. Sollas, history of the earth; Mr. Mackinder, the natural regions of the Old World; Mr. Dickson, the climatic regions of the globe; Mr. Herbertson, mountain types; Prof. Weldon, general course of morphology; variation, inheritance, and natural selection; Mr. Goodrich, annelids; Mr. Jenkinson, vertebrate embryology; Mr. Günther, arthropoda; Mr. Barclay Thompson, mammalian morphology; mammalian palæontology; Prof. Gotch, the central nervous system; Prof. Gotch and Mr. Ramsden, advanced course of physiology; Mr. Mann, advanced histology of nervous system; Mr. Burch, physiological physics; Mr. Mann, practical histology; Prof. Vines, elementary course of botany; Prof. Tylor, early stages of civilisation (arts of subsistence and protection); Sir J. Burdon Sanderson, general pathology; Dr. Ritchie, pathological bacteriology; Dr. Collier, medical diagnosis; Mr. Symonds, fractures and dislocations; Prof. Thomson, vascular and respiratory systems; Mr. Smith Jerome, medical pharmacology and materia medica; Prof. Esson, the synthetic geometry of conics; Prof. Love, hydrostatics and hydronamics; Prof. Elliot, the theory of functions.

Mr. William Hatchett Jackson, science tutor of Keble College, who has been elected to the post of Radcliffe's librarian, vacant by the resignation of Sir Henry Acland, has entered on his duties. The new Radcliffe Library, erected for the University by the Drapers' Company, is meanwhile approaching completion.

Scholarships in natural science are announced by the following colleges:—Merton and New, July 3; Balliol, Christ Church and Trinity, December 4; Magdalen, December 11.

It has been decided that diplomas in geography shall be granted by the University; the details of the scheme have yet to come before Congregation and Convocation.

Cambridge.—Honorary degrees are to be conferred on the Hon. Edmund Barton, delegate from New South Wales in connection with the Australian Commonwealth Bill, and on H.M. the King of Sweden and Norway.

There are vacancies at the University Tables in the Zoological Stations of Naples and Plymouth. Applicants should write to Prof. Newton before May 24.

It is proposed to affiliate the University of Tasmania. Bachelors of Arts and Bachelors of Science of that University will thereby be entitled to proceed to Cambridge degrees after two years' residence.

The Financial Board estimate that, owing to the loss of fees, &c., consequent on the absence of many members of the University in South Africa, the income of the Chest will next year fall short of the necessary expenditure by 650*l*.

Seventeen additional freshmen were matriculated on May 5.

Mr. Thomas Andrews, F.R.S., has presented to the Chemical Laboratory a valuable echelon spectroscope, for which the special thanks of the University have been ordered.

Dr. Tunnicliffe has been appointed to the chair of materia medica and pharmacology in King's College, London.

Dr. John Wyllie has been elected to succeed the late Sir Thomas Grainger Stewart in the chair of medicine in the University of Edinburgh.

In order to enable Essex dairy-farmers, and ladies engaged in dairy-work, to gain an insight into the organisation and practice of the agricultural industries of Denmark, the Essex Technical Institution Committee have made arrangements for a party to visit that country. Visits will be made to a number of schools and other institutions, farms, and manufactories concerned with dairying, and a valuable insight will be obtained into Danish methods. Full particulars of the programme can be obtained from Mr. T. S. Dymond, County Technical Laboratories, Chelmsford.

The growth of municipal technical schools in England during the ten years which followed the passing of the Technical Institution Act, 1889, formed the subject of an inquiry made by the National Association for the Promotion of Technical and Secondary Education a short time ago. The results showed that a capital sum of 2,340,651*l* had been spent on technical schools, and that there were 239 such schools (including agricultural and dairy schools and domestic science schools) in existence or in course of establishment. Since the conclusion of the inquiry, technical schools had been erected, or it had been decided to erect them, in several other towns, and the latest report shows that the total amount incurred for 272 schools under municipal and public bodies is now at least 2,643,172*l*.

The progress of science and education in the United States is largely due to the interest taken in the work of colleges and universities by private benefactors. Scarcely a week passes without affording instances of generous gifts to institutions of this kind, by persons who desire to promote the development of national character and industries. As an example of this public spirit, we have the case of Dr. D. K. Pearson, of Chicago, who, on attaining his eightieth birthday recently, decided to add 525,000 dollars to the 2,000,000 dollars he had previously given to colleges. Then we have the announcement in *Science* that Mr. Andrew Carnegie has promised the trustees of the Carnegie Institute, Pittsburg, Pa., to become responsible for 3,000,000 dollars, the amount estimated as necessary for the proposed extension and enlargement of the building at the entrance of Schenley Park. The new building will be nearly six times as large as the present one. We should be glad to be able to record many similar gifts to institutions devoted to science and education in this country.

One of the good effects of the technical education movement during the past ten years is that many secondary schools, such as grammar and endowed schools, which formerly excluded science from their curricula, have had to adapt themselves to modern requirements as a condition of receiving assistance from technical education authorities. The annual report of the National Association for the promotion of Technical and Secondary Education refers to an inquiry undertaken to determine the extent of the changes which have been brought about in this way, both by the establishment of new secondary schools and by the adaptation of existing secondary schools for the purposes of technical education. The facts revealed by the inquiry go to show that in England alone, since 1889, 81 new public secondary schools have been established, while 215 existing schools have been extended mainly for the purposes of science teaching. As regards the schools in the latter category, the extensions to 195 of them have resulted in the addition of 251 physical and chemical laboratories, 77 workshops for manual training, 76 lecture-rooms, and 50 class-rooms. The total sum of money involved by these developments is 764,449*l*. By their capital grants to secondary schools, County Councils have exerted a direct influence in the reorganisation, and have secured a voice in the management and control of the schools. By the Councils' annual maintenance grants, the work of reorganisation has been gradually consolidated, and the permanence of proper management and control has become assured. It is not surprising, therefore, that the latter, as a continuous source of income to secondary schools, have been increasing in number and in value during recent years.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 1.—"Researches on Modern Explosives: Second Communication." By W. Macnab, F.I.C., and E. Ristori, Assoc. M.Inst.C.E., F.R.A.S. Communicated by Prof. Ramsay, F.R.S.

The object of the experiments was to endeavour to find a means of determining more accurately than has hitherto been done the temperature reached when an explosive is fired in a closed vessel.

A modification of the method developed by Sir W. C. Roberts-Austen was employed. A thin platinum wire was melted by the heat of the explosion, but a thick wire was unaltered. This showed that the temperature reached was above the melting point of platinum, and also that the duration of the maximum temperature was very short. From this it was argued that if rhodium-platinum couples of different diameters, sufficiently thick not to be melted during explosion, were used in a bomb, the deflections of the galvanometer indicated would vary inversely with the sizes of the wires forming the couples; that in this way data might be obtained from which might be calculated the deflection of an infinitely thin couple, which could be capable of taking up the heat in an infinitely short time, and that this deflection expressed in degrees would represent the actual temperature reached.

Couples formed of wires of pure platinum and platinum alloyed with 10 per cent. of rhodium, varying in diameter from 0·01 to 0·044 of an inch, were employed. Each couple was successively fixed inside the bomb, and on firing the explosive the deflection of a spot of light reflected from the mirror galvanometer was photographically recorded.

These records show the uniformity of the results, and also the time occupied in heating each couple to its maximum, and that the deflections are in inverse order to the thickness of the couple used.

Two series of experiments made with two different explosives—ballistite (composed of 30 per cent. nitroglycerine and 70 per cent. gun-cotton) and gelatinised gun-cotton—were carried out with a number of different couples, and the results expressed as curves show the gradual rise of the deflections as the thickness of the couple diminishes; but all through the gun-cotton curve is below the ballistite curve, thus indicating that the temperature reached during explosion of the gun-cotton is lower than that of the ballistite.

Experiments made with the following explosives showed that the relative temperature can be easily ascertained. Gun-cotton gave the lowest temperature, and in order came cordite, ballistite (composed of 70 per cent. soluble nitro-cotton and 30 per cent. nitroglycerine) and ballistite (composed of 50 per cent. soluble nitro-cotton and 50 per cent. nitroglycerine).

Another series of experiments is in progress for determining the other necessary elements which will be required before the value of these deflections of the galvanometer can be accurately expressed in degrees of temperature.

April 5.—"Über Reihen auf der Convergenzgrenze." Von Emanuel Lasker, Dr. philos. Communicated by Major MacMahon, F.R.S.

Linnean Society, April 19.—Dr. A. Günther, F.R.S., President, in the chair.—On behalf of the Hon. Charles Ellis, the President exhibited photographs of a large tree, *Taxodium distichum*, growing at Oaxaca in Mexico, and of another gigantic tree, a native of Cambodia. The circumference of the former, at a height of 3 feet from the ground, was stated to be 143 feet, while the height was estimated to be not more than 100 feet. The native name for this tree is *Sabino*. Mr. Daydon Jackson read an account of it, quoting from Loudon's *Mag. Nat. Hist.* vol. iv. (1831), p. 30, and Humboldt's "Views of Nature," p. 274. The second gigantic tree, which could not be satisfactorily determined from the photograph, had been observed growing on the Makong River, near the celebrated ruins of the great city of Angkorwat in Cambodia.—Messrs. W. B. Hemsley and H. H. W. Pearson read a paper on some collections of high-level plants from Tibet and the Andes. Mr. Hemsley first gave a brief history of the botanical exploration of Tibet, followed by an account of the unpublished collections presented to Kew by Captain Wellby and Lieut. Malcolm, by Captain Deasy and Mr. Arnold Pike, and by Dr. Sven Hedin. These collections were all made at great altitudes in Central and Northern Tibet; few of them below 15,000 feet, and some of them at 19,000 feet and upwards. The highest point at which flowering plants had been found was 19,200 feet above the level of the sea. The plants recorded by Deasy and Pike at altitudes of 19,000 feet and upwards are:—*Corydalis Hendersoni*, *Arenaria Stracheyi*, *Saxifraga parva*, *Sedum Stracheyi*, *Saussurea bracteata*, *Gentiana tenella*, *G. aquatica*, an unnamed species of *Astragalus*, and an unnamed species of *Oxytropis*. These are the greatest altitudes on record for flowering plants. Deep-rooting perennial herbs having a rosette of leaves close to the ground, with the flowers closely nestled in the centre, are characteristic of these altitudes. The predominating natural orders are:—Compositæ, Leguminosæ, Cruciferæ, Ranunculaceæ and Gramineæ. The Compositæ largely predominate, and the genus *Saussurea* is represented by numerous species. Specimens of about a dozen species were shown to illustrate the great diversity exhibited by this genus in foliage and inflorescence. Liliaceæ and the allied orders were very sparingly represented. Two or three species of onion occur; one of them, *Allium Semenovii*, in great abundance up to 17,000 feet. None of the collections contained any species of orchid.—Mr. H. H. W. Pearson described the Andine flora, with special reference to Sir Martin Conway's small collection of plants brought from Illimani in the Bolivian Andes in 1898. In consequence of the labours of d'Orbigny, Pentland, Meyen, Weddell, Mandon and other botanists, the high-level flora of the mountains of Bolivia is better known than that of any other equally elevated region of the Andes. Weddell's collections form the nucleus of the materials from which the "Chloris Andina"—the classic work on the flora of the High Andes—was prepared. Many collectors have obtained plants in various parts of the Andes at elevations stated to be greater than 17,000 feet. Colonel Hall states that he saw four plants on Chimborazo in 1831 at "nearly 18,000 feet." These were two species of *Draba*, one of which was *D. aretoides*, H. B. K., and two Composites, one being a *Culcitium*. Mr. Whymper and others have thrown some doubt upon the determination of this elevation, and it is probable that it was over-estimated. Out of forty-six species of flowering plants obtained by Sir Martin Conway, seven are from 18,000 feet or above it, two being as high as 18,700 feet. These, the highest Andine plants on record, are *Malvastrum flabellatum*, Wedd., and *Deyeuxia glacialis*, Wedd. Thirty-nine species in this collection were found above 14,000 feet; these belong to thirty-four genera and twenty-one natural orders; fifteen (*i.e.* about three-eighths of the collection) are Compositæ. Of the thirty-four genera, one only—*Blumenbachia*—is endemic to South America. The species, with one exception, are confined to the Andes, eight or nine of them not being found outside Bolivia. In the collection made by Mr. Fitzgerald's expedition in the Aconcagua valleys between 8000 and 14,000 feet, ten genera (*i.e.* one quarter of the whole) are endemic in South America. The contrast between this and the small endemic element in the Conway collection from above 14,000 feet gives additional support to the generalisation that the flora of high levels is more cosmopolitan than that of low levels.—A paper was read by Mr. E. S. Salmon on some mosses from China and Japan.

MANCHESTER.

Literary and Philosophical Society, April 24.—Prof. Horace Lamb, F.R.S., President, in the chair.—The following gentlemen were elected honorary members of the Society:—Prof. James Dewar, F.R.S., London; Prof. J. A. Ewing, F.R.S., Cambridge; Prof. A. R. Forsyth, F.R.S., Cambridge; Prof. James Geikie, F.R.S., Edinburgh; Prof. Ernst H. P. A. Haeckel, Jena; Prof. H. A. Lorentz, Leyden; Mr. Robert Ridgeway, Washington, U.S.A.; and Mr. Beauchamp Tower, London. The following were elected officers of the Society for the session 1900–1:—President, Prof. Horace Lamb, F.R.S.; vice-presidents, Prof. O. Reynolds, F.R.S.; Mr. Charles Bailey; Prof. W. Boyd Dawkins, F.R.S., and Mr. J. Cosmo Melvill; hon. secretaries, Mr. Francis Jones and Prof. A. W. Flux; treasurer, Mr. J. J. Ashworth; hon. librarian, Mr. W. E. Hoyle.

PARIS.

Academy of Sciences, April 30.—M. Maurice Lévy in the chair.—On the telescopic planets, by M. C. de Freycinet. The ideas of Laplace upon the distribution of the telescopic planets in concentric spherical layers round the sun are developed analytically and confirmed. If the asteroids are divided into three groups according to their inclination, the mean distance of the planets of these groups from the sun is sensibly constant. —On the transparency of aluminium for the radium radiation, by M. Henri Becquerel. A study of the penetration of thin aluminium sheet by the radium rays, the latter being placed in a strong magnetic field and the effects of the deviable and non-deviable rays being studied separately.—Study of manganous fluoride, by MM. Henri Moissan and Venturi. Pure anhydrous manganous fluoride, MnF_2, was obtained in four ways: by the action of a solution of hydrofluoric acid upon metallic manganese, by the interaction of gaseous hydrogen fluoride and the metal, by heating manganese fluosilicate in a current of HF at 1000°, and by dissolving manganese carbonate in the acid. The crystallised MnF_2 could not be prepared from aqueous solution, on account of the sparing solubility of the salt in water, but is readily obtainable by fusing a mixture of the salt with manganese chloride.—Agricultural maps of the Canton of Redon. The composition of the soil from the point of view of lime, magnesia, potash and nitrogen, by M. G. Lechartier. An account of the work carried out at the agricultural station of Rennes.—On the vertical trunks, stems and roots of *Cordaites*, by M. Grand'Eury. The view is put forward that *Cordaites*, like *Sigillaria* and other fossil plants dealt with in previous papers, actually grew in the place where they are found, many ligneous trees commonly regarded as growing only on dry land flourishing well with their lower portions constantly submerged in water.—Prof. Suess was nominated a Foreign Associate in the place of the late Sir Edward Frankland.—On a relation between the theory of continuous groups and the differential equations with fixed critical points, by M. Paul Painlevé.—On the function S introduced by M. Appell into the equations of dynamics, by M. A. de Saint Germain.—An improved and simplified solar microscope, by M. A. Deschamps.—The telemicroscope, by M. A. Deschamps.—On an experiment of M. Jaumann, by M. P. Villard. In an experiment described by M. Jaumann, a charged glass rod was brought near a tube immersed in oil, in which kathode rays were being developed, the bundle being repulsed. As these results were not in agreement with the usual hypotheses concerning the kathode, an attempt was made to repeat the experiments, but no deviation of the rays in the opposite direction to that predicted by the theory could be obtained.—On the radium radiation, by M. P. Villard. The rays not deviable in a magnetic field have much greater penetrative power than the deviable rays. The ordinary X-rays from a Crookes' tube behave similarly.—Luminescence of rarefied gases round a metallic wire communicating with one of the poles of an induction coil, by M. J. Borgman.—On the hysteresis and viscosity of dielectrics, by M. F. Beaulard. From the results of the experiments given, the author concludes that dielectrics do not present the phenomenon of hysteresis, but are only endowed with viscosity.—On samarium, by M. Eug. Demarçay. The properties of the samarium isolated by the method of double magnesium nitrates previously described are so well defined that it would appear to be a simple substance analogous to other elements and not a mixture. The pale yellow colour of the oxide is apparently not due to any impurity. The atomic weight, as determined by the sulphate method, is about 147·5.—On the combination of sulphur dioxide with metallic iodides, by M. E. Péchard. Potassium iodide, either in solution or in the solid state, rapidly absorbs sulphur dioxide, the compound $KI.SO_2$ being formed. This compound is easily dissociated into its constituents, its dissociation pressure at 0° being 60 cm. of mercury, at 30°, 238 cm. Other iodides form similar compounds.—On the gases emitted by the Mont Dore springs, by MM. F. Parmentier and A. Hurion. The gas is carbon dioxide containing 0·49 per cent. of nitrogen and ·01 per cent. of argon. —Bromination with aluminium bromide, by M. Ch. Pouret. Organic chlorinated compounds, heated to their boiling points for some time with aluminium bromide, give good yields of the corresponding bromine derivatives. The preparation of bromoform, methylene bromide, methyl bromide, ethyl bromide, pentabromethane, ethylene, ethylidene and acetylene bromides is described in detail.—The action of monochloracetic esters upon the sodium derivative of acetylacetone, by M. F. March. The compounds $(CH_3.CO)_2.CH.CH_2.CO.OC_2H_5$ and $(CH_3.CO)_2.CH.CH_2.CO.OCH_3$ are described; and also the products of the reaction between these bodies and phenylhydrazine.—Action of ethylidene chloride upon phenols in presence of potash, by MM. R. Fosse and J. Ettlinger.—On the presence of tyrosine in the water of contaminated wells, by M. H. Causse. The water from contaminated wells at Lyons gave an orange coloration with the chloromercurate of sodium paradiazobenzenesulphonate which proved not to be due to cystine. Tyrosine was then extracted and identified by analysis.—On some changes which occur in plants grown in the dark, by M. G. André. A set of comparative analyses of maize and lupin plants grown in sunlight and in the dark.—Studies in development of *Petromyzon Planeri*, by M. E. Bataillon.—Modifications in structure observed in cells undergoing a true fermentation, by MM. L. Matruchot and M. Molliard. The fermentation of the fruit of *Cucurbita maxima* was carried out under conditions excluding the possibility of intervention of any foreign organisms. Every cell in a state of true fermentation shows a very clear nucleus, a small amount of chromatine arranged on the periphery of the nucleus, a protoplasm full of vacuoles, and numerous minute drops of essential oil formed in the protoplasm.—Botanical zones in French Western Africa, by M. A. Chevalier.—On the granites and syenites of Madagascar, by M. A. Lacroix.—On the Gothlandian of the Peninsula of Crozon (Finisterre), by M. F. Kerforne.—Influence of temperature on the fatigue of the motor nerves of the frog, by M. J. Carvallo. Temperature has a considerable influence upon the activity of motor nerves, the excitability increasing up to 20° C.—The functions of the crystalline tube of the Acephala, by M. Henri Coupin. The function of this tube appears to be digestive, a storehouse of diastases.—Topography of the mouth as regards sensitiveness of taste, by MM. Ed. Toulouse and N. Vaschide.

AMSTERDAM.

Royal Academy of Sciences, March 31.—Prof. H. G. van de Sande Bakhuyzen in the chair.—On orthogonal comitants, by Prof. Jan de Vries.—On indigo fermentation, by Prof. Beyerinck. Indigo fermentation is the decomposition of the glucoside indican into indoxyl and glucose by the action of a cell. This is effected in two ways: first, by katabolism, *i.e.* by the direct action of the living protoplasm on the indican; secondly, by specific enzymes. All the indican splitting bacteria examined act by katabolism, and are quite inactive when dead. The indican plants and some kinds of yeast contain indigo enzymes, and so are still active when dead. The indigo enzymes of *Indigo leptostachya*, *Polygonum tinctorium*, *Phajus grandiflorus*, *Saccharomyces sphaericus*, and the emulsion of sweet almonds, which also acts feebly on indican, proved to be quite different enzymes with optima of activity at 61°, 42°, 53°, 44° and 55° C. respectively. The action of all of them is increased by acid to the amount of 0·5 c.c. normal per 100 c.c. of indican solution; more acid as well as alkali decrease their activity. In indigofera there is no katabolism, whilst in *Polygonum* there is a slight katabolism at low, in *Phajus* a very strong katabolism at high, temperatures. Hence the last two decompose indican in both ways at once, while indigofera does so by enzyme action only. In the leaves of *Phajus* indican is localised in the protoplasm both of the cells of the epidermis and of the mesophyll; the indigo enzyme occurs in the chlorophyll granules.—Prof. Hoogewerff presented on behalf of Mr. J. Hazewinkel, manager of the "experimenting station" for indigo at Klaten (Java), a paper, entitled "Indican, its splitting up, and the enzyme which brings this about." This paper contains the results of inquiries, made in 1898, which for technical reasons were not intended for publication. Beyerinck's publication makes further withholding useless. Mr. Hazewinkel observed that when all enzyme actions are excluded, an aqueous solution might be obtained from leaves of *Indigofera leptostachya*, which solution by the action of enzymes and subsequent oxidation yielded indigo. The glucoside-indican found in this solution appeared to be a fairly stable substance (also at boiling heat and when acted upon by alkalis), provided it was not exposed to the action of enzymes (indimulsin, emulsin) and of acids. Mr. Hazewinkel proved in various ways, among others by the formation of indizubine (with isatin), that the indigo-forming splitting-product of indican is indoxyl, and inquired into various circumstances influencing the detection of indoxyl in those solutions and the formation of indigo from indoxyl, and also observed that during the so-called fermentation of indigo leaves, no indican, but indoxyl is present in the fermentation fluid.—Prof. Hoogewerff also made a communication on behalf of Mr. H. ter Meulen and himself, entitled "A Contribution to the Knowledge of Indican." Basing their inquiries upon the above-mentioned inquiries by Mr. Hazewinkel and those made by Prof. Beyerinck, Prof. Hoogewerff and Mr. ter Meulen prepared pure indican from leaves of *Polygonum tinctorium*, cultivated by Prof. Beyerinck, and from indican solutions received from Mr. Hazewinkel. Indican crystallises out of an aqueous solution with 3 mol. H_2O, probably in rhombic crystals, melting at 51° and decomposing, when heated, to a higher temperature with the formation of violet vapours; it tastes bitter and is optically active, exerting a left-handed rotation. Over sulphuric acid *in vacuo* it loses its water of crystallisation; its melting point is then 100°–102°. It dissolves pretty readily in water, methyl alcohol, ethyl alcohol and acetone, and very slowly in benzole, carbon disulphide, ether or chloroform. It is represented by the formula $C_{14}H_{17}NO_6$, corresponding to the formula proposed by Marchlewski. The result obtained was 56·7 per cent. C, 5·8 per cent. H, 4·7 per cent. N; the molecular weight was determined cryoscopically. On decomposition with HCl and oxidation with air, indican yielded indirubinous indigotine. No difference was observed between indican out of *Indigofera* leaves and that obtained from *Polygonum* leaves. Further investigations were promised.—The following papers were also presented for publication in the *Proceedings*: On a special case of Monge's differential equation, by Prof. W. Kapteyn.—On the locus of the centres of hyperspherical curvature for the normal curves of *n*-dimensional hyperspace, by Prof. Schoute.—On the power of resistance of the red-blood corpuscles, by Mr. Hamburger.—(1) On behalf of Mr. J. D. van der Waals, junr., a paper on equations, containing functions for different values of the independent constant; (2) on behalf of Dr. J. Verschaffelt, a paper on the critical isotherm and the densities of saturated vapour and liquid in the case of isopentane and carbonic acid, by Prof. van der Waals.—On the 14-monthly period of the motion of the earth's pole, with determinations of the azimuth of the meridional signs of the Leyden Observatory in the years 1882–1896, by Prof. H. G. van de Sande Bakhuyzen, on behalf of Mr. J. Weeder.—Prof. Hoffman presented for publication in the *Transactions* a paper, entitled "Zur Entwicklungsgeschichte der Sympathicus."

DIARY OF SOCIETIES.

THURSDAY, MAY 10.

ROYAL SOCIETY, at 4.30.—On the Diffusion of Gold in Solid Lead at the Ordinary Temperature: Sir W. Roberts-Austen, F.R.S.—On Certain Properties of the Alloys of Gold and Copper: Sir W. Roberts-Austen, F.R.S., and Dr. T. K. Rose.—Experiments on the Value of Organic Sensation as Contributory to Emotion: Prof. Sherrington, F.R.S.—On the Brightness of the Corona of April 16, 1893. Preliminary Note: Prof. Turner, F.R.S.—The Radio-Activity of Uranium: Sir W. Crookes, F.R.S.

ROYAL INSTITUTION, at 3.—A Century of Chemistry in the Royal Institution: Prof. J. Dewar, F.R.S.

MATHEMATICAL SOCIETY, at 5.30.—Special Meeting.—The Differential Equation whose solution is the Ratio of Two Solutions of a Linear Differential Equation: M. W. J. Fry.—A Congruence Theorem relating to Eulerian Numbers and other Coefficients: Dr. Glaisher, F.R.S.—Linear Substitutions Commutative with a given Substitution: Dr. L. E. Dickson.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—A Frictionless Motor Meter: S. Evershed.

IRON AND STEEL INSTITUTE, at 10.30.—Ingots for Gun Tubes and Propeller Shafts: F. J. R. Carrulla.—The Manufacture and Application of Water-Gas: Carl Dellwik.—The Equalisation of the Temperature of Hot Blast: Lawrence Gjers and Joseph H. Harrison.—The Manganese Ores of Brazil: H. Kilburn Scott.—The Utilisation of Blast-furnace Slag: Ritter Cecil von Schwarz (Liége).

FRIDAY, MAY 11.

ROYAL ASTRONOMICAL SOCIETY, at 8.—On the Alleged Rotation of the Spiral Nebula M 51 Canum Venat: H. H. Turner.—Observations of Minor Planets at Windsor, New South Wales: John Tebbutt.—The Duration of the Greater Sun-spot Disturbances for the Years 1881 to 1899: Rev. A. L. Cortie.—Note on Measures by Prof. Barnard of Two Standard Points on the Moon's Surface: S. A. Saunder.—Micrometrical Measures of Double Stars: W. Coleman.—Diagrams for Planning Photographic Observations of Eros: A. R. Hinks.

PHYSICAL SOCIETY, at 5.—Discussion of Prof Lodge's Paper on the Controversy concerning Volta's Contact Force.—The Heat of Formation of Alloys: Mr. J. B. Tayler.—On the Want of Uniformity in the Action of Copper-Zinc Alloys on Nitric Acid: Dr. Gladstone, F.R.S.—An Electromagnetic Experiment, and Experiments illustrating the Aberration called Coma: Prof. S. P. Thompson, F.R.S.

MALACOLOGICAL SOCIETY, at 8.—On a New Species of *Despoena*, Newton (*Proserpina*, Gray): with Notes on some Allied Forms: E. R. Sykes.—On some New Mollusca from the Philippines: G. B. Sowerby.—On some Lamellibranch Remains occurring in a Sandstone from the Malay Peninsula: R. Bullen Newton.

SATURDAY, MAY 12.

ROYAL INSTITUTION, at 3.—South Africa: Past and Future: Dr. Alfred P. Hillier.

MONDAY, MAY 14.

SOCIETY OF ARTS, at 8.—The Incandescent Gas Mantle and its Use: Prof. Vivian B. Lewes.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Nature and Man in British New Guinea: Prof. A. Haddon, F.R.S.

TUESDAY, MAY 15.

ROYAL INSTITUTION, at 3.—Brain Tissue considered as the Apparatus of Thought: Dr. Alex Hill.

ANTHROPOLOGICAL INSTITUTE, at 8.30.

ROYAL STATISTICAL SOCIETY, at 5.—Municipal Finance and Municipal Enterprise: Sir H. H. Fowler.

WEDNESDAY, MAY 16.

SOCIETY OF ARTS, at 8.—A National Repository for Science and Art: Prof. Flinders Petrie.

ROYAL METEOROLOGICAL SOCIETY, at 4.30.—The Wiltshire Whirlwind of October 1, 1899: the late G. J. Symons, F.R.S.—The Variations of the Climate of the Geological and Historical Past and their Causes: Dr Nils Ekholm.

ROYAL MICROSCOPICAL SOCIETY, at 7.30.—Exhibition of Microscopic Pond Life.——At 8.—On the Lag in Microscopic Vision: E. M. Nelson.

THURSDAY, MAY 17.

ROYAL SOCIETY, at 4.30.

ROYAL INSTITUTION, at 3.—A Century of Chemistry at the Royal Institution: Prof. J. Dewar, F.R.S.

ZOOLOGICAL SOCIETY, at 4.30.—The Freshwater Fishes of Africa: G. A. Boulenger, F.R.S.

SOCIETY OF ARTS (Indian Section), at 4.30.—The Industrial Development of India: J. A. Baines.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Alternating Current Induction Motors: A. C. Eborall.

CHEMICAL SOCIETY, at 8.—Chlorine Derivatives of Pyridine. VI. The Orientation of some Aminochloropyridines: W. J. Sell and F. W. Dootson.

FRIDAY, MAY 18.

ROYAL INSTITUTION, at 9.—The Structure of Metals: Prof. J. A. Ewing, F.R.S.

EPIDEMIOLOGICAL SOCIETY, at 8.30.

SATURDAY, MAY 19.

ROYAL INSTITUTION, at 3.—South Africa: Past and Future: Dr. Alfred Hillier.

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