THURSDAY, JUNE 9, 1881

THE STEPHENSON CENTENARY

GEORGE STEPHENSON was born June 9, 1781. The importance of this event to us who now inhabit civilised countries is certain; for whatever view we may take as to the inevitability of railways, it is matter of history that for twenty-five years—1815 to 1830—after Stephenson had to all intents perfected the system of railway and locomotive, which still holds its own, no other engineer or competent mechanic went even so far as to admit its merit. It is therefore to George Stephenson that we are indebted for our existing railways, for the immense extension of mechanical contrivance which has followed in their train, and for all that these have done for us in the way of improving the circumstances of life.

As the custom of centennial celebrations has become almost universal, it would partake of irreverence to allow the hundredth anniversary of the birth of one who has given us so much to pass unnoticed. But in what form can we celebrate such an event? No oratory can remind us of Stephenson's name when we continually hear the puffing of his engine. What monument can compare with the cuttings and embankments seen whichever way we turn? In truth Stephenson's works are ever before the eyes and sounding in the ears of all people. We have no political or social purpose to serve by a national ceremony. Killingworth or Newcastle will have its dinner and, as we understand, the intention is that some money should be subscribed for an educational foundation. This is all very well, but it is confined to a few who take a special interest in the place, and is no measure of that universal offering to the memory of our hero which goes up, not once in a hundred years, but hourly.

To the readers of NATURE who are not only of the travelling public, but to whom doubtless the works of Mr. Smiles are familiar, anything we can say as to the life and work of Stephenson must seem totally inadequate. But not to let the occasion pass we will endeavour, by reference to some of the features of Stephenson's work, to illustrate a thought which has recurred to us with ever-increasing force when considering the works of those who have pioneered the way in practical mechanics. This thought may be expressed somewhat as follows:—That if we are to accept the proved ability to predict results with certainty as conclusive evidence of a knowledge of the laws and principles on which these results depend, then it is evident that acute observation of mechanical and physical phenomena does lead to a very clear insight into the laws and principles involved, although the observer may be—generally has been—altogether unable, save by the prediction of results, to give definite shape to his abstract ideas, and much more to give them articulate expression. And further, that this apprehension of principles, acquired by the observation of the dependent phenomena, is the only real apprehension, and is a very different thing from that knowledge or conviction of the truth of principles which comes from reading or argument, and which, however useful for purposes of criticism, rarely if ever leads to a prediction.

In the instance of Stephenson we have a perfect example. He received absolutely no education except by his own observation of the animals and other works of nature in the vicinity of his dwelling, and the rude mechanism of the surrounding collieries. Such too were the exigencies of his existence, that although he was assiduous in the task of self-instruction, as in all other things, in 1815, at the age of thirty-four years, and at the very time when he was making his first engines, "Blucher" and "Puffing Billy," the first of a race destined to overrun the earth and create the greatest of all revolutions, though he could read and write he had not as yet mastered the rule-of-three. Yet in the construction of these very engines he showed his confidence in results, the prediction of which shows that he had acquired an insight into principles which were entirely unexpressed at that time, and as regards some of which their expression is still incomplete.

Amongst the mechanism of the railway, almost every detail of which was conceived by Stephenson, there are certain details or features which, with a view to rescue them from being altogether claimed for other inventors, the friends of Stephenson have ever marked as bearing more distinctly the impression of Stephenson's hand. These are the smooth driving-wheel, the chimney blast, and the multitubular boiler. This is as it should be.

But, as it seems to us, in thus bringing into prominence the special features of Stephenson's system, Stephenson's friends have effectually diverted attention from that which is of far more importance. Thus, although it has never been claimed for Stephenson that he was the first to use smooth driving-wheels, Trevithick and Hedley having been obviously before him, it is contended that Stephenson consistently from the first maintained the sufficiency of the adhesion, while the others invented "imaginary difficulties" which led them to contrive all sorts of means of preventing the wheels of their locomotives from slipping. This view of the matter is however essentially wrong, and is unfair to both sides, for on the one hand, while there is no evidence to show that Trevithick or Blenkinsop ever ignored the tractive power of smooth wheels, neither is there any evidence to show that Stephenson ever maintained that the adhesion of smooth wheels would suffice to accomplish that for which the rack was being used. Had he done so he would have been wrong. But, on the contrary, there is ample evidence to show that Stephenson clearly perceived—that at the very onset he determined by careful experiment—the limit of the adhesion of his smooth wheels, and that he never attempted to use them except on a level road. The question at issue is much broader and more important than that of mere mechanical contrivance. It was as to how far the locomotive should be set to the task of the horse in drawing its load over the hills and valleys, and how far the hills should be cut down and the valleys filled up.

This, the level road, the very form of the railway, was Stephenson's main idea. And it was his foresight and determination in respect of this that made his railways a success from the first. His experience and observation had led him to perceive what all subsequent experience has confirmed, that the locomotive, in virtue of its size and clumsiness, could only be usefully employed on a nearly level railway. He did not actually maintain that

it would be impossible to make a machine that would travel on common roads and even mount hills, but "even suppose that such a machine could be constructed to carry twenty or thirty passengers at ten miles an hour, put it on a level railway and it would carry 200 or 300 passengers at thirty or forty miles an hour."

In his first colliery railways at Killingworth and Hetton he laid the lines in a series of flat reaches separated by inclines, and working the inclines by fixed engines, confined the functions of the locomotive to drawing the waggons along the flat reaches. It was this insistence on the level road that enabled him to use smooth wheels, and not that he had discovered any adhesion previously unknown or that others had overlooked.

Stephenson's position was a nearly level line at any price on which the adhesion of the wheels is sufficient as against a road following the slope of the country, for which, according to his view, by whatever means the adhesion might be increased, the iron horse was ill adapted. In the clear conception of the importance of this level road, coupled with his determinate insistence in carrying out his view, no matter what the difficulty—the veritable removal of mountains—have we not the best of all proof that, however unconsciously, he was guided by a perception of that law which connects the limits in size and activity of structures, with the strength of the material of which they are composed. And by which law we may now perceive that it is only by smoothing the road and so reducing the call for strength and power that we have made our machines to exceed in size and speed the limits which Nature had reached in her animals.

Into another law, called the Conservation of Energy, there can be no doubt that Stephenson had an insight far beyond his time. He saw that the conveyance of a load was not a question of force, but of the product of force into the distance traversed, and that however great might be the tractive power of his engine, its speed must depend on the ratio of the rate at which steam could be generated to the load. So long therefore as the tractive power was so large as—compared with the steam-generating power of his boiler—to prevent his engine, when fully loaded, travelling at more than ten miles an hour, he could gain nothing by increased adhesion. But, on the other hand, in his first engine the desideratum was increased steam-generating power for the same weight of boiler.

With, as Robert Stephenson has told us, the direct object of accomplishing this, George Stephenson turned the exhaust steam in the form of a jet or blast up the chimney of his second locomotive, "Puffing Billy." If this is so, and there appears no evidence to the contrary, it was a prediction with regard to the motion of fluids, for the making of which there is as yet no established law in the theory of hydrodynamics. That the result is such as was here predicted, or that a jet of steam or of air playing at high velocity along the interior of an open-ended tube does impart motion to the air within the tube and causes a current, is of course now well known, but our present knowledge is derived from the experience of the locomotive chimney. There is no evidence that it was known to any one before 1815, nor indeed has there been found any other mechanical purpose of general importance in which the same action could be usefully employed. Neither in the stationary engine nor yet in the marine engine has it proved economical. Thus the locomotive and its offspring, the portable engine, were the only machines possessing this organ.

Although it has been the custom for writers on the steam-engine to speak as though the manner of action of the blast were self-evident, this only shows that these authors have not understood it—indeed how should they? The general law on which the action of the blast depends is that a jet of fluid issuing into surrounding fluid at rest will not, when it has more than a certain velocity, proceed in a straight vein or column, but begins at once to wriggle, and as it advances involves itself in an extremely complex manner with the surrounding fluid, with which it shares its forward momentum. It is only during the last few years that the generality of this action and the circumstances on which it depends have attracted attention, and the completeness with which the action has been overlooked is shown by the numerous attempts that have been made to invent fanciful explanations of the following phenomenon. When a jet of steam, say half an inch in diameter, issues from a high-pressure boiler, as from a gauge cock, although the steam itself must have the temperature of boiling water, still the hand may be held in the jet at a distance of two or three inches from the cock without any inconvenience. How has the temperature of the steam become lowered? is the question for the answering of which numerous hypotheses have up to quite recently been invented. The answer is that the temperature of the steam does not become lowered, any more than the strength of the mustard in a sandwich, but that the steam has involved within its column layers of cool air, sandwich fashion, and as the combination rapidly passes the same point of the skin, the sensation produced is that of the mean temperature of the air and steam.

It is on this action of a jet to mix itself up with the surrounding medium that the draught produced by the blast up the chimney depends, and Stephenson's confident prediction of this draught is the best evidence that observation had led him to a perception of the more general action.

Considering the capacity of the man as shown by his other work, it would have been a matter for surprise had not Stephenson acquired a unique knowledge of the phenomena of fluid motion. He had the best opportunity for observation—his whole time had been spent in the care of pumps, pumping-engines, and the arrangements for ventilating and draining mines. His habit was to bring all his ideas at once to the test of experiment; and in devising his safety-lamp he had carried out a very careful series of experiments on the behaviour of jets and the rate of their admixture with the surrounding air.

Although, as shown by the employment of the multitubular boiler, Stephenson's mechanical insight does not perhaps stand out in so very clear a light, inasmuch as he made this step at the suggestion of Mr. Booth, still it cannot have been fortuitous that in adopting these small tubes he should have at once introduced all those conditions on which their employment is alone successful.

That small tubes of the same aggregate capacity as a single flue afford greater cooling surface for the hot gases is indeed obvious, but it was Stephenson's own observation that taught him that such increase was desirable,

while the fact that the gases in passing through the small tubes would encounter much greater resistance than in the single flue rendered the successful employment of the multitubular boiler dependent on the increased action he could give to the blast. However in all respects he came out right in the very first trial.

In the "Rocket" he had a self-moving machine, which resembled the moving animal not only in the fact that they both derived their power of motion from the combustion of carbon, but the physiology of the machine resembled that of the animal system in that essential particular which connects the action of the heart and lungs with that of the muscles, so that any demand upon the activity of the latter is at once met by increased activity in the former. In the locomotive the law of adjustment is perfect. Whatever the load within the limit imposed by the adhesion of the wheels, and whatever the speed, the stimulating action on the fire is sufficient, and no more than sufficient, while in all cases the tubes are sufficiently long, and no more, to pass the heat generated into the boiler.

The functions of the locomotive engine more nearly correspond with the functions of moving animals than do the functions of any other machine, and hence it was essential that there should be a correspondence between the organisation of the locomotive and that of working animals, which correspondence may be dispensed with in other engines. Is it not probable, we ask, that he who produced the locomotive physiologically complete had been guided, however unconsciously, by the truth of his observation of those animals which his machine was to set free from their task? OSBORNE REYNOLDS

THE HISTORY OF SALT

The History of Salt. By Evan Marlett Boddy. (London: Baillière, Tindall, and Cox, 1881.)

THIS book is quite a literary curiosity: the author hopes, and not without reason, that it will be found to afford amusement. Mr. Boddy we take to be a medical student, and it is a kindness to him to suppose that he is young. After reading the first half-dozen pages of his work the idea gradually dawned upon us that he intended it for an elaborate joke, very much after the manner, we should suppose, of Mr. Benjamin Allen and Mr. Robert Sawyer, had those gentlemen been tempted to follow the paths of literature. But, *adhibenda est in jocando moderatio*, and never more so than when the joke is at the expense of a venerable parent. In dedicating his work to his father Mr. Boddy, for the credit of human nature, must be acquitted of the charge of a conscious joke, otherwise such an instance of filial disrespect would be without parallel.

This astonishing production owes its origin to a letter advising total abstention from salt, which had appeared in a temperance journal, and the author felt himself constrained, for the good of humanity, to deliver himself of the succession of "*farcical puerilities*" and "*whimsical crudities*" which make up the "*imaginative plerophory*" "*redundant of inane folly and trivial hyperbole*" of his book. The words in italics are Mr. Boddy's; he of course applies them to the opinions of other people. With the sanction of Vespasian's law, that it is unlawful to give ill language first, but civil and lawful to return it, we think ourselves justified in applying them to Mr. Boddy's book. And how richly that book merits them we proceed to make abundantly clear, and on the author's own showing.

Mr. Boddy is too hard upon the unfortunate letter-writer in the journal of temperance: he is not even grateful to him as the remote cause of the existence of his own book. The letter-writer, "with amusing self-complacency, accused it [salt, not temperance] of producing evils of an astounding nature—such is the latitude of pragmatical ignorance and silly egotism. The palpable absurdity of such an argument must be apparent even to the most careless thinker: it is with the view of exposing such a fallacy, both injurious and irrational, that I have written this treatise." One is tempted to ask—If the argument is so palpably absurd, even to the most careless thinker, why in the world has Mr. Boddy taken the trouble to write his treatise?

It does not seem to be generally known what would happen to a world devoid of salt; such, according to Mr. Boddy, is the "dense obtenebration with which the subject is surrounded." The picture of a saltless world, as drawn by our author, is something awful to contemplate. Nothing but the thought of "our ignorant conceits," our "unaccountable obliquity of judgment," and "the apathetic indifference" with which we have hitherto looked upon the humble condiment which has graced our tables "in the smallest receptacles, as if it were the most expensive article," and to which we, "in the most finical, grotesque manner," help ourselves "in almost infinitesimal quantities, as if it were a mark of good breeding and delicacy," would compel us to reveal the "imaginative plerophory." The nervous reader will be pleased to fortify himself with at least a teaspoonful of the condiment before he begins its perusal.

"Were the human race once deprived of the chloride of sodium, even for a limited period of time, we should not only lose a natural healthful incentive for our food, but disease, with all her attendant miseries, would spread with such relentless impetuosity as would defy, and even paralyse, the efforts of the most skilful physician, the ingenuity of the surgeon, and the scientific improvements and hygienic precautions of the sanatarian. The strength and vigour of manhood would fade as if blasted by disease, food would act as a poison, the blood would not be replenished with the salt which it requires, and consequently our skins would soon be covered with corruption, our cattle would die, our crops would be nipped in the bud, the air would be full of offensive insects, the soil would become foul and barren, the sea a waste of stagnant waters, and all the beautiful productions of nature would wither and decay, and our glorious earth would degenerate into a hideous solitude, solely inhabited, very probably, by monsters horrible to behold, more repulsive than those gigantic reptiles which once roamed by the dreary marshes of an incomplete world."

And yet, according to Mr. Boddy, "the English working classes are nearly, if not altogether, unacquainted with the benefit of salt": "at the tables of the wealthy it is perfectly absurd to see the small amount which is used." We are not even allowed the poor consolation of knowing that in our false economy we are unwittingly conserving our choicest blessing. "We do not diet ourselves as we should: in this respect we are far behind the veriest

savage, cannibal though he be." We cannot inure ourselves to salt at too early an age; we ought indeed to pickle our babies: "To rub new-born infants with salt" is a practice "in every respect cleanly" and "strictly conducive to health."

Mr. Boddy has evidently spent much pains on his history: but, as he confesses, in trying to begin at the beginning he has laboured under many difficulties. He has traced the history of salt from the time of Moses and Job by the aid of such written records as he has been able to meet with, but on the question of its history before their time he is obliged to fall back on his inner consciousness.

"The origin of salt is one of those enigmas of nature which as yet has completely frustrated the most accomplished and scientific geologists, and no suggestion has yet been made which will satisfactorily and conclusively account for its formation; for whatever hypothesis has been stated there is sure to be an objection so difficult to overcome that the author has been fain to admit that it is thoroughly impracticable, and therefore inadmissible."

Even our author is fain to express himself guardedly on this point—

"If we take salt as a whole, leaving out of the question altogether the different conditions in which it is found, and with no reference at all to its existing either in the earth, above the earth, in lakes, or in the sea, but looking at it simply as it is, a mass of rock, or a volume of water holding it in solution, it inclines one to the belief that it possesses a dual inchoation, though the original source of both may have been connate; but owing to extraneous causes which were brought to bear, one branch became crystallised rock-salt, while the other, through immaturity, remains in a state of solution."

"Why the sea is salt" has given rise to many pretty fables: Mr. Boddy invents still another fable; but it is not at all pretty: it is that "sea-water is the result of some subterranean communication with reservoirs of salt through the media of volcanic foci" (p. 53). This perhaps hardly does justice to Mr. Boddy's powers of narrative: the picture of the saltless world proves that he can do better; and yet even this is surpassed by that of the insect world of Cheshire on a rainy day (p. 60). But it is scarcely fair in the interests of the book itself to quote all its best things, even if our space and the reader's patience were longer.

Mr. Boddy is apprehensive of the reviewers: "An unknown author is placed at a great disadvantage and at the mercy of those who may laud a book to the skies if they please, satirically criticise another, and pass over a third with a sarcastic smile or a significant shrug of the shoulders. I am afraid that my little volume will unfortunately be found among the latter, but I candidly acknowledge that I hope it will be regarded as belonging to the first, or at least the second."

Our theory of the origin of this book differs somewhat from that of its author, as given above; Mr. Boddy's father (to whom the book is dedicated) was, we are informed, a ship's surgeon; and it occurs to us that this book is the result of the molecular motion of a brain which can trace its ancestry to a prolonged regimen of salt junk and pickled pork. It is the most striking instance of heredity we have yet met with, and despite our fear that Mr. Boddy may describe our notion as "a brazen assertion and a subtle paralogism," we commend it to the notice of Mr. Francis Galton.

OUR BOOK SHELF

Text-Book of Practical Organic Chemistry for Elementary Students. By H. Chapman Jones. 100 pp. (London: Joseph Hughes, 1881.)

MOST teachers of organic chemistry have felt that if their students could be made to work through a fairly simple series of typical experiments the work of learning would be rendered easier, and the knowledge gained would be made more definite and more real. Just such a series of experiments is described in this little work by Mr. Chapman Jones. The experiments are well chosen and clearly described; no costly apparatus is required, yet the student who works carefully through the book will certainly have laid a solid basis of knowledge of organic chemistry on which he may build a satisfactory structure.

An outline of methods whereby organic acids may be detected is given towards the end of the book, but the main part is devoted to experiments illustrative of fractional distillation and precipitation, formations and general properties of leading hydrocarbons, alcohols, and acids, etherification, &c.

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. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.*]

Trevandrum Observatory

As I was reading in a recent issue of your valuable journal (vol. xxiii. p. 482) a letter on the magnetic storm of August, 1880, showing the universality and simultaneity of the disturbance by comparing the observations at Greenwich, Toronto, Zi-ka-Wei, and Melbourne, I felt curious to know whether any such disturbance was noted here in the Government Observatory, and if so, whether the time corresponded with that given in your paper. On my application the gentleman in charge of the Observatory put into my hands, the inclosed abstract for the whole month of August, which I herewith forward to you. It contains, as you will see, not only the magnetic observations with the unifilar, bifilar and balance, but also the meteorological data for the necessary correction, &c. The reference throughout the paper is to the local time, which may be easily reduced to the Greenwich time, as the longitude is given. The observations, I may add, are quite reliable, though made by native agency, and I hope may prove useful on this occasion. But the paper inclosed I fear is too long to find room in your crowded columns, and what I beg you to do is to place it at the disposal of any of your scientific contributors or friends who take an interest in the question of terrestrial magnetism, and may be therefore expected to make use of the material here furnished.

A word more before I close. Your readers might know this observatory, said to be situated near the magnetic equator, was once in a very flourishing condition under the direction of Mr. John Allan Broun. On his retirement to Europe the establishment was reduced and a limited series of observations introduced, which he continued to direct till his recent demise. Since then the observations recorded are lying unused for the want of a scientific chief. If any scientific gentleman or society should generously offer some help in the way of directing the labours of this institution, I venture to think that the Government would gladly avail itself of such help, and the cause of science could then be materially promoted.

P. SOONDREM PILLAY

H.H. the Maharajah's College, Trevandrum, Travancore, South India, May 6

Symbolical Logic

FRESH criticism of my logical writings in a work just published ("Symbolic Logic," by John Venn, M.A., Fellow and Lecturer in the Moral Sciences, Gonville and Caius College, Cambridge) must be my excuse for troubling the editor and readers of NATURE with a third letter on the above subject.

On page 94 of his work Mr. Venn strikes the key-note, as it seems to me, of its whole purport and spirit. "Those who propose a new notation," he says, "commonly, and not unnaturally, assume that it is to supersede all others. But those who approach it as strangers know that the odds are decidedly that it will only prove one more of those many attempts which perplex and annoy the lecturer, historian, and critic. Hence we may fairly use the argument, dear to those in authority, that if we loosen the sanctions of orthodoxy, heresies will multiply. Only those whose professional employment compels them to study a number of different works have any idea of the bewildering variety of notation which is already before the world. . . . No doubt it would be rank intolerance to forbid such new attempts, *but an attitude of slight social repression towards them may serve to check too luxuriant a growth of new proposals.*"

The italics are mine. Alas, how little Mr. Venn appreciates the irrepressible restlessness of that most ungovernable organ, the human brain, if he really thinks that the "attitude of slight social repression" which he recommends would have the desired effect! Amateur logicians, as well as professionals, *will* start theories and invent notations of their own in happy unconsciousness that they are causing any annoyance to "lecturers, historians, and critics," whom indeed they not improbably picture to themselves (when the all-absorbing nature of their occupation allows them to think of them at all), as ardent devotees of science like themselves, who will be delighted with the new instrument of research which they hope to place in their hands. And more provoking still, scientific societies and editors (including a goodly number of the said lecturers, historians, and critics) *will* print in their *Proceedings* and magazines new proposals which they think likely to prove interesting or valuable, without being influenced by any motive whatever beyond a pure and simple desire to further the progress of science.

Mr. Venn professes great admiration for the late Prof. Boole's genius, and I heartily agree with him, though we admire on somewhat different grounds. I ground my admiration on the fact that Boole worked wonders with an unnecessarily complicated and otherwise defective symbolical method of his own invention. Mr. Venn apparently grounds his admiration on the singular supposition that Boole's method is really very simple and very effective, but that its author did not understand very clearly the real principles of its construction, and did not by any means apply it with as much ease and dexterity as he might have done. I am quite sure that this is not the impression which Mr. Venn intended to create in the minds of his readers, but I am no less sure that this is the impression which a perusal of his book *will* create in their minds—at least in the minds of such as have not read Boole himself. One remark of Mr. Venn's surprises me. He says (p. 385) that Boole "justly regarded his problems in Probability as the crowning triumph of his system." Surely I am not mistaken in my impression that I have somewhere seen Mr. Venn quoted as holding an opinion very much at variance with this statement—in fact attacking as erroneous the very principle on which Boole's "General Method in Probabilities" is based. May I ask Mr. Venn this plain question, Does he or does he not agree with Boole's solution of the question which he proposed on pp. 321 and 336 of his "Laws of Thought" as a decisive "test of the sufficiency of received methods," and (by implication) of the efficacy of his own General Method?

The main points on which Mr. Venn and I differ are the following:—

1. Mr. Venn maintains that the sign + in such expressions as $x + y + z$ should in logic, as in ordinary algebra, be always understood in an *exclusive* sense, so that unless we know x, y, z to be mutually exclusive, the above expression should be written in a different and, as he admits, a much less simple form. I hold, on the contrary, in common with Prof. Jevons and several others, that since, on the non-exclusive plan, the simple form $x + y + z$ may, without the slightest risk of ambiguity, be substituted at any stage of an investigation for any of its exclusive equivalents (such as $x + x'y + x'y'z$), or be replaced, if necessary, by any exclusive equivalent, the non exclusive interpretation of the symbol + gives us far more mastery over our symbolical expressions, and should therefore be preferred to the needlessly restrictive and hampering exclusive interpretation which Boole attaches to this symbol. How very serious the disadvantages of this interpretation really are is unwittingly illustrated by Mr. Venn himself on p. 262, where he finds himself obliged to admit that certain important simplifications which he discusses are "purely a matter of tact and skill, for which no strict rules can be given." If he had read my third paper in the *Proceedings* of the London Mathematical Society a little more attentively he would have found in my directions for reducing any complex disjunctive expression to its "primitive form" that these simplifications are not at all a pure matter of tact and skill, but may be obtained by a simple, never-failing, and purely mechanical process, which, however, a little tact and skill may do much to abbreviate. On the exclusive interpretation of the symbol + this process would be simply unmeaning. The problem which Mr. Venn discusses (expressed in my notation) is this:

Reduce the expression $(f:g)\ (gl:f)\ (l:f')$ to its simplest form.

By inspection [since any implication $\alpha:\beta$ is equivalent to $\alpha\beta':0$, and any compound implication of the form $(\alpha:x)\ (\beta:x)\ (\gamma:x)$ to a single implication $\alpha+\beta+\gamma:x$] this, on the non-exclusive plan, is seen to be equivalent to $fg' + glf' + lf:0$.

Reducing the disjunctive antecedent of this implication to its *primitive form* (a purely mechanical process, as already remarked), we get $fg' + gl:0$, or its equivalent, the compound implication $(f:g)\ (g:l')$, a result which Mr. Venn obtains apparently by a vague tentative process "for which no strict rules can be given."

2. Mr. Venn and I also hold different opinions as to whether or not symbolical logic should have signs to express relations corresponding to those of subtraction and division in mathematics. His opinion is that such signs *should* be introduced, and at once. My opinion (an opinion which I believe I share with most logicians) is that we had better not encumber ourselves with those symbols till they can be proved to subserve some useful purpose. The important question is—not, as Mr. Venn appears to think, whether such symbols can be intelligibly interpreted, but whether they will in any way help us in discovering new truths; in other words, whether they can be turned to any practical use in the solution of logical problems. If Mr. Venn can adduce a single intelligible logical problem which can be solved more simply or easily by the help of these signs than without them, I shall declare myself at once a convert to his views. So far I have come across no such problem, and must therefore for the present remain in the ranks of his opponents. As an illustration of what Mr. Venn calls the inverse method (*i.e.* division) in logic, he gives (p. 266) the equation—

$$(x + \bar{x}y)\ w = x + \bar{x}yz,$$

in which w (which denotes the books *in a certain library*) is to be expressed in terms of x, y, z (which respectively denote *philosophical* books, *divinity* books, and *protestant* books). His result is—

$$w = x + \bar{x}yz + \frac{0}{0}\bar{x}\bar{y},$$

which he translates into ordinary language thus:—

"The library must have certainly contained all philosophy and protestant divinity, and may possibly have contained any kind of works which are neither philosophy nor divinity; this latter constituent being left entirely indefinite."

Mr. Venn's data in the non-exclusive notation would be—

$$(x + y)\ w = x + yz,$$

and my result (much more simply and easily obtained) is—

$$x + yz : w : x + y' + z.$$

According to my definitions of my letter-symbols, we speak throughout of some *one* originally unclassed book, so that w, x, y, z will respectively denote the statements: It is in the *library*; It is a *philosophical* work; It treats of *divinity*; It is a *protestant* work. My result may therefore be read:—

Any work on philosophy or protestant divinity will be found in the library; and every work in the library is either philosophical, secular, or protestant. (By a *secular* work I mean simply a work that does *not* treat of divinity.)

The antecedent of w in my result is equivalent to the first "constituent" in Mr. Venn's result; but the consequent seems to me to give us much more intelligible information about the library than Mr. Venn's latter constituent ("May possibly have contained," &c.), which he truly describes as "entirely indefinite."

3. Another opinion of Mr. Venn's, unless I misunderstand him, is that all logical equations should, as a preliminary to their solution, be expressed in the form $\alpha = 0$, which, of course, is equivalent to my $\alpha : 0$. My opinion is that this, in logic as in mathematics, is sometimes convenient and sometimes not, and that we should not in logic, any more than in mathematics, tie our hands by this or any other unnecessary restriction.

The other points in which I differ from Mr. Venn have been mentioned in my former letters (see NATURE, vol. xxiii. p. 578, and vol. xxiv. p. 5), and need not be here repeated. Mr. Venn however labours under a serious misapprehension if he thinks that I attach any importance to the distinguishing features of my method *as mere barren conceptions*. Their real importance lies in the *use* which I have made of them, and this use cannot be fairly appreciated without examination of my published solutions in the *Proceedings* of the London Mathematical Society, in the *Educational Times*, and in the *Philosophical Magazine*. I must protest against that spirit of criticism which would offer two or three chipped bricks as a fair specimen of a house, and would depreciate the labours and damp the zeal of all scientific workers by unduly emphasising the undeniable fact that all logical and mathematical methods are, after all, mere combinations, developments, or extensions of a few simple truths which are the common property of all mankind. Even Boole's "actual originality," Mr. Venn tells us, though I think he means *priority*, "was by no means so complete as is commonly supposed and asserted" (see Mr. Venn's Introduction, p. 28). According to this method of criticism we might ascribe the invention of the steam-engine to the person (unfortunately unknown) who first discovered the important principle of a revolving wheel, and turned it to practical account by making a wheel-barrow.

In conclusion I must thank Mr. Venn for the compliment which he kindly pays me on p. 372 of his work, but I think it would read better without the parenthesis, "as he assures us is the case." The "assures" is a little too strong for the simple statements which I made, and which it never occurred to me that any one would dream of doubting. The compliment would also please me more if it did not so completely ignore the earliest, the most difficult, and the most important of my papers in the *Proceedings* of the Mathematical Society, namely, that which treats of the limits of multiple integrals. This part of my method (which gave rise to all the succeeding developments) resembles nothing, so far as I know, that has preceded it; and if Mr. Venn had found time to read it, the objectionable parenthesis which I have quoted would scarcely have presented itself to his mind as in any way called for. HUGH MCCOLL

Boulogne, May 25

Resonance of the Mouth-Cavity

SINCE communicating to Mr. Sedley Taylor my recent observations on the capabilities of the mouth as a resonator, and forwarded to you, with my permission, for publication in NATURE, I have made the following experiments with perfect success, and believing that they will be interesting to your acoustical readers I send a list of them to you, and hope you will be able to find a place for its insertion in your next issue :—

Experiment I.—While one of the overtones of a loud prime was resounding in my mouth another person heard it distinctly, upon the ear of the latter being held near the source of resonance.

Experiment II.—While a cart—any other noisy vehicle will do as well—was going along the street, I readily tested the composite nature of the noise by the resonant capabilities of my mouth.

Experiment III.—I turned the water-tap on into a basin (the water was running with a good force), and from the noise make by the falling liquid I was able to get different sounds quite easily.

In both these latter experiments I observed, while opening and closing my mouth, that the pitch rose and fell as when one slides a finger up and down a vibrating fiddle-string.

Experiment IV.—I held down in the treble part of a harmonium—with an 8-feet stop out—several consecutive keys together, and while the notes were sounding which composed the horrible discord, I was able to single out any of them separately by the sympathetic resonance of my mouth.

This experiment can be done equally well at the organ.

Experiment V.—I held down four or five of the low keys of the organ with the 8-feet trumpet drawn, and the beats of the overtones resounded very prominently, so that by taking two contiguous ones at a time the result was like the *voix céleste* stop.

Experiment VI.—I tried several notes in the *c*—*c* octave of the clarinet organ stop, and heard the regular order of partial tones by resonance, but the even ones were weak and odd ones very strong.

Experiment VII.—I held down *c'* and *g'* on the harmonium, and heard the first coincident partials beat distinctly—due to equal temperament.

Experiment VIII.—The first five partial tones of an average bass voice were studied. The notes chosen for observation were $\flat p$, *f*, *g*, $a\flat$, $b\flat$. To each note the vowels *A* as in *hay*, *A* as in *ah*, *E* as in *me*, *I* as in *high*, *O* as in *oh*, *U* as in *you*, were sung.

It was found that not only did the different vowels give different qualities, but that the same vowel had a different quality for almost every one of the five notes sung. The *E* as in *me* and *U* as in *you* had generally weak low overtones. The *I* as in *high*, on the contrary, gave them out well.

It will perhaps be as well to say, for the benefit of those who may not have tried to get a sympathetic resonance of the mouth, that success is likely to be sooner obtained by first practising the mouth in going from the *ou* to the *ah* shape, and from the *ou* to to the *e* shape.

It is also recommended that the ears be stopped by the fingers when doing these experiments, in order to lessen the possibility of mistaking the direct sound for resonance.

JOHN NAYLOR

5, West Park Terrace, Scarborough, June 1

"How to Prevent Drowning"

I FEAR that if persons who cannot swim place reliance on the advice given by Mr. MacCormac in your impression of June 2 (vol. xxiv. pp. 62, 101) they will hardly succeed in saving their lives should they happen to fall into deep water. It is an error to say that the "human frame, bulk for bulk, is lighter than water," for unless that frame be covered with fat beyond the average, it has a greater specific gravity than water. And after all, a tolerably fat body is lighter, bulk for bulk, than water only by virtue of the air in its lungs, and should that air be expelled by the frantic screams of the immersed person, he will soon find, if unable to swim, that the notion of his frame being specifically lighter than the water is a myth. The dead body even of a tolerably fat person being destitute of air in the lungs, sinks at once to the bottom in salt as in fresh water. The average human being, were he to permit his body to sink as far as it will, would soon find himself at the bottom of the sea or river. Besides, even in the case of a person fat enough to be lighter, bulk for bulk, than water, it is necessary that he should assume a certain position in order that he may succeed in keeping his nose and mouth above the water, and unless he learn how to do this in the water itself I doubt if instruction on dry land would ever enable him to float. We all know the story of the Hibernian who, having narrowly escaped drowning, vowed he would never enter the water again until he had learnt to swim, but we are not told if he ever qualified himself for going into the water again. To try and persuade people that by attending to certain rules they may get into deep water without the risk of drowning is to create a false confidence which will rather increase than diminish the number of deaths by drowning. Imagine a terrified person just plunged for the first time into deep water trying to recall all the directions he has read about shutting his lips, swallowing his breath, permitting his body to sink until it shall displace as much water as equals the body's weight, treading the water, and so on. Why he would require, in the midst of his agony of fear, to possess as many contradictory qualities of mind as Macbeth says no man can have. I venture to assert that no one was ever saved from drowning by following such directions as your correspondents here give. It should be stated in the plainest manner that there is no safety for a person in deep water but in a knowledge of swimming. Swimming should be taught to every boy and girl as a necessary branch of education. It has these advantages over much that is taught in schools, that it is a useful, a delightful, and a healthful accomplishment. R. E. DUDGEON

52, Montagu Square, W., June 3

Dust-winds at Hankow

DURING the spring of 1878 my attention was directed to the dust-winds which are not of unfrequent occurrence along the valley of the Yang-tse in the warm and dry seasons of the year. These dust-winds, as I observed them at Hankow, had sometimes the appearance of a dense mist; whilst at other times the air seemed to be penetrated by a fine haze; and in all cases a fine and almost impalpable dust was deposited

which was with difficulty excluded from the interior of houses. Their duration varied from a few hours to two days; and from the fact that one of the dust-winds was simultaneously experienced at Hankow, Kiukiang, and Chinkiang—a portion of the river's course nearly equal to 450 miles—I may conclude that they were not local phenomena, but possessed a considerable horizontal extension. The dust, which in all respects resembles the loam forming the banks and alluvial plains of the Yang-tse, is composed of mineral particles and vegetable *débris*—the former varying from $\frac{1}{500}$ to $\frac{1}{1000}$ of an inch in size, and being generally siliceous or calcareous in composition.

Three dust-winds came under my observation on March 25, April 21, and May 1; all of them possessed the following meteorological conditions:—During the two or three preceding days the barometer fell, whilst the mean daily temperature rose, and in two instances the winds were light and southerly. During the continuance of the dust-winds the barometer rose, the mean daily temperature ceased to rise, and light winds with a force of 1 and 2 prevailed varying in direction from north to north-east. For a period of a day or two after the dust-winds had ceased the thermometer registered a lower mean daily temperature, the barometer continued to rise, and the wind retained the same northerly direction. In all three cases there was a disturbed electrical condition of the atmosphere: in the first instance a severe thunderstorm accompanied by heavy rain occurred on the day following; the second dust-wind was accompanied at its commencement by a little thunder and lightning, but by no rain; whilst during the two days preceding the third dust-wind there was a considerable amount of thunder and lightning, together with heavy rain.

From this comparison of the prevailing atmospheric conditions in connection with these dust-winds, a more probable explanation of their occurrence may be obtained, than that which is often proposed when simply assigning a "sudden breeze" and a "hot day" as the conditions required to give rise to them.

H. B. GUPPY

17, Wood Lane, Falmouth, June 1

A Singular Cause of Shipwreck

THE strange loss of the *Phœnix* off the Iceland coast may perhaps lend some interest to the following:—

Last summer was the best the Icelanders had had for long past. I regret that I can give no thermometric readings, as my instrument became useless during the voyage. The weather in the north was nearly as warm as it has been here lately. All the snow-fed rivers were very full. The Jökulsà was nearly up to its high water-mark quite early in the season, and the Blanda was almost impassable. Icelanders who rode with me said that they had never seen the mountains from Hof's Jökul to Eyrik's Jökul so free from snow.

I append extracts from a letter which I have just received from one of my guides.

A. J. HUBBARD

St. Thomas's Hospital, S.E., June 4

(*Verbatim copy*)

"Hjedinstrofda, April 16, 1881

". . . This winter has been so uncommonly strong that none such has existed this century. The frost has been extremely severe—32° R., once at Akureyri, and 36° R. (= 49½° Fahr.) somewhere with Myvatn. . . . Ptarmigans and other birds froze to death. The farmers had spent most of their hay, and their cattle were to be killed or starve to death. All the sea was covered with ice, mostly polar ice, as far as one could see from the tops of the mountains. On the 2nd inst. the weather was mild, and on the 7th we had a real thaw, and every day since very mild and fine weather. But —— it is possible that the ice will not drive away before late in August, and no ship can come to any harbour on the northern coast; this happened in 1869.

"KRISTJÀN JÓNASARSON"

An Optical Illusion

THE optical illusion described in NATURE, vol. xxiv. p. 54, is, as I have already mentioned, referred to by Priestley (History, &c., Vision, Light, and Colours, vol. ii. p. 725). The description is as follows:—"M. Le Cat well explains a remarkable deception by which a person shall imagine an object to be on the opposite side of a board when it is not so, and also inverted and magnified. It is illustrated by Fig. 162, in which D represents the eye and C B a large black board pierced with a small hole. E is a large white board placed beyond it, and strongly illuminated, and *d* a pin or other small object held betwixt the eye and the first board. In these circumstances the pin shall be imagined to be at F on the other side of the board, where it will appear inverted and magnified, because what is in fact perceived is the shadow of the pin upon the retina; and the light that is stopped by the upper part of the pin, coming from the lower part of the enlightened board, and that which is stopped by the lower part coming from the upper part of the board, the shadow must necessarily be inverted with respect to the object." ("Traité des Sens," par M. Le Cat, Amsterdam, 1744, p. 298.)

C. J. WOODWARD

Birmingham and Midland Institute, Birmingham, June 6

THE VISITATION OF THE ROYAL OBSERVATORY

THE Report of the Astronomer-Royal to the Board of Visitors on Saturday last at the annual visitation was listened to with special interest, and indeed the attendance of astronomers and others at the Observatory was very much larger than usual, because it was generally understood that this would be the last occasion of the kind on which the veteran astronomer would be seen at his post. We learn that an appropriate address was made to him by the Board of Visitors when he announced his attention of relinquishing his official duties in order to enable him to devote all his time and energies to the researches he has now on hand.

The astronomical observations, which occupy the first part of the Report, have been carried on with the usual diligence. Most of the routine work of the Observatory seems to have gone on in the usual fashion through the last year.

One of the objects of interest on this occasion was Halley's ancient tombstone, which, after its removal from Lee Churchyard (where it had been replaced by a new stone with a facsimile of the inscription), had been placed in the South Ground, where it had been lying for several years. It has now been carefully restored, and mounted on the east wall of the lobby of the North Dome.

The sun's chromosphere has been examined with the half-prism spectroscope on 29 days during the period to which this report refers. Fourteen sun-spots have been examined on 20 days, with reference to the broadening of the lines in their spectra. The results confirm the remark that some of the lines of iron are broadened in some spots, whilst others are broadened in other spots. Displacements of some of the lines of iron towards the red, and of others towards the blue, have also been noted in the case of one spot. A remarkable spectrum of a sun-spot showing 17 strong black lines or bands, each as broad as b_1, in the solar spectrum, was observed on November 27 and 29, 1880. These bands, to which there is nothing corresponding in the solar spectrum (except some very faint lines), have also been subsequently remarked in the spectra of several spots.

For the determination of motions of stars in the line of sight, 168 measures have been made of the displacement of the F line in the spectra of 43 stars, 87 of the b_1 line in 27 stars, and 8 of the b_4 line in 4 of these stars. Of these 70 stars 16 had not previously been examined, and the total number of stars of which the motions have been spectroscopically determined is now 91. In the case of 6 of the stars observed in the last year, a dispersive power equivalent to that given by 16 prisms of 60° has been used. Ten measures have been made of the relative displacement of the F and *b* lines in the spectra of the east and west limbs of Jupiter.

Comet 1810 *d* (Hartwig's), and the aurora of 1881, January 31, have been spectroscopically examined.

Between 1880, May 9, and 1881, May 13, photographs of the sun were taken on 140 days, and of these 284 have been selected for preservation. There are only 8 days

out of 149 days on which the sun's disk was observed to be free from spots, whilst in the preceding year there was a complete absence of spots on 64 days out of 145.

The spectroscopic observations of all kinds have been completely reduced to 1881, May 6.

Touching the magnetical and meteorological instruments it was pointed out that the alterations of the photographic cylinders of the magnetical and meteorological instruments, which were in contemplation at the time of the last report, so as to make their time-scales the same in extent and in position on the record-sheets, have been to a great extent carried out. In the case of the declination and horizontal force magnets, two reflecting prisms with convex cylindrical front surfaces have been mounted by Mr. Simms above the registering cylinder, which has been lowered so that each prism receives the light from the magnet opposite to it. By this arrangement the traces of both magnets fall (as regards time-scale) on the same part of the sheet. The cylindrical lenses formerly used have been removed, being replaced by the cylindrical surface of the prism. The new arrangement is found to be perfectly satisfactory, and Mr. Simms is proceeding with a similar change in the case of the earth-current apparatus and of the vertical force and barometer registers.

A modification has been made in the system of determining the time-scales by the substitution of hourly breaks in the register, for the photographed hour-lines. The break at each hour is made automatically by a slight alteration in the apparatus hitherto used for registering the hour-lines. The time-scales for the declination, horizontal force, vertical force, barometer, and electrometer are now laid down in this way.

The unsatisfactory state of the earth-current register has been already noticed. After the change mentioned in a preceding section, it was soon found that the indications of the earth-current wires were disturbed by a continual series of petty fluctuations which almost completely masked the proper features of earth-currents. By cutting off the communications with those parts of the wires called the North Kent East Line and the Ladywell Line these disturbances were checked; but there remains a periodical disturbance at every hour, which entirely destroys the value and credit of the results. It seems not impossible that something may depend on imperfection of earth-communication. If this fault cannot be removed, the Astronomer-Royal proposes to return to the original system of independent wires (formerly to Croydon and Dartford).

The new pressure plate of Osler's anemometer has worked well. The limiting pressure of fifty pounds on the square foot was twice exceeded during the snow-storm of 1881, January 18.

The photographic records of the measures of magnetic earth-currents, in two directions upon the earth's surface nearly at right angles to each other, are maintained with the same regularity as those of the ordinary magnetic forces, and are preserved in readiness for reference or publication when need may require. An extensive confederacy is now organised, principally in Germany, for register of the earth-currents at several stations.

The following are the principal results for magnetic elements in the year 1880:—

Approximate mean westerly declination	18° 32′
Mean horizontal force	3·912 (in English units). 1·804 (in metric units).
Mean dip	° ′ ″ 67 34 55 (by 9 inch needles). 67 35 53 (by 6-inch needles). 67 36 3 (by 3-inch needles).

The report proceeds:—

"In respect of diurnal inequalities of magnetic horizontal force and its direction, though all measures are ready, the curves are not yet actually formed. In the last report I adverted to the usual character of these curves. Assuming it to be certain that they originate from the sun's power, not immediately, but mediately through his action on the earth, it appears to me (as I suggested long ago) that they are the effects of the attraction of the red end or north end of the needle by the heated portions of our globe, especially by the heated sea, whose effect appears to predominate greatly over that of the land. I do not say that everything is thus made perfectly clear, but I think that the leading phenomena may be thus explained. And this is almost necessarily the way of beginning a science."

The number of hours of bright sunshine, recorded with Campbell's Sunshine Instrument, during 1880, was 1214, which is about the same as the average of the four years for which we have a record.

The discussion of the electrometer results for the year 1879 shows that the potential of the atmosphere is usually positive; that it is least in summer and greatest in winter, and especially in the colder weather of winter. There is also a definite diurnal inequality, having double maxima and minima, the maxima, on the average of the year, occurring at about 8h. a.m. and p.m. and the minima at about 3h. a.m. and p.m. In character the diurnal curve has a resemblance to the barometric curve, but the points of maxima and minima precede those of the barometric curve by about two hours. On days of magnetic disturbance, when aurora is visible, nothing unusual is remarked in the electrometer indications. Excepting thunderstorms the greatest disturbances are experienced in showery weather, and are probably local disturbances only.

The time work is thus referred to:—

"In the first few years after the strict and systematic examination of competitive chronometers, beginning with 1856, the accuracy of chronometers was greatly increased. For many years past it has been nearly stationary. I interpret this as showing that the effects of bad workmanship are almost eliminated, and that future improvement must be sought in change of some points of construction. One which occurs to me (I mention it principally as a specimen of departure from customary forms) is this. The impact of the escape-wheel upon the pallet of the balance-axis takes place very near to that axis, and must produce considerable friction, though of short duration. I proposed to the late Mr. Charles Frodsham to meet this by use of a broader pallet and a lighter impact of longer duration. The decease of that accomplished horologist prevented the completion of the trials which he had commenced for carrying out my suggestion. Other variations of the established form might be worthy of trial.

"The Greenwich time-ball has been regularly dropped automatically at 1h. on every day throughout the year, with the exception of 6 days when the violence of the wind made it imprudent to raise the ball, and 8 days when the severe frost of last winter prevented its being raised; and of one day when there was accidental failure.

"The Deal ball was not raised (on account of high wind) on 10 days. It was not dropped (through failure in the telegraphic connection) on 7 days, and was erroneously dropped about 5s. too soon by telegraph signals on one day; and on another day it was not dropped at 1h. owing to telegraph signals continuing up to 1h.; on one day the current was too weak to release the trigger. On every other day the ball has been dropped automatically at 1h.

"As regards the Westminster clock, its errors have been under 1s. on 31 per cent. of the days of observation, between 1s. and 2s. on 47 per cent., between 2s. and 3s. on 18 per cent., and between 3s. and 4s. on 4 per cent.

"The distribution of time-signals to all parts of the country continues to be made on the same system as in late years, by means of the chronopher at the central

office of the Post Office telegraphs. In connection with this system, I would express the hope that the proposal to establish an hourly signal at the Start Point will be borne in mind.

"Last autumn a telegraphic determination of the longitude of Leiden was made with great care by M. M. Bakhuyzen. The interchange of signals between Greenwich and Leiden occupied nearly four months. I may here remark that the American extension of longitude carried out under Commander Green, U.S.N., to which reference was made in the last report, will be most useful for the transit of Venus in 1882. Cannot a British officer be found to complete the operations for Australia and New Zealand? I lament that this has not been done. Mr. Gill has undertaken the necessary work for the Cape."

The following important general remarks conclude the report:—

"The present meeting may afford a fitting opportunity for the expression of my views on the general objects of the Observatory, and on the duties which they impose on all who are actively concerned in its conduct. Assuming as beyond dispute that these ought to be carried out in a spirit liberal in itself and honourable to the nation, I proceed to state my opinion on the line of action which they suggest.

"The object prescribed to the Observatory is the promotion of "Astronomy and Navigation." And, since the abolition of the Board of Longitude, the second of these objects (which historically gave rise to the introduction of the first) presses upon the directors of the Observatory much more strongly than before. Considering then the claims of astronomy as b aring on navigation and our responsibilities in reference to them, we find that those responsibilities are by no means narrow. Whatever the rest of the scientific world may do or may not do, we are responsible for determinations of the fundamental elements of sidereal, solar, and especially lunar astronomy, with the highest accuracy that modern skill can secure. The same apparatus of instruments and of mathematical treatment which fix the places of fundamental stars will apply to those of other stars; the same which apply to the sun will apply to planets and comets (not unconnected with solar theory, by virtue of perturbation) and even to satellites. And we could hardly consider ourselves as discharging our duty to the more educated portion of the nation, or as maintaining our proper position in the world, if we did not include in our operations these latter offshoots of the first-mentioned objects.

"But new astronomical subjects have arisen of which no one dreamed when our constitution was first fixed. The first of these was the measures of double stars. But this, though important as ever, has almost disappeared from our view when occupied with solar and spectroscopic physics. I yield to no one in the interest which I take in these subjects, and in the admiration with which I regard the positive conclusions and the problematic suggestions which are founded on them. But I still point out that these are not parts of our original system, and their connection with the Greenwich Observatory is at any time liable to question.

"I now advert to the general subject of navigation. And first I remark that magnetism, in its ordinary and nautical form, is indisputably a proper subject for the Observatory. But within the present century there have arisen:—the accurate examination of magnetic irregularities, the partial reduction of daily irregularities to practical laws (still wanting theoretical explanation), and the establishment of the simultaneous co-existence of occasional disturbances covering the whole surface of the earth. Connected with these is the observation of magnetic currents through the terrestrial soil, registered at Greenwich for many years past, and now attracting attention on the Continent. Perhaps no branch of physics bears the same prospective importance as these. Yet I conceive that their continued study in this Observatory requires special authorisation.

"The original views in making astronomy contributory to navigation were limited to observations of the moon. But in the latter part of the last century the possibility of making chronometers subservient to the determination of longitude (a subject to which the late Board of Longitude gave good attention, and to which the Government has always offered liberal rewards) was proved, and in the present century the improvement has been very great. This has been effected by our Hydrographical Office (mainly through the action of the Observatory), partly by specific rewards, partly by careful attention to the accuracy of every chronometer purchased. And the practical value of the chronometric system has been very greatly increased by taking advantage of the galvanic distribution of time currents, and by the galvanic exhibition of ball-drops and other signals. There can be no doubt that all the agencies involved in this system are well employed, and that they are a legitimate part of the Observatory duty as originally contemplated.

"Still I remark that the Observatory operations bearing on chronometric navigation are not carried out to the extent which I could desire. It is known to all persons familiar with chronometers that rates of the chronometers, obtained while the ships are actually in voyage, would possess remarkable value. We possess the power of giving facility for obtaining these to a large part of our mercantile navy, by exhibiting a time-signal at every hour, at Deal (where the necessary apparatus already exists) and on the Start Point. I have several times brought this proposal, as regards the Start, before the Government, but unsuccessfully. But I should have done wrong if I had omitted, in this general survey of the duties of the Observatory, to state my continued conviction that this is a proper and very desirable addition to the other points of assistance which we can give to navigation.

"Next—closely connected however with the subject of navigation—is the knowledge of the longitudes of distant ports, as referred to the Greenwich Observatory. And I approach this subject with grief. We have entirely abandoned the longitudes of the Atlantic, which have been cleared away, before our eyes, by the scientific enterprise of another nation. The Pacific, bearing those vast and important colonies, almost entirely British, is equally neglected; though so much is ready that the mission of a single officer would quickly establish all. The same aspiring nation which has mastered the Atlantic is now bent (as I understand) on adding to its scientific dominion the Pacific. I think this is not honourable to our nation.

"There remains another subject, which occupies no small part of the force of the Observatory, and which I am unable to connect with either of the two great divisions to which I have alluded—the subject of meteorology. It is exceedingly popular in the country, perhaps because it requires little of expense or of science. It is also pursued at many foreign observatories, where vast numbers of observations are produced without attempt at classification or reduction. We at least are not amenable to this accusation, and may appeal to our reduction of more than twenty years' collected observations as giving matter of permanent interest to the more scientific meteorologist, and even to the geologist. Still I call attention to the fact that this is a subject which, though introduced mainly by myself, I regard as foreign to the original 'Astronomy and Navigation' of the Observatory.

"There is still a matter for consideration, not in our observations, but in the mechanism by which they are made available to the world—I mean our printing. I have repeatedly expressed my opinion that the extent of our printing is far too great: not in the full exhibition of reductions, but in the minute details of individual observations. There are printed every year more than 7000 transits or circle readings, each consisting of 6 or 7 indi-

vidual readings, of which only the mean is useful. I do not believe that, since the year 1835 at least, any person in the world except ourselves has actually taken a mean. As each reading contains 3 or 4 figures, there are printed in each year something like 150,000 useless figures. Reliance must be placed somewhere on the skill and fidelity of the observer, and (considering the severity with which every figure of transit-wire and of circle-microscope, and of their means, is examined here) this reliance may be placed at least as well on the means as on the originals. I have reason to think that the bulky volume of nearly 900 pages, might be reduced to about three-fifths of its present size by omitting those originals.

"I would submit for the consideration of the Board whether it might not be advantageous that they should hold a special meeting to consider the subjects which I have indicated. The length of time at an ordinary visitation, and the circumstances under which the Board meets, are not sufficiently favourable for the discussion of broad questions of Observatory policy."

HOLTZ'S ELECTRICAL SHADOWS

IN an extremely elegant series of researches Prof. W. Holtz of Berlin has lately brought to light the existence of a new class of electrical phenomena, to which their distinguished discoverer has assigned the name of *Electric Shadow-figures*. Though nearly six months have elapsed since they were described in the Proceedings of the Göttingen *Gesellschaft der Wissenschaften*, no detailed account of them has appeared in any English journal. Yet the shadow-figures are remarkably easy to produce, and the whole research is of extreme simplicity, as very little apparatus is required beyond the simplest odds and ends to be found in every physical laboratory, the only large instrument necessary being one of Holtz's electrical machines.

The fundamental arrangement is that shown in Fig. 1. From the discharging-rods of a Holtz machine the brass balls are removed. To the left rod there is attached in place of the ball a circular disk of some 10 to 20 centimetres diameter, having its front face either flat or slightly concave. To the right rod a point is fixed, and it is drawn back till from 6 to 15 centimetres distant from the disk. A piece of silk or satin of the same size as the front surface of the disk is laid upon it while the machine is in action, it adheres of itself to the surface, and the preparation is now complete. Before the silk is placed over the disk a small "brush" discharge of blueish light is all that can be distinguished at the point of the right-hand discharging-rod: but this now changes to a very faintly glowing star. At the same moment the central region of the silk-covered disk exhibits a peculiar glimmering light over a well-defined circle. The utmost care is needed to shut out all extraneous light from the room, otherwise the delicate appearances which follow cannot be seen. It is upon this circular patch of feeble light that the shadow-figures are thrown. Its pale gleam becomes more vivid when the machine is more energetically worked: it enlarges in area but diminishes in brightness as the point is drawn back from it, and contracts with an accompanying increase in brightness as the point is brought nearer. It is possible to obtain a similar glimmering surface also upon a large metal ball covered with silk and attached to the rod in place of the concave disk, or instead a screen made of two or three folds of silk stretched over an ebonite ring may be placed between the two discharging-rods, the ends of both being furnished with points. In each case it is important that the silk be without crease or wrinkle, otherwise an evenly illuminated disk of light will not be obtained.

If now a body of definite outline of form be interposed between the point and the disk, an electrical shadow of it will be cast upon the luminous circle. These shadows are truly electrical, not optical, for all bodies do not cast them, and, more curious still, different bodies though of the same shape may cast differently shaped shadows. Conductors of electricity cast well-defined shadows, and so do semi-conductors, such as wood and cardboard. True insulators of small dimensions cast no shadows. The insulation or non-insulation of the conducting bodies makes no difference in their shadow-giving power. A cross cut out of cardboard casts (as in Fig. 1) a well-defined shadow at the centre of the field, but the exterior portions are somewhat hazy. An ebonite cross casts no shadow. A cross made up of two strips, one of cardboard, the

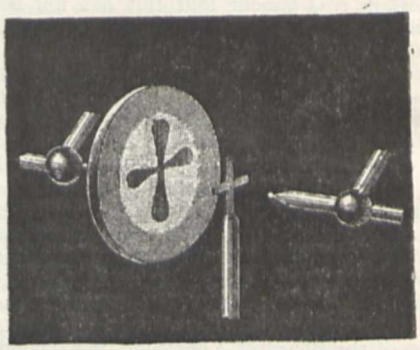

FIG. 1.—Electric shadow cast by a cardboard cross.

other of ebonite, fastened with shellac, casts only a single bar of shadow. Rings of tinfoil, cardboard, or wire also cast shadows. Such small objects are conveniently held by attaching them to the end of glass rods. The size of the shadows increases if the objects are displaced from their central position to right or left. A strip of card or thin metal casts the same shadow whether it be held broadside or edgeways in the field. A wire grating having 5 millimetres width between the bars obscures the field like an opaque body. Breathing on a strip of ebonite or glass renders its surface a feeble conductor, and it casts a transient shadow. A glass rod heated at one point casts a shadow at the heated point, the shadow dying out as the

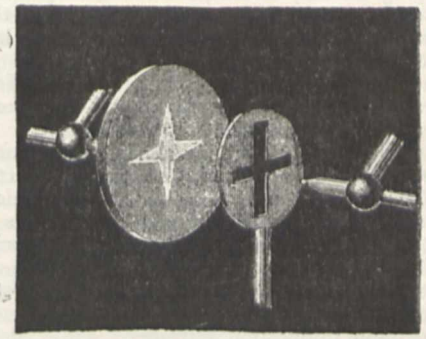

FIG. 2.— uminous figure projected through aperture in cardboard screen.

rod cools. No shadow is cast by a conductor whose surface is completely covered by insulating material, such as a shellac-covered wire or a glass tube containing water, but dry externally. The smoke ascending from a cigar casts moving shadows upon the silken screen. If a small ball be fixed upon the left discharging-rod in place of the point the shadow on the silk is poor, but a second shadow is observed upon the surface of the ball, and this is excessively small, reminding one of the diminished erect virtual optical image in a small polished ball. This one experiment succeeds best if the ball be made the positive con-

ductor. For the other experiments it makes little difference whether the electrification of the point be positive or negative, except that when the point is positively electrified the illuminated surface is a little larger than when negatively electrified. A larger disk of light can also be obtained by working the machine at a greater velocity, but at the same time the shadows are rather smaller.

Prof. Holtz has also obtained the inverse phenomenon of *luminous-figures* by two different means. If two pointed needles are fixed horizontally side by side upon the discharging rod opposite to the disk, there appears a vertical streak of light across the glimmering field. If the needles be replaced by a horizontal strip of metal with its edge directed toward the disk, a vertical bright streak is also produced. A short metallic tube affixed to the discharging rod produces on the disk a dark central spot surrounded by a nebulous bright ring. The second kind of *luminous-figures* is produced in the manner shown in Fig. 2, where a circular disk of metal or cardboard having a central aperture of recognisable form is interposed between the point and the screen. The result is a luminous image of the aperture which, though well-defined at the middle, is marred at the outer regions, the shadowed portions appearing to encroach more upon the illuminated parts as we pass to the peripheral region. The following experiment is curious :—If a square aperture be chosen, the luminous figure projected on to the silken surface shows well-defined corners; but if a small round disk of card be interposed between the discharging point and the square aperture the luminous square on the silken screen at once exhibits rounded corners.

Another interesting point connected with the shadow-figures is that they can be fixed in a temporary manner, like Lichtenberg's figures, by sifting upon the silken surface lycopodium-powder or other fine dust. This collects chiefly upon the contours of the figures, though under certain conditions the luminous and shadowed parts exhibit a contrasted density in the deposit of dust upon them. These dust-figures have an obvious relation with those obtained by Wiedemann from the discharge of Leyden jars through a pointed conductor against the surface of various bodies. It would be interesting to ascertain whether by this process also shadow-figures can be produced.

In explanation of these appearances Prof. Holtz propounds the view that they are due to a rectilinear discharge of electrified particles from the point of the discharging-rod, the discharge taking the general form of a cone, but in which the paths of the outermost particles diverge more widely as they approach the silken disk. The function of the silk he believes to be to retard the discharge, and thereby to increase the electric density on the point. The conducting bodies which are interposed in order to produce shadows act therefore by deflecting the flying particles from their path, either by absorbing or reflecting them. In many cases this action would appear to be a repulsion, since the shadows are always larger than the objects, and suffer more distortion by enlargement nearer the borders of the disk. To explain the production of the double shadows, the rather doubtful hypothesis is advanced that there is a rectilinear discharge of particles in both directions at once.

Quite independently of these observations, the same kind of phenomena have been investigated in America by Messrs. Fine and Magie of the Green School of Science, Princetown, N.J. These experimenters were aware of the existence of shadows on the positive discharging knob, but believed that they were the first to discover the existence of a negative shadow. They found however that non-conductors cast the best shadows, and added the interesting observation that the lines of electrical action were deflected by the presence of a conducting body at the side of the field, and the form of the shadow correspondingly altered. Negative shadows were also observed, they remark, some years ago by Prof. C. A. Young.

These shadow-figures become doubly interesting when compared with the "molecular-shadows" obtained by Crookes from electric discharges in high vacua. Further experiments are probably needed before their precise nature is fully known. S. P. T.

BEN NEVIS OBSERVATORY.

A PROPOSAL was made a year or two ago to erect an observatory on the top of Ben Nevis for meteorological observations, but nothing was done owing to the want of the necessary funds. A committee has been formed, however, within the last few months for the purpose of raising a testimonial to Mr. David Hutchison, who did so much in opening up the West Highlands to tourists with his steamboats, and we observe that it is proposed that the testimonial take the shape of an observatory on the top of Ben Nevis. The committee is a large and influential one, and the proposed scheme has every appearance of being successfully carried out.

In the meantime the Scottish Meteorological Society has commenced daily observations on Ben Nevis, which will be continued during the summer months—the Society having accepted a handsome offer by Mr. C. L. Wragge, who has had experience of such work, to climb to the top of Ben Nevis every morning in time to make observations there at 9 a.m. A complete set of the best instruments has been procured. The barometer (a *Fortin*), is an excellent instrument, and is constructed to read as low as 23·000 inches, in the procuring of which Mr. Scott of the Meteorological Office kindly gave his assistance. On Tuesday, May 31, Mr. Wragge, with Mr. Livingstone, of the Public Schools, and nine workmen ascended the mountain, and the instruments were fixed and secured in proper positions, and all, including the barometer, were found to be in good working order. The regular observations began on the following day, June 1, Mr. Wragge being at his post on the top of the Ben, 4406 feet above the sea, at 9 a.m. He remains an hour at the top, and makes three observations, viz. at 9, 9.30, and 10 a.m. Even during the stormy weather of Saturday last, the observations were made and the observer back to Fort William at 1.30 p.m., on which occasion the temperature at the top was as low as 28°·0.

Simultaneously with the Ben Nevis observations, a complete series of observations are also made near sea-level by Mrs. Wragge. These observations, together with the observations made at the neighbouring stations of Roy Bridge, Corran, Landale, Airds, Lismore, and Dalnaspidal (1450 feet above the sea), will give the data required in dealing with some of the more important problems in meteorology.

NOTES

AMONGST the few existing institutions for the higher education of women, perhaps none has done better work during the last thirty years in a quiet, unobtrusive fashion than Bedford College, York Place. The recent action of London University in opening its degrees to women has given a fresh impetus to women's education; and Bedford College has set itself the task of providing the training for which London University offers only the test—a task in which it has already achieved such success as to give a sure promise of a brilliant future. The funds, however, at its disposal, derived mainly from the bequest of the late Mrs. Reid, prove inadequate to the strain thus put on its resources, and an appeal for support is now being circulated which deserves the attention of the friends of education. In that appeal details of the work and aim of the College will be found. Space will only allow us to add that subscriptions will

be received by the hon. secretary, Bedford College, 8 and 9, York Place, W.

AMONG the houses of historical interest on which the Council of the Society of Arts have just erected memorial tablets, is No. 35, St. Martin's Street, Leicester Square, in which Sir Isaac Newton lived for some time.

M. LITTRÉ, the eminent philologist and philosophical writer, died on the 1st inst., at the age of eighty years. His celebrated French dictionary is probably the best dictionary ever published in any language ; not only is its method thoroughly scientific, but it contains nearly every important scientific term in use in French scientific literature.

LAST night a complimentary dinner was given at Freemasons' Tavern to Dr. Danford Thomas, the new Coroner for Central Middlesex. Over a hundred representatives of the various professions were present. Dr. B. W. Richardson was in the chair.

THE *conversazioni* of the Society of Arts and the Civil Engineers, on Thursday and Friday last, were as usual successful ; over 2000 people were present at each.

THE anniversary meeting of the Vienna Academy was held on May 30. R. Maly, Professor of Chemistry at Gratz, and F. Lippich, Professor of Physics at Prague, were elected correspondents.

THE Dundee Naturalists' Society have three dredging expeditions in their programme of excursions this summer—one on June 11 to St. Andrew's Bay, a second on July 20 to the Bell Rock, and a third on August 31 to Lunan Bay.

MR. EDISON has written to M. Georges Berger, asking for 120 horse-power to work the large generator he is sending to Paris for the forthcoming exhibition.

EXPERIMENTS are being made with a view to running trains through the St. Gothard Tunnel by electricity, with motive power obtained from the Reuss and the Tessin. The boring of the Arlberg tunnel proceeded last month at the rate of six and a half metres per day. The making of the lines of access will shortly be undertaken.

AT an examination held by the Sanitary Institute of Great Britain on June 2 and 3, six candidates presented themselves, and the Institute's certificate of competency as Local Surveyor was awarded to Samuel S. Grimley and to Arthur Whitcombe, and the Institute's certificate of competency as Inspector of Nuisances was awarded to John Latein Cowderoy, to Joseph Rains, and to William Wilkinson.

WE have received a copy of a paper by J. H. Collins, F.G.S., published in the *Journal* of the Royal Institution of Cornwall, No. xxiii., which contains analyses of the new minerals Henwoodite, Enysite, Duporthite, Penwithite, as well as of other minerals and rocks. Good analyses of minerals are always useful for reference ; and Mr. Collins is rendering a service to science in publishing the results of his work. His paper would have been more valuable had he mentioned the methods employed for separation and determination of the mineral constituents, as, for instance, in the analyses of minerals containing alumina, iron, and phosphoric acid. It would likewise save trouble if the percentage composition of his assumed formulæ for minerals were placed in parallel columns with the quantities obtained. That they agree "fairly well" is a little vague.

THE earthquake shocks on Mount Vesuvius were followed on the 1st inst. by a strong eruption. Broad and active streams of lava ran quickly down the north-east side of the mountain.

A SHOCK of earthquake occurred at Serajewo (Bosnia) on June 2, at 4h. 40m. a.m., duration 2 sec.

ON the 1st inst. the Duke of Edinburgh placed the top stone on the new Eddystone Lighthouse. The stonework of the structure has now been completed after a labour of three years. The lantern has yet to be placed on the top of the structure, and the illuminating apparatus has to be fixed, and all the internal fittings are to be applied, but this is work that can be carried on at any time of the tide, so that the whole of the work will, it is expected, be completed in another year, twelve months within the period stipulated in the contract.

IN a report on the health of Swatow, just published by order of the Inspector-General of Chinese Maritime Customs, Dr. E. J. Scott refers to a plague of caterpillars which visited the neighbourhood last summer, literally covering the fir-trees, on which they lived exclusively, and leaving them perfectly denuded of leaves. The hill sides in many places looked as if a fire had passed over the trees and scorched them. The Chinese were very much afraid to handle these caterpillars, as they declared that they were exceedingly poisonous, and Dr. Scott says they are to some extent right, as he knew of two foreigners who were injured by them. When crushed, they exuded a glutinous fluid of a light-green colour, very irritating to the skin, and producing rash, which caused much inconvenience for ten days or a fortnight.

DR. HAHN has recently published a work, in which he gives photographic reproductions of more than one hundred thin sections of meteorites on thirty-two plates. In that class of meteoric stones which bear the name of chondrites, on account of the curious round nuclei they contain, Dr. Hahn believes he can demonstrate the existence of a whole series of organic forms belonging to the animal world. A number of the sections shows a structure closely resembling corals. Dr. Weinland publishes an article on this subject in No. 16 of the *Ausland*, Dr. Hahn having placed the thin sections at his disposal ; and he states that he gained the conviction that he was really beholding remains of animals belonging to the family of Favosites, well known among Silurian, Devonian, and Coal fossils. For further information we must refer our readers to the article mentioned.

AN epidemic among the crayfish of all the rivers and rivulets of the Stettin district has led to the complete destruction of that crustacean in those waters.

IN the north of France great devastation is caused by large field-mice (*Arvicola arvalis*) among the crops. The plague is particularly severe in the departments of Seine-et-Oise, Eure-et-Loire, Loiret, Seine-et-Marne, Yonne, Aube, Marne, and Haute Marne.

"LA BELLE JARDINIÈRE," one of the largest clothing establishments in Paris, is employing with success magneto-electric machines for the transmission of power, from the basement to the top of the building. The two machines have been built by Siemens Brothers.

AN opera performed on the stage of the Paris Grand Opera House was heard satisfactorily at the Rue Riche Opera House by a number of French officials a few days ago. The feat was performed with the new Ader telephone, of which the peculiarities have not been made public. The performance will be repeated at the International Exhibition.

M. MEREJKOFFSKY'S report on his anthropological journey in the Crimea (*Izvestia*, 1881, fasc. 2) contains interesting measurements of skulls of the Crimean Tartars—the pure Steppe Tartars who do not present a mixture with Greeks, as the south-coast

Tartars do, nor with the Nogaï, who are now, however, not numerous. After having measured the skulls of about 200 persons, he finds that the cephalic index is: 0·908 for children from 4 to 7 years old, 0·882 from 8 to 9 years, 0·876 from 10 to 12 years, 0·871 from 13 to 14 years, 0·852 from 15 to 19 years, and 0·845 from 20 to 23, being the average from 82 measurements. When discussing the figures received for 27 very pure representatives of Tartars, he shows that the maximum figures were, in four cases, from 0·886 to 0·903, and the minimum in two cases, 0·789 and 0·800; for the 21 others the index varies comparatively little, namely, from 0·822 to 0 876. M. Merejkoffsky has observed among the Tartar women the use of tattooing in small spots between the eyebrows and on the forehead. As to the staining the nails red, which is spread everywhere among the women, and sometimes also among men, M. Merejkoffsky, after having discussed the same custom among other peoples, arrives at the conclusion that it is a survival from the time when the whole skin was stained with red, originally with the blood of enemies, to inspire dread.

THE geysers of Whakarewarewa, New Zealand, are stated to have lately been in a state of agitation, throwing hot water to a great height. The natives anticipated still further eruptions. The geysers have been dormant for six months.

THE Annual Report for 1879-80 contained in the *Proceedings* of the Norwich Geological Society complains of the little interest taken in the work of the Society by the members; the bulk of the work seems to be done by the members of the Geological Survey stationed in the neighbourhood. The presidential address, by Mr. J. H. Blake, "On the Age and Relation of the so-called 'Forest-bed of the Norfolk and Suffolk Coast,'" is of considerable interest. It has been separately reprinted. Among the other papers is one on "The Subdivisions of the Chalk," by Mr. A. J. Jukes-Browne.

THE Twenty-Third Report of the East Kent Natural History Society contains some of the more important papers read during the year. We regret to see that the interest of some of the members in the welfare and work of the Society is not so great as it might be, and that, as in not a few similar societies, the bulk of the work falls on the shoulders of a few of the more energetic members.

WE are glad to find a decided improvement in No. 1, vol. x. of the *Canadian Naturalist*. The papers are mostly geological, a large proportion are original, or at least of purely Canadian origin, and all of scientific value. Principal Dawson contributes some important Palæontological Notes, and there is a long paper by Mr. R. Chalmers on the Glacial Phenomena of the Bay Chaleur Region, with a map. Dr. G. M. Dawson writes of the Geology of the Peace River Region. Appended are Meteorological Notes for 1880, and a curious statement as to the Niagara Falls having been dry for a day, March 31, 1848.

Naturæ Novitates, the fortnightly list of novelties in scientific literature, started some time ago by Friedländer of Berlin, continues, we are glad to see, to flourish. It is calculated to be of real service to workers in science.

MR. JOSCELINE BAGOT and Mr. Drummond, of the Grenadier Guards, accompanied by Mr. T. Wright, the winner of the International Balloon Contest, went up in a balloon from the Crystal Palace on the 1st inst. at 1 p.m. When the ropes were loosed they ascended to the height of 5000 feet, and travelled slowly in a south-westerly direction for the distance of about eight miles. The balloon then suddenly sank, but ballast being thrown out, it rose again to 8000 feet, and traversed in the direction of Epsom. The aëronauts then descended in a field about a quarter of a mile from the Grand Stand, which they reached n time to witness the race for the Derby.

SIR R. TEMPLE'S lecture on the lake region of Sikkim is given in the current issue of the Geographical Society's *Proceedings*, illustrated by a capital map and some very good engravings from the author's sketches on the spot. The other papers are a translation from the Russian by Mr. Delmar Morgan of Dr. Regel's account of his expedition from Kuldja to Turfan in 1879-80, and Mr. F. C. Selous' notes on recent explorations in Mashuna-land, the latter of which adds something to our knowledge of the hydrography of the Zambesi basin, and is accompanied by a map in the text showing the routes of Mr. Selous and others. The geographical notes relate chiefly to the work of various expeditions on the Congo and other parts of West Africa. There are also notes of some interest on the true name of the Chukches and on Richmond Gulf, Hudson's Bay. Mr. James Stevenson contributes a memorandum of the longitude of Lake Nyassa, which is followed by a full abstract of the proceedings of the Paris and Berlin Geographical Societies.

THE paper by General Pitt-Rivers announced last week will be read at the Anthropological Institute on the 14th, not 7th inst.

THE additions to the Zoological Society's Gardens during the past week include a Macaque Monkey (*Macacus cynomolgus* ♂) from India, presented by Mr. W. Nugent; a Vulpine Phalanger (*Phalangista vulpina* ♂) from Australia, presented by Master H. Berridge; ten Green Lizards (*Lacerta viridis*), European, presented by Mr. H. N. Moseley, F.Z.S.; two Ostriches (*Struthio camelus* ♂ ♀) from Africa, two White-backed Piping Crows (*Gymnorhina leuconota*), a Laughing Kingfisher (*Dacelo gigantea*) from South Australia, deposited; a Prince Albert's Curassow (*Crax alberti* ♀) from Columbia, two Golden Agoutis (*Dasyprocta aguti*) from Guiana, two Common Boas (*Boa constrictor*) from South America, on approval; a Japanese Deer (*Cervus sika* ♂), a Cuming's Octodon (*Octodon cumingi*), born in the Gardens; five Impeyan Pheasants (*Lophophorus impeyanus*), four Peacock Pheasants (*Polyplectron chinquis*), a Ruddy Sheldrake (*Tadorna rutila*), bred in the Gardens.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—In a Convocation holden on June 7 a decree was passed, without opposition, to amend the statute relating to the Degree in Medicine. According to the new decree, those who enter their names for the First Examination for the Degree of Bachelor of Medicine, and who satisfy the Regius Professor of Medicine that they have obtained Honours in the School of Natural Science, or that they have passed the Preliminary Honour Examination in the same School, shall not be required to be examined either in Chemistry or in Mechanics and Physics at the First Examination for the Degree of Bachelor of Medicine.

In the same Convocation the statute to enable non-members of the University to pass an examination in lieu of Responsions was also passed without opposition. The first examination in lieu of Responsions will be held towards the end of the ensuing long vacation.

Mr. George B. Ferguson, M.D., Hertford College, has been nominated Examiner in the Natural Science School in place of Prof. Lankester, and Mr. John Watts, M.A., Balliol College, in place of Dr. Odling.

Prof. Sayce announces a public lecture in the Taylorian Institution, June 8, on the ancient Hebrew inscription recently discovered in Jerusalem.

An examination will be held in Exeter College early in October for the purpose of filling up a Natural Science Scholarship, tenable for four years during residence. The age of the Candidates is not limited, but they will be expected to give evidence of sufficient Classical knowledge to be able to pass Responsions. The examination will be in Biology, Chemistry, and Physics. Candidates will be expected to show proficiency in at least two of these subjects, and the Scholar will be

required to read for Honours in Biology in the Natural Science School. The examination will be to a large extent practical, but special weight will be given to comprehension of general principles. Candidates for the Scholarship may obtain further information by application to the Rector, or to W. L. Morgan, Esq., the Lecturer in Biology at Exeter College.

CAMBRIDGE.—Prof. Humphry has given notice of a class in human osteology, to be held by the demonstrator (Dr. Creighton) during the long vacation, commencing July 4; and a class for practical histology (by Mr. Hill), beginning July 7.

Mr. J. W. Clark is continued in the office of Superintendent of the Museums of Comparative Anatomy and Zoology for two years.

The offer of the Cambridge Philosophical Society to make their library available as the nucleus of a general scientific library in the new museums, to be placed under the care of a librarian appointed by the University, has been formally accepted by the Senate.

Inter-collegiate lectures in higher mathematical subjects are offered for the ensuing long vacation by Mr. Allen at St. Peter's, on electro-magnetism; by Mr. Mollison (Clare), on heat; by Mr. Stearn (King's), on hydrodynamics; by Mr. Niven (Trinity), on elasticity; and by Mr. Lewis (Trinity), on vortex motion and viscosity.

NOTTINGHAM.—The following appointments have been made to the professoriate of Nottingham University College:—The Rev. J. F. Blake, M.A., F.G.S., Professor of Natural Science; Dr. J. A. Fleming, B.A., D.Sc. (London), Professor of Mathematics; Dr. Frank Clowes, D.Sc., F.I.C., F.C.S. (London and Berlin), Professor of Chemistry; the Rev. J. E. Symes (Cambridge), Professor of Literature.

AN important memorial to Lord Spencer, Mr. Mundella, and the Committee of Council on Education is now in course of signature, urging the more systematic teaching of science in elementary schools. The suggestions are made in prospect of the fundamental changes which are contemplated in the Code. The memorialists urge that in Standards I., II., and III. systematic Object Lessons should be given which should lead up to the more scientific teaching to be required in the higher standards. These Object Lessons should have reference to three main divisions of knowledge. They should include, first, Shape and Size, and the properties of bodies depending on them; second, Properties of Matter, including a knowledge of the obvious qualities of material and implements; and third, Plants and Animals, with a knowledge of their uses. At present the elementary stages of teaching have to do too little with things and too much with words, and the memorialists suggest that the existing standards favour this. The memorial has already received the signatures of Prof. Max Müller, Dr. Caldicott, Mr. Eve, Prof. Meiklejohn, Prof. Carey Foster, and leading members of many School Boards.

AT the Education Society on June 6, with Dr. Gladstone in the chair, a discussion was held "On Science Teaching in Intermediate Schools." After the opening remarks of the President, Miss Franks, Mr. Lake, Prof. Guthrie, Prof. G. Carey Foster, Mr. Cooke, and other gentlemen, gave the results of their experience or expressed their opinions. The main conclusions were: that natural knowledge should be taught, not from books, but from things themselves; that the lessons should not consist of information committed to memory, but of knowledge acquired by the child's own observation and experience; that by such object-lessons he should be led to observe the natural facts or processes around him and to exercise his powers of comparison as well as of perception, and thus arrive at such generalisations as are within his capacity; that after the first more general knowledge of the common things around him the child should be led along the broad lines of interest to some more special departments of science. In this later stage the reasoning powers of the child will be more called into action, and the knowledge of the teacher will be presented in a more systematised and abstract form, but still in such a way as shall best develop the intelligence of the scholar.

THE promoters of the Stephenson Centenary at Newcastle-on-Tyne have determined to commemorate the occasion by erecting, if funds can be obtained, a building in that town for the use of the College of Physical Science, to be called the Stephenson College. It is estimated that a sum of 20,000*l.* will be required, of which 1000*l.* has been promised by Sir William Armstrong, and 2000*l.* by other friends. The Newcastle College of Physical Science was established and endowed ten years ago by the combined efforts of the inhabitants of the town and the University of Durham.

SCIENTIFIC SERIALS

American Journal of Science, May.—Action of frost on the arrangement of superficial earthy material, by W. C. Kerr.—Dall's observations on Arctic ice and the bearing of the facts on glacial phenomena in Minnesota, by N. H. Winchell.—Projection of lines of equal pressure in the United States, west of the Mississippi, by H. A. Hagen.—Neumann's method of calibrating thermometers, with ways of getting columns for calibration, by T. Russell.—William Hallowes Miller, by J. P. Cooke.—Geology of Peace River region, by G. M. Dawson.—Shadows obtained during the glow-discharge, by H. B. Fine and W. F. Magie.—New form of galvanometer for powerful currents, by C. F. Brackett.—American Jurassic dinosaurs, by O. C. Marsh.

THE *American Naturalist* for May, 1881, contains: George Macloskie, the endo-cranium and maxillary suspensorium of the bee.—R. E. C. Stearns, *Mya arenaria* in San Francisco Bay.—H. L. Osborn, the squid of the Newfoundland Banks in its relation to the American Grand Bank Cod Fishery.—A. S. Packard, jun., the brain of the embryo and young locust.

Journal of the Franklin Institute, May.—On the ratio of expansion at maximum efficiency, by R. H. Thurston.—The Wootton locomotive engine, by J. S. Bell.—The efficiency of the *Anthracite's* engines, by C. R. Roelker.—Experiments in Mulhouse on a Corliss steam-engine, described by Chief-Engineer Isherwood.—Repairing a broken crank with wire-rope, by J. C. Kafer.—Concentration of low grade ores.

Annalen der Physik und Chemie, No. 5.—On transpiration of vapours (2nd part) by L. Meyer and O. Schumann.—On the specific heat of chlorine, bromine, and iodine gas, by K. Strecker.—On volume changes of some metals in fusing, by F. Nies and A. Winkelmann.—Thermochemical researches, by C. v. Than.—On the supposed heating of ice, by A. Wüllner.—On the double refraction of light in frictional liquids in motion, by A. Kundt.—New modification of light by reflection on narrow metallic gratings, by J. Fröhlich.—An apparatus for observation of Newton's rings, by L. Sohncke.—Magnetic researches, by E. Warburg.—On the variability of the capacity of condensers with a rigid insulator, by H. Herwig.—Derivation of the electrodynamic laws of induction, by N. Umow.—On the motion of an electric particle in a homogeneous magnetic field and the negative electrical glow, by E. Riecke.—Measurement of the force of terrestrial magnetism on a linear conductor capable of rotation, by the same.—An acoustical apparatus for lecture purposes, by H. Maschke.—Whether electricity, in changing insulating-plates, penetrates into their mass? by W. Holtz.—An old diving-bell, by G. Budde.

Journal de Physique, May.—Photometric studies, by A. Cornu.—Indices of refraction of water in surfusion, by B. C. Damien.—Optical properties of a plate of metal polarised by an electrical current, by G. Lippmann.—On the passivity of iron, by E. Bibart.—Mechanical inscription of Lissajous' figures, by A. Crova.

Archives des Sciences Physiques et Naturelles, No. 5, May 15.—Review of Marsh's work on the Odontornithes, by A. Humbert.—The chemical composition of albuminoid substances (continued). by Dr. Danilewsky.—*Compte rendu* of meetings of the Geneva Chemical Society, by M. Amè Pictet.

Rivista Scientifico-Industriale, No. 8, April 30.—The Gardini battery.—Velocity of sound in chlorine (continued), by S. Martini.—Geological note on the region of S. Vito (Marni), by G. Terrenzi.

Atti della R. Accademia dei Lincei, vol. v. fasc. 11.—On the functions of the urinary bladder, by A. Mosso.—On the physiological action of apoatropine, by the same.—Crystallographic study of two chloroplatinates of Dr. Ciamician, by L. Valle.—Observations on the horizontal diameter of the sun in 1880, by L. Respighi.—New modifications of the process for extraction of arsenic, by F. Selmi.—New researches on the pathological base, and a saccharifying ferment of the urine of a scorbutic patient, by the same.

Sitzungsberichte der physikalisch-medicinischen Societät zu Erlangen, November, 1879, to August, 1880.—On general theta-functions, by M. Noether.—Preparations of human ear-bones for lecture purposes, by L. Gerlach.—On the occurrence of two ampullæ in the outer (horizontal) arch of the bony labyrinth, by the same.—On the excretion of hippuric and benzoic acid during fever, by T. Weyl and B. v. Anrep.—On section-systems of algebraic curves, by J. Bacharach.—On the work-product of muscles, by J. Rosenthal.—On dichroïtic fluorescence on platinocyanides of magnesium; experimental proof of the perpendicularity of the light-vibrations to the plane of polarisation, by E. Lommel.—On the phenomena, in polarised light, of a plate of platinocyanide of magnesium cut at right angles to the optic axis, by the same.—On an artificial lung-cavity preparation, by F. Penzoldt.—On gluten, by T. Weyl and H. Bischoff.—On carbonic oxide hæmoglobin, by T. Weyl and B. v. Anrep.—On vagus-stimulation, by J. Rosenthal.—On unipolar nerve-stimulation and false nerve-stimulation by derived currents, by the same.—On fluorescence, by E. Lommel.—On the invariant representation of algebraic functions, by M. Noether.—On the parasitism of *Elaphomyces granulatus*, by M. Reess.—On poisoning with morels, by E. Bostroem.—On adventive formations, by A. Hansen.—Does the ground-air contain ammonia? by L. Rinck.—On oxygen determination, by F. Zeitler.—Contributions to pathological anatomy, by E. Bostroem.

SOCIETIES AND ACADEMIES

LONDON

Geological Society, May 25.—R. Etheridge, F.R.S., president, in the chair.—Rev. Tom Bullock Hardern, M.A., LL.M., was elected a Fellow of the Society.—The following communications were read:—On the discovery of some remains of plants at the base of the Denbighshire grits, near Corwen, North Wales, by Henry Hicks, M.D., F.G.S.; with an appendix by R. Etheridge, F.R.S., Pres. Geol. Soc. Traces of these fossils were first observed in 1875 by the author in Pen-y-glog quarry, about two miles east of Corwen. Further research has resulted in the discovery of more satisfactory specimens, which have been examined by Messrs. Carruthers, Etheridge, and E. T. Newton. Among them are spherical bodies resembling the *Pachytheca* of Sir J. D. Hooker, from the bone-bed of the Ludlow series, supposed to be Lycopodiaceous spore-cases; also numerous minute bodies stated by Mr. Carruthers to be united in threes, and to agree with the forms of the microspores of Lycopodiaceæ, both recent and fossil; and some fragments, which may belong to these plants, and others, probably belonging to plants described by Dr. Dawson from the Devonian of Canada under the name of *Psilophyton*. The above testify to the existence of a very rich land-flora at the time. Mixed up with these however are numerous carbonaceous fragments of a plant described also by Dr. Dawson from the Devonian of Canada, which he referred to the Coniferæ, but which is, according to Mr. Carruthers, an anomalous form of Alga. The former called it *Prototaxites;* the latter renamed it *Nematophycus*. Numerous microscopical sections, showing the beautiful structure of this interesting plant from the specimens found at Pen y-glog, have been examined by Mr. Etheridge and Mr. Newton, and their conclusions agree with those of Mr. Carruthers. The evidence seems to show that at this mid-Silurian period the immediate area where the plants are now discovered must have been under water, and that the mixture of marine and dry-land plants took place in consequence of floods on rapid marine denudation. The author indicated that the land-areas must have been to the south and west, chiefly islands, surrounded by a moderately deep sea, in which Graptolites occurred in abundance. The position of these beds may be stated to be about 2000 feet below the true Wenlock series, and about the horizon of the Upper Llandovery rocks.—Notes on a mammalian jaw from the Purbeck beds at Swanage, Dorset, by Edgar Willett. Communicated by the President.

Physical Society, May 28.—Prof. Fuller, vice-president, in the chair.—Mr. C. Woodward exhibited apparatus for illustrating wave-motions to a class. This consisted of a number of glass panes of equal size mounted on stands so that they could be ranged in a line or in rank and file. Patches of blue paper were attached to them to represent the moving particle of the wave, the positions being determined by a diagrammatic card which fitted each pane. A machine for showing Fresnel's conception of polarised light consisted of two axles fitted with a number of cranks which supported a roof of rafters bearing at their ridges a number of beads to guide the eye in tracing the wave-motion. By turning the axles the cranks shifted the frame of rafters, and the beads displayed the wave-motion, which was vertical, elliptical, or circular according to the adjustment.—Prof. G. Forbes explained the experiments made by him and Dr. Young to determine the velocity of light. The method employed was that of Fizeau, but instead of having one distant reflector and observing the total eclipse of the reflected ray by a tooth of the revolving wheel, two reflectors, one a quarter of a mile behind the other, were used, and two rays, which were observed when of equal brightness. This method was found more accurate than Fizeau's own plan, and gave curves of brightness. The speeds of the toothed wheel were adjusted until the two rays appeared of equal brightness. The general result was that the velocity of the light of an electric lamp is 187,200 miles per second. Cornu found the light of a petroleum lamp to be 186,700 miles per second, and Michaelson that of the sun to be 186,500 miles per second. The higher number of Prof. Forbes is probably due to the bluer light of electricity, for further experiments made with coloured lights and the spectrum seemed to prove that blue light travels probably over 1 per cent. faster than red light. The experiments were made at Wemyss Bay, in Scotland. Mr. Spottiswoode, P.R.S., said he had followed Prof. Forbes with interest, and these results appeared to modify our ideas of the luminiferous ether. Lord Rayleigh inquired why it was that Jupiter's satellites showed no difference in tint in emerging from eclipse if red and blue rays travelled with unequal velocities? Prof. Forbes believed it due to the gradual character of the emergence of the satellites from behind their primary. According to the new theory variable stars should however seem bluish with an increase of their light. Prof. G. C. Foster pointed out that dispersion of the light in the air would rather have had the effect of retarding the blue rays. Mr. Hall of Baltimore, U.S., then exhibited the experiment in which a current of electricity flowing longitudinally along a thin foil of metal is caused to yield a transverse or lateral current by inserting the foil between the poles of a magnet. The lateral current is observed on a sensitive galvanometer, and care is taken in the first place to find points of connection with the foil, which yield no current before the magnet is applied. The results were that if iron is called + the series is iron +, silver −, gold −, platinum −, tin −. Curiously, nickel, though a magnetic metal like iron, is −; but on inquiry by Prof. Chandler Roberts it proved that the nickel employed was perhaps impure. Cobalt ranges between iron and silver, and is +, like iron. Prof. Perry suggested that the displacement and huddling of the lines of flow of the current by the magnet might cause the current; but Mr. Hall said that an experiment had been tried to test that, and went to prove that it was not due to crowding of these lines.—The Secretary read a paper by Prof. J. H. Poynting on the change of bodies from the solid to the liquid states. There are two types of change exemplified by ice-water and by sealing-wax: in the one a surface melting at the same temperature, in the other a softening of mass and heating. The first was thought by Prof. Forbes to be a limiting case of the second type, but the author gives reasons for supposing that it is rather an exchange phenomenon analogous to what takes place when water evaporates, and the melting-point is reached when the number of molecules passing from the ice to the water is equal to the number passing from the water to the ice. The sealing-wax type is analogous to the change of state in a liquid-gas above its critical point, where it changes gradually from a rather liquid to a certainly gaseous state.

Anthropological Institute, May 10.—Major-General A. Pitt-Rivers, F.R.S., president, in the chair.—Mr. Hyde Clarke exhibited a collection of stone implements collected by Mr. Papadopoulo Keramenes of Smyrna.—Lieut.-Col. R. G. Woodthorpe, R.E., read a paper on the wild tribes of the Naga Hills.—Prof. G. Dancer Thane read a paper on some Naga skulls.

May 24.—Major-General A. Pitt-Rivers, F.R.S., president, in the chair.—Mr. E. H. Man read a paper on the arts of the Andamanese and Nicobarese. After exhibiting and describing the new objects from the Andaman and Nicobar Islands, comprised in the second collection recently presented by him to General Pitt-Rivers, the author gave a slight sketch of the aborigines of the former group; he stated that they are divided into at least nine tribes, linguistically distinguished, and in most, if not all, of these there are two distinct sections, viz. inland and coast men. In confirmation of this

statement Mr. Man read a translation he had made of an account obtained in 1876 from a member of the inland branch of the Awko jûwai tribe, inhabiting a portion of the Middle Andaman, regarding their habits and mode of life, the details of which had since been fully corroborated. In many mental characteristics affinity to the Papuans would appear to exist, and the standard in social and marital relations is shown to be far higher than could be expected from a race so entirely outside the pale of civilisation; the previous accounts of their laxity in this respect are now proved to be erroneous. They have no forms of religion or ideas of worship, and though they have faith in a Supreme Being, the Creator, their belief in the Powers of Evil is much more strongly developed. The habitations of the eight tribes of Great Andaman are of three varieties, partaking almost invariably of the nature of a simple lean-to, while those of the remaining tribe, Jârawa-(da), are somewhat similar in form to the huts erected by the Nicobarese. The rights of private property are recognised and respected; there also appears to be a fair division of labour and perfect equality between the sexes in their social intercourse.—Dr. Allen Thomson, F.R.S., read a paper on some bone necklaces from the Andaman Islands. Several of the specimens exhibited by the author were constructed entirely of human bones, while some were composed of bones of various animals, and others were partly made up of pieces of coral.—Mr. J. Park Harrison, M.A., exhibited an incised slate tablet and other objects from Towyn. The figures upon the slate appeared to represent celts, urns, &c.

Photographic Society, May 10.—J. Glaisher, F.R.S., president, in the chair.—Mr. Leon Warnerke read a paper on a new discovery regarding gelatine emulsion. This consisted in the observed fact that when gelatine emulsion has been submitted to the combined action of light and pyrogallic acid, it becomes insoluble in warm water; a gelatine negative is transferred to glass or paper, and from the back, with warm water, all parts not acted upon by light and the developer can be washed away; consequently a solvent of the silver not acted upon, such as hypo-sulphite, becomes unnecessary, and the remaining film or picture is left intact, and from its purity can be reacted upon in many ways hitherto extremely difficult or impossible. This discovery also becomes valuable in its application to the Woodbury printing process, phototype printing, and burnt-in photography on ceramic ware.

Institution of Civil Engineers, May 31.—Mr. Abernethy, F.R.S.E., president, in the chair.—The paper read was on "The Production of Paraffin and Paraffin Oils," by Mr. R. Henry Brunton, M.Inst.C.E.

PARIS

Academy of Sciences, May 30.—M. Wurtz in the chair.—The following papers were read:—Memoir on the temperature of the air at the surface of the ground and down to 36 m. depth, also the temperature of two pieces of ground, the one bare, the other covered with grass, during 1880, and on the penetration of frost into these, by MM. Becquerel. The effects of the severe cold receive special attention. The screening influence of snow is shown. *Inter alia*, the propagation of frost is slower in grassy ground than in bare ground. In the latter the rate increases very slightly with the depth, the propagation being very regular. In grassy ground the increase is very notable, and with increasing depth, the rate tends to come near that in bare ground. Each layer of ground is subject to two calorific effects: one due to variations of external temperature; the other to the action of deep layers which tend to give a constant temperature.—On rabies, by M. Pasteur, with MM. Chamberland, Roux, and Thuillier. The seat of the virus is not in the saliva alone; the brain contains it, and the authors have successfully inoculated with brain substance. They have also succeeded in shortening the time of incubation, inoculating directly the brain of a dog with cerebral matter from a mad dog (and having recourse to trepanation).—Nebulæ discovered and observed at Marseilles Observatory, by M. Stephan.—On the theory of motion of celestial bodies, by M. Gyldén.—On a new means of accelerating the service of canal-locks, by M. De Caligny.—On the genera *Williamsonia* Carruth. and *Goniolina* D'Orb (continued), by MM. de Saporta and Merion.—Observation and elements of the comet *a* 1881 (L. Swift), by M. Bigourdan.—On Fuchsian functions, by M. Poincaré.—Algebraic relations between the superior sines of a given order, by M. Rouyaux.—On the sines of superior orders, by M. West.—On the discontinuous phosphorescent spectra observed in almost perfect vacuum, by Mr. Crookes. M. Edm. Becquerel recalled his own spectroscopic studies of the light of phosphorescent substances and his excitation of such substances by submitting them to the discharge in vacuum tubes (in which case the rise of temperature and the electric light itself complicated the effects).—New interrupter for induction-coils, by M. Deprez. A claim of priority (to M. Ducretet) on the conical mirror; reply to a communication of M. Pifre, by M. Mouchot.—Discussion of the theory of three fundamental colour sensations; distinctive character of these colours, by M. Rosenstiehl. Certain properties attributed to primary colours do not belong to them exclusively, *e.g.* their producing all perceptible colours when mixed two and two, and the sensation of white arising from the three fundamental sensations being excited equally. The fundamental property of the primary triad is stated to be that colours situated on either side of a primary colour (in the graphic triangle) and equidistant to sight have their complementaries so near together that it becomes difficult to distinguish those which are consecutive.—On the oil of wild thyme, by M. Febve.—On geological microzymas; reply to MM. Chamberland and Roux, by M. Béchamp.—On a vanadate of lead and copper of Laurium, by M. Pisani.—On the existence of the Cambrian formation at Saint Léon and Châtelperron (Allier), by M. Julien.—On the coal-formation of Commentry; experiments made with a view to explain its formation, by M. Fayol. He reproduced the conditions and effects on a small scale by means of basins with a constant level of liquid, receiving currents of water with pebbles, sand, clay, coal, plants (previously immersed some time, so as to sink in quiet water), &c.—Movements of the frog consequent on electric excitation, by M. Richet. Frogs (intact) show great resistance to electric stimuli. (Two Thomson elements were used, with a coil.) The response to a single stimulation of the leg or sciatic nerve was generally more than 0·15 seconds after; the delay was oftener half a second, sometimes as much as ten seconds. With repeated excitations the reaction is sometimes extremely slow. In general the response is more rapid the stronger the excitation. Fatigue comes quickly. Excitations of the sensibility stop voluntary movements. The general movements of flight or defence in intact frogs, on electric excitation, seem to be determined by the bulb. Are they (M. Richet asks) reflex or voluntary?—On symmetrical vaso-motor actions, by MM. Teissier and Kaufmann. Under certain conditions the reverse of the law established by Brown-Séquard and Tholozan holds good; a capillary dilatation on the left side, *e.g.* will produce a vascular constriction on the right side, or *vice versâ*.

VIENNA

Imperial Academy of Sciences, June 2.—M. Burg in the chair.—E. Hornstein, contribution to a knowledge of the system of asteroids.—Prof. S. Stricker, on the law of convulsive action.—Dr. Ludwig Langer, on the chemical composition of human fat at different ages.—Prof. E. Zuckerkandl, on the communications of the venæ pulmonales with the bronchial veins and the veins of mediastinum.—Prof. W. Loebisch and Dr. A. Loos, on glycerin-xanthogenates.—Dr. P. Wesselsky and Dr. R. Benedikt, on hydroquinonic and orcinic ethers.—Dr. L. Szajnocha, contribution to a knowledge of Jurassic Brachiopoda of the Carpathian rocks.—Prof. T. Finger, on an analogon to Kather's pendulum and its use for measuring gravitation.—Dr. S. Ehrmann, on the determinations of nerves in the pigment-cells of frogs' skin.

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