THURSDAY, FEBRUARY 28, 1878

SNAKE POISON

EVERY now and again the British public is horrified by accounts of the famines which periodically carry off myriads of our fellow-subjects in India, but comparatively few have the least idea of the enormous destruction of human life which occurs there from the ravages of wild animals and venomous snakes. In a most interesting lecture recently delivered at a meeting of the Society of Arts by Sir Joseph Fayrer, the lecturer estimated the loss of life at no less than 20,000 human beings and 50,000 head of cattle annually. Wild animals destroy most of the cattle, but venomous snakes kill more human beings than all the wild animals put together. The bites of these reptiles caused the death of 17,000 persons, and over 3,000 cattle in the year 1875, and these figures very probably understate the facts, as the returns upon which they are based are incomplete. The desirability of obtaining an antidote to snake poison is thus evident, and many attempts have been already made to discover one. Another has been added to the already numerous investigations on this subject by Mr. Pedler, who has lately published the results of his research in a paper read before the Royal Society. Before proceeding to seek for the antidote, he endeavoured to analyse the poison chemically, and thus discovered several facts of great interest. The venom of snakes seems to contain very much the same proportion of solids at all times, even under such different climatic conditions as during the wet and dry seasons. It may be kept for two or three months without alteration, but if preserved for a year or eighteen months, it becomes insoluble, and, to a great extent, loses its poisonous qualities. Its composition is very like that of albumen, and, indeed, the dried poison, which looks very like gum arabic, contains about sixty per cent. of albumen, and only forty per cent. at most of the poisonous principle. By the use of solvents, Mr. Pedler endeavoured to separate a crystalline principle, such as Lucien Bonaparte affirmed to be present in the poison of the rattlesnake. His attempts were unsuccessful, and he therefore tried to obtain it by dialysing the poison through parchment paper. Part of the poison dialysed, and part did not. On evaporating the fluid inside the dialyser, the residue formed a gummy mass, with a poisonous action. The water outside the dialyser also gave a similar result, but in it a few crystals could be detected. It was, if anything, rather more poisonous than the ordinary virus. He did not succeed, however, in obtaining any very definite crystalline substance. Ammonia, which has lately been highly recommended as an antidote in snake poisoning, he found, as did Fontana two hundred years ago, to be useless, and indeed its addition to the poison before injection seemed really to hasten death.

Some organic poisons may have their physiological action greatly altered by changing their chemical constitution. Thus strychnia has its action completely altered by combination with iodide of methyl, so that instead of producing convulsions, it causes complete paralysis, like curara. At the same time its deadly power is greatly diminished, and it occurred to Mr. Pedler that the poisonous properties of cobra virus might be diminished in a similar way. On testing this supposition, he found it to be correct, as the poison, after digesting with ethylic iodide, took five times as long to kill an animal as fresh cobra poison would have done. Hydrochloric acid also diminished the activity of the virus, and platinum chloride had a still more powerful action. This salt seems to combine with the poisonous principle of cobra virus, forming with it a yellow amorphous precipitate, which is very insoluble in water, and which has little or no poisonous action. This result of the action of platinum chloride on cobra virus out of the body is most satisfactory; but this apparent antidote has not the same power when the poison has once entered the system. When the poison is injected under the skin and the platinum chloride is injected shortly afterwards into the same spot, death appears to occur even more quickly than when no antidote whatever is used, the second injection seeming to drive the poison before it and to cause it to act more rapidly. When the platinum chloride, however, is injected at the same point, but somewhat more deeply than the virus, so that in passing inwards the poison might come in contact with the platinum, life is considerably prolonged. If a short time elapses between the injection of the poison and that of the platinum, death ensues, even though the interval be only one or two minutes. It would thus seem that when the platinum chloride is brought directly into contact with the poisonous principle of the cobra venom it renders it insoluble and prevents its poisonous action, but that it is not a physiological antidote, and will not counteract the deadly action of the virus after it has once entered the circulation. It may be useful as a local application, but cannot be regarded as an antidote. Every means hitherto tried of counteracting the effects of cobra venom has thus proved ineffectual. Artificial respiration, proposed by Sir Joseph Fayrer and Dr. Lauder Brunton, gave fair promise of success, and by its use the heart may be kept beating for many hours. Indeed in one case an animal apparently dead for many hours has been partially revived by it, yet on no occasion has a fatal issue ever been averted by its use. The experiment just mentioned was performed by a commission appointed by the Indian Government, at Sir J. Fayrer's suggestion, to examine into the modes of preventing death from snake bite. A dog was bitten one afternoon by a water snake, and apparently died about three o'clock. Artificial respiration was at once commenced, and the heart continued to beat, but the animal seemed to be perfectly dead, and the limbs no longer responded to electrical stimuli. Early next morning, however, an alteration took place. The limbs again answered to electricity, voluntary movements occurred, and the eyelids closed not only when the eye was touched with the finger, but when the hand was simply brought near it. This showed that the animal could see the approaching hand, and closed its eyes in order to protect them from the expected touch. The dog seemed to be in a fair way to recovery, but about noon it began to get worse, and finally died at three o'clock on the second day, twenty-four hours after its first apparent death. Whether a combination of artificial respiration with

other appliances may yet enable us to prevent death altogether, is a question which can only be determined by a continuance of those experiments which led to the use of artificial respiration alone. But however valuable such a method as this may occasionally be in saving the lives of English officers, government officials, or persons living within reach of skilled assistance, and who might otherwise be doomed to certain death from the bite of a cobra, it is obvious that it is too complicated to be of much service to the numerous natives who are bitten in localities where no other assistance can be had than that of their comrades, equally ignorant with themselves. If any great diminution is to be effected in the frightful mortality annually resulting from the bites of venomous snakes in India, the remedies must either be so simple and easy of application that they can be used by the most ignorant, or the snakes must be destroyed. The best instructions yet given for the treatment of persons bitten by poisonous snakes are contained in Sir Joseph Fayrer's magnificent work on "The Thanatophidia of India." He recommends that a tight ligature be applied to the limb above the bite, that the bitten part be cut out as quickly as possible, and that the wound thus left be cauterised with a hot coal or hot iron, or touched with nitric or carbolic acid, while brandy or ammonia should be administered internally. Even this treatment, simple though it be, requires knowledge, as well as instruments and skill, which the majority of the natives do not possess. Sir Joseph Fayrer therefore recommends that in every police station and public place plain directions should be printed and hung up, and that at all such places a supply of whipcord, a small knife, a cautery iron, and a bottle of carbolic or nitric acid should be kept, as well as a supply of liquor ammonia for internal administration. But, as Sir Joseph Fayrer says, although comparatively little is to be expected even from this rational mode of treatment, much may be anticipated from prevention, and it is to be effected by making known the nature and appearance of the venomous as distinct from the innocent snakes, and by offering rewards (to be judiciously distributed) for the destruction of the former. The differences between many of the non-venomous and the venomous snakes are not known to the natives, and it is important that a knowledge of such distinctions should be widely disseminated, not only that the venomous ones may be more easily recognised, and thus avoided or destroyed, but in order to prevent death or serious illness from sheer fright, which may frequently result from the bite of a non-venomous species. For this purpose it would be well if the pictures of the chief venomous snakes contained in Sir Joseph Fayrer's work, or cheaper but accurate lithographic copies of them, were displayed in every police station and public place throughout India. Rewards should be paid for the destruction of venomous snakes only, and if these pictures were exhibited in the way suggested there would be little or no excuse for any mistake, either on the part of the natives who killed the snakes, or the officers whose duty it would be to pay the reward. As to the amount of reward, and its mode of distribution, there should, he suggests, be a department, or branch of a department, with a responsible chief and subordinate agents, for whom certain rules should be laid down, to be observed steadily and without hindrance throughout the country, leaving much, as to detail, to the discretion of local authorities. If the destruction of venomous snakes and wild animals in India were intrusted to an officer such as controls the Thuggie and Dacoitee department, he considers that the result would in a few years be as good in the case of noxious animals as it has been in that of noxious men, Thugs and Dacoits.

THE BEETLES OF ST. HELENA

Coleoptera Sanctæ-Helenæ. By T. Vernon Wollaston, M.A., F.L.S. 8vo, pp. i.–xxv., 1–256, coloured plate. (London: Van Voorst, 1877.)

THIS, the last of its lamented author's valuable descriptive works on the geographical distribution of beetles (in personally collecting the material for which, it is to be feared that his physical exertions during a weak state of health induced the attack that ended recently in his death), must have been the most satisfactory to him, on account of the complete isolation of its subject, and his discovery of its most striking endemic fauna. The investigation of the *Coleoptera* of the Madeiras, Salvages, Canaries, and Cape-de-Verdes, with which his name will always be associated, had already resulted in a firm opinion that their peculiar beetle-types could not be satisfactorily referred to any geographical area now existing, but rather to some submerged Atlantic region, of which these groups are the modern representatives; and the results of his exhaustive work at St. Helena cannot have failed to materially strengthen this idea. Curiously enough, also, the most dominant type in this island is one to which Wollaston was always specially devoted, viz., the *Cossonidæ*, a little known family of weevils, whereof the inordinately numerous species here found, consisting of variations of some half-dozen forms occasionally developed to so marvellous an extent as to be almost ludicrous, amply justified his expression (*in litt.*) that he had "tumbled on his legs in this little oceanic preserve of the southern Atlantic."

To any one interested in the faunæ of islands, no better conditions could be afforded than those found in St. Helena. Its vast distance from the nearest continents (nearly 1,200 miles from Africa, and 1,800 from South America) and, indeed, from the nearest island (Ascension, 700 miles), added to its complete severance by a fathomless depth at a mile and a half from its present coast-line, are premises of themselves suggesting the probability of abnormal resident forms; and the peculiar and very dense original vegetation of ebony, redwood, boxwood, *Psiadia*, asters, gumwood, cabbage-palms, tree-ferns, &c., would reasonably be expected to foster a development of special wood-feeding types, to the partia or entire exclusion of other groups. This development, anticipated by Wollaston from the eccentric species received in former years, is wonderfully illustrated by an analysis of the present work. In it, 203 species are recorded, and may probably be taken as very nearly exhausting the fauna, since the author captured, mounted, and examined (with a delicacy, precision, and care peculiar to himself) no less than 10,000 specimens. Of the difficulty attending the collection of such a mass in six months, the author affords an indication by his remark

(*Entomologists' Monthly Magazine*, xii. p. 252) that the net may be used over miles of grassy mountain-slopes without finding a single flower-frequenter, or anything approaching to it. Under these conditions, it is not to be wondered at that Mr. Melliss's account of the island, not long ago reviewed in NATURE, should, as not representing the work of an expert, have failed adequately to represent its peculiar coleopterous features. Of the 203 species above mentioned, fifty-seven have undoubtedly been conveyed to the island through various external media, and have since established themselves—many of them, indeed, being the regular followers of civilisation. Seventeen of the remainder possess doubtful claims to be considered indigenous, or even to have been taken in St. Helena at all. Of the 129 species left, and which may be safely deemed endemic, the distribution is highly eccentric. Whole groups, hitherto regarded as well-nigh cosmopolitan, are either entirely absent or barely represented; and one section, the weevils, is most unduly exaggerated, especially in one of its families. The missing divisions are water-beetles (both *Hydradephaga* and *Philhydrida*—the aquatic *Carnivora* and *Herbivora*), and *Longicornia;* and their absence is the more noteworthy, as proper natural conditions exist for both of them; and, as to the latter, other wood-feeders have inordinately increased and multiplied. The *Necrophaga* (a wide term, covering many families of universal distribution, including bone-, skin-, and fungus-feeders, acting as natural scavengers, and whereof we have, even in Great Britain alone, over 450 species) and *Trichopterygia* have each but a single representative. The *Pseudotrimera* (*Coccinellidæ*, &c.) and *Lamellicornia* can each only supply two. As to the former of these groups, Prof. Westwood has well observed that the inference is a want of *Aphides* and other plant-lice, on which lady-birds are the natural parasites; and on this point it would be interesting to know if the usual Homopterous vegetable-feeders are really wanting. If not indigenous they might be readily introduced; and, enumerating even the avowedly introduced *Pseudotrimera* in Mr. Wollaston's list, we find only four species to keep them down, since the *Corylophidæ* and *Erotylidæ* included in the group by the author cannot be reckoned. As to the Lamellicorns, the want of indigenous mammals would readily account for the absence of such of them as feed on the excreta of those animals (*two* only, both introduced, can be found; here Baron von Harold would assuredly perish of inanition!); but the mighty tropical clan, revelling in rotten wood, should surely in such a latitude, with the decaying forests of centuries for pabulum, have reared more than the miserable tale of four, whereof but two are autochthones! Next in number come the *Priocerata* and *Phytophaga*, respectively counting but three. The *Elateridæ* and *Anobiidæ*, essentially wood-feeders, are the only families of the first of these that provide indigenous species: how they have failed to produce more is incomprehensible. The fact of plant-feeding beetles being of the greatest scarcity has been already quoted from the author himself, and is equally unintelligible. The *Staphylinidæ* and *Heteromera* each supply six indigenous forms, the paucity of the latter being perhaps accounted for by the lack of those sandy wastes peculiarly affected by so many of its members. Next in importance come the *Geodephaga*, or land carnivorous beetles, whereof as many as fourteen (in fact all but one, and of them no less than eleven here described as new) are recorded. Here, again, the peculiarity of the island is emphasised, as the eleven new species, all of the genus *Bembidium*, depart widely from the shingle-, mud-, and marsh-frequenting habits of that vast and widely distributed genus, occurring as they do in the high central mountain ridges, and living inside the fibrous stems of rotten tree-ferns, an unexpected habitat as strange as that recorded in the Horatian lines:—

> "Piscium et summa genus hæsit ulmo,
> Nota quæ sedes fuerat columbis."

These arboreal Bembids have necessitated the creation of three new sub-genera, distinguished by abnormally minute eyes, want of wings, rounded outline, fossorial legs, and moniliform antennæ; and would alone have been sufficient to have stamped the fauna as *sui generis*.

Last, and most important, come the *Rhynchophora* or weevils, with no less than ninety-one representatives, more than two-thirds of the whole number. These again are represented in unusual proportions, the *Cossonidæ* numbering fifty-four, two-fifths of the entire fauna (we have in England but nine, out of 3,000 species), and the *Anthribidæ* twenty-six. The conclusion derived by the author is, that, as these weevils unquestionably represent the dominant autochthonous family, and all (but one) are of lignivorous habits, St. Helena may be pictured in the remote past as a densely-wooded island, in which they performed their natural functions of tree-destroyers among tree-ferns and *Compositæ* on a gigantic scale, unaided by the usual timber-eaters. The well-nigh complete destruction of indigenous trees in modern times has no doubt been accompanied by the loss of many a link in the aboriginal chain of these peculiar forms. Those that still survive are of such eccentric structure and facies that the creation of eleven new genera and forty new species has been necessitated for their reception in the present work, which, had it been the sole production of its author, would have effectually prevented his name from passing into oblivion.

E. C. RYE

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.*]

Oxygen in the Sun

ATTENTION having recently been directed by Dr. Schuster and Mr. Meldola, in connection with my discovery of oxygen in the sun, to the location of the oxygen, it may be of interest to allude to some experiments to determine the question by direct observation of the image of the sun spectroscopically. For this purpose I used a spectroscope furnished with a very fine grating on silvered glass given to me by Mr. Rutherfurd. This grating of 17,280 lines to the inch can be arranged to give a dispersion equal to twenty heavy flint glass prisms. The spectroscope was attached to my 12-inch Clark refractor, and I employed the full aperture of this telescope to produce an image of the sun on the slit. It did not seem practicable to use the spectroscope on the 28-inch Cassegrain reflector in this research, because the tremulousness of the air was usually too great, the image of the

sun being magnified to five inches in diameter. Even with the 12-inch refractor the occasions suitable for a critical examination are rare.

In front of the slit I also brought the terminals of the secondary circuit of an induction coil, which were connected with a Leyden battery. The current through the primary wire of the Ruhmkorff was furnished by a Gramme machine. This arrangement permitted the production of a strong oxygen spectrum near the spectrum of the sun's limb.

The most obvious point to determine was whether the oxygen lines visible in the spectrum of the solar disc projected beyond the apparent limb of the sun as seen in the spectroscope; in other words, whether oxygen could be detected in the lower parts of the chromosphere. For this purpose I looked particularly at the bases of the prominences. I saw a large number of reversed lines, including some of the more delicate lines of Young's preliminary catalogue, but on no occasion could I be sure that the oxygen lines were seen outside of the limb. Of course, unless such an observation could be made in a perfectly tranquil atmosphere, certainty could not be attained. The experiments were terminated temporarily on account of getting my right arm caught in the engine, but they will probably be resumed next summer.

On examining Prof. Young's catalogue of chromosphere lines made at Sherman Station, in the Rocky Mountains, it appears that he does not note the great oxygen group near G, and as his observations were made with remarkable accuracy and care, this would tend to corroborate the view that the bright-line spectrum of oxygen as seen on the sun's disc must have its upper limit close to the apparent spectroscopic limb of the sun.

HENRY DRAPER

Observatory, Hastings-on-Hudson, New York, January 28

Brain of a Fossil Mammal

IN NATURE (vol. xvii. p. 222) is an account of some remarkable characters of the brain of *Coryphodon*, as determined by Prof. Cope, and recently published in the *Proceedings* of the American Philosophical Society, vol. xvi. It may interest some of the readers of NATURE to know that the subject had been previously investigated by the writer, who published a description and figures of the brain cast of *Coryphodon* in the *American Journal of Science*, vol. xi. p. 427, May, 1876, more than a year before the article above quoted appeared. Prof. Cope made no reference to my paper, although perfectly familiar with it. His figures moreover do not represent, even approximately, the brain of *Coryphodon*, owing to serious errors in his observations, which were based upon an imperfect specimen, as I have shown elsewhere (*American Journal of Science*, vol. xiv. p. 83). One of the most glaring of these errors is seen in the supposed olfactory lobes which, as figured, include no small part of the nasal cavities, and naturally add a very remarkable feature to this brain cast. The specimens from which my figures and description were taken are in excellent preservation, and are in the Yale College Museum, where they have been examined by Prof. Huxley and many other anatomists.

The attention called by NATURE to this paper of Prof. Cope's makes the present correction seem necessary for English readers, especially as the paper quoted is a typical one, illustrating the methods and work of its author. O. C. MARSH

Yale College, New Haven, Conn., February 7

Origin of Tracheæ in Arthropoda

IN NATURE (vol. xvii. p. 284) is a notice of a work by Dr. Palmen, of Helsingfors, on the morphology of the tracheal system. From the wording of the notice it appears as if the views of Dr. Palmen as to the origin of tracheæ from skin-glands, and as to the importance of Peripatus as an ancestral form of the Tracheata, were new to science. I was, to the best of my belief, the first to discover that Peripatus was provided with tracheæ; and in a paper on the structure and development of *Peripatus capensis*, published in the *Phil. Trans.* for 1874, I discussed the question of the origin of tracheæ, and put forward exactly similar views to those cited in your notice. These views have been adopted by Prof. Gegenbaur in his new edition of his "Grundriss der Vergleichenden Anatomie" (1878), in so far at least as that Peripatus is placed in a separate division of the Arthropoda, "the Protracheata." Haeckel, following Gegenbaur, supposed his Protracheata to have been provided with tracheal gills, but the diffuse arrangement of the tracheæ in Peripatus led me to conclude that the ancestral tracheata were terrestrial, and not aquatic, in habit, and that tracheal gills were comparatively late developments.

I am very glad to find that Dr. Palmen has arrived at similar results. Unfortunately, the place of publication of his treatise is omitted from your notice. It would be of value if you saw fit to append the reference as a note to the present letter.

Exeter College, Oxford H. N. MOSELEY

[Dr. Palmen's paper was published in Helsingfors.—ED.]

The "Phantom" Force[1]

III.

WHILE very clearly establishing that it is to the force urging a body that the potential energy which the body *has not*, but can have, must properly be assigned, and calling it very appropriately the "energy of tension,"[2] a very apposite remark (which I do not remember to have met with before) is added by "X" in his concluding paragraphs. The body could not command this "force-work" in any position unless it had *been put* into the proper position to command it; and the *actual energy* spent in putting it there *is the* "energy of tension" which, although forfeited to the force, *it can* reclaim. In this view it is not surprising that potential energy should have the same terms for its measurement as actual energy, since it is nothing but the actual energy which the body, or some agent operating upon it, has really lost; and if we pass from permanent forces to those ephemeral ones which physical agents can produce on an already existing arrangement of bodies, then, according to the existing configuration of the bodies when the force is generated, and in proportion to the "potential," or to the available statical energy developed, so is the work of the agent used to bestow this energy. In these cases of temporary "potentials" the actions are not actions at a distance, but through an intermediate medium, it may be strung with motion, and with permanent forces, which have absorbed the work applied to put the intervening medium, as it were, on the stretch, and to develop the ephemeral energy of tension. But we recognise this very clearly (as for instance in charging well-insulated electrical conductors) only in the rare cases of reversible arrangements. The fatigue and exhaustion which we soon feel when holding out at arm's length a heavy weight (although we do no work upon the weight) arises, for example (like that of a galvanic battery exciting an electro-magnet and supporting a heavy armature), from two causes, the first of which, the excitation of the magnet and armature, and the tightening of the muscles, or producing the requisite statical energy for the occasion, absorb but a small portion of the work. The main expenditure is "frittered away" (a most expressive description of the process, which I owe to Prof. Tait) in aimless and random paths as heat, by the wasteful process of electrical or muscular currents afterwards kept up to maintain the excitation.

I have thus far sketched out a general view of physics (one which is perfectly adapted to satisfy its general requirements), in which self-balancing actions and reactions, only depending in intensity on the distance between their centres are supposed to be permanently implanted in pairs of material particles, a special case, or fresh assumption regarding the general system of forces contemplated in the Newtonian theory of mechanics, which either may, or may not be the complete theory of their action, but which assists the mind very greatly, by giving them a mechanical explanation, in forming true and correct preliminary notions of the two leading laws of the great modern science of energy. And here I may take the opportunity to mention that my own views of the relationship of modern physics in its various mutually dependent branches to that famous foundation of mechanics which Newton laid (or perhaps I should rather say, since the supremacy of mechanics is by no means yet conceded, of the Newtonian basis of mechanics to modern physics) have been mainly imparted and completed by a perusal of the excellent little manual on "Matter and Motion" by Prof. J. Clerk

[1] Continued from p. 322.

[2] The term "statical energy" introduced by Sir W. Thomson (see a note in Prof. Tait's "Sketch of Thermodynamics," p. 52), and now proposed (NATURE, vol. xvi. p. 521) by "W. P. O." to be substituted for the above, is of all the phrases yet used to denote it, the truest and simplest description of its real character. That it appertains to the force and not to the body is apparent both from this name and from the definition (which I have endeavoured to illustrate) that it is the "work" of the "agent," a property or possession of *that individual*, equal and opposite to, but *not the same* as its "net," or effected work.

Maxwell, reviewed by Prof. Tait in NATURE (vol. xvi. p. 119), a very moderate acquaintance with which has sufficed to remove from my mind all the doubts and perplexities which, without such assistance, must beset every cultivator of physics and mechanics attempting to take a comprehensive view of these two parallel sciences in their close relations to each other. The latter science especially, mutilated and deformed, and roughly scattered up and down in fragments, as we commonly find it represented, wears in general in our crude brains and in ordinary practice very much the same dismembered aspect which physics in its numerous subordinate branches presents to those who devote their attention especially only to some particular one of its departments.

But the new and comprehensive science of energy has, besides, its own special debatable region, in much the same way that mechanics has, although of an entirely different description; and however cheerfully we might consent, by basing all the propositions of mechanics (a perfectly possible proceeding, as has here been indicated) upon a system of permanent and reciprocal force-pairs, to include among the vicissitudes of force-action, besides its own clearly distinguishable phenomena, also (with countless impenetrably hidden fields of operation) all the known agencies of its more versatile and less easily definable kindred science of energetics, yet it can scarcely be regarded as immediately desirable, in the absence of sufficiently abundant proof, to make this assumption; nor is it perhaps expedient, on the new account just mentioned, to take it too readily for granted as a sound and simple basis of the leading laws of the new science, until the field of phenomena which the latter are framed to include is itself so clearly defined and circumscribed, as not to offer in its own relations and conditions objections to the course which may seem to contain in them anything which may prove to be insuperable, or which might very quickly lead to its abandonment.

To assert the principle of virtual velocities concerning the agent force, although we can voluntarily enlist the action of this agent in mechanical combinations, does not necessarily compromise our free will in any way, because the manner of enlisting this servant of our will cannot be definitely, and in a scientific point of view completely specified as the necessary form which the exercise of volition must take; and accordingly no natural law which completely binds and describes any force, can possibly describe and define also, as completely, the volition which produces it. But even if the volition concerned in producing a force were, as a cause, completely definable, and if we may assume that pure inductive science is capable immediately of so describing it in part, and of ultimately (in its indefinitely achieved development) reaching no partial or imperfect view of every process of volition, so as to be able with assigned actions of will to construct a perfectly unerring plan of all the operations of a Providence subjected to these conditions, and to trace without a single fault or discontinuity the whole current of consequent events belonging to them, yet it is evident that the result would lack an element of genuineness, of whose absence we should immediately be conscious as rendering it an inadequate and unauthentic represesentation of the operations of that perfect will and of that Divine Omnipotence, to whose purposes we owe the obedience and the entire subserviency of our wills in all our actions. This moral obligation of our actions springs from a side of our natures *truly* unseen, but to which we owe dictates of our actions as quick and spontaneous as those which come endorsed with reason to us from our natural senses. On the other hand, to suppose that reason will ever bridge the gap which divides inanimate from living agency, and will be able to register perfectly on her tablets (in the way just now supposed) every event of volition, is as visionary as to suppose her capable of apprehending and of taking a measurable account of the purposes of those actions which we hold to be inspired. But in the part which reason plays as a faculty given to us for learning wisdom and for seeking after and cultivating virtue from our cradles, in all the vicissitudes of life, there appears to be no break or interruption to its ownward progress, though its goals may be partly invisible and partly unattainable; and "new forces" in nature must evidently lie abundantly along its path. The "forces" of living beings, in particular, are inscrutable to it, and those of humanity at least must especially be so, for two reasons, a *moral*, as well as a vital or organic one, both differently descriptive of the ultimate constitution of our free will. If, therefore, there appears no ground (as I believe that Hirn's, and perhaps other experiments, have shown) for introducing an exception of living agents in the law of conservation of energy, perhaps the progress of physiology and of biological physics may also show that to make the same exception in the law of dissipation, or of the loss of availability of energy in every action, is equally incapable of substantiation could we see those forms of energy which we, and other living beings, make use of in apparently transgressing the generality of this law by partially restoring their availability to some very obvious forms of energy.

In this view of infinite progress of investigation, energy must keep its form of energy of motion, or of such energy converted into work of "agents;" and from what has been above described, it is not necessary that the work of these agents should be the energy thus abandoned in *a new kinetic* form. All the actions of an agent *can be imagined* to be consequences of special kinds of motion, but of what advantage it may be *to suppose it*, when in the midst of conceptions so distractingly profound and unapproachable as encircle the new science of energy, an agent as simple and intelligible as mechanical force is presented to our understanding as an example of what an agent of will and purpose may perhaps be like, it is very difficult to reflect upon and comprehend.

At the outset of this long-since-begun, and now quite-differently-concluded letter from what I contemplated, I proposed, in connection with Mr. Crookes' famous series of investigations (especially those last crowning points of his discoveries in which vacua so perfect were produced as fairly to eliminate the principal cause of rotation of the arms of a radiometer, originally recognised in the action of residual gas), to point out some means by which, in vacua so complete, the mode of action of force might possibly be elucidated by experiments. A beam of rays, bent and reflected, for example, so as to fall at grazing incidence from the right or left on a flat end, instead of on a vane of one of the arms of a very perfectly-exhausted radiometer, might be found to move it sensibly, and perhaps more distinctly, as the exhaustion reached its limit, in opposite directions corresponding to the directions from which the beam grazed the face, which it would be difficult to attribute to molecular impacts of the residual gas; and in the action of such an external, and to all ordinary perceptions quite uncounterpoised, force (supposing radiation really to produce it), a field of new discoveries relating to direct mechanical effects of the luminiferous ether would obviously present itself, which would be of the highest interest and consequence. But as regards the interpretation of any effects which might be observed, especially in connection with new views of the nature of potential energy which they might open out, I prefer now to refrain from offering any hints or suggestions, knowing that any inquiry which offers prospects of studying force under a new aspect, cannot be guided and directed beforehand, so as either to establish or confute any of the already well-proved laws of its action, but that in the broad principles which the science of energy presents for our consideration and development it could only be prosecuted as a new science, a new branch of general physics contributing something like its predecessors (heat, radiation, chemical action, electricity, &c., but *what* we should attempt in vain to picture to ourselves) in the capacious science of energy, as a new ascent towards that lofty pinancle to which in common with several other natural sciences energetics also proposes to raise itself in the end, to contemplate the Divine works of True Beneficence and to discern in the stately Temples of the Universe the allotted place of man.

These are some of the teachings of the radiometer which rose up before me when in an unguarded moment I asked myself the question: What change from the point of view of energy conservation would it introduce into our view of the experiment if, supposing that a force were found to actuate the vane of a radiometer, which was a direct effect of radiation, we were to sacrifice the integrity of Newton's third law of motion by assuming the existence of a new class of forces which act alone unaccompanied by any equal and opposite reaction?[1] The answer here must be that *if energy is still to be conserved* (that is to say, if we can *point out the source and destination* of all the work that is performed), *there must be a law in* these outer forces connecting them *with known physical agents* in such a manner that as much work is done upon them in any assigned change of configuration as is supplied by those physical agents in the change, and as the internal forces and other agents in the changing system also furnish by their action. (See Prof. Clerk Maxwell's definition of a "conservative system" in "Matter and Motion," p. 59, where the action of internal forces is excluded by supposing the system to

[1] Reaction is not meant here, of course, to imply Newton's imaginary "resistance of an acceleration;" but the real active tendency of some equal opposite force only, is meant to be understood.

return to its original configuration). In other words, we cannot suppose energy to be conserved unless we *connect the new forces by some fixed laws* with known and already determinate physical agents, and we must be content to regard the system *as non-conservative* until the necessary physical connection is assigned and introduced which will account for the free forces that we have observed, and will allow us to comprehend their action under the known laws of inanimate natural agency. This way of dealing with the work of "external forces" on a system which the new science of energy has devised, and shown to be the only one which in these cases can be generally employed, has perhaps contributed (but only by the unavoidable abstruseness and abstractness which belong to the new science itself) to invest with something of the appearance of a "phantom" and with an air of mystery, the character of force, and the laws of its operation as they have been universally studied in mechanics. But rightly regarded according to the simple principles of philosophical consistency and progress, which the new science of energy recognises in its probable extensions, there can be no doubt that it will really tend to establish more clearly than before the familiar notions of mechanics, and to open out fields of application of the time-honoured laws of motion and of force in unforeseen directions, in which their certainty and truth will continue to be felt as surely and to be described as simply now and hereafter, as they were in the days of Galileo and of Newton.

Newcastle-on-Tyne A. S. HERSCHEL

Faraday's "Experimental Researches"

MR. SILVANUS P. THOMPSON, of Bristol, has made, in NATURE (vol. xvii. p. 304) an inexplicable attack upon my issue of Faraday's "Experimental Researches in Electricity," 3 vols. 8vo. 1839–55, unwarranted by logic or facts.

Mr. Thompson ordered my issue, which is advertised as "*a perfect copy*" of Faraday's work, through a Bristol bookseller, to whom it was charged at the trade price of 36*s*. Mr. Thompson declined to ratify his purchase, and there the matter should have ended, as I would readily have cancelled the transaction with his agent.

Mr. Thompson says that I *profess* to supply *a perfect copy* of Faraday's "Experimental Researches," implying that my professions are deceitful. I am at a loss to understand his meaning, because the fact is that I can and do supply perfect copies.

The history of the book is as follows:—Faraday's "Experimental Researches," 3 vols., appeared in 1839–55, in 3 vols. 8vo, with plates, and in course of time two of the volumes fell out of print, which raised the market value of occasional copies to seven and eight guineas. Availing myself of the opportunity of buying from Mrs. Faraday the copyright and existing stock, I completed, by facsimile reprint, a small number of copies, as is plainly stated on the title-pages of vols 1 and 2. I alone possess the right to reprint the whole or a portion of the work.

It was at Mrs. Faraday's express wish that only such a reprint has been executed, and I was further advised to that course by eminent Fellows of the Royal Society. Mr. Thompson's innuendo of wilful deception is an infamous slander unworthy of a man of science.

I consider I deserve the thanks of all purchasers of Faraday's "Researches" for having invested my capital in the long dormant copyright of this work, and having thus put it in the power of students to obtain "perfect copies" at a moderate price.

Messrs. Taylor and Francis, the printers of the former edition, executed for me the reprint of the first two volumes (the stock of the original third volume not having been exhausted.) The original dates were preserved to show that no alterations had been made, and to preclude the notion, which Mrs. Faraday desired to avoid, that she had sanctioned a veritable new edition.

After this explanation I do not doubt that Mr. Thompson will see he has deceived himself, and I expect that he will apologise for his ill-advised attack upon my genuine and authorised reissue, and admit that it is indeed a perfect copy of Faraday's great work. BERNARD QUARITCH

Singing in the Ears

THIS consists of two or more continuous or alternating tones originating within the ear, very faint and sounding like a tea-kettle just beginning to boil, or a distant orchestra tuning. It is heard when there is undue pressure of the circulation in the head, as after long mental application, or upon hanging the head downwards. To my ear these tones bear constant musical relations to each other, and as the phenomenon bears directly on the theory of the *mechanism* of *audition*, its verification is a matter of importance.

Will the readers of NATURE who can observe it write me what are the *intervals* of *pitch* (*i.e.* thirds, fourths, octaves, fifths, &c.) between the different tones heard together or alternating?

XENOS CLARK

916, Washington Street, San Francisco, Cal.

Meteor

ABOUT 12.47 A.M. (Irish time) on Monday the 18th inst., I observed a brilliant meteor when looking north from the south side of Dublin. It resembled a bluish white ball with an apparent diameter of about one-fifth that of the moon, which was shining brightly at the time, and left behind it a continuous yellowish luminous train. When first sighted it appeared at an angular distance of about 15° from the polar star, and appeared to be in the constellation of the Dragon, about midway between the brilliant star of the constellation of Lyra and the polar star, somewhat below the line joining these constellations.

Its path was apparently a line about 5° from the vertical, and inclined from west towards east, and I lost sight of it when at an angle of 10° with the horizon by intervening buildings. Its brilliancy surpassed that of the moon, which at the time was bright enough to allow of distinguishing printed characters. It did not burst while in sight, and I heard no report.

Royal College of Science, Dublin H. HATFIELD

Eucalyptus

I have only just observed Dr. Calmy's letter in your impression of the 7th inst. (p. 283). The febrile attacks to which I alluded in NATURE (vol. xvii. p. 10) were sufficiently serious to incapacitate shepherds and stockmen for anything like continuous work for two or three weeks, and on some days the men were quite prostrated. The mosquito of which I spoke as not being banished by the presence of Eucalyptus is that species of Culex whose larval state is passed in water (the larvæ may even be seen in rain-water collected in decayed parts of trees), and I cannot call to mind a single place from which these pests were absent, trees being present. No doubt they may be carried many miles by the wind from their place of birth; but the real question is whether any species of gum so drains the land as to banish both mosquito and malaria by drying wet soil. If so, how is it that we find in Australia swamps which have existed for apparently an indefinite time, and do not look in the least likely to dry up, though the "blue" gum grows all round them, where the mosquito is rampant and malarious fever not by any means rare? I entirely agree with Dr. Calmy that the mosquito may be a "real danger to the rash traveller." One not acclimatised would suffer agonies among the mangrove swamps of Moreton Bay. I have had my own hands so paralysed by the poison that I could not close them without difficulty; and a new arrival, whom I took there on a duck-shooting expedition, was almost blinded, and became seriously ill for some days, though he was exposed to the attacks of the insects only a few hours. Whatever may be the case in Algeria or the Campagna, no one familiar with Australia will give the gum-trees there credit for having banished swamps, malaria, or mosquitos. Is not the Newfoundland mosquito of the pine forests to which Dr. Calmy alludes bred in water? ARTHUR NICOLS

February 20

Telephone Experiments

THE following experiments with the ordinary small portable telephone may interest your readers.

Experiment 1. Connect a small strip of zinc by a thin covered wire to one of the binding screws of the instrument, and connect in the same way to the other binding screw a plate of metal with a rough edge; a saw does well. Place the end of the piece of zinc in the mouth, or hold it between moist fingers. Take a shilling between the fingers of the other hand and pass it along the teeth of the saw. The sound is clearly heard in the telephone. If instead of a shilling, a sovereign or a penny be used, the result is much the same, but if a piece of zinc be substituted, the sound in the telephone, if not lost, becomes very feeble.

Experiment 2. With the apparatus as before, let a number of persons, taking hand in hand, form a chain. At one end of this chain the zinc is held, and at the other the shilling. When the saw is rubbed the sound is heard in the telephone so long as the hands are held, but on leaving go anywhere in the chain the telephone becomes silent. This experiment is successful with

eight persons, and no doubt would be with a larger number. The hands should be moistened.

These experiments show in a simple and striking way that in the telephone we have an instrument which is sensitive to very minute electric impulses. W. CARPMAEL

24, Southampton Buildings, W.C.

ELIAS MAGNUS FRIES

BY the death of Fries, Sweden has lost one more of the line of eminent botanists whose labours have thrown a lustre so great upon Scandinavian science. Well versed in all domains of phanerogamic botany, and especially skilled in his native plants, it was amongst the cryptogams he spent the more active years of his long life. While lichenology owes to him valuable illustrations, fungology received at his hands a large element of its construction. In the acquisition, description, and systematic arrangement of the larger fungi he exhibited a zeal, a tact, and a perspicuity which seem to have left comparatively little to be done in later times, either by way of addition or improvement.

Elias Magnus Fries was born in Småland on August 15, 1794. His father, pastor of the church at Femsjö, was an ardent and accomplished botanist. As there were no boys of his own age whom the young Fries could make companions, he constantly accompanied his father in his walks, and was in his earliest years made intimate with all the flowering plants of a district diversified by forest, mountain, marsh, and river. About the age of twelve he lighted upon an especially brilliant Hydnum, and was then first incited to the study of the Agarics and their allies, that abound in his native land more than in any other region of Europe. Before he left his school at Wexio he knew, and had given temporary names to, nearly 400 species. In 1811 he entered the University of Lund, where he had Schwartz, Agardh, and Rezius as his teachers; and in 1814 was chosen Docent of Botany. In this year he published his "Novitiæ Floræ Suecicæ," first part, the second part following in 1823. In 1815 appeared his "Observationes Mycologicæ," the first important result of his fungological researches. In the following year, dissatisfied with the method of Persoon, he began to construct an entirely new system. As a first fruit he wrote his "Specimen Systematis Mycologicæ," a tract of a few pages, and, in outline, his great work the "Systema Mycologicum," the first volume of which appeared in 1821 and the last in 1829. In 1825 he sent forth the "Systema Orbis Vegetabilis," first part, a work not further completed, and in 1828 the "Elenchus Fungorum," a commentary on the Systema. In 1831 was published "Lichenographia Europæa Reformata," and in 1838 his second great work, the "Epricisis Systematis Mycologici." About this time he completed the manuscript of a "Synopsis Ascomycetum," in which he had included upwards of 600 new species. Owing to his impatience of the critiques of Corda, Kunze, and the German fungologists who had begun to avail themselves of the new aid of the perfected microscope, an assistance which Fries denied himself, he refrained from publishing it, but one may hope this valuable MS. may still exist. In 1834 he was made Professor of Practical Economy at Upsala, from which place he gave out the "Flora Scanica." He was sent to the Rigsdag in 1844 and 1848 as representative of his university, and was made a member of the Swedish Royal Academy in 1847 In 1851 he succeeded to the chair of Botany at Upsal, vacated by Wahlenberg, which he resigned only a few years before his death to his son. In 1846 he published the "Summa Vegetabilium Scandinaviæ," and in 1860, "Sveriges ätliga och giftiga Svampar," with fine coloured plates. A project of the Royal Society of Holm to publish at its expense drawings of all species of Hymenomycetes under Fries's direction, induced him to write a third and fuller description of the Agarics, of which he printed only 100 copies, under the title of "Monographia Hymenomycetum Suecicæ," in 1863. The first fasciculus, however, of the corresponding "Icones," appeared only in 1867; a second volume was commenced towards the end of last year. Fries lived at Upsal all the latter years of his life, in good health, and in constant correspondence with the botanists of this and other countries, taking, so far as his age permitted, all his early interest in his favourite Agarics. Thus he published, in 1874, a second edition of his "Epicrisis," including in it all the later found European species.

He died, after a short illness, on the 8th inst.

THE TELEPHONE, AN INSTRUMENT OF PRECISION

THE applications to which the telephone may in future be put cannot yet be all foreseen. I have to-day had its value shown to me in a remarkable way. 1. I used a thermo-electric intermittent current by drawing a hot end of copper wire along a rasp completing the circuit. A telephone was put into the circuit, in another room, and every time that the wire was drawn along the rasp a hoarse croaking was heard in the telephone. 2. I used a thermopile with a Bunsen burner shining on it from a distance of six feet. The current was rendered intermittent by the file, and the sound was most distinctly heard. A Thomson's reflecting galvanometer was introduced into the circuit which showed that the currents were extremely small. 3. The feeblest attainable currents were now tried. The thermopile was removed, and without any artificial application of heat it was shown by the galvanometer that the natural differences in the temperatures of the different junctions in the circuit were sufficient to generate feeble electric currents only just perceptible with the mirror galvanometer. These were easily detected by aid of the rasp and the telephone. Even when contact was simply made and broken with the hand, a click was heard in the telephone. 4. Lastly, these feeble currents were rendered still more insignificant by passing them through the body of a friend who held one end of the wire in each hand, and still the effects were faintly audible. Here the galvanometer, which was still in circuit, hardly gave any indication.

I have now added the telephone to the list of apparatus in the laboratory, considering it to be perhaps the most delicate test of an electric current which we possess.

In these experiments only one telephone is used, viz., at the receiving end. Employed in this way with a powerful current sent from the other end of the line, we may hope to have messages sent through submarine cables much more rapidly than at present. Probably it will be best to have the intermittent nature of the current maintained by an induction-coil, or by a spring rubbing against a continuously rotating cog-wheel, when the current is allowed to pass only when required by the depression of a key which communicates to the listener at the receiving end the long and short dashes of the Morse alphabet.

I ought to mention that I believe the person who first used a thermo-electric current with a telephone was Prof. Tait. GEORGE FORBES

Andersonian College, Glasgow, February 13

OUR ASTRONOMICAL COLUMN

LOHRMANN'S LUNAR CHARTS.—At last astronomers are put in possession of the charts of the moon's surface, commenced by W. G. Lohrmann, of Dresden, in 1821. They are now completed in twenty-five sections; but previously only one part, containing four topographical sections, had been published. This was issued at Leipsic in 1824; a small general chart was lithographed at Dresden at a later period. It is through the active

interference of Prof. Julius Schmidt, the Director of the Observatory at Athens, whose elaborate lunar work is well known, that the complete publication of Lohrmann's charts has been effected. A pretty detailed prospectus has been circulated. The price of the entire work will be 2*l.* 10*s.*

THE PERIODICAL COMET, 1873 II.—The interesting comet of short period discovered by Tempel on July 3, 1873, was, it is understood, taken in hand by one of the able astronomers attached to the Observatory of Vienna, in which case an ephemeris may soon be expected. The last calculation of elements assigned a period of revolution of only 1,850 days, and it is possible that observations in November, 1873, may have indicated a still shorter period, so that the comet may again arrive at perihelion very early in the summer. Four days after the perihelion passage this comet makes a very near approach to the orbit of Mars, but the recent discovery of satellites to this planet detracts from the importance which would otherwise have attached to a study of the comet's motion, in the hope of eventually improving our knowledge of the planet's mass.

MINOR PLANETS.—Of all the members of this group the elements of which have been calculated, No. 153, *Hilda*, discovered by Palisa at Pola on November 2, 1875, makes by far the nearest approach to the orbit of Jupiter, and on this account it is desirable the planet should be kept under observation at successive oppositions. So far, it does not appear to have been recognised during the present one, though an ephemeris extending to February 20, was given in number 84 of the *Berlin Circular*; this will have been owing, no doubt, to its situation in a part of the sky for which we have no charts showing very small stars. According to the estimation made by Palisa on the night of discovery when the planet's distance from the earth was 3·22, and from the sun 4·20, its brightness at present will be equal to that of a star of the thirteenth magnitude. Subjoined is a continuation of the ephemeris deduced from the best orbit yet available, that by Kühnert, which is founded on observations from November 2 to December 30, 1875 :—

HILDA: AT GREENWICH MIDNIGHT.

	R.A.	N.P.D.	Dist. from Earth.
	h. m. s.	° ′	
February 28	7 57 36	78 49·2	3·723
March 2	7 56 57	78 44·5	3·760
,, 4	7 56 21	78 39·9	3·780
,, 6	7 55 48	78 35·3	3·801
,, 8	7 55 18	78 30·8	3·823
,, 10	7 54 52	78 26·5	3·845
,, 12	7 54 30	78 22·3	3·868
,, 14	7 54 12	78 18·1	3·893

Mr. W. Godward, of the *Nautical Almanac* Office, availing himself of the observations of Ceres which have been made at the Royal Observatory, Greenwich, at every opposition between 1857 and 1876, has corrected the elements of this, the first discovered of the small planets, and has succeeded in representing its course during the interval of about twenty years, with a precision which we do not remember to have seen attained in any previous investigation of the like nature. The residual errors in R.A. and declination in no case amount to five seconds of arc. Applying the corrections given by Mr. Godward in the *Monthly Notices* of the Royal Astronomical Society for January last, there result the following doubtless very exact elements of Piazzi's planet for 1878 :—

Epoch, 1878, November 16·0 G.M.T.

	° ′ ″	
Mean longitude	47 50 24·5	
Longitude of perihelion	149 40 57·1	From M. Eq. of Epoch.
,, ascending node	80 47 43·1	
Inclination	10 37 17·9	
Angle of eccentricity	4 30 57·2	
Mean daily motion	771″·31117	

From the *Berlin Circular* No. 85, it appears that with the exception of the small planet observed by Prof. Peters on February 6, which proves to be *Antigone*, the planets lately observed are new. Their numbers and discoverers, with dates of discovery and magnitudes, are :—

No. 180 ...	Perrotin ...	Jan. 29 ...	12·0m.
No. 181 ...	Cottenot ...	Feb. 2 ...	10·0m.
No. 182 ...	Palisa ...	Feb. 7 ...	10·5m.
No. 183 ...	Palisa ...	Feb. 8 ...	12·0m.

As we anticipated, No. 180 proves to be distinct from *Urda*, which remains to be recovered.

BIOLOGICAL NOTES

THE ORIGIN OF THE CARBON OF PLANTS.—Mr. J. W. Moll has made in Prof. Sach's laboratory at Würzburg, some researches on this subject during the summer of 1876. A detailed account of these, with the conclusions at which he has arrived, is promised in the *Landwirthschaftliche Jahrbücher von Nathusius und Thiel*, but a brief account will be found in the last number of the *Archives Néerlandaises*, tome xii., 4me livre. A plant with green-coloured cells can, under the influence of light, take the carbon it requires from the atmosphere, releasing in the act of doing so, so much oxygen. This is a fact, too well vouched for by the experiments of Boussingault, Vogel, Rauwenhoff, and Harting, to admit of a doubt, but the quantity of carbon dioxide in our atmosphere is very small, and the quantity of carbon stored up during say a summer's growth in some large forest, is very great. Moreover, the roots of such plants are fixed in a soil which is highly charged with carbonaceous products, so the question quite naturally arises, may not the roots take up some of these atoms of carbon ready to their hand? or may they not at least take up the carbon in the form of carbon dioxide, send this up the green granules in the leaves, and so give them a more abundant supply than they could get from the surrounding air? Besides, is it not a fact that most plants seem to thrive in a fine rich leaf mould, and may not its richness in carbon be partly the cause? One of the first questions Mr. Moll set himself to answer was—Can leaves decompose carbon dioxide which is furnished to the root of the stem from which the leaves spring? Now, starting with assent to Prof. Sach's discovery that the starch of the chlorophyll granule is the first visible product of the fixation of some carbon atoms, there was here a ready method of proving whether this were so or not. In the course of several experiments it was contrived that leaves destitute of these starch granules should be in an atmosphere deprived of carbon dioxide, while at the same time they were well exposed to the influence of light. The roots were fixed in moist soil well supplied with carbon dioxide, and the result was that under these circumstances no starch granules were formed; and in a modification of this experiment, where one portion of a leaf was allowed to be exposed to ordinary air, that portion at once set to forming its starch. Botanists no doubt will welcome the publication of the experiments of which we have now only the brief result; doubtless more research will end in more discoveries in this most interesting field, for how can one account for the fact that some plants do, as we might say, fatten by feeding on carbon atoms, although these very plants cannot take these atoms when in union with oxygen?

FERNS AND MOSSES.—Hofmeister's work on the "Higher Flowering Plants (Cryptogamia)" is truly indispensable to every scientific botanist, and, thanks to Mr. Curry, the English student has it at his command. It commences with an account of a not uncommon little plant called *Anthoceros lævis*, and it finishes with an account of those cryptogams very high in rank and vast in size, known to us as cone-bearers, and of which the churchyard yew or the giant Wellingtonia may serve as

types. Of these cryptogams none are better known than the ferns and the mosses, and as the reader of Hofmeister's work, or, as we are but too glad to be able to add, of most of the very recent handbooks of botany, well know, both of these groups have this in common—that they pass, as it were, through two existences, one of which we may call the "fruit-bearing" stage (the sexual stage), and the other the "spore-bearing" stage (the a-sexual stage). The former of these two is the stage so apparent to us all in flowering plants, where, as a product of the fertilisation of the contents of the carpel by the pollen from the stamens, we have the fruit. In the ferns, as a rule, this first stage is one in which the plant, as it were, thinks only of producing its male and female cells, and the growth of the plant is lost in the care which it takes to continue the species. Shake a spore from the frond of some immense tree-fern, let it germinate, and the plant which will grow thereout will be a little green thing not so big as the top of one's thumb ; but it will form its "archegonium" and its "antheridium," and the contents of the latter fertilising the contents of the former, the result will be a plant which in time will equal the large tree-fern in size, but which at this, its great vegetative stage, will never produce aught but spores. In the mosses this state of things is different. The moss-stems which we gather as objects of beauty or use, these are the fruit-producing stages ; these concern themselves with growth as well as with what is usually antagonistic to growth, reproduction ; and in the second stage, which in the ferns is the only one popularly known, we have but a short-lived, small-sized, spore-producing plant, sometimes quite hid away in the lovely foliage of the moss plant, sometimes starting up from it, and then known popularly as its fruit, but really only its spore-producing stage. It is only very recently that Dr. Karl Goebel (*Botanische Zeitung*, October, 1877) has called attention to the development of the prothallium (sexual stage) of a delicate little fern called *Gymnogramme leptophylla*, which is to be found in Jersey, along both shores of the Mediterranean, and probably in all suitable localities in Africa, Asia, Australia, and South America. It and a few other species are annuals, so that at once we see that their a-sexual stage, which is also their vegetative one, is quite limited. Moreover, their little stems are often not more than an inch in height and the texture of the frond is almost pellucid. It thus approaches the mosses in the feebleness of this stage ; but the most interesting fact brought to light by Dr. Goebel is that the sexual stage, generally in the ferns so evanescent, is here absolutely somewhat long-lived, and more, that it is even somewhat vegetative, something like that of *Anthoceros lævis*. Such a form, which makes a bridge to thus connect the two groups (ferns and mosses), is of great importance, and Dr. Goebel's memoir, which is illustrated, is not only of great value from the accuracy of its details and from his deductions therefrom, but also as showing how much can be done even with apparently well-known forms.

PROF. GRIMM ON THE FAUNA OF THE CASPIAN.—We notice the appearance of the second part of Prof. O. A. Grimm's (Russian) work on the Aralo-Caspian Expedition. It is devoted exclusively to the Caspian and to its fauna, and contains the description of worms, sponges, and molluscs, discovered during the expedition, together with a general sketch of the vertical and horizontal distribution of Caspian molluscs. Prof. Grimm divides them into three regions, out of which the lowest one (deep sea) corresponds to older forms of fossils, whilst the upper one has its nearest relatives in youngest forms of fossils. In a concluding chapter Prof. Grimm discusses the interesting question as to the influence of conditions of life on morphological structure, and shows by many illustrations the accommodation of forms to varied conditions at different depths. The work is illustrated by many drawings.

TRANSFORMATION OF CARTILAGE INTO BONE.—The last *Bulletin* of the Belgian Academy of Sciences (vol. xliv. No. 11) contains a very valuable paper of Dr. Leboucq, Superintendent of Anatomical Researches at the University of Ghent, on the mode of formation of the bone tissue in the long bones of mammalians, in which the author discusses and resolves by his researches, based on a new principle, the much-debated question whether the embryonal cartilage is substituted by a new tissue, or is directly transformed into a bone. The great difficulty of rendering the minute cartilage cells apparent among other cells, is resolved by the author by his employing soda, and decalcifying the sections with acidulated glycerine ; the cells thus preserve their shape, and receive a beautiful colour, as is seen from a chromolithographed plate accompanying the paper. By using this method the author was enabled to prove that the minute cartilage cells take an active part in the formation of bones, quite performing the part of osteoblastes. The researches were carried out in the Ghent Laboratory, under the direction of Prof. van Bambecke, and the paper is accompanied by a very favourable comment thereon by Prof. van Beneden.

OWLS.—M. Alphonse Milne-Edwards has recently read before the Academy of Sciences of Paris two ornithological papers of interest. One on the affinities of the Owl, *Pholidus badius*, demonstrates, from its skeleton, that it belongs, quite contrary to the general opinion of naturalists, to the Bubonidæ, near to *Syrnium* and *Nyctale*, and not to the Strigidæ. In the species the posterior margin of the sternum has two pairs of well-developed notches, and the furcula is not complete at its symphysial extremity. This being the case, the genus *Strix* is now the only member of the family of the Strigidæ, and the pectination of the inner edge of the nail of the third toe found in it is no longer to be taken as of much importance in the group. In the second paper a new genus of Strigine Owls is described, from Madagascar, and named *Heliodilus*.

ALGÆ OF THE WHITE SEA.—At a recent meeting of the St. Petersburg Society of Naturalists, M. Chr. Gobi read an interesting paper on the algæ of the White Sea. The number of species he has discovered reaches seventy, of which ten are green algæ, six *Fucus*, and twenty-nine red algæ. The algæ of the White Sea are a mixture of representatives of the Arctic and of the Atlantic basins, as well as of fresh water and salt water forms, the mixed characters of the flora being especially obvious with respect to the green algæ.

GEOGRAPHICAL NOTES

LAPLAND.—An important exploration of Russian Lapland is being carried out by the Swedish lieutenant Sandeberg. Hitherto only the coast of the region has been known with anything like accuracy, the interior features being set down solely from conjecture. Lieut. Sandeberg commenced his work in 1876, and we learn from the *Geographische Blätter* (Heft 1, 1878) of the Bremen Society, it will be continued till 1880. The country will be carefully explored and accurate observations taken, which will enable Lapland to be at last mapped satisfactorily. Lieut. Sandeberg is accompanied by several zoologists who are investigating minutely both the mainland, island, and sea fauna, and have already made considerable additions to our knowledge in this direction. During the last two summers Sandeberg has found seventy-eight new species of birds in the Kola peninsula, of which one at least is stated to be quite new to science. Large collections in other departments have also been made. Previous to Sandeberg, no educated European has explored Russian Lapland, which is of such great importance to the zoologist,

geologist, botanist, and archæologist. Among other finds it may be mentioned that near Golotizk, on the east coast of the White Sea, he found a great ancient manufactory of flint implements of the stone age, of the purest and highest Scandinavian forms, which previously had been seldom found east of the Baltic, and never on the coast of the Arctic Ocean or the White Sea. The collections will be divided between the State Museums of Russia, Sweden, and Norway, all three countries affording facilities for the conduct of the expedition.

CHINA.—In accordance with the terms of the Chefoo Convention, Her Majesty's minister at Peking, about a year ago, sent to Chung-king, in the Chinese province of Szechuen, which lies at the junction of the River Ho-tow with the Yang-tsze Kiang, Mr. E. Colborne Baber, of her Majesty's Consular Service, who was one of the interpreters attached to the Yünnan mission, and who, before proceeding on that bootless errand, was at considerable pains to qualify himself for scientific exploration. Mr. Baber started last July on an expedition in the western districts of the province. But little was heard of Mr. Baber's doings until the end of the year, except from a private letter in which he described himself as floating down the River Min, among low hills covered with fir and insect wax trees, and in sight of (though at a distance of sixty miles on the south-west) the holy mountain of Omi, on the borders of Thibet. On December 27 the *North China Herald*, of Shanghai, published a portion of another letter from Mr. Baber, in which he mentions that, from the point just named, he made north-west and from Ya-chow began to veer south. Passing Ning-yüan-foo he went to Hwa-li-chow; then turned east and crossed the Yang-tsze into Yünnan, not far from Tung-chwar. Thence through the wildest and poorest country imaginable, the great slave-hunting ground from which the Lolos carry off their Chinese bondsmen—a country of shepherds, potatoes, poisonous honey, lonely downs, great snowy mountains, silver mines, and almost incessant rains, Mr. Baber tracked the course of the Upper Yang-tsze to Ping-shan. No European, he says, has ever been in that region before, not even the Jesuit surveyors, and the course of the Yang-tsze, there called the Gold River (Kin-sha Kiang), as laid down on their maps, is a bold assumption and altogether incorrect. Mr. Baber adds that "a line, drawn south-west from a mile or two above Ping-shan, will indicate its general direction, but it winds about among those grand gorges with the most haughty contempt for the Jesuits' maps."

MOUNT TONGARIRO.—The celebrated burning mountain of New Zealand, Tongariro, has at last been explored by an Englishman, Mr. P. F. Connelly. The volcano is regarded as *tapu*, or sacred, by the Maoris, who have hitherto resisted all attempts to explore the mountain on the part of the colonists. The volcano is situated nearly in the centre of North Island, and though only 6,500 feet high, is less accessible than either Mount Edgecumbe or Ruapehu, both of which exceed 10,000 feet in height. Mr. Connelly overcame all resistance, and by the help of some chiefs more friendly than the rest, succeeded in thoroughly exploring the crater, took a number of sketches and photographs of the locality, and determined the positions of the most important peaks.

AFRICAN EXPLORATION.—The King of the Belgians has sent to M. Quatrefages a telegram stating that two other Belgian officers should proceed to Zanzibar within a few days, to supply the places of the unfortunate MM. Crespel and Maes, whose death we announced last week. Telegraphic orders have been sent to the remaining members of the expedition to continue their journey to Tanganyika. The Paris Geographical Society, anxious to acknowledge such a determined policy, have resolved to take steps to accelerate the public subscription instituted on behalf of international African exploration. It has been resolved also to establish a local committee on a very large scale; not less than a hundred persons of distinction will be selected, with power to add to their number.

PARIS GEOGRAPHICAL SOCIETY.—The distribution of prizes will take place not in April, as usual, but at the meeting to inaugurate the Society's hotel, now building. It will be ready in the month of September or October next. The gold medal will be awarded, as already reported, to Mr. Stanley, but another gold medal of the same value will be given to the veteran M. Vivien de Saint Martin, the celebrated geographer, for the many valuable works published by him during the last thirty years, and principally "L'Année Géographique."

AMERICAN GEOGRAPHICAL SOCIETY.—We have received two numbers of the *Bulletin* of this Society, containing the proceedings of the meetings for the first half of 1877. One number is devoted to the admirable summary of geographical work for 1876, which constituted the address of the President, Chief Justice Daly, and to which we alluded at the time. In the other number (No. 4) the principal paper is on the volcanoes of the U.S. Pacific coast, by Mr. S. F. Emmons.

MAPS OF THE SEAT OF WAR.—The Russo-Turkish war has called forth a very large number of maps of the Balkan peninsula. We learn that a Russian gentleman has made a collection of maps of the seat of war, numbering more than 150, and will exhibit the collection at Paris. The largest number of such maps has been published in Germany, and the most detailed maps appear to be those published in Finland.

ARCTIC EXPLORATION.—Mr. James Gordon Bennett has petitioned the U.S. Congress to grant the American register to the steamer *Pandora* for an Arctic expedition under the command of American naval officers.

SOCIAL ELECTRICAL NERVES[1]

THE efficient carrying out in a large city of any extended system of telegraphic communication for police, fire, and social purposes demands an intimate acquaintance with existing systems, so as to insure the establishment of only the most perfect organisation. In an ordinary telegraphic communication between two or more stations a line wire connects the terminal station with the instruments in the circuit, and the distant end of this wire is in connection with the earth, while the other end, after connection through the instrument, passes to one pole of a battery, the other pole of which is also in connection with the earth. Thus the electrical circuit is completed partly by the line wire and partly by the earth wire. Such is an ordinary circuit. At times when telegraphic communication is required only for short distances, as in houses and buildings, a second wire takes the place of the earth circuit. In the auto-kinetic system for the introduction of fire, police, and social telegraphs upon an extended scale an essential feature is the employment of two parallel wires, laid over a city and suburbs, starting from a central station to the various district stations, and from thence ramifying in every direction so as to embrace the most important areas for the purposes required. Each of these two wires has its special duty to perform. One is employed for the purpose of starting the instrument, which may therefore be termed the "starting" wire. The other is used for the transmission of the message, and may be termed the "transmitting" wire. It is by this novel arrangement that the auto-kinetic system enables any number of speaking stations to be placed upon a circuit without possibility of interference. Thus in each district of a

[1] Continued from p. 306.

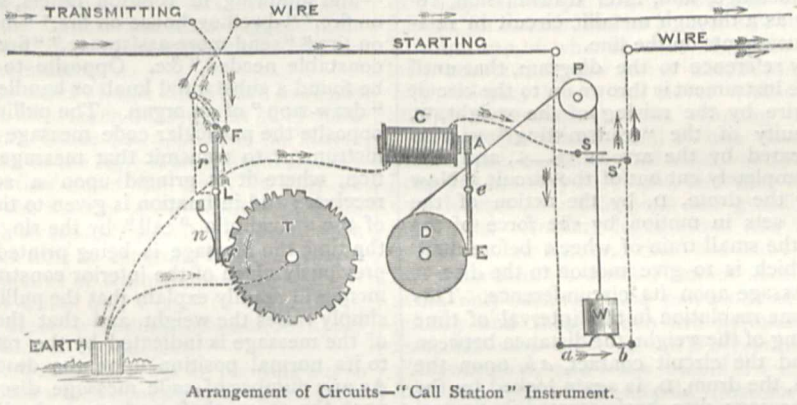
city—say Glasgow—the head police and fire station in the central district will be in direct communication with the sub-stations in the northern, western, southern, eastern, and St. Rollox districts, and each of these again will be local centres, and command a host of street, fire, and police "call" stations placed at convenient distances along the thoroughfares in their respective districts.

Another distinctive principle of the auto-kinetic system is that which has already been noticed, namely, the "starting" and "transmitting" wire traversing the streets together. If we suppose a number of speaking stations to be required along the route—say 300—it is evident that at each point where an instrument is placed the two wires will require to be brought into the instrument—the one to start the instrument when a communication is to be sent, and the other to pick up and automatically transmit that message to the district centre. We have before stated that no instrument is "in circuit" except when speaking, and then only during the time occupied in the transmission of the message. It therefore follows that at each station along the line, while in a state of rest, the electrical continuity of both the "starting" and "transmitting" wire must be maintained independent of the apparatus.

A general outline of the manner of employing these two wires will explain the system.

We will commence first with the *modus operandi* of the "starting" wire, then with that of the "transmitting" wire, and finally describe the nature of the automatic apparatus by which the novel and important features of the auto-kinetic system are obtained.

Assume for a moment that the apparatus is inclosed in an iron erection somewhat similar to that of a street pillar letter-box, and that in the inside of this box one portion of the instrument consists of an ordinary electro-magnetic coil C, an armature A, and detent E working on a centre *e* locking into a small arrangement of wheel-work and barrel D, without any maintaining power; and that one end of the wire of this electro-magnetic coil is connected permanently with the earth, the other end being attached to a metallic spring S placed in position to form a contact, under certain conditions, with a second spring S′ in connection with the "lead in" from the starting wire nearest to the district sub-station. In this position as regards the instrument it is a broken circuit, and of course, therefore, the instrument is out of connection. If now we trace the other "lead in" from the "starting" wire and conceive it to be brought into the pillar-post and carried up to the second spring S′, and as from this spring a connection exists with the "starting" wire, a continuous metallic circuit is established through the pillar-box, indicated in the illustration by the ⟶ as far as the passing of "starting" electric currents is concerned from any other instrument along the circuit which may have to travel the wire without affecting the instrument under notice, which



Arrangement of Circuits—"Call Station" Instrument.

remains electrically out of circuit by reason of the break in continuity at the spring S attached to the coil wire. We will now advance a step further, and assume that the continuity of the "lead in" of the "starting" wire furthest from the district station is only maintained so long as a weight W rests upon the two ends *a* and *b*. It will therefore be evident that were the weight W raised, the through continuity at *a b* maintained by the weight would be destroyed, and until so far raised as to mechanically press the springs S and S′ together—the coil wire spring and the lead in "starting" wire spring—the through circuit on the starting wire is broken. Now the weight W being raised what follows? The moment that the springs S and S′ are brought into contact electrical continuity is established between the district station and this instrument, and the battery current flows from that station along the starting wire, passing all intermediate instruments which are necessarily out of circuit, enters the electro-magnetic coil C, and throws the instrument to earth as a terminal with the district centre, at once cutting off all interference that might arise from other instruments along the line speaking at the same time.

Thus, for the moment that the two springs S and S′ are in contact, the current has entered the coil C, the armature A has been attracted, and the detent E being withdrawn has liberated the drum D which commences to revolve, having been wound up by the elevation of the weight W.

The liberation of the detent, therefore, instantly causes the weight W to descend, and the act of falling separates the two springs S and S′, the starting wire, as far as this particular instrument is concerned, being thrown off, and the through circuit also remaining broken until the weight has descended and closed the contact by pressure at *a b*.

Before we proceed, let us suppose that during this interval of time between the raising of the weight and its falling, some other instrument or instruments along the line had been called into requisition, what would happen? The weight W at each instrument would have been raised, placing the springs S and S′ in metallic contact, and the instrument thrown into position ready for *speaking;* but as no current could pass along the starting wire until continuity had been restored at the *a b* of the first speaking instrument, which for the moment had become a terminal instrument, no current could enter the coil C of the second instrument; and as the detent E could not be released, the weight would remain suspended, until the arrival of the current along the starting wire attracted the armature and released the drum; in due course the second instrument is immediately thrown off the circuit, and succeeded automatically by a third, fourth, or any number along the line in succession, according to their distance from the district centre or battery station. It will therefore be seen that as the battery current always is in readiness to

follow down the "starting" wire from the central station, were twenty or thirty instruments set in action simultaneously; that nearest the central station will record first, and as, in the act of recording, it becomes a terminal, the remainder will follow in the order of their distance along the "starting" wire from the central station. Thus were twenty fires to occur in a district at the same time, and twenty "call" instruments were to be simultaneously put into requisition, the whole twenty would record their several messages without interference at the central station, following one another in successive intervals of time, determined by the automatic falling of the weight on to the circuit poles *a* and *b*. Now, as this interval of time for each instrument is about three seconds, the whole twenty messages would be automatically recorded in about one minute, or less time than it has taken to read the account of what would take place.

We have now traced the action of the "starting" wire, which may be stated to perform its functions mechanically by the act of raising a weight momentarily placing it in circuit with the instrument, which becomes immediately a terminal station; and again by the falling of the weight the instrument is thrown off, and the through circuit along the "starting" wire restored.

We proceed to examine into the action of the second or "transmitting" wire, and explain the process by which, on the starting of the instrument, this picks up automatically the message, and, after transmission, resumes its continuity as a through metallic circuit in relation to the other instruments on the line.

It will be seen, by reference to the diagram, that until the moment that the instrument is thrown on to the circuit of the "starting" wire by the raising of the weight, W, the through continuity of the "transmitting" wire is maintained as indicated by the arrows ⟶, and that the instrument is completely cut out of the circuit. Now the act of starting the drum, D, by the action of the "starting" current, sets in motion, by the force of the descending weight, the small train of wheels before mentioned, the use of which is to give motion to the disc, T, bearing the code message upon its circumference. This disc makes exactly one revolution in the interval of time occupied by the falling of the weight, the distance between the springs, S S′, and the circuit contact, *a b*, upon the restoration of which, the drum, D, is again locked by the detent, E, and the message disc has assumed its normal position.

We will now trace the action of this message disc. The through continuity of the transmitting wire, when the disc is at rest, is maintained by the pressure of the lever, L, upon the two circuit springs, F. This pressure is exerted so long as the disc is in position by means of the insulated stud, *f*, upon which the lower end of the lever, L, rests. The moment, however, that the disc, T, revolves, the lever, L, falls back upon the pin, *r*, the contact between the springs, F, is broken, and the transmitting wire is thrown to earth, through the disc. As the end of the lever, L, comes into metallic contact with the "make" and "break" prominences upon its circumference, currents flow to the central station along the circuit in the direction indicated by the dotted arrows. Now as these currents are passed in groups to represent letters and words, a code message, or any code message out of a given number, may be automatically printed at the receiving instrument at the central station. In the example given, the currents passed are the Morse signals, indicating the position of the calling station, namely, MAIN ST., GORBALS, which would at once inform the central station of the exact locality of the fire. The weight once more at rest, the transmitting wire is no longer to earth at that call station, but is again thrown into circuit by the contact of the springs, F.

From the explanations given, several very important results have been established. Every instrument while transmitting a code message is for the moment made a terminal station, all other instruments on the same circuit being thrown off so as to avoid all possibility of interference. At no time is any greater resistance thrown into the circuit than that of the single instrument employed to transmit the code message. Again, only a very small amount of battery power at the central station is required, only one instrument being in action at the same time. Whatever number of instruments on a circuit may be called into requisition at the same time, they will all automatically record their messages one after the other in succession, commencing with that nearest to the battery station, and be all automatically started and brought to rest, without any mechanical complication of parts or delicate electrical adjustments. Such results have never before been obtained and at once place the *auto-kinetic* system in advance of every other.

A general description of the apparatus, as placed in the hands of the public will now be comparatively easy to understand, and the stability and simplicity of its construction at once recognised.

A messenger presenting himself before any one of the street pillar "call stations" will, on opening the iron door, find a dial plate on which some eighteen or twenty printed sentences are enamelled in bold characters; first, the name of the street indicating the position of the "call station," as in the example given—"Main street, Gorbals"—and following in rotation others, such as "warehouse on fire," "dwelling-house on fire," "mill on fire," "theatre on fire," "send more assistance," "fire got under," "police constable needed," &c. Opposite to each message will be found a substantial knob or handle, something like the "draw-stop" of an organ. The pulling out of the handle opposite the particular code message required causes the instrument to transmit that message to the central station, where it is printed upon a self-recording Morse receiver; and intimation is given to the inspector on duty of the arrival of a "call" by the ringing of a bell during the time the message is being printed. The description previously given of the interior construction of the instrument will readily explain that the pulling out of the handle simply raises the weight, and that the final transmission of the message is indicated by the return of the handle to its normal position upon the descent of the weight. As any number of code message discs may be mounted upon the same shaft, and as each disc would have its special make and break lever acting upon the circuit springs, F, there is little additional complication in the internal arrangement from a plurality of code signals being introduced, the working parts being mostly common to either one or twenty discs. The advantages above described are not the only features of importance in connection with the auto-kinetic system.

A corporation carrying out such a system as described for street police, and fire "call stations," may derive a considerable annual revenue from introducing special "private fire call" instruments into all the large mills, warehouses, works, and more important private dwellings at a small annual charge to the respective owners. As the number of such "private call" stations introduced upon the circuit is practically without limit, irrespective of the money return to a corporation in a commercial view, the great security to property against any very serious loss by fire is a matter of vast importance. It is well known that the annual losses by fire amount to enormous sums, and often thousands of pounds may be lost by a few minutes' delay in giving early intimation of the outbreak to the brigade.

The auto-kinetic system of using the two wires whereby only one speaking instrument can be in circuit at a time, renders them likewise peculiarly adapted for the employment of the telephone in introducing a social system of communication between offices and works, or for the legal profession between the courts and their various

offices, as all messages of the most private nature can be sent without publicity, an advantage possessed by no other system.

It is unnecessary to point out any other of the many practical applications to which this auto-kinetic system may be applied. It is a system that must shortly extend its social metallic nerves to all the large centres of commerce and manufacture in this kingdom, and its various applications will then become more fully developed and known.

THE RAIN-TREE OF MOYOBAMBA

SOME little while since a paragraph went the round of the papers, describing, on the authority of the United States Consul in the province of Loreto, a tree existing in the forests near Moyobamba, in Northern Peru.

According to the *Madras Times* and *Overland Mail* of December 15, 1877, "The tree is stated to absorb and condense the humidity of the atmosphere with astonishing energy, and it is said that the water may frequently be seen to ooze from the trunk, and fall in rain from its branches in such quantity that the ground beneath is converted into a perfect swamp. The tree is said to possess this property in the highest degree during the summer season principally, when the rivers are low and water is scarce, and the Consul therefore suggests that the tree should be planted in the arid regions of Peru, for the benefit of the farmers there."

As always happens in cases of this kind, there have not been wanting those who have taken this singular story quite seriously, and the India Office has applied to the Royal Gardens, Kew, on behalf of the Agri-Horticultural Society of Madras for information about the tree. It may be interesting to some of the readers of NATURE, and it will certainly save future correspondence, if I explain once for all what I have been able to ascertain as to the origin of the fable and the amount of truth which it contains.

Pœppig's "Reise in Chile und Peru" (2 vols., 1835), which contains much useful botanical information, apparently makes no reference to the subject.

I am indebted to Dr. Francis Darwin for pointing out to me a very similar account which appears in the *Botanische Zeitung*, January 21, 1876, pp. 35, 36, in which Prof. Ernst, of the University of Caracas, records his observations upon a tree of *Pithecolobium* (*Calliandra*) *Saman*, Benth.

"In the month of April the young leaves are still delicate and transparent. During the whole day a fine spray of rain is to be noticed under the tree, even in the driest air, so that the strongly-tinted iron-clay soil is distinctly moist. The phenomenon diminishes with the development of the leaves, and ceases when they are fully grown."

I found that the specimens of this tree in the Kew Herbarium brought its range close to Moyobamba, as they included some gathered by the traveller Spruce, near the neighbouring town of Tarapoto. It appeared probable, therefore, that the Tamia-caspi—the name given in one variant of the story—was *Pithecolobium Saman*, though the cause of the rain was more mysterious than ever. Being vouched for by so competent an observer as Prof. Ernst, its occurrence could not well be denied, while on the other hand, the *Pithecolobium* being a well-known cultivated tree in the West Indian Islands, it was quite clear that if the "raining" from its foliage were a normal occurrence, it would long ago have been put on record.

Mr. Spruce has, however, obligingly supplied me from the astonishing stores of information which he possesses with the true history of the whole matter, and he has also been so good as to allow me to communicate to the readers of NATURE the substance of what he has told me.

"The Tamia-caspi, or rain tree of the Eastern Peruvian Andes, is not a myth, but a fact, although not exactly in the way popular rumour has lately presented it. I did not know there was any doubt as to the true origin of the 'rain.' I first witnessed the phenomenon in September, 1855, when residing at Tarapoto (lat. 6½° S., long. 76° 20′, W.), a town or large village a few days eastward of Moyobamba, and little more than 1,000 feet above the sea-level. I had gone one morning at daybreak, with two assistants, into the adjacent wooded hills to botanise. . . . . A little after seven o'clock, we came under a lowish spreading tree, from which with a perfectly clear sky overhead a smart rain was falling. A glance upwards showed a multitude of cicadas sucking the juices of the tender young branches and leaves, and squirting forth slender streams of limpid fluid. We had barely time to note this when we were assailed by swarms of large black ants, which bit and stung fiercely, and obliged us to beat a retreat, my companions calling out as they ran 'Tamia-Caspi! Tamia-Caspi!' When we had shaken off our assailants, I ventured to approach the spot so near as to make out that the ants were greedily licking up the fluid as it fell. . . .

"My two Peruvians were already familiar with the phenomenon, and they knew very well that almost any tree, when in a state to afford food to the nearly omnivorous cicada, might become (*pro tem.*) a Tamia-caspi, or rain-tree. This particular tree was evidently, from its foliage, an *Acacia*, but as I never saw it in flower or fruit, I cannot say of what species. I came on cicadas, similarly occupied, a few times afterwards, and on trees of very different kinds, but never without the pugnacious ants on the ground beneath. Among the trees on which I have seen cicadas feed, is one closely allied to the acacias, the beautiful *Pithecolobium Saman*. The young branches are very succulent, and they bear elegant bipinnate leaves. . . . The pods are greedily eaten by deer and cattle. Another leguminous tree visited by cicadas is *Andira inermis*, and there are many more of the same and other families which I cannot specify. Perhaps they avoid only such as have poisonous or strongly resinous juices; and those which are permanently tenanted by ferocious ants such as all *Polygoneæ*, the leguminous *Platymiscium*, and a few others. . . . These ants rarely leave the tree which affords them food and shelter, and they jealously repel all intruders, the slightest scratch on the smooth bark sufficing to call their sentinels to the spot. They are quite distinct from the robust marauding ants that drink the cicadas' ejectamenta.

"I have no doubt you have above the true explanation of the Tamia-caspi, or rain-tree. As to the drip from a tree causing a little bog to form underneath and around it, that is a very common circumstance in various parts of the Amazon Valley, in flats and hollows, wherever there is a thin covering of humus, or a non-absorbent sub-soil, and the crown of foliage is so dense as to greatly impede evaporation beneath it. On such sites the Achuál palm (*Mauritia flexuosa*) common enough between Moyobamba and Tarapoto, as well as on the savannahs of the Orinoco, and in subriparial forests of the Amazons—affords a striking example of this property, as has already been remarked by Gumilla, Velasco, Humboldt, and others. Finally, although I never heard the name Tamia-Caspi applied to any particular kind of tree, during a residence of two years in the region where it is now said to be a speciality, it is quite possible that in the space of twenty-one years that have elapsed since I left Eastern Peru, that name may have been given to some tree with a greater drip than ordinary; but I expect the cicada will still be found responsible for 'the moisture pouring from the leaves and branches in an abundant shower'—the same as it was in my time."

Mr. Spruce's notes are so precise and careful that there is little difficulty in accepting his explanation of the rain-tree. It is, however, hard to understand the omission of all insect agency in the equally careful account given by

Prof. Ernst, who attributes the "rain" to secretion from glands on the footstalk of the leaf on which drops of liquid are found, which are rapidly renewed on being removed with blotting paper. It is curious that precisely the same question has been the subject of controversy in the Old World with respect to honey-dew. It is generally believed that this is the result of the aggregate ejecta of Aphides feeding on the juices of the lime. So competent an observer, however, as Boussingault was of opinion that honey-dew was a spontaneous exudation, and it seems not impossible that the lime, as well as the *Pithecolobium Saman* may, under some abnormal circumstances, exude a sugary secretion which insects would eagerly feed on.[1]

W. T. THISELTON DYER

NOTES

WE have to record still another great loss to science in the death on Tuesday, at Rome, of Father Secchi, the eminent astronomer, whose serious illness we recently recorded. We can do no more at present but announce the sad event.

ABOUT 355*l.* have been subscribed to the Darwin Memorial Fund, the idea of which, our readers may remember, originated at Cambridge on the occasion of conferring the degree of LL.D. on Mr. Darwin. We would again draw the attention of our readers to the fund; many of them, we are sure, will be glad to contribute to it, and those who desire to do so should lose no time in sending their subscriptions to the treasurer and secretary, Mr. A. G. Dew-Smith, Trinity College, Cambridge.

A COMMITTEE of members of the several classes of the French Institute, together with a number of eminent scientific men, has been formed to promote the erection of a monument to Leverrier in the grounds of the Paris Observatory. It is expected that foreigners as well as Frenchmen will subscribe.

PROF. FLOWER'S Hunterian Lectures at the Royal College of Surgeons this year will treat of the Comparative Anatomy of Man, more particularly of the Osteological and other Physical Peculiarities of the Races of Australia and the Pacific Ocean. The first two lectures will be devoted to an exposition of the principal methods of craniological research, exemplified by a series of fifty Australian and as many European skulls. The account of the structure of each race will be preceded by a notice of the principal facts of its history and social condition. The lectures commence on Monday next at 4 o'clock, and will be continued at the same hour on Mondays, Wednesdays, and Fridays, till March 28. Any one interested in the subject is admitted.

THE Philosophic Faculty of the University of Zurich has just conferred the degree of Doctor Philos. *honoris causa* on Mr. J. J. Wild, formerly of the scientific staff of H.M.S. *Challenger*, and author of the recent work, "Thalassa," embodying some of the results of that expedition.

THE Photographic Society have awarded to Capt. Abney a silver Progress Medal for having made the greatest advance in the science of photography during the past year.

THE third general meeting of Polish naturalists and physicians will take place at Cracow this year. The two former meetings were held at Posen and Lemberg respectively.

THE Committee of the French Association for the Advancement of Science held a meeting last Thursday. The 16th of August was appointed for the opening of the session, which will be presided over by M. Fremy. The general and sectional meetings will take place at the Hôtel des Beaux Arts, Paris, which contains an immense number of rooms tastefully decorated with fine pictures. The Committee has distributed 8,850 francs among a number of inventors who are constructing machines or scientific apparatus for exhibition. A number of other *encouragements* for similar purposes will be distributed; among the scientific men who will be assisted we are in a position to mention the name of M. Mouchot, for establishing on a large scale his celebrated solar steam-engine.

THE annual session of the Deutsche anthropologische Gesellschaft for 1878 begins at Hamburg on August 11. The meetings on the 12th, 13th and 14th take place at Kiel, and those on the 15th and 16th at Lübeck.

IN the January session of the Berlin anthropologische Gesellschaft, Prof. G. Fritsch delivered an exhaustive address on the subject of Bushman drawings, in which he compared his own observations in the Cape Colony with the late discoveries of Rev. C. G. Büttner in the neighbourhood of Ameib, in the Damara region. These combined results show the widely extended presence of these drawings in South Africa and the existence of a surprising familiarity with perspective and the principles of grouping. In view of the fact that the Bushmen are probably the most degraded race of mankind now existing, dwelling as they do in caves and living from hand to mouth, these evidences of the first principles of art among them possess no small degree of value as explanatory of numerous attempts at illustration before the stone and bronze ages. This is especially the case with the cave dwellers of the so-called reindeer epoch, whose remains have been uncovered recently in France and Switzerland. Anthropologists have had frequent discussions during the past year with regard to the origin of the sketches of animals in the cave of Thainingen, supposed to date back to this epoch; and the opinion has been stoutly maintained that the human race at this stage of development was utterly unable to produce works of this kind. This view will scarcely be tenable in light of these late discoveries among the Bushmen, who are certainly not advanced beyond the stone-age.

IT is expected that the British Archæological Association will hold its annual congress next summer at Wisbeach, to which it has been courteously invited by the Mayor and Corporation. If this arrangement should be definitely made the Prince of Wales will be asked to allow his name to be used as the patron of the congress.

THE Russian division in the Paris Exposition will contain a most interesting anthropological collection, the material for which is now being gathered by a Commission in Moscow. Among the more prominent features are an enormous cranial collection from the various parts of the empire, and a model of a Russian barrow. The latter is being executed by the sculptor, Ssewojugin, in natural size, and will offer a perfect imitation of the skeletons, ornaments, weapons, &c., as usually found in these ancient remains. The Russian educational system will be likewise very fully represented, as was the case in 1876.

THE official report of the Munich Session of the German Scientific Association, which took place last September, has just appeared. It forms a volume of 264 quarto pages, and has been prepared with unusual care. Reports of all addresses delivered have been furnished by the speakers themselves, who numbered considerably over a hundred. The number of members and participants in the last session was 1,800, of whom 650 were from Munich or its vicinity. We notice that the Society is exceedingly strict in the observance of one of its statutes stating that it shall possess no property with the exception of its archives, for the receipts exactly cover the expenses.

THE death is announced of Major-General Sir Andrew Scott Waugh, F.R.S., of the Royal Engineers, at the age of sixty-eight. He entered the Bengal Engineers in 1827, and assisted in the making of the great Trigonometrical Survey of India in 1832. He also took a leading part under Sir George Everest

[1] I have translated Boussingault's paper, and collected the evidence on both sides, in the *Journal* of the Royal Horticultural Society, new series, vol. iv. pp. 1–7.

in the measurement of the great Indian arc for determining the figure and dimensions of the earth. In 1843 he was appointed Surveyor-General of India and Superintendent of the Trigonometrical Survey. He received the honour of knighthood in 1860, and the Gold Medal of the Royal Geographical Society in 1857–58.

MM. HENRY brothers, the celebrated astronomers, have invented a telegraphic warning apparatus, which can be used for telephones. It is powerful, cheap, and simple, and musical sounds emitted can be heard at a distance without placing the ear at the opening of the mouth-piece.

THE *Gardener's Chronicle* announces that M. Thuret's fine garden at Antibes has fortunately become the property of the French nation, and will be constituted a Mediterranean branch, as it were, of the Jardin des Plantes at Paris. The direction will be in the hands of M. Naudin, now of Collioure, who in this new field of action will have greater scope than before for his experiments in naturalisation. The object is to maintain the garden as a botanic and experimental garden, where all new introductions may be tried and distributed to other gardens.

IT is stated that the German poet, Friedrich Bodenstedt, the author of the charming "Lieder des Mirza Schaffy," is now engaged in translating the poems of the Persian philosoper Omer Cheijan. The latter was born at Nishaboor, in the twelfth century, and was one of the greatest astronomers and philosophers of his time. He recorded the results of his studies in verse.

AT a village near the well-known German watering place, Langenschwalbach (in the Prussian province of Nassau) some interesting experiments have been recently made with the common nettle (*Urtica dioica*). They consisted in working this weed in the same manner as hemp; the fibres obtained were fine as silk, while they yielded nothing to hemp fibres as regards durability. A considerable area has now been planted with nettles at the locality named.

SOME highly interesting antiquities were recently found near Wisby, on the Swedish island of Gottland, in the Baltic. Excavations are being made for a new railway, and in a gravel pit, about a foot under the surface, a copper casket was found, which contained two sets of bronze weights, each set consisting of five different pieces, and belonging to an old Arabic monetary system. Besides these weights there was a peculiar magnifying glass in the box, while on the top of all there were found two balance scales, a larger and a smaller balance beam, the former with chains, the latter with flaxen strings, which were still preserved. All the objects were artistically finished and made of bronze.

PROF. LEIDY has been engaged, in connection with Dr. Hayden's expedition during the past season, in exploring the region about Fort Bridger, Uintah Mountains, and the Salt Lake Basin, with special reference to the occurrence there of rhizopods. These have been for several years the special object of Prof. Leidy's attention, and his extensive manuscripts, with many coloured drawings, will probably be published before long.

MR. W. H. HOLMES, the artist of Dr. Hayden's party, has been prosecuting explorations among the Pueblo villages, both ancient and modern, in Northern New Mexico and Arizona, and has collected data for making models in plaster of the pueblos of Taos and Acorna, which will probably be added to the superb series of these archæological restorations deposited by Prof. Hayden in the National Museum.

WE understand that the National Entomological Exhibition, which will be opened at the Royal Aquarium, Westminster, on March 9 is likely to be a great success. Already several thousand square feet of space have been applied for.

IT is surprising to hear that M. Ruhmkorf's workshop has been sold by auction at the ridiculous price of 42*l*.

A NOVEL use of the telegraph has lately been adopted by the Norwegian Government. As is well known, the herring fishery forms one of the most important sources of income for the country, the captures being made as the great shoals come from the depths of the sea to deposit their spawn in the Norwegian fiords. It frequently happens that the object of their visit is accomplished, and they return to the ocean before news of their arrival reaches the fishers on distant parts of the coast. This difficulty is now obviated by the construction of a telegraphic line, 200 kilometres in length, composed chiefly of submarine cables, by means of which the fishers along the whole coast are enabled to gather at once on the approach of a shoal to any particular fiord. The abundant captures made in this way show the investment in telegraphic wire to have been a most profitable speculation.

BARON VON BIBRA states in the *Journal für praktische Chemie*, that he has been enabled to restore the handwriting in old manuscripts, by washing them with a solution of tannin, and drying at 75° C. He has likewise found that nitro-benzene can be used for the restoration of antique paintings, whether painted on wood or canvas.

A STRANGE little work has just been published at Weimar (Weissbach); its title is "Das Buch der Katzen," its author Herr Gustav Michel. In six letters the author gives an interesting account of the somewhat rich material, treating the same in turn from a scientific, historic, domestic, religious, and mythological point of view.

IN a communication to the American Philosophical Society on the 1st inst., by Mr. A. Wilcocks, of Louisiana, the author describes an interesting observation which he made of a shadow cast by Venus, against a white wall, in a piazza. "The shadow of a hand," he states, "distant twelve feet from the wall, I found perfectly sharp and well defined. And more striking still, the shadow of the twigs of a pecan tree, distant fifty yards, were also sharp. These last shadows were faint, from the effect of the diffused light of the sky which illumined the wall."

WE take the following interesting statistical data from the *Jahresbericht* for 1877 on the establishments of the world-known firm of Krupp at Essen, Rhenish Prussia. The number of workmen in the cast-steel works amounts to 8,500. There are 298 steam-engines with separate boilers in the establishment, and the total of their horse-power amounts to 11,000. Besides these there are 77 steam hammers at work varying in weight from 2 cwt. to 50 tons. The products in every 24 hours amount to about 12 English miles of rails with tyres, axles, wheels, springs in proportion, as well as 1,500 shells of various sizes and constructions. In one month 300 guns (of various bores) are produced. Since 1847 no less than 15,000 cannon have been made. The daily consumption of coal and coke is 1,800 tons. There are 21,000 gas flames on the works. A railway of 60 kilometres length, with 24 locomotive engines, and 700 carriages exclusively belongs to the establishment; there are also 44 different telegraph stations, and a fire brigade with 8 engines. A new shooting ground of 18 kilometres length is now being adapted near Meppen (Hanover). In the coal and other mines belonging to the firm there are 5,300 workmen. Their mines in northern Spain produce 200,000 tons of iron ore annually; 5 steamers belonging to the firm convey these ores to their destination. The metallurgical establishment contains 700 workmen. In 3,277 workmen's dwelling-houses built by the firm there live 16,200 men, women, and children. They are supplied with provisions, &c., at 22 stores at wholesale prices. The bakehouse produces about 195 tons of bread per day. Last, but not least, there are 4 general schools with 21 classes, and an industrial school for girls and women on the establishment.

LORD JOHN MANNERS stated in the House of Commons on Thursday last that experiments have been made by officers of the Post-Office with the telephone, the result being that the instrument is not at present considered suitable for public telegraphy.

IN Prof. Lebour's letter on Marine Fossils in the Gannister Beds of Northumberland, in last week's NATURE, the word *country* should have been *county*. It is the first time marine forms have been found in this series in Northumberland.

THE additions to the Zoological Society's Gardens during the pas week include two Black-winged Pea-Fowls (*Pavo nigripennis*) from Cochin China, presented by the Hon. A. S. G. Canning, F.Z.S.; a Javan Parrakeet (*Palæornis javanica*) from Muttra, North-West India, presented by Mr. Barthorp; two Red-vented Bulbuls (*Pycnonotus hæmorrhous*) from India, presented by Col. A. L. Annerley, F.Z.S.; two Leopards (*Felis pardus*) from Persia, deposited; two Barbary Wild Sheep (*Ovis tragelaphus*) from North Africa; two Pale-headed Parrakeets (*Platycercus pallidiceps*) from North-East Australia; four Turquoisine Parrakeets (*Euphema pulchella*) from New South Wales, pu chased; two Tigers (*Felis tigris*), born in the Gardens.

ON COMPASS ADJUSTMENT IN IRON SHIPS [1]

II.

AN important objection was made to me some years ago by Capt. Evans against the use of quadrantal correctors in the Navy, that they would prevent the taking of bearings by the prismatic azimuth arrangement, which forms part of the Admiralty standard compass. The azimuth mirror (Fig. 5) applied to the compass before you was designed to obviate that objection. Its use even for taking bearings of objects on the horizon is not interfered with by the globes constituting the quadrantal correctors, even if their highest points rise as high as five inches above the glass of the compass-bowl. It is founded on the principal of the camera lucida. The observer when taking a bearing turns the instrument round its vertical axis until the mirror and lens are fairly opposite to the object. He then looks through the lens at the degree divisions of the compass-card, and turns the mirror round its horizontal axis till he brings the image of the object to fall on the card. He then reads directly on the card the compass bearing of the object. Besides fulfilling the purpose for which it was originally designed, to allow bearings to be taken without impediment from the quadrantal correctors, the azimuth mirror has a great advantage in not requiring any adjustment of the instrument, such as that by which, in the prism compass the hair is brought to exactly cover the object. The focal length of the lens in the azimuth mirror is about 12 per cent. longer than the radius of the circle of the compass-card, and thus, by an elementary optical principle, it follows that two objects a degree asunder on the horizon will, by their images seen in the azimuth mirror, cover a space of 1°·12 of the divided circle of the compass-card seen through the lens. Hence, turning the azimuth instrument round its vertical axis through one degree will only alter the apparent bearing of an object on the horizon by ·12°. Thus it is not necessary to adjust it exactly to the direct position for the bearing of any particular object. If it be designedly put even as much as 4° awry on either side of the direct position, the error on the bearing would hardly amount to half a degree. If the instrument were to be used solely for taking bearings of objects on the horizon, the focal length of the lens should be made exactly equal to the radius of the circle, and thus even the small error of ·12° in the bearing for one degree of error in the setting would be avoided. But one of the most important uses of the azimuth instrument at sea is to correct the compass by bearings of sun or stars at altitudes of from 0° to 50° or 60° above the horizon. The actual focal length is chosen to suit an altitude of 27°, or thereabouts (this being the angle whose natural secant is 1·12). Thus if two objects whose altitudes are 27°, or thereabouts, and difference of azimuths 1°, are taken simultaneously in the azimuth mirror, their difference of bearings will be shown as one degree by the divided circle of the compass-card seen through the lens. Hence for taking the azimuth of star or sun at an altitude of 27°, or thereabouts, no setting of the azimuth mirror by turning round the vertical axis is necessary, except just to bring the object into the field of view, when its bearing will immediately be seen accurately shown on the divided circle of the compass-card. This is a very valuable quality for use in rough weather at sea, or when there are flying clouds which just allow a glimpse of the object, whether sun or star, to be caught, without allowing time to perform an adjustment, such as that of bringing the hair, or rather the estimated middle of the space traversed by the hair in the rolling of the ship, to coincide with the object. The same degree of error as on the horizon, but in the opposite direction, is produced by imperfect setting round the vertical axis in taking the bearing of an object at an elevation of 38°.

Thus for objects from the horizon up to 38° of altitude the error in the bearing is less than 12 per cent. of the error of the setting. For objects at a higher elevation than 38° the error rapidly increases; but even at 60° altitude the error on the bearing is a little less than half the error of the setting; and it is always easy, if desired, to make the error of the setting less than

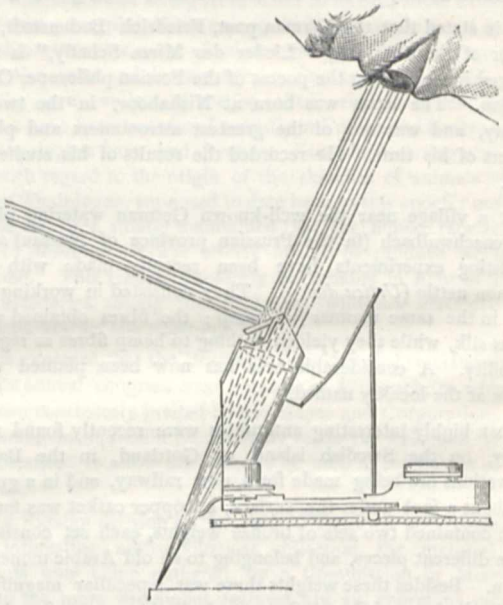


FIG. 5.

a degree by turning the instrument so that the red point, which you see below the lens, shall point within a degree of the position marked on the circle of the compass-card by the image of the object.

For taking star azimuths the azimuth mirror has the great advantage over the prism compass, with its then invisible hair, that the image of the object is thrown directly on the illuminated scale of the compass-card. The degree of illumination may be made less or more, according to faintness or brilliance of the object, by holding a binnacle lamp in the hand at a greater or less distance, and letting its light shine on the portion of the compass-card circle seen through the lens. Indeed, with the azimuth mirror it is easier to take the bearing of a moderately bright star by night than of the sun by day: the star is seen as a fine point on the degree division, or between two, and it is easy to read of its position instantly by estimation to the tenth of a degree. The easiest, as well as the most accurate of all, however, is the sun when bright enough and high enough above the horizon to give a good shadow on the compass-card. For this purpose is the stout silk thread which you see, attached to the framework of the azimuth mirror in such a position that when the instrument is properly placed on the glass of the compass-bowl, the thread is perpendicular to the glass and through the central bearing-point of the compass.

Another advantage of the azimuth mirror particularly important for taking bearings at sea when there is much motion, is

[1] Report of paper read to the Royal United Service Institution, February 4, by Sir Wm. Thomson, LL.D., F.R.S., P.R.S.E., Professor of Natural Philosophy in the University of Glasgow, and Fellow of St. Peter's College, Cambridge. Revised by the Author. [The Council of the R.U.S.I. have kindly permitted us to publish Sir W. Thomson's paper in advance, and have granted us the use of the illustrations.—ED.] Continued from p. 334.

that with it it is not necessary to look through a small aperture in an instrument moving with the compass-bowl, as in the ordinary prism compass, or in the original nautical azimuth compass (described 280 years ago by Gilbert, Physician in Ordinary to Queen Elizabeth, in his great Latin book. "On the Magnet and on the Earth a great Magnet"), which is very much the same as that still in use in many of the best merchant steamers. In using the azimuth mirror the eye may be placed at any distance, of from an inch or two to two or three feet, from the compass, according to convenience, and in any position, and may be moved about freely through a considerable range on either side of the line of direct vision through the lens, without at all disturbing the accuracy of the observation. This last condition is secured by the lens being fixed in such a position of the instrument that the divided circle of the compass-card is in its principal focus. Thus the virtual image of the divided circle is at an infinite distance, and the images of distant objects seen coincidently with it by reflection in the plane mirror show no shifting on it, that is to say, no parallax, when the eye is moved from the central line to either side. From the geometrical and optical principles explained previously, it follows also that if the azimuth instrument be used for taking the bearing of an object whose altitude is less than 27°, then the effect of turning the frame carrying the lens and mirror in either direction will seem to carry the object in the same direction relatively to the degrees of the card; or in the contrary direction if the altitude exceeds 27°. But if the altitude of the object be just 27°, then the azimuth instrument may be turned through many degrees on either side of the compass-card, without sensibly altering the apparent positions of the objects on the degree-divisions.

II.—*An Adjustable Deflector for completely determining the Compass Error when Sights of Heavenly Bodies or Compass Marks on Shore are not available.*

About thirty years ago Sir Edward Sabine gave a method in which, by aid of deflecting magnets properly placed on projecting arms attached to the prism circle of the Admiralty standard compass, a partial determination of the error of the compass could be performed at any time, whether at sea or in harbour, without the aid of sights of heavenly bodies or compass marks on shore. The adjustable magnetic deflector before you is designed for carrying out in practice Sabine's method more rapidly and more accurately, and for extending it, by aid of Archibald Smith's theory, to the complete determination of the compass error, with the exception of the constant term "A" of the Admiralty notation, which in almost every practical case is zero, and can only have a sensible value in virtue of some very marked want of symmetry of the iron work in the neighbourhood of the compass.[1] When it exists it can easily be determined once for all and allowed for as if it were an index error of the compass card, and it will, therefore, to avoid circumlocutions in the statements which follow, be either supposed to be zero or allowed for as index error.

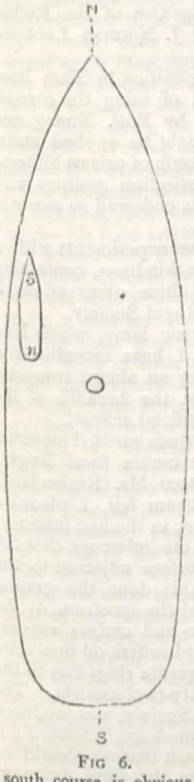


Fig. 6.

[1] I had a curious case lately of the effect of unsymmetrical iron on a midship steering compass, due to a steam-launch about thirty feet long placed fore-and-aft on the port side of the deck with its bow forward and its stern five or six feet before the thwart-ship line through the position of the compass. Adjustment having been performed by means of the globes and magnetic correctors to correct the quadrantal error (D), and the semicircular error, it was found (as was expected) that the compass was correct on the east and west points, but showed equal westerly errors of about 3½° on the north and south points. There were, therefore, approximately equal negative values of "A" and "E" each 1¾°. The captain was, of course, warned of the change he would find when he was relieved of the steam-launch at Rangoon, the port of his destination. The explanation of the westerly deviation when the ship's head was north or south, by the inductive magnetism of the steam-launch, according to which its stern would be a true north pole when the ship is on the north course, and a true south pole when the ship is on the south course, is obvious from the annexed diagram, in which the letters *n*, *s*, denote true north pole and true south pole of induced magnetism in the steam-launch when the ship's head is north magnetic.

The new method is founded on the following four principles:—

1. If the directive force on the compass needles be constant on all courses of the ship, the compass is correct on all courses.

2. If the directive force be equal on five different courses, it will be equal on all courses.

3. Supposing the compass to be so nearly correct or to have been so far approximately adjusted, that there is not more than eight or ten degrees of error on any course, let the directive forces be measured on two opposite courses. If these forces are equal the compass is free from semicircular error on the two courses at right angles to those on which the forces were measured; if they are unequal there is a semicircular error on the courses at right angles to those on which the forces were measured, amounting to the same fraction of the radian (57·3°) that the difference of the measured forces is of their sum.

4. The difference of the sums of the directive forces on opposite courses in two lines at right angles to one another, divided by the sum of the four forces, is equal to the proportion which the quadrantal error, on the courses 45° from those on which the observations were made, bears to 57·3°.

The deflector may be used either under way or in swinging the ship at buoys. The whole process of correcting the compass by it is performed with the greatest ease and rapidity when under way with sea room enough to steer steadily on each course for a few minutes, and to turn rapidly from one course to another. For each operation the ship must be kept on one course for three or four minutes, if under way, by steering by aid of an auxiliary compass, otherwise by hawsers in the usual manner if swinging at buoys, or by means of steam-tugs. A variation of two or three degrees in the course during the operation will not make a third of a degree of error in the result as regards the final correction of the compass. The deflector reading is to be taken according to the detailed directions in sections 14 and 15 of the printed "Instructions." This reading may be taken direct on the small straight scale in the lower part of the instrument. The divided micrometer circle at the top is scarcely needed, as it is easy to estimate the direct reading on the straight scale to a tenth of a division, which is far more than accurate enough for all practical purposes. This reading with a proper constant added gives, in each case, the number measuring in arbitrary units the magnitude of the direct force on the compass for the particular course of the ship on which the observation is made.

The adjustment by aid of the deflector is quite as accurate as it can be by aid of compass marks or sights of sun or stars, though on a clear day at any time when the sun's altitude is less than 40°, or on any clear night, the adjuster will of course take advantage of sights of sun or stars, whether he helps himself also with the deflector or not.

III.—*New Form of Marine Dipping Needle for facilitating the Correction of the Heeling Error.*

This instrument is designed as a substitute for the vibrating vertical needle, hitherto in use for carrying out the observations of vertical force, whether on board ship or on shore, required for performing the operations described in Part iii. Section 4, and ths last three pages of Part iv. of the Admiralty Manual. It consists of a light bar-magnet or "needle" of hardened steel wire, supported by means of a very small aluminium cradle on a stretched platinum wire, of which the two straight parts on the two sides of the needle are, as nearly as may be, in a line through its centre of gravity. One flat end of the needle is painted white, with a black line through its middle parallel to the platinum wire. When the instrument is properly placed for use the platinum wire is horizontal, and the needle is brought into a horizontal position by turning one end of the platinum wire until the elastic force of the torsion balances the turning motive (or "couple") due to the vertical component of the magnetic force of the locality. A divided circle is used (as the torsion head of the original Coulomb's Torsion Balance) to measure the degrees of torsion to which, according to Coulomb's original discovery, the turning motive is proportional. Thus, the magnetic moment of the needle being constant, the vertical component of the magnetic force in the locality of the observation is measured simply in degrees or divisions of the torsion head. A glass plate, fixed in a vertical position parallel to the platinum wire and close to the painted end of the needle, has a horizontal score across it on the

level of the platinum wire. By aid of a totally reflecting prism, like that of the prismatic azimuth compass, with one side convex, the user of the instrument looking downwards sees when the black line on the end of the needle is exactly level with the score on the glass plate. This mode of sighting has proved very satisfactory; it is very easily and quickly used, and it is so sensitive that with the dimensions and magnetic power of the instrument before you it shows easily a variation of vertical force amounting to $\frac{1}{1000}$ of the earth's vertical force in this locality. The accompanying printed instructions for the adjustment of my compass describe in sufficient detail the way of using it for correcting the heeling error.

In the instrument before you there is a divided paper circle in the bottom of the box to serve as a "dumb card," to be used with the azimuth mirror when there may be occasion for the use of a non-magnetic azimuth instrument. This appliance has nothing to do with the dipping needle, and is introduced because, while adding little or nothing to the cumbrousness of the instrument, it saves the adjuster the necessity for carrying a separate azimuth instrument with him.

(*To be continued.*)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—From the University Calendar for 1878 we learn that the Undergraduates, who were last year 2,590, have now risen to 2,659, while the members of Convocation have increased from 4,870 to 5,026. During the year 320 have taken the degree of Master of Arts, and 446 that of Bachelor of Arts. The number of matriculations, which in 1868 was 579, and which in 1876 was 650, rose in 1877 to 770. But this increase was due to the number of candidates for a musical degree. The list of members of Congregation—that is, of the legislative body of resident members of Convocation—has increased, but only slightly. In 1876 they numbered 314; in 1877, 322. But the proportion between clergymen and laymen has considerably changed during the year. In 1876 there were 180 clergymen and 134 laymen; in 1877 the laymen have risen to 154, and the clergymen have fallen to 168. Of the whole body of Fellows (exclusive of Christ Church), resident and non-resident, there are at present 192 laymen and 116 clergymen.

CAMBRIDGE.—The Council of the Senate having had under consideration a letter from Prof. Hughes, Woodwardian Professor of Geology, representing the need for additional assistance, propose that an assistant be appointed, with a stipend of 200*l.* per annum, whose duties shall be to assist the Professor in the arrangement and care of the geological collections, to give such instruction and demonstrations as may be required, and to assist students making use of the museum. It is proposed to vest the appointment in the Professor, with the consent of the Vice-Chancellor.

EDINBURGH.—A site has been secured in Chambers Street, close by the University, for the erection of a new school of medicine for extra-academical teachers, on the spot formerly occupied by Minto House, so long the scene of the demonstrations and prelections of eminent extra-mural lecturers.

TAUNTON COLLEGE SCHOOL.—A microscopic cabinet by Smith and Beck, with other valuable apparatus, has been presented to the Rev. W. Tuckwell by his late assistant-masters at the Taunton College School, as an expression of their personal sympathy and their recognition of the services rendered by him to the higher education.

PRUSSIA.—January 20 was a red letter day for a number of professors in Prussian universities, no less than fifteen receiving orders of different ranks from the Emperor William.

DRESDEN.—On May 1 the Royal Polytechnic Institution at Dresden will celebrate the fiftieth anniversary of its foundation. Originally confined to the narrowest limits, the Institution has rapidly developed, and is now one of the most frequented polytechnic schools of Germany.

GREIFSWALD.—The attendance on the university shows a decrease as compared with the past summer. The students number 43 in the theological faculty, 73 in the legal, 126 in the philosophical, and 218 in the medical. The corps of professors and privat-docenten is at present 60. A library of 60,000 volumes, well equipped laboratories and collections, and ample revenues place Greifswald on a par with most German universities, but for a number of years it has failed singularly to compete in point of attendance with many poorer centres of study.

TÜBINGEN.—The university shows at present the highest winter attendance since its foundation. The students are divided as follows: Theology (evangelical), 215, (catholic), 108; law, 256; natural sciences and medicine, 222; philosophy, 145.

MÜNSTER.—Prof. R. Sturm, of the Darmstadt Polytechnic, has been appointed to the chair of mathematics, rendered vacant by the late death of Prof. Heis. The number of students at present is 312.

BERLIN.—Prof. Schwedener, of Tübingen, has received a call to Berlin to fill the second professorship for Botany lately created at the University.

VIENNA.—In the lately presented educational budget of Austria the sum of 50,000*l.* is appropriated for the erection of new buildings for the Vienna University.

DORPAT.—The hitherto rigorous rule of Russian universities requiring from all instructors the possession of Russian diplomas of the doctorate, &c., has been modified in the case of Dorpat, recognition being made of foreign degrees and professorial positions.

SIBERIA.—The Imperial Commission appointed to settle the long-debated question as to the University of Siberia, has definitively given the preference to Tomsk, against Omsk. We are glad to learn this result, because of the central position of Tomsk, its larger population, not exclusively administrative, as at Omsk, and the larger number of secondary schools. Several Siberian merchants have endowed the future University with considerable sums of money.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, January 31.—"On the Expression of the Product of any Two Legendre's Coefficients by means of a Series of Legendre's Coefficients," by Prof. J. C. Adams, F.R.S.

Royal Society, February 24.—"On the Use of the Reflection Grating in Eclipse Photography," by J. Norman Lockyer, F.R.S.

The results obtained by the Eclipse Expedition to Siam have led me to think that, possibly, the method of using the coronal atmosphere as a circular slit, suggested by Prof. Young and myself, for the Indian eclipse of 1871, might be applied under very favourable conditions, if the prism or train of prisms hitherto employed were replaced by one of those reflection gratings with which the generosity of Mr. Rutherfurd has endowed so many of our observers.

To test this notion I have made some experiments with a grating, which I owe to Mr. Rutherfurd's kindness, containing 17,280 lines to the inch. The results of these observations I have now the honour of laying before the Royal Society.

In front of the lens of an ordinary electric lamp, which lens was adjusted to throw a parallel beam, I have introduced a circular aperture, cut in cardboard, forming an almost complete ring, some two inches in interior diameter, the breadth of the ring being about $\frac{1}{8}$ inch. This was my artificial eclipse.

At a distance from the lamp of about thirteen yards, I mounted a $3\frac{3}{4}$ inch Cooke telescope, of fifty-four inches focal length. Some distance short of this focus I placed Mr. Rutherfurd's grating, and, where the first order spectrum fell, I placed a focussing screen. To adjust for sharp focus, in the first instance, the grating was so inclined to the axis of the telescope that the image of the ring reflected by the silver surface adjacent to the grating was thrown on to the screen. This done, the grating was placed at right angles to the axis, and the spectrum of the circular slit, illuminated by sodium vapour and carbon vapour, photographed for the first, second, and third orders on one side. The third order spectrum, showing the exquisite rings due to the carbon vapour flutings was produced in forty-two seconds. The first order spectrum, also submitted to the Society, was produced in the same period of time, and was very much over-exposed; it is, therefore, I think not expecting too much that we should be able to take a photograph of the eclipse, in the third order, in two minutes; but let us make it four. Similarly, we may hope for a photograph of the second order in two minutes, and it is, I

think, highly probable also that a photograph of the first order may be obtained in one minute.

It is clear then that, by mounting photographic plates on both sides of the axis, one solidly mounted equatorial of short focal length may enable us to obtain a large number, with varying lengths of exposure, of the next eclipse. I have insisted upon the solidity of the mounting because, if any one plate is to be exposed during the whole of totality, the instrument must not be violently disturbed or shaken while the eclipse is going on. I think, however, it is quite possible to obtain many photographs, of the lower order spectra, without any such disturbance. The same plate may be made to record three, or even four, exposures in the case of the first order, by merely raising or lowering it after a given time, so that a fresh portion of the same plate may be exposed, by means of a rapid screw or other equivalent contrivance. Similarly, the plates on which the spectra of the second order are to be recorded may be made to perform double duty.

Linnean Society, February 7.—Prof. Allman, F.R.S., president, in the chair.—Sir John Lubbock, Bart., read a paper, "Observations on the Habits of Ants," being his fifth contribution on this subject. In continuation of former experiments he finds that ants recognise old acquaintances and attack strangers. Their intelligence is questionable in cases where a thin circle of glycerine bars their access to honey which they have already visited by a paper bridge, for when the latter is taken away they do not pile up a few grains of earth and thus cross the barrier. Spite of the many observers and plentifulness of ants' nests, it is still doubtful how their nests commence. Sir John's experiments show that the workers of *Lasius flavus* will not adopt an old queen from another nest. But on the other hand, the queen of *Myrmica ruginodis* has the instinct of bringing up larvæ and the power of founding communities. As to intimating to each other discovery of food, he considers this does not necessarily imply any power of describing localities, but rather by a simple sign co-workers accompany each other to the treasure. They do not summon their brotherhood by sounds to a repast found by one or another. Their affection for friends is outbalanced by hatred of strangers. A few of each kept prisoners in separate bottles with wide meshed muslin over the mouths, those free outside again and again excitedly endeavoured to attack the latter, but used no means to free the former, their own companions. Further experiments prove scent more than sight guides them in following up food which has been shifted in position after its having been partaken of, and a return to the nest made. Ants avoid light when thrown into their nests, and they then congregate into the darkest corners. Taking advantage of this habit by a series of ingenious experiments—wherein strips of coloured glass, in other instances shallow cells containing coloured solutions, such as fuchsine, bichromate of potash, chloride of copper, &c., were used—Sir John arrives at the conclusion that they are influenced by the sensation of colour, though probably different from the effect produced in man. A predominate preference is given to red, green follows, yellow comes next, while to blue and violet there appears to be a decided aversion. The longevity of ants would seem greater than generally admitted, some specimens of *Formica fusca* being at least five years old.—Mr. Thiselton Dyer made a brief communication on the so-called "rain-tree" of Mogobamba, South America, an account of which we give elsewhere.—Then followed a paper "On the shell of the Bryozoa," by Mr. Arthur W. Waters. The points he more particularly drew attention to were:—The great difference of the young and old cells caused by a constant growth of shell-substance, so that the older zooecia become closed up. This growth progresses at various rates. Passing through the shell are tubes filled with corpuscles of the chylaqueous fluid, which thus become oxidised. The supposed nervous filament of the colonial connection the author believes to be rather for the supply of material from one part of the zooarium to another. He further suggests that the varying thickness of the plates in the walls of the colonial connection should be used as a factor in specific determination, and especially would it be useful in comparing recent and fossil forms. There is a possibility of the avicularia and adventitious tubes being homologous, and helping to maintain the vitality of the colony when the polypides have disappeared.—Messrs. A. G. Agar and C. Berjeau were elected Fellows of the Society.—The President having put the motion, it was unanimously resolved to present an address to Prof. C. T. Ernst von Siebold on his approaching jubilee.

Zoological Society, February 5.—Prof. Mivart, F.R.S., vice-president, in the chair.—Prof. Mivart read a paper entitled "Notes on the Fins of Elasmobranchs, with Considerations on the Nature and Homologies of Vertebrate Limbs," wherein the author detailed his dissections of the fins of Elasmobranchs, which dissections had convinced him that the paired and azygos fins are of similar nature. He represented them all to have resulted from the centripetal growth and coalescence of a primitively distinct series of cartilaginous rays developed in longitudinal folds, of which one was dorsal, one ventral, and two were lateral. He also advocated the view that the limb-girdles result from the further centripetal growth of the coalescing limb-cartilages, which growth seeks a *point d'appui*, the pectoral limb-girdles in fishes shooting upwards and downwards, as well as inwards to obtain a firm support, and, at the same time, to avoid the visceral cavity. He contended that the Archipterygium was not to be sought for in *Ceratodus*, which he by no means regarded as a primitive type of structure, but rather in *Raia* and especially in the ventrals of *Polyodon*. He objected to Gegenbauer's view that the metapterygium formed the limb axis of the cheiropterygium, advocating instead the propterygium, or, if not that, then the mesopterygium. He cited the varying conditions described as evidences of the presence of an innate intra-organic polar force as the main agent in morphological modifications.—A communication was read from Mr. W. A. Forbes, F.Z.S., containing an account of the birds collected by the *Challenger* Expedition at Cape York and on the neighbouring islands. The collection consisted of sixty-one skins referable to thirty-eight species, all, or nearly all, of which belonged to well-known Australian forms, one or two only being uncertain on account of the immature condition of the specimens.—A communication was read from Mr. Francis Nicholson, F.Z.S., in which he gave an account of a small collection of birds made in the neighbourhood of Abeokuta, West Africa. Amongst these was a new species of Finch which was proposed to be called *Amadina sharpei*.—The Rev. S. J. Whitmee, C.M.Z.S., read a paper on the mode of the modifications of anger, fear, &c., in fishes, and on the use of their spines, as observed by him during his residence in the Samoan Islands.—Messrs. P. L. Sclater and O. Salvin gave an account of the collection of birds made by Prof. Steere during his recent journey across South America, from Para to Callao. The 911 specimens obtained were stated to be referable to 362 species, of which five were described as apparently new to science, and proposed to be called *Oryzoborus atrirostris*, *Myiarchus semirufus*, *Furnarius pileatus*, *Capito steerii*, and *Crypturus transfasciatus*.—Prof. Garrod read a note on the anatomy of the Binturong, *Arctictis binturong*, and the fourth portion of his series of notes on the anatomy of passerine birds.—Mr. Howard Saunders, F.Z.S., read a paper on the subfamily of the *Larinæ*, or Gulls, being a monographical revision of the group, which he considered to consist of the genera *Pagophila*, *Rissa*, *Larus*, *Rhodostethia*, and *Xema*, containing altogether forty-nine species. With regard to *Pagophila*, he drew attention to a structural peculiarity which appeared to have been previously unnoticed, *i.e.*, the junction of hallux to the inner toe by a serrated membrane. Mr. Saunders also remarked upon the occasional presence of a small but well-developed hind toe and claw in individuals of the Kittiwake (*Rissa tridactyla*) from Alaska.—A communication was read from Mr. Martin Jacoby, containing descriptions of some new species of phytophagous coleoptera.—Two communications were read from Lieut.-Col. R. H. Beddome, C.M.Z.S. The first gave a description of a new form in the family of Tree-agames from the higher ranges of the Anamallays, proposed to be named *Lophosarea anamallayana*. The second contained the descriptions of some new species of *Uropeltidæ*, from Southern India.

Anthropological Institute, February 12.—Mr. John Evans, D.C.L., F.R.S., president, in the chair.—Mr. H. C. Sorby, F.R.S., read a paper on the various colouring matter met with in human hair. In this paper the author described the manner in which the various coloured substances met with in human hair may be separated and distinguished. Four quite different and well characterised pigments have been obtained, but of these two serve to modify the tints of hair to only a very limited extent. The general colour is mainly due to a black and a brown-red pigment, both of which can be easily obtained in a separate form, and used like water colours, as shown by the numerous drawings which were exhibited. All the varying tints of black, brown, dark and lighter red, and most of the pale tints are easily proved

to be due to a variation in the total and relative amounts of these two substances as shown by a series of comparative analyses. The paper concluded with some remarks on the bearing of these facts on ethnology, and with a consideration of the probable explanation of certain changes in the colour of hair occasionally met with, but not yet fully understood.—The Director then read a paper by the Hon. Chas. C. Jones, jun., on bird-shaped mounds in Putnam County, Georgia.

Meteorological Society, February 20.—Mr. C. Greaves, F.G.S., president, in the chair.—Dr. Tripe read a paper on the winter climate of some English sea-side health resorts. The places selected were Scilly, Torquay, Penzance, Guernsey, Barnstaple, Ventnor, Llandudno, Ramsgate, and Hastings, and the climatic features of each were compared with those of London. The results of this discussion may be briefly summed up as follows, viz. :—The mean daily winter temperature of these seaside places, and especially of those situated on the coast of Devon and Scilly, is higher than at London; the mean daily maxima and minima are also higher, and especially the latter; so that the daily and monthly ranges of temperature are smaller; the mean humidity is less, the general direction of the wind about the same, but the number of rainy days and the rainfall are greater at the sea-side. As regards the wind, therefore, the chief point to be especially noticed is the amount of shelter afforded by high land, as at Ventnor, and especially of protection against the stormy and cold winds which ordinarily prevail at the end of February and in March. The soil also should be considered, as heavy rains at gravelly and chalky places are not so objectionable as on clayey ground.—The discussion on this paper was adjourned until the next meeting, which will be held on March 20.—The following were elected Fellows of the Society :—W. C. Baker, W. Berridge, W. M. Burke, Rev. J. A. L. Campbell, Prof. J. Eliot, Lieut. C. S. F. Fagan, C. H. Holden, Prof. H. J. S. Smith, Capt. W. Watson, C. Woollett, and Miss E. A. Ormerod.

Institution of Civil Engineers, February 12.—Mr. Bateman, president, in the chair.—The paper read was on the evaporative power of locomotive boilers, by Mr. J. A. Longridge, M. Inst. C.E.

PARIS

Academy of Sciences, February 18.—M. Fizeau in the chair.—The President gave an account of the funeral of M. Claude Bernard on the 16th inst., and the discourses pronounced by MM. Dumas, Mezières, and others. (These are published in the *Comptes Rendus*.)—Meridian observations of small planets at the Greenwich and Paris Observatories during the fourth quarter of 1877, by M. Villarceau.—On some applications of elliptic functions (continued), by M. Hermite.—Experimental researches on the fractures traversing the earth's crust, especially those known as joints and faults (continued), by M. Daubrée. His object is to show that torsion may account for many of those effects.—Tibio-calcanean resection, by M. Sedillot.—Refutation of M. Pasteur's criticism of his opinion as to the origin of alcoholic yeast and lactic yeast, by M. Trécul.—The vibrations of matter and the waves of the ether in vision, by M. Favé.—Remarks on the satellites of Mars, by M. Roche. He considers the first satellite comparable to the inner ring of Saturn in its origin; it owes its existence (as satellite) to being a little more separated from its planet.—On the law of reciprocity for invariants and covariants of binary quantics, by Prof. Sylvester.—On MM. Clebsch and Gordon's theory of associated forms, by the same.—Presence of magnetic spherules similar to those of atmospheric dust, in rocks belonging to ancient geological periods, by MM. Meunier and Tissandier. If the identity be admitted, we must infer that the layers of the earth's crust contain materials of cosmic origin which fell in a very distant epoch (such particles are found in the Devonian series). It is important to determine where they first appear.—On the vibratory forms of solid and liquid bodies, *à propos* of a note by M. Dubois, by M. Decharme. A claim of priority.—Separation of the non-ferruginous elements of rocks, based on their difference of specific gravity, by M. Thoulet. The specific gravity of most of the essential minerals of rocks varying between 2·2 and 3: these may be separated from each other by immersion in solutions which are without chemical action on them, but whose specific gravity is comprised between the same limits. Such are solutions of iodide of mercury in iodide of potassium. (Details of the method are given.)—On the state of phylloxerised vines in the commune of Mezel (Puy-de-Dôme), by M. Truchot.—Theory of Vesta: perturbations dependent on the first power of the perturbing masses, by M. Leveau.—On the special conditions in the contour of plates, by M. Boussinesq.—On the conditions for a quadratic form of n differentials to be transformed so that its coefficients lose a part or the whole of the variables they contain, by M. Levy.—On the summatory formula of Maclaurin and interpolar functions, by M. Genocchi.—On Bell telephones and string telephones, by M. Breguet. By attaching a string telephone (with parchment membrane) to any point of a Bell telephone, one may hear through it a person using a Bell telephone. Several string telephones may thus be connected. A mode of making the string telephone more practicable is described.—On telephony, by M. Salet. A telephone is described in which the movements of the two membranes are absolutely correspondent, the great electric resistance of liquids being utilised for the purpose.—On the ebullition of superposed liquids, by M. Gernez.—Extraction of gallium, by MM. Lecoq de Boisbaudran and Jungfleisch. The authors had obtained 62 grammes of metallic gallium by treating 4,300 kilogrammes of Bensberg blende (the method is described).—Method of volumetric determination of potash, by M. Carnot.—Dissociation of hydrate of chlorine, by M. Isambert. With regard to solubility of chlorine in water, he says that under 9° it is only the hydrate that is formed and dissolved in the water; above this temperature, at ordinary pressure, there is merely a solution of a gas in the water. Air passed through a solution of chlorine under 9° gradually carries off all the chlorine, as if there was solution and not combination.—Action of chloride of benzoyle on leucine, by M. Destrem.—On the identity of muscular inosite and vegetable sugars of the same composition, by MM. Tanret and Villiers.—On the preparation of amylene, by M. Etard.—Experimental researches on the maturation of the grape, by MM. Saint Pierre and Magnien.—On some volatile products of coal-pits set on fire, by M. Mayençon. He examined efflorescences round the fumeroles (the pits were in the Loire valley). The most abundant substances are ammoniacal compounds, arsenic, aluminium, iron, chlorine, and sulphur.—On the conditions of development of ligula, by M. Duchamp.—Sensations of light and colour in direct and indirect vision, by MM. Landolt and Charpentier.—On the geological constitution of the Island of Réunion (first part), by M. Velain. The succession of volcanic phenomena seems to be similar to that at Santorini.—Origin and distribution of limestone in maritime sands, by M. Contejean.—Barometric differences between neighbouring stations according to the direction of the wind (continued) by M. Renou.—On the flash of lightning which caused the burning of the belfry of Toucy (Yonné), on January 25, by M. Roché.

CONTENTS