THURSDAY, JUNE 17, 1880

TWO DARWINIAN ESSAYS

Studies in the Theory of Descent. By Dr. Aug. Weismann, Professor in the University of Freiburg. Translated and Edited by Raphael Meldola, F.C.S., Secretary of the Entomological Society of London. Part I. On the Seasonal Dimorphism of Butterflies, with Two Coloured Plates. (London: Sampson Low, Marston, and Co., 1880.)

Degeneration. A Chapter in Darwinism. By Prof. E. Ray Lankester, F.R.S. NATURE Series. (Macmillan and Co., 1880.)

THE first of Dr. Weismann's "Studies," of which Mr. Meldola has given us an excellent translation, with the author's latest notes and additions, is devoted to a thorough examination of the well-known but hitherto little understood phenomenon of the seasonal forms of butterflies. For the benefit of those unacquainted with entomology we may state, that many butterflies have two, or even three broods in a year. One brood appears in spring, their larvæ having fed during the preceding autumn and passed the winter in the pupa state, while the others appear later in the year, having passed rapidly through all their transformations and thus never having been exposed to the cold of winter. In most cases the insects produced under these opposite conditions present little or no perceptible difference; but in others there is a constant variation, and sometimes this is so great that the two forms have been described as distinct species. The most remarkable case among European butterflies is that of *Araschnia prorsa*, the winter or spring form of which was formerly considered to be a distinct species and named *Araschnia levana*. The two insects differ considerably in both sexes, in markings, in colour, and even in the form of the wings, so that till they were bred and found to be alternate broods of the same species (about the year 1830) no one doubted their being altogether distinct.

In order to learn something of the origin and nature of this curious phenomenon Dr. Weismann has for many years carried on a variety of experiments, breeding the species in large numbers and subjecting the pupæ to artificial heat or cold for the purpose of hastening or retarding the transformation. The result of these experiments is, that by subjecting the summer brood to severe artificial cold in the pupa state, it may be made to produce perfect insects the great majority of which are of the winter form; but, on the other hand, no change of conditions that have yet been tried have any effect in changing the winter to the summer form. Taking this result in connection with the fact that in high latitudes where there is only one brood a year it is always the winter form, Dr. Weismann was led to the hypothesis that this winter form was the original type of the species, and that the summer form has been produced gradually, since the glacial epoch, by the summer becoming longer and thus admitting of the production of a second or summer brood. This explains why the production of the winter form (*A. levana*) from summer larvæ is easy, it being a reversion to the ancestral type; while the production of the summer form (*A. prorsa*) from autumnal larvæ is impossible, because that form is the result of gradual development; and processes of development which have taken thousands of years to bring about cannot be artificially reproduced in a single season.

This hypothesis was supported by experiments with another two-brooded species, *Pieris napi*, with similar results, the winter form being produced with certainty by the application of cold to summer pupæ; and Mr. Edwards, in America, has made similar experiments with the various forms of *Papilii ajax*, finding that the summer broods can be changed into the winter form by the application of cold, while the winter broods can never be made to assume the summer form by hastening the process of transformation. In the Arctic regions and in the high Alps there is only one form of *Pieris napi*, which very closely resembles the winter form of the rest of Europe, and this could never be the least changed by rapidly developing the pupæ under the influence of heat.

Another curious case is that of one of the Lycænidæ (*Plebeius agestis*) which exhibits three forms, which may be designated as A, B, and C. The first two, A and B, are alternate broods (winter and summer) in Germany, while in Italy the corresponding forms are B and C, so that B is the summer form in Germany and the winter form in Italy. Here we see climatic varieties in process of formation in a very curious way.

That temperature during the pupa stage is a very powerful agent in modifying the characters of butterflies, is well shown by the case of *Polyommatus phlæas*. The two broods of this insect are alike in Germany, while in Italy the summer brood has the wings dusky instead of copper-coloured. The period of development is exactly the same in both countries, so that the change must, it is argued, be attributed to the higher temperature of the Italian summer. It has been noticed that in Italy a large number of species of butterflies are thus seasonally dimorphic which are not so in Central and Northern Europe.

Dr. Weismann lays great stress on the varied effects of temperature in modifying allied species or the two sexes of the same species, from which he argues that the essential cause of all these changes is to be found in peculiarities of physical constitution, which cause different species, varieties, or sexes to respond differently to the same change of temperature; and he thinks that many sexual differences can be traced to this cause alone without calling in the aid of sexual selection. The general result arrived at by the laborious investigation of these phenomena is, that—"a species is only caused to change through the influence of changing external conditions of life, this change being in a fixed direction which entirely depends on the physical nature of the varying organism, and is different in different species, or even in the two sexes of the same species;" and he adds:—"According to my view, transmutation by purely internal causes is not to be entertained. If we could absolutely suspend the changes of the external conditions of life, existing species would remain stationary. The action of external inciting causes, in the widest sense of the word, is alone able to produce modifications; and even the never-failing 'individual variations,' together with the inherited dissimilarity

of constitution, appear to me to depend upon unlike external influences, the inherited constitution itself being dissimilar because the individuals have been at all times exposed to somewhat varying external influences." The present writer has arrived at almost exactly similar conclusions to these, from a study of the geographical distribution and specific variation of animal forms, as stated in an article on "The Origin of Species and Genera," which appeared in the *Nineteenth Century* of January last, and it is gratifying to find them supported by the results of a very different line of inquiry, and by the authority of so eminent and original an observer as Dr. Weismann.

The second work referred to in our heading, is Prof. Lankester's British Association evening lecture last year at Sheffield, now republished with illustrations as one of the useful little volumes of the "Nature Series." It discusses the little-known phenomena of "Degeneration" as a phase of development much more general, and of far greater importance than is usually supposed. Degeneration causes an organism to become more simple in structure, in adaptation to less varied and less complex conditions of life. "Any new set of conditions occurring to an animal which render its food and safety very easily attained, seem to lead as a rule to degeneration; just as an active healthy man sometimes degenerates when he becomes suddenly possessed of a fortune; or as Rome degenerated when possessed of the riches of the ancient world. The habit of parasitism clearly acts upon animal organisation in this way. Let the parasitic life once be secured, and away go legs, jaws, eyes, and ears; the active and highly-gifted crab, insect, or annelid may become a mere sac, absorbing nourishment and laying eggs."

We see incipient cases of degeneration in the loss of limbs of the serpentiform lizards and the pisciform mammals; the loss of eyes in the inhabitants of caverns and in some earth-burrowers; the loss of wings in the Apteryx and of toes in the horse; and, still more curious, the loss of the power of feeding themselves in some slave-holding ants. More pronounced cases are those of the barnacles—degenerated crustacea, and the mites—degenerate spiders; while we reach the climax of the process in Ascidians—degenerate vertebrates, and such mere living sacs as the parasitic Sacculina and Lernæocera, which are degenerated crustaceans. Not only such lesser groups as the above, but whole orders may be the result of degeneration. Such are the headless bivalve mollusca known as Lamellibranchs, which are believed to have degenerated from the head-bearing active cuttle-fish type; while the Polyzoa or Moss-polyps stand in the same relation to the higher Mollusca as do the Ascidians to the higher Vertebrates.

While discarding the hypothesis that all savages are the descendants of more civilised races, Prof. Lankester yet admits the application of his principle to explain the condition of some of the most barbarous races—"such as the Fuegians, the Bushmen, and even the Australians. They exhibit evidence of being descended from ancestors more cultivated than themselves." He even applies it to the higher races in intellectual matters, and asks: "Does the reason of the average man of civilised Europe stand out clearly as an evidence of progress when compared with that of the men of bygone ages? Are all the inventions and figments of human superstition and folly, the self-inflicted torturing of mind, the reiterated substitution of wrong for right, and of falsehood for truth, which disfigure our modern civilisation—are these evidence of progress? In such respects we have at least reason to fear that we may be degenerate. It is possible for us—just as the Ascidian throws away its tail and its eye and sinks into a quiescent state of inferiority—to reject the good gift of reason with which every child is born, and to degenerate into a contented life of material enjoyment accompanied by ignorance and superstition."

This is very suggestive; but we may, I think, draw a yet higher and deeper teaching from the phenomena of degeneration. We seem to learn from it the absolute necessity of labour and effort, of struggle and difficulty, of discomfort and pain, as the condition of all progress, whether physical or mental, and that the lower the organism the more need there is of these ever-present stimuli, not only to effect progress, but to avoid retrogression. And if so, does not this afford us the nearest attainable solution of the great problem of the origin of evil? What we call evil is the *essential* condition of progress in the lower stages of the development of conscious organisms, and will only cease when the mind has become so thoroughly healthy, so well balanced, and so highly organised, that the happiness derived from mental activity, moral harmony, and the social affections, will itself be a sufficient stimulus to higher progress and to the attainment of a more perfect life.

For numerous instructive details connected with degenerated animals we refer our readers to the work itself—truly a small book on a great subject, and one which discusses matters of the deepest interest, alike to the naturalist and the philosopher.

ALFRED R. WALLACE

NATURE'S HYGIENE

Nature's Hygiene: a Series of Essays on Popular Scientific Subjects, with Special Reference to the Chemistry and Hygiene of the Eucalyptus and the Pine. By C. T. Kingzett. (London: Baillière, Tindall, and Cox, 1880.)

THE subject of this book is, practically, Peroxide of Hydrogen. Such a title as "Peroxide of Hydrogen, with Special Reference to its Sanitary Applications," might not have proved so taking as "Nature's Hygiene," but it would have been quite as descriptive of the subject-matter of the work. Mr. Kingzett strives to show that the position which has been assigned to ozone as "Nature's purifier and disinfectant," is not altogether merited by that body, but that it should rather be given to peroxide of hydrogen. There can be no doubt that these substances have been frequently confounded, and that in numerous instances reactions which have been attributed to ozone have been caused by hydrogen peroxide. It has been stated, for example, that the aromatic parts of flowers produce ozone, and that this substance is formed in considerable quantity by plants rich in essential oils—indeed the late Dr. Daubeny was of opinion that the oxygen evolved from plants by the decomposition of carbon dioxide in sunshine was always more or less ozonised; and other observers have sought to show that

oil of turpentine and substances allied to the terpenes have the property of transforming oxygen into ozone. There is no doubt whatever that ozone is soluble in oil of turpentine; this is incontestably proved by the experiments of Soret, who, as all chemists know, has made capital use of the fact, but this is quite another thing to saying that oil of turpentine *generates* ozone. This confusion between ozone and hydrogen peroxide has mainly arisen from the difficulty of discriminating between the two substances, and it is only since the researches of Struve, made about ten or eleven years since, that the presence of the latter body in the air may be said to have been demonstrated. Observers were led astray by the supposition that the simultaneous existence of the two substances was impossible; chemically speaking, they were held to be incompatible. Recent observations have shown that the opinions hitherto held on this point must be modified. We are at present very much in the dark as to the causes which lead to the formation of peroxide of hydrogen in nature, but that many plants, and especially those which secrete essential oils, contribute to its production is almost certain. In the book before us Mr. Kingzett has collected a mass of evidence on this matter, and has presented it in an eminently readable and interesting form. Perhaps the most valuable part of the work is that which relates to the power exercised by the various members of the genus Eucalyptus in preventing or destroying malaria—which power according to our author is related to their property of forming peroxide of hydrogen.

The *Eucalyptus globulus* was discovered by Labillardière in Tasmania towards the close of the last century, but it is only within the last quarter of a century that its anti-miasmatic properties have become known to Europeans. To whom the credit of the discovery is due is not clearly made out. M. Ramel, Baron Müller, and Sir W. Macarthen appear to have been among the first to draw attention to its extraordinary power, and seeds of the tree were sent by them from time to time to Europe. The testimony in support of this power is most convincing. In marshy districts near Eucalyptus forests fever seems to be unknown, and in parts of Corsica and Algeria where the tree has been planted for the sake of its reputed virtues endemic fevers have been stamped out. M. Gimbert, in a report to the French Academy, instanced the case of a farm situated in a pestilential district about twenty miles from Algiers, where by planting a number of the trees the character of the atmosphere was entirely changed. Similar testimony comes from Holland, the South of France, Italy, California, and many other parts of the world as to the febrifugal attributes of this tree. In no case is the evidence more convincing than in that of Algeria, as we have it related to us by Dr. Santra, and, quite recently, by Consul Playfair. Large tracts of land have been quite transformed by the agency of the "fever-destroying tree" as it has come to be called, and wherever it is cultivated fevers are found to decrease in frequency and intensity. Fewer districts in Europe have a more evil reputation than the Campagna as a veritable hot-bed of pestilential fever, and people who know the country round Rome may remember the monastery at Tre Fontane on the spot, as tradition tells, that St. Paul met his death. Life in this monastery meant death to the monks, but since the Eucalyptus has been planted in the cloisters fever has disappeared and the place has become habitable.

That the aromas of plants have in all ages been held to act as preventives of disease, especially against those of an infectious or malarial type, is well known, and in every visitation of plague which has afflicted this country we read of people carrying strong-smelling gums or balsams about their persons. The physicians of a bygone time had vinaigrettes in the handles of their canes to protect them from the exhalations of their patients, and the miserable wretches who came out of the fever-haunted prisons and bridewells of a century or two ago to stand their trials were surrounded by some aromatic herb to protect the court from possible contagion. Even the chaplain as he accompanied the doomed man to the gibbet had presented to him a bouquet as a precaution against the dreaded jail-fever.

Whether peroxide of hydrogen is invariably produced by the process of oxidation of the aromatic parts of plants is not yet proved, but that it frequently is so seems beyond question. There can be no doubt too that this substance is a very powerful antiseptic; the experiments of Mr. Kingzett and others are quite conclusive on this point.

OUR BOOK SHELF

The Science of Voice Production and Voice Preservation, for the Use of Speakers and Singers. By Gordon Holmes, Physician to the Municipal Throat and Ear Infirmary. (London: Chatto and Windus.)

THE author says that this work is an abridgment of his "Vocal Physiology and Hygiene," of which a notice has already appeared in NATURE (vol. xxi. p. 271), and that it is intended "to furnish persons who make an artistic or professional use of the vocal organs with a concise account of those relations of the voice to physical and medical science which are only cursorily alluded to, or passed over altogether, in treatises on elocution and singing."

The account is concise enough, in the sense of not occupying much space, if we omit the chapter headed "Hygiene of the Voice," which is mainly occupied with general hygiene; but we greatly doubt whether those who "make an artistic or professional use of the vocal organs" will derive much advantage from its study, that is, whether they will be able to carry away much that will be of use to them. In striving to be concise the author seems to have become vague. Although, of course, he must be professionally well acquainted with the details of the vocal organs and their laryngoscopic appearance, he has not succeeded in conveying a clear knowledge of so much as it imports the singer and public speaker to know. Nor are his woodcuts of the larynx at all satisfactory; those, for example, of "the larynx when sounding a note about the level of the ordinary speaking voice," and "during the emission of falsetto notes," being calculated to convey false impressions to those who see them for the first time. His knowledge of the physics of sound, and especially of phonetics, appears to be entirely secondhand. There is the same impression conveyed by his treatment of the registers and voice training for singers. The consequence is a want of definiteness and exactness in all these important branches of his subject. Thus, on p. 2, he tells us that sound travels through air at the rate of about 1,090 feet in a second, but neglects to add "at freezing temperature," or that it goes faster when the air is heated, so that, in fact, about 1,120 feet at 60° F. is the more common rate. At

other times his language is rather singular, as when he says that stammering "frequently arises from a muscular defect, giving rise to a *clumsiness in getting the tongue round one or more letters*" (p. 94), or speaks of the vocal bands being "tensed" (p. 105), or says that "musical gifts of voice are rather *phylogenetic* in their origin," the word in italics not appearing even in Mayne, or speaks of "living up hills" (p. 146). In a book written for singers and public speakers Latin and Greek and technical expressions should certainly be explained, if not avoided, such as *phylogenetic*, already adduced, and *frænum linguæ* (p. 95). The article on hygiene conveys a good deal of information, but we suspect most readers will rather remember the amusing account of the dietetic habits of singers, quoted from other sources, on p. 114, than be able to dig out what relates to the voice from the great mass of other matter. In conclusion, we cannot help feeling that the words "the science of," in the title, are not justified by the book itself, and might be advantageously replaced by the single word "on."

Ceylon Coffee Soils and Manures: a Report to the Ceylon Coffee Planters' Association. By John Hughes. (London : Straker Bros. and Co., 1879.)

THE writer of this report has at least gathered together a large amount of useful information about the coffee plant, coffee soils, and coffee manures. As an agricultural chemist he has, not unnaturally, attributed excessive importance to the composition and condition of the soils in which healthy and diseased coffee trees are found ; manures also are indicated as amongst the chief remedial measures. Doubtless, the proper maintenance of the "condition," as it is technically termed, of coffee soils has been woefully neglected. Indeed, where there is neither rotation nor even alternation of crops the difficulty of securing continued vigour of growth and ample crops of fruit must be considerable, even when soils are rich and seasons favourable. But let any adverse influences, whether of excessive rainfall, or of mechanical and chemical injury to the soil occur, and then the plant is more likely to succumb to the attacks of its enemies, vegetable and animal. Thus wheat straw deprived of adequate supplies of soluble silica becomes more subject to injury from insects and mildew. Other examples might be found of a connection between certain deficiencies in the soil and certain diseases in the plant, but it is unsafe to make a hasty generalisation on this point. In combating the coffee-leaf disease we must first of all devote ourselves to the fungus which is its direct cause. There can be little doubt that calcium sulphide, which proved so efficient a means of destroying the *Oidium* of the vine will be equally destructive to the *Hemileia vastatrix*. A mixture of sulphur and quicklime, or a wash made by simply boiling these two materials together, is much less active.

When Mr. Hughes makes suggestions about the sources of manurial substances available for Ceylon, about the making and preservation of cattle and vegetable manure, and about terracing and draining, we can heartily endorse his recommendations. And when he gives us a number of careful analyses, some of which are of considerable interest, even apart from their connection with the growth of coffee, we are grateful for information which is sure to become useful under some circumstances and at some time. But there are certain portions of Mr. Hughes's Report which seem to have been introduced with no special object, or which are of questionable value. We hardly need to be taught that "Planters want a practical remedy rather than an elaborate description of the disease" (p. 140). The appearance of what look like recommendations of the manurial preparations of particular manufacturers should have been avoided (pp. 27 to 30). We could have spared the repetition of the well-worn table of manurial values on p. 100, and the analysis of Bude sand (p. 36). The term *granitic* as applied (p. 37) to a limestone containing over 70 per cent. of calcium and magnesium carbonates needs a word of explanation. Of really interesting data furnished by Mr. Hughes we may cite the analyses of castor-seed cakes (p. 15), in which the nitrogen is shown to differ widely—brown and black cakes containing but 4½ per cent., while white cakes show no less than 7½. Although we do not believe in the third decimal places (how often can we chemists secure accuracy in the tenths?) in Mr. Hughes's soil analyses (pp. 46, 53, 65, 72, 77, 81, 150)—particularly as his phosphoric acid determinations were not made by the molybdic acid process—yet these results represent a mass of laborious researches, and ought to furnish much material for the management of Ceylon coffee soils. The analyses of healthy and diseased coffee-leaves (pp. 142-144) deserve careful study ; they point unmistakably to the fungoid origin of the disease. A. H. C.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

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

Cloud Classification

BETWEEN M. Poëy and his latest critic (NATURE, vol. xxii. p. 96) it would be impertinent for me to interfere. But until my objection to a part of Howard's original classification has met with some response from those who maintain the adequacy of that classification I must continue, at the risk of some repetition, to call attention to this objection. It can be stated briefly, and I do not see why the answer thereto, if such exist, should be deferred as too long for discussion.

E. H. appears to admit that an observer, when within a cloud (which is then to him a fog), cannot distinguish *cumulus* from *stratus*. He, however, elevates the stratus, or rather one variety of it, "a few feet (or even inches) from the earth," so as to cut "the taller trees in a horizontal line, leaving their tops and bottoms free." He proposes to shelve the question "whether it is desirable to use the term 'stratus' for clouds in a totally different sky region, which differ both in their origin and their nature from the true stratus" (*i.e.*, from the *stratus* of the sky-region of half-length elms in the Thames basin). Now it is precisely this question which the large and growing class of observers, who wish to record the modifications of clouds, can no longer permit to be left unsettled. If clouds are to be classified according to their form at all, some name is absolutely required for a class of clouds which is in all latitudes common, and in the higher predominant. These are the clouds to which the observers can neither give the title *cumulus* nor the title *cirrus*, the clouds which are disposed in beds or layers whose vertical thickness is small. When in trifling amount they arrange themselves in irregular disks or patches capable of being occasionally mistaken for *cumulus* when in the zenith, but elsewhere seen as streaks or threads transverse to the meridian. When in large amount they cover a great portion or the whole of the sky with a shallow and nearly level canopy. In England, putting together observations made at all hours of day and night, clouds belonging to this class are recorded in about 60 per cent. of the observations. Of observations made at 2 p.m. they occur in about 38 per cent. ; of observations made between sunset and sunrise in upwards of 90 per cent. Of observations made at all hours in the English Midlands from October, 1879, to February, 1880, inclusive, they were recorded in 83 per cent. To leave this class nameless is intolerable. To give to them either of the compound titles *cumulo-stratus* and *strato-cumulus* is objectionable, because in form they do not resemble *cumulus* at all (I might add that to a defender of Howard's unamended system they also do not resemble *stratus* at all, differing, as we are told, not only in elevation, but in "origin and nature," both from ground-fog and middle-tree fog). A similar objection lies against the application to these clouds of

the terms *cirro-stratus* and *strato-cirrus*. Finally the terms *cumulo-stratus* and *cirro-stratus* are sorely needed for varieties of clouds intermediate between the class I have described and the *cumulus* and *cirrus* types, if any part of Howard's terminology is to be left to us at all.

It would be a pity that that terminology, lucid and expressive, should perish, merely because, to a few minds, the originator of a system must needs appear infallible, and his classification perfect as Minerva when issuing from the head of Jupiter. I think that Luke Howard would have been the last to put forward such a claim. W. CLEMENT LEY

June 8

The Motion of Fluids

PROF. REYNOLDS, in the course of his review (NATURE, vol. xxi. p. 342) of my book on the above subject, cites two instances in which I have been guilty of what he considers loose and vague reasoning. I would ask space for a few remarks on the points in question.

To take the more important matter first, Prof. Reynolds says, *apropos* of a certain proof of the velocity-potential theorem given in Art. 23:—

"Mr. Lamb has offered a proof of this now historic theorem, which, if judged by the space it occupies, should be much simpler than the acknowledged proofs of Cauchy and Stokes. As no authority is cited, it would appear that this proof is here given for the first time. If so, the author has done himself great injustice in not examining or explaining his reasoning more closely. For, as it stands, it suggests the idea that he has ignored the fact that dx, dy, dz, on the left of his equation, are integrals through a finite time, and hence, inasmuch as he has given no reason to the contrary, may be of a different order of magnitude from their initial values, da, db, dc, which appear on the right of his equation. If this is not so it is a peculiarity of the motion of continuous fluid, and needs establishing; otherwise we might infer that two people who had once shaken hands could never after be so much as a mile apart."

Prof. Reynolds, who himself strongly recommends the careful study of "work from the master's hand," will hardly take it amiss if I ask him to turn to the proofs which he justly cites as classical, and to notice that they contain, one of them (Cauchy's) in exactly the same form, the other in a form which is mathematically equivalent, the very assumption which he here calls in question. The assumption is in fact nothing more than a tacit limitation, which is made at the very outset of the subject, as to the class of motions which are proposed for study. In the "Eulerian" method it is implied that the first derivatives of the component velocities u, v, w with respect to the co-ordinates x, y, z are to be everywhere and always finite throughout the motion considered; in the "Lagrangian" method the corresponding, and equivalent, assumption is that the derivatives $\frac{dx}{da}$, $\frac{dx}{db}$, $\frac{dx}{dc}$, &c, and also $\frac{d^2x}{da\,dt}$, $\frac{d^2x}{db\,dt}$, $\frac{d^2x}{dc\,dt}$, &c., are to be finite. We do not assert that these are universal characteristics of fluid motion, for it is easy to imagine cases in which they are violated; we merely exclude such cases *ab initio* from the scope of our investigations. But, in one form or another, these fundamental limitations are, from the point of view of analytical hydrodynamics, unavoidable; they are made implicitly every time we write down the equations of motion, and it is therefore not surprising that they should be found to be essentially involved, not only in the proof which Prof. Reynolds on this account criticises, but in every other proof of the velocity-potential theorem which has yet been propounded.

I have only to add that the proof in question is, and professes to be, merely a very obvious corollary to H. Weber's transformation of the Lagrangian equations.

The other passage of Prof. Reynolds's review which I wish to notice is as follows:—

"There is a considerable amount of vagueness attending the author's use of the term *particle*. Having rightly defined fluids as being such 'that the properties of the smallest portions into which we can conceive them divided are the same as those of the substance in bulk,' he proceeds to reason about a particle as though it were a discrete quantity, the position of which is defined by some point, thus ignoring the fact that, according to his definition, the same particle of fluid may at one time be a sphere, at another a filament of indefinite length, or a sheet of indefinite breadth. This vagueness appears to have led him into error in Art. 11."

A good deal of this criticism is, I think, met by the remarks already made. In a fluid moving subject to the conditions I have stated, only finite changes of shape can be produced in a moving element within a finite time.

Prof. Reynolds does not indicate the precise nature of the "error" which he finds in Art. 11. After a careful reconsideration, the argument of that article appears to me to be sound; but I am free to confess that it is not stated with all the clearness desirable, and that the article is further disfigured by an unfortunate clerical error in the foot-note, where "$u = \pm \sqrt{x}$" should be read for "$u = \pm x$." HORACE LAMB

Adelaide, March 30

On the Physical Aspects of the Vortex-Atom Theory

WILL any charitable person explain a difficulty which I (and other non-mathematical people) have encountered when seeking to understand and be satisfied with this theory?

The only proof of those properties of vortex rings which match the physical properties of atoms that I have met with is that in Bésant's "Hydromechanics"; and is based on the initial-co-ordinate method.

Now it seems to me that this method assumes what is equivalent to the permanence of the vortex filament; so that in proving the latter by use of this system of co-ordinates we may be merely arguing in a circle.

For it assumes that if initially we have any infinitesimal tetrahedron $\delta a \cdot \delta\beta \cdot \delta\gamma$, then after the *finite time*, t, this will still form a tetrahedron $\delta x \cdot \delta y \cdot \delta z$.

Now I cannot see that one can assume this; that—to use the words in a late article of NATURE—"if two people have once shaken hands they can never be 100 miles apart."

And this inseparability of the particles of a fluid thus *assumed* bears a very close relation to the permanence of the vortex filament which we wish to prove. W. L.

Cheltenham, May 29

[It appears to us that our correspondent here confuses between the permanence of any fluid filament and the permanence of the vortex character of the filament. The assumption that every filament remains continuous cannot be said to be equivalent to assuming that the direction of the filament at every point remains coincident with the axis of rotation of its constituent elements at that point, which is what Helmholtz has taught us.—ED.]

The Aurora Borealis and its Colours

WITH regard to Drs. De La Rue and Müller's paper on the Aurora (NATURE, vol. xxii. p. 33) there is still a point I should like to see explained. Is it considered by physicists that in electric discharges similarity of colour is sufficient to indicate similarity of constitution, even when their spectra are quite unlike? The paper, together with the reply to Prof. Smyth, certainly seems to imply this; though I have not previously seen it stated to be the case.

With regard to the red part of auroræ, so far as my observations indicate its position, they show it to be above the greenish part in the auroræ seen here; though according to Weyprecht's observations, it is below the green in the Arctic regions.

Sunderland, June 9 T. W. BACKHOUSE

A New Audiphone

FURTHER experiments on the timbre of musical instruments as rendered by the audiphone have led me to the selection of the following as a distinct improvement on the birchwood veneer, both for musical purposes and also for ordinary conversation. It has the same advantage as my previous form in not requiring to be held by the hand, it costs nothing, and requires no making. Take a sheet of stiff brown paper about 11 × 15 inches, the paper being such as is ordinarily used for making up heavy parcels. Put the ends together, the middle forming a loop, and hold the ends between the teeth. The paper must be pretty stiff, as the loop must stand out round and full, and of course the paper must be without folds or creases. THOS. FLETCHER

Museum Street, Warrington

Crystal-Ice

IN reference to the "crystal ice" proposed by Dr. Calantarients, of Scarborough, for skating upon with ordinary skates,

it may not be generally known that more than thirty years ago a skating pond was constructed in Liverpool, consisting, I believe, entirely of crystallised Glauber's salt. I have a perfect recollection of this miniature lake with its grotto-like surroundings, of its black looking ice with innumerable white scorings marking the tracks of the skaters, yet, strange to say, I cannot remember whether I skated on it myself. The impression that I did seems to be confused with other skating scenes. This perhaps does not look like very reliable evidence, but that the "rink" (under another name) of artificial ice did exist, and was popular, will no doubt be affirmed by many witnesses besides myself. The date would be about 1845, if I am not mistaken, and the speculation ultimately failed owing to a public impression (possibly a wrong one) that the exhalations from the surface of the pond caused sickness and headache. R. H.

The Stone in the Swallow

YOUR correspondent, Dr. P. P. C. Hoek, requests information respecting the origin of the fable to which the poet Longfellow refers at the end of the first part of "Evangeline"—"The stone in the nest of the swallow." In Burton's "Anatomy of Melancholy," p. 434, at the top (Wm. Tegg's edition), after describing in the delightfully quaint style of the age the curative virtues of various stones, he quotes the following:—

"In the belly of a swallow there is a stone called 'chelidonius,' which, if it be lapped in a fair cloth and tied to the right arm, will cure lunatics, madmen, make them amiable and merry."

In a foot-note there are references made to the following authors:—Albertus, Eucellius, cap. 44, lib. 3; Plin, lib. 37, cap. 10; Jacobus de Dondis, &c.

It seems probable that Longfellow got his version of the story from some of the descendants of the French Acadians, to whom the poem relates, and it may have come down from the same sources from which Burton derives his account of the matter. It may be noted that the two versions do not in any way clash, Burton's simply referring to the whereabouts of the stone, "in the belly of the swallow," its name and benefits to those afflicted with insanity; while Longfellow's version relates more to the finding and locality of the stone and its uses to the young swallows, leaving its supposed value to man, depending on the general term of being "lucky." JOHN LOCKE

Trinidad, West Indies, May 24

Stags' Horns

IN reference to the opinions recently expressed in your journal regarding the disappearance of the horns of stags, deer, &c., I may mention that this is usually attributed here to the action of rodents rather than of the deer themselves. Even if a deer should occasionally be seen gnawing a horn it would be very difficult to account for the disappearance of all the annual crop of antlers in this way. From the nature of their dentition (having no incisor teeth in the upper jaw) the destruction of such a mass of hard material must be very difficult. Moreover slight examination will show whether the tooth marks are those of the large teeth of a deer or of the small incisors of a rodent.

Antioch College, Ohio, U.S.A. E. W. CLAYPOLE

ON SOME POINTS CONNECTED WITH TERRESTRIAL MAGNETISM

I HAVE on more than one previous occasion brought forward some of the various points which are here grouped together. These points are three in number.

(α) Regarding the sustaining power of the earth's magnetism.

(β) Regarding the diurnal and other changes of the same.

(γ) Regarding earth currents and auroras.

I may state at once that this only professes to be a working hypothesis.

(α) *Regarding the Sustaining Power of the Earth's Magnetism.*—I do not here intend to discuss the cause of the earth's magnetism, but I would ask in the first place if it is not possible that this cause may be something small and one which (assuming it to continue at the present moment) we may not readily perceive. If we assume this cause or magnetic nucleus to be small is it not possible to imagine that there is a machinery which acts upon this nucleus (just as we have in certain magneto-electric engines) so as to swell up the magnetism of the earth ultimately to saturation.[1]

May not this machinery be the great convection currents, the anti-trades, that go from the equator to the poles in the upper regions of the earth's atmosphere, and which may be looked on as conductors moving across lines of magnetic force?

It would appear to me that the tendency of such currents will be to swell up and sustain the magnetism of the earth.

(β) *Regarding the Diurnal and other Changes of Terrestrial Magnetism.*—It will of course be natural, entertaining the views now enunciated, to regard the diurnal changes of the convection currents of the earth's atmosphere, as these are manifested in the upper regions, to be the cause of the diurnal changes of terrestrial magnetism.

If this view be taken it might be argued that wind changes in these upper regions should also produce magnetic variations. The reply is that apparently they do. In conjunction with Mr. Morisabro Hiraoka I have compared together the simultaneous records of magnetic declination ranges at Kew and at Trevandrum, and I find evidence of a progress of things from west to east, so that on the whole a particular magnetic-range phenomenon occurs at Kew 9·7 days before it occurs at Trevandrum. Again, I have attempted to show, in conjunction with Mr. Dodgson, that a particular magnetic phenomenon occurs at Kew one day before it occurs at Prague.

It would thus appear that there is a progress of magnetic phenomena from west to east, just as we know there is a progress of meteorological phenomena. As, however, the meteorological phenomena which we can examine occur in the *lower* atmospheric regions, while the magnetic phenomena are, according to this hypothesis, associated with currents in the *higher* regions, it does not follow that magnetic and meteorological phenomena should travel from west to east at the same rate. I may also mention that we have reason to believe that magnetic changes lag behind corresponding solar changes just as meteorological changes would do.

It is manifest that it will be comparatively easy to settle the fact of a progress from west to east of magnetic weather, and that if such exists it will most readily ally itself with the hypothesis above mentioned.

In the next place, if we regard those changes in the convection-currents of the earth which depend on the year we have reason to imagine that such are most pronounced at the equinoxes. It is also well known that magnetic disturbances are most frequent at these times.

Let us next proceed to regard the secular change of the earth's magnetism. To account for this magneticians have felt the need of something movable, and the hypothesis of a "little earth," a solid nucleus moving within the recesses of our planet, has found much support. But is it not more likely that the result may be caused by a secular variation in the distribution of the convection-currents of the earth? If the question be asked, What reason have we for imagining the existence of such a variation, the answer will be, A much better reason than we have for entertaining the conception of a "little earth." For there is some reason, at any rate, for imagining the power of the sun to be subject to a complicated series of periodicities. Now a secular variation in the power of the sun would produce a secular change not only in the intensity, but in the direction of the convection-currents of the earth, and, according to the above hypo-

[1] If I am not mistaken Sir W. Thomson is inclined to regard the earth as a magneto-electric engine.

thesis, these in their turn would produce a secular magnetic change.

(γ) *Regarding Earth Currents and Auroras.*—I have for some considerable time looked on the earth as a Ruhmkorff's coil with a magnetic nucleus. Above this nucleus we may suppose that we have the primary rocks, which are non-conductors, while above these we have the moist or comparatively moist surface of the earth, which is a conductor. Above this, again, we have the lower strata of the atmosphere, which are non-conductors, while above this we have the upper strata, which are conductors.

Now suppose that a small but abrupt change of the earth's magnetism takes place, no matter how. We need not enter into the causes of such.

We have thus two secondary coils, if I may use the expression: (1) the moist surface of the earth, (2) the upper regions of the atmosphere; and both of these will be animated with secondary currents, on account of the abrupt change of the earth's magnetism. These secondary currents will be in one direction for a magnetic change of one kind, and in the opposite direction for a magnetic change of the opposite kind.

Now whenever there are magnetic storms, that is to say, when there are small but abrupt changes of the earth's magnetism, it is well known from the Greenwich records that we have violent earth currents, which are alternately positive and negative, and that we have also auroral displays in the upper regions of the earth's atmosphere. We cannot examine the auroral displays as we can the earth currents. But with regard to earth currents I would remark that the *form* of the phenomena they display is entirely against the supposition that such currents are the main cause of the changes in terrestrial magnetism, and in favour of that which maintains that they are secondary currents induced by magnetic changes.

In conclusion I would guard against its being supposed that all luminous appearances in the atmosphere are due to the same cause. I only hold that certain appearances which occur at times of magnetic perturbation and simultaneously throughout a large portion of the earth have the origin now mentioned. B. STEWART

ON A NEW JELLY-FISH OF THE ORDER TRACHOMEDUSÆ, LIVING IN FRESH WATER

ON Thursday last, June 10, Mr. Sowerby, the secretary of the Botanical Society of London, observed in the tank in the water-lily house in Regent's Park a peculiar organism, of which he was kind enough to place a large number at my disposal on the following Monday.

The organism proves to be an adult medusa belonging to the order Trachomedusæ and the family Petasidæ of Haeckel's system ("System der Medusen," erster Theil). It comes nearest among described genera to Fritz Müller's imperfectly known *Aglauropsis* from the coast of Brazil.

The most obviously interesting matter about the form under notice is that it occurs in great abundance in perfectly fresh water at a temperature of 90° Fahr.

Hitherto no medusa of any order has been detected in fresh water—except perhaps some stray estuarine forms (? Crambessa).

It is exceedingly difficult to trace the introduction of this animal into the tank in the Regent's Park, since no plants have been recently (within twelve months) added to the lily-house, and the water is run off every year. Probably a few specimens were last year or the year before present in the tank, and have only this year multiplied in sufficient abundance to attract attention. Clearly this medusa is a tropical species, since it flourishes in water of the high temperature of 90° Fahr.

Mr. Sowerby has observed the medusa feeding on Daphnia, which abcunds in the water with it.

The present form will have to be placed in a new genus, for which I propose the name Craspedacusta, in allusion to the relation of its otocysts to its velum.

It is one of the sub-class Hydromedusæ or Medusæ craspedotæ, and presents the common characters of the order Trachomedusæ (as distinguished from the Narcomedusæ) in having its genital sacs or gonads placed in the course of the radial canals. It agrees with all Tracholinæ (Trachomedusæ and Narcomedusæ) in having endodermal otocysts, and it further exhibits the solid tentacles with cartilaginoid axis, the centripetal travelling of the tentacles, the tentacle rivets (Mantelspangen), the thickened marginal ring to the disk (Nessel ring) observed in many Tracholinæ.

Amongst Trachomedusæ, Craspedacusta finds its place in the Petasidæ, which are characterised as "Trachomedusæ with *four* radial canals, in the course of which the four gonads lie, with a long tubular stomach and no stomach-stalk."

Amongst Petasidæ it is remarkable for the great number of its tentacles, which are *all* solid; and for its very numerous otocysts. Further, it is remarkable among all Hydromedusæ (velate medusæ, that is, exclusive of Charybdæa) for the fact that centrifugal radiating canals pass from the otocysts *into the velum, where they end cæcally.*

The genus may be characterised as follows:—

MOUTH quadrifid, with four per-radial lobes.

STOMACH long, quadrangular, and tubular, projecting a good deal below the disk.

DISK, saucer-shaped, that is, flattened.

RADIATING CANALS 4, opening into the marginal canal.

GONADS 4, in the form of 4 oval sacs, depending into the cavity of the subumbrella from the four radiating canals.

MARGINAL or RING CANAL voluminous.

CENTRIPETAL CANALS (such as those of Olindias, Geryonia, &c.) absent.

TENTACLES solid; in three sets, which are placed in three superimposed horizons:—

1. A set nearest the aboral pole, of 4 large per-radial tentacles. These are the *primary* tentacles.
2. A second tier of (in large specimens) 28 medium-sized tentacles placed between these in four groups of seven. These are the *secondary* tentacles.
3. A third tier of (in large specimens) 192 small tentacles placed in groups of six between adjacent secondary tentacles. These are the *tertiary* tentacles.

TENTACLE-RIVETS (Mantel-spangen) connecting the roots of the tentacles with the marginal ring (Nessel-ring) are connected with all the tentacles of each of the three horizons.

OTOLITHS placed along the line of insertion of the velum—about eighty in number (fewer in small specimens). From sixteen to twenty are placed between successive per-radial tentacles arranged in groups of two or three between the successive secondary tentacles.

VELAR CENTRIFUGAL CANALS (which are really the elongated otocysts) are peculiar to this genus, passing from the otoliths (one inclosing each otolith) into the velum, and there ending blindly. They appear to correspond in character to the *centripetal* canals found in other Trachomedusæ in the disk.

OCELLI are absent.

[The presence of velar otocystic canals constitute the chief peculiarity of the genus Craspedacusta, and may necessitate the formation of a distinct family or sub-order for its reception. The minute structure of the otoliths and canal-like otocysts I am now engaged in investigating.]

The above characters are derived from the examination of *adult* male specimens, which were freely discharging ripe, actively motile spermatozoa.

The species may be known as CRASPEDACUSTA SOWERBII, nov. gen. et sp.—I name the species in honour of Mr. Sowerby, who discovered it, and to whose quick observation and courteous kindness zoologists are indebted for the knowledge of this interesting animal.

The sole character which I can give as specific over and above the generic characters summarised above is that of size. The diameter of the disk does not exceed one-third of an inch.

Locality.—The water-lily tank in the gardens of the Botanical Society, Regent's Park, London.

Very abundant during June, 1880. Probably introduced from the West Indies. E. RAY LANKESTER

NOTES FROM JAVA

THE following extracts from a letter written from Java by Mr. Henry O. Forbes to Mr. H. N. Moseley, F.R.S., have been sent to us for publication as of considerable interest. The letter is dated March 19. Mr. Forbes, who has been engaged in collecting in Java, expects shortly to leave for Celebes, Timor, Timor-laut, and other eastern islands. Timor-laut is the most important island of the Malay Archipelago yet remaining to be explored, and is likely to yield many natural history treasures. Mr. Forbes's letter refers to certain passages in Mr. Moseley's "Notes by a Naturalist on the *Challenger*." The question of the mode of growth of Myrmecodia and Hydrophytum has been lately before the Linnean Society.

"With regard to birds carrying seeds from one island to another, I have observed on the Cocos Keeling Islands (South Indian Ocean) a species of heron which nested in a high tree (species unknown) there, quite covered with its oblong hooked seeds. I was informed by the proprietor of the island that many of these birds, from their feathers getting so thickly covered with the seeds, actually die. I can therefore imagine that many of these seeds might adhere for even *weeks and months*, and so get transported to very distant regions.

"At p. 493 you note the habit of hot-water drinking. It is quite a custom among, at any rate, the Sudanese, among whom I have been living some time, who, in the afternoons, invite each other to come and have a cup of hot water. It is drunk either plain or with a little arenga sugar.

"I have found here a large quantity of algæ growing in the hot springs at a temperature of 132° F. What the species are or is I have not yet ascertained.

"With reference to Myrmecodia and Hydnophytum, I find some difficulty in reconciling in all cases the statement (p. 389) that 'the ants gnaw at the base of the stem, and the irritation produced causes the stem to swell,' with what I have myself observed. I have grown many young seedlings, some of which were entirely unmolested by ants, and yet produced a bulbous swelling at the base; others were certainly scratched, but that was all, by the ants, the smallest scar being visible. On opening many of those which were unmolested I observed a degenerated, soft, spongy portion, not in connection with the exterior. May not this spot increase till an external opening is formed, and the ants have an entrance made for them to carry out, as I have seen them doing, the soft spongy substance inside? I have seen other seedlings that had a small orifice close to the rootlet, leading into an interior oval or round expansion in the bulb, and though I closely observed them I failed to detect ants touching them. All these seedlings I grew from the seed till they reached at most a couple or three inches or a little more, when they generally became the home of some ants. After they had become infested I did not pursue observations on them, as my time was much occupied, and because the object of my observation was to discover if they bulbed, &c., without the aid of ants. I should much like to see these plants grow with all ant life removed from them entirely. If opportunity again offers I shall continue my experiments. I have repeatedly noticed on large Myrmecodia and Hydnophyta which were crowded with ants (on both genera I have found only one species of ant) that in many places irregularly-shaped areas of degeneration existed quite cut off from communication with the wonderful series of galleries and chambers which form this ant-hive. These were found oftenest near the upper portion of the bulb, and towards which excavations were being directed. I have not observed that the surface of the rounded mass gives off any twigs bearing leaves or flowers. All my specimens have had the shape of a bulb more or less gobose, or elongate, prickly, tenanted by ants, giving origin to a much thinner stem, not, or rarely, chambered nor passaged, but also armed, and from which the leaves and sessile flowers proceeded, the latter from hollows in which numerous ants were constantly moving about. The Hydnophyta generally give off at once leaves at the summit of a more or less irregular bulb.

"I have seen the same species of ant inhabiting the swollen-up hollow leaves of a species of Hoya or Æschynanthus. The plant I saw had many of its leaves in this condition. I gathered it one day while on the march, and I fear it is lost. It *may* have been sent to the British Museum, but I am not certain. I have not met with another instance. There was a small hole in the apex of the leaf, and through it the ants came and went. The leaf looked as if all the mesophyllum had been cleared out and the epidermis blown out into a bladder. This observation may not be quite accurate as to the description of leaf, but I noted that the species of ant was the same.

"Here it is quite impossible to obtain a perfect rhinoceros skull, unless one has the good fortune to shoot it oneself, for the horn is so highly prized that it alone fetches from 200 to 300 rupees (Dutch guelders), being eagerly bought by the Chinese. It is believed in by all the natives as a sure and certain antidote for snake-bites and for purifying water. A respectable hadji affirmed to me with the persistency of belief that on his way to Mecca—he went in a native vessel—the stock of fresh water on board ran out, and that all on the vessel, by drinking sea-water out of a rhinoceros horn, found it to be—not salt water!"

ON THE FERTILISATION OF COBÆA PENDULIFLORA (HOOK. FIL.)

COBÆA PENDULIFLORA is a graceful climber, growing rather sparingly in our mountain-forests. It was described and figured by Karsten under the name of *Rosenbergia penduliflora* ("Flora Columbiæ," I. 27, t. ix.), and afterwards in the *Bot. Mag.*, t. 5757. Karsten's plate is very pretty, but in all the specimens I have seen the linear lobes of the corolla were never so red as he paints them, nor do the stamens ever hang straight downwards parallel to the style, as his figure shows. The plate in the *Botanical Magazine* has only one defect, the artist having overlooked the hooklets and the ends of the tendrils.

The plant grows exceedingly quickly when kept in shade. A specimen now in my garden was raised from seed sown October 3, 1879, which sprang up a fortnight later, and covered, in less than three months, a wall twelve feet high and ten feet long. It climbs exactly in the same manner as *Cobæa scandens*, described by Darwin in his "Climbing Plants." The flowers have very little to attract attention, their colour being dull green, with very little red on the filaments, and there is no smell. Though not of great horticultural interest, the plant fully deserves the attention of the botanist on account of the peculiar circumstances under which the flowers are fertilised. Sir J. D. Hooker has made already some pertinent remarks on

this point in his description in the *Bot. Mag.*, and it was for the further investigation of the case that I raised a plant in my garden.

The flowers grow on long peduncles, which generally have a horizontal position, projecting some five or six inches from the mass of the foliage. When the calyx opens, the filaments as well as the style are irregularly twisted; but in about two or three days all become straight. The style hangs obliquely downwards; the filaments all bend sideways, the bend being inside the tube of the corolla, a little over the hairs at their base. There is often a distance of 15 centimetres between the anthers of either side. About 5 or 6 o'clock p.m. the anthers burst, and soon after the style rises and assumes a central position, so that there is a distance of about 10 centimetres between the stigmata and any of the anthers. *Only then* is nectar being secreted by the glandular disk round the base of the ovary, but so copiously that by means of a small pipette I obtained from each flower a mean quantity of 0·14 cubic centimetres. This nectar is completely transparent, very sweet, and slightly mucilaginous. It contained a kind of gum which is precipitated by absolute alcohol. *The nectar appears therefore when the anthers have done their work;* even an hour before their rupture no trace of it is to be found. The nectar-cavity in the tube of the corolla is completely shut up by the numerous spreading hairs at the base of the filaments, so that an outflow is impossible. The grains of pollen are very large (0·2 millim. in diameter) and of the same structure as in *Cobæa scandens*. They are covered by a glutinous layer, and are heavier than water.

Several weeks passed at first before I witnessed the manner of fertilisation. The stigmata were every morning carefully examined, but no pollen could be discovered on them. The filaments twisted back again and got somewhat frizzled, after one single night's expansion. About noon the corolla drops off, separating from close to the glandular ring, and then slipping down over the style, which, by this time, is again in a relaxed hanging position. There is always some nectar in the tube of the corolla after its separation, but none remains in the calyx round the ovary, nor does its secretion continue.

These facts show clearly that the fertilisation must take place in the same night after the bursting of the anthers, and it was but natural to suppose that it was effected by nocturnal moths. It would appear, furthermore, that *the nectar is not of any direct advantage to the plant*, as Mr. G. Bonnier emphatically affirms (*Annales des Sci. Nat. Bot.*, sér. vi. vol. viii. p. 206), because of its being produced and lost in all flowers, fertilised or not, in the same way.

As soon as the number of flowers increased (on some evenings twenty to twenty-five had their anthers opened), I found every morning most of them with pollen on the stigmata, and keeping a close watch, I discovered that the plant was visited by several large Sphingidæ belonging to the genera *Chaerocampa*, *Diludia*, and *Amphonyx*. I observed altogether four visits of an Amphonyx, three of a Chaerocampa, and one of a Diludia. All of them proceeded in the same manner. Holding the body close over the style, they dipped their spiral tongues into the tube of the corolla, beating all the while the anthers so violently with the tips of the fore-wings that they dangled about with great velocity in every direction. The grains of pollen being covered by a sticky substance, many of them adhered to the wings. I have caught an Amphonyx which, after having visited six flowers consecutively, had the tips of the fore-wings almost yellow with pollen. When leaving a flower for another one, some of this pollen is even lost on the foliage, but by the time the insect takes its central position before the flower the stigmata are likewise touched by the wings, and thus some pollen is left on them. Some flowers remain without being fertilised, especially in places where the moths cannot reach them easily. All flowers fertilised in this manner set fruit very soon; but no flower gave a fruit without having its stigmata pollenised by crossing.

Self-fertilisation is therefore excluded, and this is further proved by the following experiments:—Twelve flowers were artificially fertilised by their own pollen and afterwards protected by muslin bags; only in one case was a fruit obtained; but I am not quite sure whether there did not come some foreign pollen on the stigmata of this flower. Cross-fertilisation was likewise tried in twelve flowers, nine being experimented on in the same evening after the opening of the anthers, and three the next morning. All the former are now with fruit; the latter remained sterile. This fact shows how very short is the period of possible fertilisation.

Flowers visited by nocturnal moths are as a rule either large and of white colour, or have a strong smell; but in our *Cobæa* the former is certainly not the case, and my olfactory nerves at least cannot discover any smell. But it is well known that insects, especially Lepidoptera, are in this respect of a really wonderful keenness, which enables them to track a scent absolutely imperceptible to man.

As I shall have a considerable crop of Cobæa-seeds, I can offer some to any botanists who should wish to grow the plant. A. ERNST

Carácas, April 4.

P.S.—As soon as the corolla has fallen off, the peduncle withdraws slowly amongst the dense foliage, where the fruit develops, protected from all kinds of injury.

EXPERIMENTAL RESEARCHES IN ELECTRICITY[1]

Part III.—*Tube-Potential; Potential at a Constant Distance and Various Pressures; Nature and Phenomena of the Electric Arc.*

MESSRS. De La Rue and Müller, in the third part of their researches on the electric discharge, commence by describing a series of experiments to determine the potential necessary to produce a discharge in a tube, exhausted gradually more and more while using a constant number of cells in all the experiments. In consequence of the life of the battery becoming so much exhausted by the method employed the experiments were confined to one gaseous medium, namely, hydrogen. Since the completion, however, of the measurements described in the paper the authors have found two other more convenient methods for determining the tube-potential, which do not exhaust the battery injuriously; these are described in an appendix. The tube, 162, employed was 33 inches long and 2 inches in diameter, the distance between the ring and straight wire terminals being 29·75 inches; the battery consisted of 11,000 cells. The discharge took place when the pressure was reduced to 35·5 mm., 46,710 M (millionths of an atmosphere), and the exhaustion was afterwards continued gradually until it fell to 0·0065 mm., 8·6 M. In commencing each set of experiments the deflection of a tangent-galvanometer was observed when the battery was short-circuited. By a table previously calculated the value of the deflection in ohms of resistance per cell could be read off; this, multiplied by 11,000, gave the total resistance of the battery; the tube was then connected with the terminals and the galvanometer again observed; this gave a less deflection and indicated a greater resistance, which, multiplied by 11,000, gave the total resistance of the tube and battery: by subtracting the resistance of the battery the resistance of the tube was ascertained. Calling the total resistance R, the tube resistance r, the tube-potential V, $V = \frac{r \times 11{,}000}{R}$. The tube-potential requisite to produce a discharge, with a pressure of 46,710 M, was found to be 10,250 cells; this gradually fell until

[1] "Experimental Researches on the Electric Discharge with the Chloride of Silver Battery," by Warren De La Rue, M.A., D.C.L., F.R.S., and Hugo W. Müller, Ph.D., F.R.S. (*Phil. Trans.*, vol. clxxi. p. 65).

a pressure of 0·642 mm., 1,082 M, was reached, the tube-potential being then only 430 cells, after which it rapidly rose, and, at 8·6 M, it required a potential of 8,937 cells to produce a discharge. From the experiments described

DIAGRAM I.

in a previous paper it was found that, in another tube, it required the full potential of 11,000 cells to produce a discharge at 3 M, and that, at 1·8 M, this potential was insufficient. The obstruction to the discharge in tube

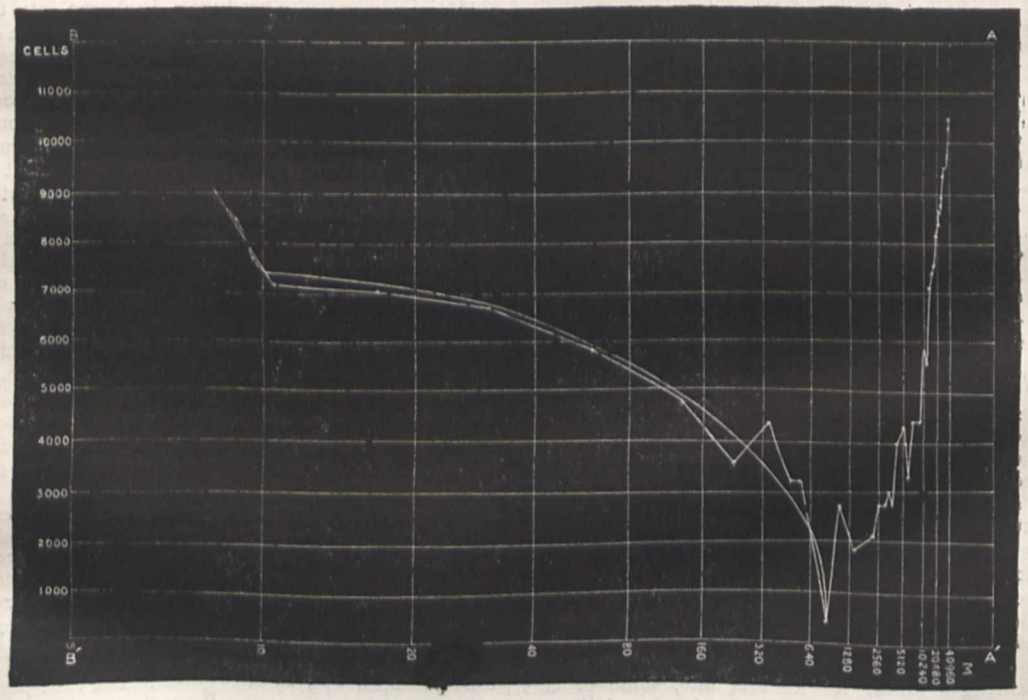

DIAGRAM II.

A—B represents an assumed mean distance of the molecules at a pressure of 5 millionths of an atmosphere. A′ to 10, A′ to 20, ... A′ to 40960, the corresponding distances at pressures 10, 20, 40960 millionths.

162 was as great at 8·6 M as at 28,553 M pressure, and required 8,950 cells in each case.

The diagram (No. I.) laid down from the results when the ring was made positive, shows the curve of the obser-

vations as actually obtained without being smoothed. The figure is a reduction to $\frac{1}{8}$ of the original; the abscissæ are as the cube-roots of the various pressures in millionths of an atmosphere, and show relatively the number of molecules in a given linear space; the ordinates are as the number of cells.

The observations were again plotted down as in Diagram No. II., making the abscissæ in the inverse ratio of the cube-roots of the various pressures in millionths, so as to represent relatively the mean distance of the molecules at the various pressures in millionths of an atmosphere; this has the effect of extending the scale for decreasing pressures beyond the minimum resistance of the tube, and of compressing it on the opposite side for increasing pressures.

The following tables show the number of cells necessary to produce a discharge for various pressures in millionths of an atmosphere :—

Pressure.	V.	
	Cells.	Increase per 1,000 M.
M		cells.
845	430	
1,000	1,000	
1,500	1,780	1,190
2,000	2,190	
		590
3,000	2,780	
		475
4,000	3,230	
		430
5,000	3,660	
		370
6,000	4,030	
		350
7,000	4,380	
		370
8,000	4,750	
		320
9,000	5,070	
		310
10,000	5,380	
		330
11,000	5,710	
		320
12,000	6,030	
		320
13,000	6,350	
		280
14,000	6,630	
		270
15,000	6,900	
		260
16,000	7,160	
		240
17,000	7,400	
		230
18,000	7,630	
		210
19,000	7,840	
		180
20,000	8,000	
		180
21,000	8,180	
		160
22,000	8,340	
		150
23,000	8,490	

Pressure.	V.	
	Cells.	Increase per 1,000 M.
M		cells.
23,000	8,490	
		140
24,000	8,630	
		170
25,000	8,800	
		160
26,000	8,960	
		140
27,000	9,100	
		150
28,000	9,250	
		140
29,000	9,390	
		140
30,000	9,530	
		120
31,000	9,650	
		120
32,000	9,770	
		110
33,000	9,880	
		100
34,000	9,980	
		90
35,000	10,070	
		80
36,000	10,150	
		80
37,000	10,230	
		70
38,000	10,300	
		60
39,000	10,360	
		60
40,000	10,420	
		55
41,000	10,475	
		45
42,000	10,520	
		30
43,000	10,550	
		30
44,000	10,580	
		10
45,000	10,590	
		10
46,000	10,600	
		0
47,000	10,600	

Pressure	V.	
	Cells.	Decrease per 10 M increase.
M		cells.
8	9,600	
		11,400
9	8,460	
		9,600
10	7,500	
		420
20	7,080	
		358
30	6,722	
		332
40	6,390	
		300
50	6,090	
		270
60	5,820	
		195
70	5,625	
		180
80	5 445	
		165
90	5,280	

Pressure	V.	
	Cells.	Decrease per 10 M increase.
M		cells.
90	5,280	
		135
100	5,145	
		945
200	4,200	
		60
300	3,600	
		48
400	3,120	
		45
500	2,670	
		39
600	2,280	
		45
700	1,830	
		51
800	1,320	
		16
900		
1,000	1,000	

An experiment was made in order to ascertain whether there was either any condensation or dilatation of the gas in contiguity with the terminals before the actual passage of the discharge. In order to do this an apparatus was constructed, as shown in Fig. 1.

It consists of a glass cylinder, 4·35 inside diameter, the depth of which is accurately the same in every part, 1·6 inch, so as to insure the parallelism of two glass disks which close its ends. Its cubical contents exclusive of the terminals was found to be 385 cub. centims.

These are held in contact with the ends of the cylinder by means of screw-clamps made of ebonite, and the whole apparatus is supported on a tripod ebonite stand, which is fastened to a square wooden foot. Attached parallel to the top and bottom glass disks, by means of flanged-screw rods, are two brass disks with rounded edges, 3·1 inches in diameter; these are maintained at a distance of 0·13 inch, 3·3 mm. at which the discharge of 11,000 cells would only just take place.

The ends which project through the glass disks are furnished with binding-screws for attaching wires from the battery.

On the side of the cylinder is a tubulure in which is fitted a gauge containing strong sulphuric acid, so as to dry the inside of the apparatus, and to indicate whether any condensation or dilatation of the gas contained in the cylinder occurs on connecting the metallic disks with the battery by means of the contact-key. The edges of the cylinder were rubbed with grease, and care was taken to prove that the apparatus was perfectly tight by causing the fluid in the limb of the gauge to stand for some time higher than that in the bulb. When connection was made with a battery of 9,800 cells, there was not the slightest indication of any alteration of volume of the contained air, so that there was neither condensation about the disks which would have caused a contraction, nor repulsion from the disks which would have caused an expansion of volume. The fluid in the stem was observed with a lens, but not the slightest motion of it took place. The same result was noticed even when water was substituted for sulphuric acid. So far, then, as this apparatus would indicate it, the result is entirely negative.

Potential necessary to produce a discharge between disks 1·5 inch diameter at a constant distance and at various pressures

The experiments were made by placing the micro-

meter-discharger, shown in Fig. 2, under the bell-jar of an air pump to which was attached a gauge about 36 inches long in order to indicate the pressure of the contained gas. In the first instance the disks were adjusted to the striking-distance at atmospheric pressure for the battery of 11,000 cells. Afterwards a less number of cells was connected with the disks and the bell-jar gradually exhausted until the discharge occurred; the height of the mercury in the gauge was then read off. Then a less and less number of cells was connected with the disks and the operation was repeated.

In air the discharge took place at ordinary atmospheric pressure with 11,000 cells when the disks were 0·13 inch, 3·3 mm. distant, and with 600 cells at an average pressure of 10 mm.

In hydrogen it took place at atmospheric pressure with 11,000 cells when the disks were 0·22 inch, 5·59 mm. distant; and with 600 cells at an average of 14 mm. pressure.

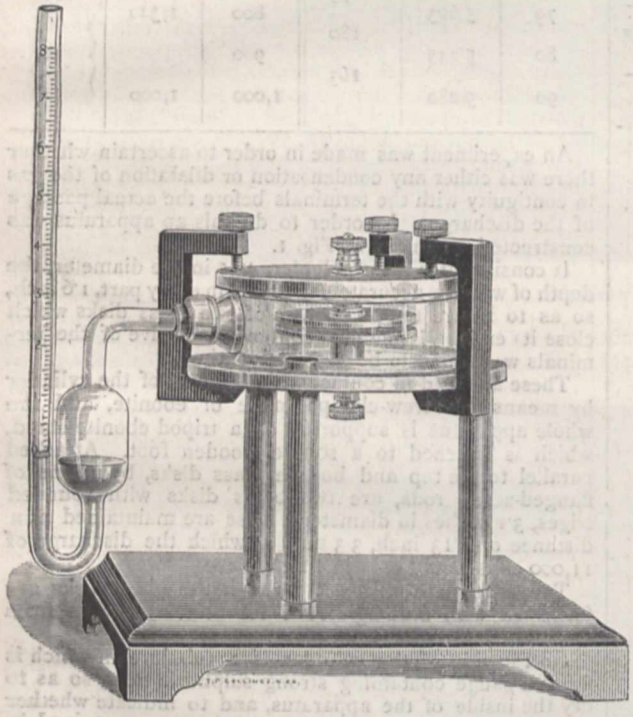

FIG. 1.

In carbonic acid, at atmospheric pressure with 11,000 cells, when the disks were 0·122 inch, 3·096 mm. distant; and with 600 cells at an average pressure of 5·2 mm.

The numbers obtained for air, hydrogen, and carbonic acid respectively were plotted down on millimetre scale paper, the abscissæ being 1 mm. = 2,500 **M**, the ordinates 1 mm. = 25 cells, and curves drawn to give a mean of the several observations. These appeared to resemble hyperbolic curves so closely that true hyperbolic curves were found partly by a geometric construction, partly by computation, which would intersect the mean experimental curves in two points. The results of experiment were again laid down on these new curves, and it was found that they did not differ more from them than they did from each other.

The ratio of the transverse axis (pressure) to the conjugate axis (potential) of the hyperbolas set out on the above-mentioned scale was—

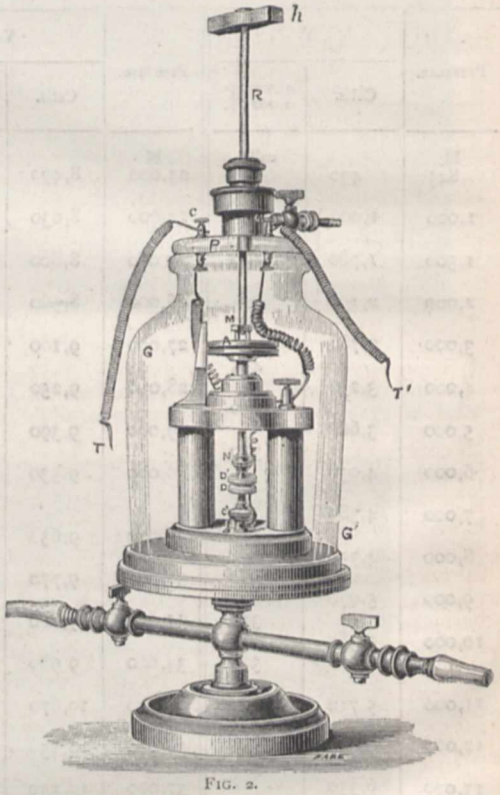

FIG. 2.

For air	0·9665
,, hydrogen	1·0170
,, carbonic acid	1·0690

The striking distances at atmospheric pressure for spherical surfaces 3 inches radius and 1·5 inch diameter, with various potentials, as given in Part I. page 68, curve VIII. and at page 118, also those for nearly flat surfaces in pages 73 and 118, were reduced to millimetres distance and plotted down in the same way, but not on precisely the same scale as the preceding curves for constant distance and various pressures. Hyperbolic curves were also found which intersected the experimental curves in two points.

It was seen in the case of spherical surfaces, the result having been obtained as the average of a great number of experiments, that the hyperbola coincided closely with the observations, while for plane surfaces, for which only a few experiments were made, the coincidences were not quite so perfect. Nevertheless, it would appear that the law of the hyperbola holds equally well for a constant pressure and varying distance as it does for a constant distance and varying pressure; the obstacle in the way of a discharge being up to a certain point as the number of molecules intervening between the terminals.[1]

In the two cases of spherical and plane surfaces the ratio between the transverse (distance) and conjugate (potential) axes of the respective hyperbolas was—

For spherical surfaces	1·240
,, disks	1·285

With the data already published in Part I., the authors have laid down a fresh curve for the striking distance

[1] Dr. Alexander Macfarlane has published in the *Transactions* of the Royal Society of Edinburgh, 1878, vol. xxvii., an elaborate and careful research of the "Disruptive Discharge of Electricity" in air and different gases, and between terminals of various forms. An abstract of this paper will be found in NATURE, vol. xix. pp. 184, 185. Dr. Macfarlane used a Holtz machine and employed higher potentials than those we used: he found that the results for the discharge between two disks 4 inches in diameter at various distances up to 1·2 centims. and with various pressures were satisfactorily represented by the hyperbola.

between flat disks on a scale of 10 centims. for a millimetre and 5 centims. to 1,000 cells.

From the curve thus laid down the following numbers were deduced :—

EMF in volts.	Striking distance in centimetres.	Difference of potential per centimetre.	Intensity of force.	
			Electro-magnetic.	Electro-static.
		volts.		
1,000	0·0205	48,770	$4·88 \times 10^{12}$	163
2,000	0·0430	46,500	4·65 ,,	155
3,000	0·0660	45,450	4·55 ,,	152
4,000	0·0914	43,770	4·38 ,,	146
5,000	0·1176	42,510	4·25 ,,	142
6,000	0·1473	40,740	4·07 ,,	136
7,000	0·1800	38,890	3·89 ,,	130
8,000	0·2146	37,280	3·73 ,,	124
9,000	0·2495	36,070	3·61 ,,	120
10,000	0·2863	34,920	3·49 ,,	116
11,000	0·3245	33,900	3·39 ,,	113
11,309	0·3378	33,460	3·35 ,,	112

The remainder of the paper is chiefly occupied with the study of the phenomena of the electric arc under various conditions of distance, pressure, and potential; the results obtained support the view that the arc and the stratified discharge are merely modifications of the same phenomenon.

(*To be continued.*)

A FOURTH STATE OF MATTER[1]

IN introducing the discussion on Mr. Spottiswoode and Mr. Moulton's paper on the "Sensitive State of Vacuum Discharges," at the meeting of the Royal Society on April 15, Dr. De La Rue, who occupied the chair, good-naturedly challenged me to substantiate my statement that there is such a thing as a fourth or ultra-gaseous state of matter.

I had no time then to enter fully into the subject; nor was I prepared, on the spur of the moment, to marshal all the facts and reasons which have led me to this conclusion. But as I find that many other scientific men besides Dr. De La Rue are in doubt as to whether matter has been shown to exist in a state beyond that of gas, I will now endeavour to substantiate my position.

I will commence by explaining what seems to me to be the constitution of matter in its three states of solid, liquid, and gas.

I. First as to Solids:—These are composed of discontinuous molecules, separated from each other by a space which is relatively large—possibly enormous—in comparison with the diameter of the central nucleus we call *molecule*. These molecules, themselves built up of *atoms*, are governed by certain forces. Two of these forces I will here refer to—attraction and motion. Attraction when exerted at sensible distances is known as *gravitation*, but when the distances are molecular it is called *adhesion* and *cohesion*. Attraction appears to be independent of absolute temperature; it increases as the distance between the molecules diminishes; and were there no other counteracting force the result would be a mass of molecules in actual contact, with no molecular movement whatever—a state of things beyond our conception—a state, too, which would probably result in the creation of something that, according to our present views, would not be *matter*.

This force of cohesion is counterbalanced by the movements of the individual molecules themselves, movements varying directly with the temperature, increasing and diminishing in amplitude as the temperature rises and falls. The molecules in solids do not travel from one part to another, but possess adhesion and retain fixity of position about their centres of oscillation. Matter, as we know it, has so high an absolute temperature that the movements of the molecules are large in comparison with their diameter, for the mass must be able to bear a reduction of temperature of nearly 300° C. before the amplitude of the molecular excursions would vanish.

The state of solidity, therefore—the state which we are in the habit of considering *par excellence* as that of *matter*—is merely the effect on our senses of the motion of the discrete molecules among themselves.

Solids exist of all consistences, from the hardest metal, the most elastic crystal, down to thinnest jelly. A perfect solid would have no viscosity, *i.e.*, when rendered discontinuous or divided by the forcible passage of a harder solid, it would not close up behind and again become continuous.

In solid bodies the cohesion varies according to some unknown factor which we call chemical constitution; hence each kind of solid matter requires raising to a different temperature before the oscillating molecules lose their fixed position with reference to one another. At this point, varying in different bodies through a very wide range of temperature, the solid becomes liquid.

II. In liquids the force of cohesion is very much reduced, and the adhesion or the fixity of position of the centres of oscillation of the molecules is destroyed. When artificially heated, the inter-molecular movements increase in proportion as the temperature rises, until at last cohesion is broken down, and the molecules fly off into space with enormous velocities.

Liquids possess the property of viscosity—that is to say, they offer a certain opposition to the passage of solid bodies; at the same time they cannot permanently resist such opposition, however slight, if continuously applied. Liquids vary in consistency from the hard, brittle, apparently solid pitch to the lightest and most ethereal liquid capable of existing at any particular temperature.

The state of liquidity, therefore, is due to inter-molecular motions of a larger and more tumultuous character than those which characterise the solid state.

III. In gases the molecules fly about in every conceivable direction, with constant collisions and enormous and constantly varying velocities, and their mean free path is sufficiently great to release them from the force of adhesion. Being free to move, the molecules exert pressure in all directions, and were it not for gravitation they would fly off into space. The gaseous state remains so long as the collisions continue to be almost infinite in number, and of inconceivable irregularity. The state of gaseity, therefore, is pre-eminently a state dependent on collisions. A given space contains millions of millions of molecules in rapid movement in all directions, each molecule having millions of encounters in a second. In such a case the length of the mean free path of the molecules is exceedingly small compared with the dimensions of the containing vessel, and the properties which constitute the ordinary gaseous state of matter, which depend upon constant collisions, are observed.

What, then, are these molecules? Take a single lone molecule in space. Is it solid, liquid, or gas? Solid it cannot be, because the idea of solidity involves certain properties which are absent in the isolated molecule. In fact, an isolated molecule is an inconceivable entity, whether we try, like Newton, to visualise it as a little hard spherical body, or, with Boscovich and Faraday, to regard it as a centre of force, or accept Sir William Thomson's vortex atom. But if the individual molecule is not solid, *à fortiori* it cannot be regarded as a liquid or gas, for these states are even more due to inter-molecular collisions than is the solid state. The individual mole-

[1] "On a Fourth State of Matter," in a letter to the Secretary of the Royal Society. By W. Crookes, F.R.S.

cules, therefore, must be classed by themselves in a distinct state or category.

The same reasoning applies to two or to any number of contiguous molecules, provided their motion is arrested or controlled, so that no collisions occur between them; and even supposing this aggregation of isolated non-colliding molecules to be bodily transferred from one part of space to another, that kind of movement would not thereby cause this molecular collocation to assume the properties of gas; a molecular wind may still be supposed to consist of isolated molecules, in the same way as the discharge from a mitrailleuse consists of isolated bullets.

Matter in the fourth state is the ultimate result of gaseous expansion. By great rarefaction the free path of the molecules is made so long that the hits in a given time may be disregarded in comparison to the misses, in which case the average molecule is allowed to obey its own motions or laws without interference; and if the mean free path is comparable to the dimensions of the containing vessel, the properties which constitute gaseity are reduced to a minimum, and the matter then becomes exalted to an ultra-gaseous state.

But the same condition of things will be produced if by any means we can take a portion of gas, and by some extraneous force infuse order into the apparently disorderly jostling of the molecules in every direction, by coercing them into a methodical rectilinear movement. This I have shown to be the case in the phenomena which cause the movements of the radiometer, and I have rendered such motion visible in my later researches on the negative discharge in vacuum tubes. In the one case the heated lamp-black and in the other the electrically excited negative pole supplies the *force majeure* which entirely or partially changes into a rectilinear motion the irregular vibration in all directions; and according to the extent to which this onward movement has replaced the irregular motions which constitute the essence of the gaseous condition, to that extent do I consider that the molecules have assumed the condition of radiant matter.

Between the third and the fourth states there is no sharp line of demarcation, any more than there is between the solid and liquid states, or the liquid and gaseous states; they each merge insensibly one into the other. In the fourth state properties of matter which exist even in the third state are shown *directly*, whereas in the state of gas they are only shown *indirectly*, by viscosity and so forth.

The ordinary laws of gases are a simplification of the effects arising from the properties of matter in the fourth state; such a simplification is only permissible when the mean length of path is small compared with the dimensions of the vessel. For simplicity's sake we make abstraction of the individual molecules, and feign to our imagination *continuous* matter of which the fundamental properties—such as pressure varying as the density, and so forth—are ascertained by experiment. A gas is nothing more than an assemblage of molecules contemplated from a simplified point of view. When we deal with phenomena in which we are obliged to contemplate the molecules individually, we must not speak of the assemblage as *gas*.

These considerations lead to another and curious speculation. The molecule—intangible, invisible, and hard to be conceived—is the only true *matter*, and that which we call matter is nothing more than the effect upon our senses of the movements of molecules, or, as John Stuart Mill expresses it, "a permanent possibility of sensation." The space covered by the motion of molecules has no more right to be called matter than the air traversed by a rifle bullet can be called lead. From this point of view, then, matter is but a mode of motion; at the absolute zero of temperature the inter-molecular movement would stop, and although *something* retaining the properties of inertia and weight would remain, *matter*, as we know it, would cease to exist.

NOTES

THE Council of the Society of Arts have awarded the Albert Medal of the Society of the present year to James Prescott Joule, LL.D., D.C.L., F.R.S., "for having established, after most laborious research, the true relation between heat, electricity, and mechanical work, thus affording to the engineer a sure guide in the application of science and industrial pursuits." The medal was delivered to Dr. Joule by the Prince of Wales on Tuesday, when Sir William Thomson received the medal awarded him by the Society in 1878.

THE Paris Academy of Sciences has awarded the Monthyon Prize to M. Camille Flammarion for his new work entitled "Astronomie Populaire." It is a large 4to volume, with magnificent engravings, which was sold in 100 penny parts. The sale in the first year of publication reached 40,000 copies.

IT is stated that M. Coggia, Astronomer to the Marseilles Observatory, will be appointed Director of the Algiers Observatory, where no observations at all have been made since its creation in 1864 by Marshal Pelissier.

THE University of Oxford has conferred the degree of D.C.L on Prof. Sylvester and Mr. Lister, the eminent surgeon.

ON Saturday, May 5, the local committee of the French Association for the Advancement of Science met at Rheims, where the next meeting is to be held in August. An exposition of local industry and archæology will be held. Arrangements have been made for excursions connected with the congress, the more notable of which will be to the Han Grottoes, which are situated in Belgium. Nothing has been arranged yet as to the lectures to be delivered.

THE new Principal of the Royal Agricultural College, Cirencester, the Rev. J. B. McLellan, has started a scheme of congresses or conferences which may prove of considerable value to agriculture. On Friday, the 5th inst., a goodly number of old Cirencester students and professors, as well as local agriculturists, met in the College Hall to discuss important agricultural questions. The morning session was occupied with the subject of cattle diseases; the afternoon was devoted to agricultural stations and research. If the papers introducing the subjects were not of a very high order, it may at least be conceded that the discussions which followed brought out some sound information and advice. If such congresses as this at Cirencester help to draw public attention to the need for some new departure in modern and scientific agriculture, and if they stimulate those interested in farming to look to the College as the central authority on a subject which that institution must learn to handle adequately, then we predict for them a substanial success.

THE annual conference at the Society of Arts on the laws, administration and inspection with regard to public health was opened on Thursday under the presidency of Mr. Stansfeld, M.P. The committee had drawn up a programme of subjects for discussion, which were grouped under the following headings:—1. Administrative Organisation: 2. Amendment of the Law: 3. Sanitary Inspection and Classification of Dwellings: 4. Further suggestions by Sanitary Authorities. In the discussion on Thursday the chairman, in opening the proceedings, pointed out the desirability of an "inquiry office" being established in connection with the Local Government Board, at which local authorities might obtain information based on experience. One great hope for the future was that the teaching of the laws of health to children was gradually spreading. The conference was resumed on Friday. In reference to the third heading, the following resolution was put to the meeting:—"That it is expedient that the Metropolitan Board of Works within the metropolis, and the County Board within each county, should

be empowered by the Legislature to make provision for the inspection and sanitary classification of dwellings, upon application being made by the owners thereof, and to grant certificates of healthworthiness in different categories, for terms of years, according to the perfection of sanitary equipment and fitness for habitation of such dwellings; and to determine the scale of fees to be paid for such inspection during construction and repair, and also upon delivery to the applicant of the certificate of classification awarded to such dwelling. In the long discussion which followed it was clear that the sense of the conference was in favour of some change, but opinions were much divided as to how inspection and certificates should be brought to bear. Among other arguments it was urged that, as Lloyd's Association inspected the construction of ships and granted certificates, it would be only an extension of a recognised system to inspect and give certificates for houses. After a protracted discussion, the resolution was passed with some few alterations. An exhibition of sanitary appliances was open free to the public. The chief novelty was the new filtering medium adopted by the Admiralty and War Office named Carferal, on which Prof. De. Chaumont has recently reported so favourably.

MR. R. L. JACK, the Government Geologist of Queensland, has been carrying out his survey operations under difficulties unknown to home geologists. While he and his party were pursuing their explorations in the north of York Peninsula they were attacked by a band of natives, Mr. Jack receiving a spear in the neck, which had to be cut out. Fortunately the wound, though troublesome, is not likely to be attended with any serious or permanent results. North of Temple Bay Mr. Jack came upon a hitherto unknown large river, which he has named the "Macmillan."

THE *Daily News* gives some account of a recent lecture by Prof. Palmieri on earthquakes. Prof. Palmieri went on to say that earthquakes have no doubt shorter or longer periods of preparation. The earth is never perfectly quiet for some time before and after a great shock, but gradually sinks into repose or increases in agitation. The Professor believes that, by registering the slight preliminary tremblings and noticing their increase or decrease it would be possible to forestall an earthquake about three days in advance, just as tempests are now foretold. If a connected system of seismographic stations were to be organised —the different stations communicating with each other by telegraph—it would be quite possible, in most cases, to issue warnings to the threatened district in time. The seismographic stations should be erected by the different Governments in quiet places where the ground was not liable to be shaken by heavy railway trains.

THE illumination of the park of the Industrial Exhibition of Melun with Wild candles has been considered successful, and will be continued every night during the whole of the summer. It is said that the proprietors of the Wild patent will take an injunction against M. Jamin for an infringement of their patent, alleging that his directing frame is not an independent invention.

M. W. DE FONVIELLE has discovered that the intermittent current of the frame of his electro-magnetic gyroscope can be made continuous if the magnet is replaced by an electro-magnet worked by an interrupter.

THE French Government has taken an important step in the education of the people; a course of teaching in agriculture has been ordered to be introduced into every primary school in the country.

MESSRS. MACMILLAN AND CO. have published a sixth edition of the late Prof. George Wilson's well-known little book, "The Five Gateways of Knowledge."

CHEMISTS engaged in the analysis of alcoholic liquids will be able shortly to possess an elaborate and complete series of tables of spirit gravities, prepared by Dr. Thos. Stevenson, of Guy's, and to be published in handy book size by Mr. Van Voorst.

MR. G. AMBROSE POGSON, British Vice-Consul at Hamburg, writes to the *Times* from that place, under date June 12, as to "St. Elmo's Fire":—A series of thunderstorms, he states, has lately passed over Hamburg. During the 11th inst. the air was densely charged with electricity; the storm broke about 10.15 p.m., lasting until 11 p.m., during which time, at very short intervals, from my station, about 1,200 yards distance from the copper-roofed tower of the church known as St. Jacobi, about 300 feet high, I saw this phenomenon apparently resting about 30 feet from the summit of the steeple. The colour was a reddish purple, and reminded one somewhat of burning potassium. From repeated comparisons with other objects during the lightning flashes, I judged these fire-balls (two were several times visible) to be from 4 feet to 6 feet in diameter. The longest duration that I timed was 42 seconds. This passing away of such dense masses of electricity by induction was visible some twenty times, but whether performed silently I had no means of ascertaining. From the apparent size of flame and the non-lighting quality of the colour, I estimated it as equal to 10,000 candles. The colour was doubtless the effect of the glare of the copper roof.

DURING 1881 no less than five exhibitions will be held at Frankfort-on-the-Main, viz., a patent exhibition, a horticultural, a balneological, an industrial, and a tanner's and furrier's exhibition.

A MEETING of the members of the Aëronautical Society of Great Britain will be held at the Society of Arts, Adelphi, on Monday, June 21, for the reading and discussion of papers, and generally for the advancement of the Society's interests. The chair will be taken precisely at 8 p.m.

WE are requested to make the following announcement with regard to the Sunday Art Exhibitions of the Sunday Society:—On Sunday, June 20, the first exhibition at the Hanover Gallery, including Hans Makart's great picture of the Entry of Charles V. into Antwerp, will be open to the members of the Society, and on the two following Sundays, June 27 and July 4, the public will be admitted by means of free tickets, which will be issued to those who apply by letter, sending a stamped and addressed envelope to the Honorary Secretary, 6, Dudley Place, W. On each Sunday the Gallery will be opened from 3 till 9 p.m. The Grosvenor Gallery will be opened to the members of the Society on Sunday, July 25, and to the public on Sunday, August 1, by tickets to be had on written application as above.

ON Saturday the Geologists' Association and the West London Scientific Association make a combined excursion to Croydon and Riddlesdown.

THE additions to the Zoological Society's Gardens during the past fortnight include a White-throated Capuchin (*Cebus hypoleucus*) from Central America, presented by Miss Baker; a Toque Monkey (*Macacus pileatus*) from Ceylon, presented by Mr. H. P. Brenan; a Brown Bear (*Ursus arctos*) from Asia, presented by Mr. Chas. Overbeck; a Pig-tailed Monkey (*Macacus nemestrinus*) from Java, presented by Mr. W. C. Lawes; a Macaque Monkey (*Macacus cynomolgus*) from India, presented by Mr. T. H. Adey; a Black-eared Marmoset (*Hapale penicillata*) from South-East Brazil, presented by Mr. G. Mantell; three Slender Loris (*Loris gracilis*) from Ceylon, presented by Lord Lilford, F.Z.S.; a Dingo Dog (*Canis dingo*) from Australia, presented by Lord Ernest Gordon; a White Pelican (*Pelecanus onocrotalus*) from North Africa, presented by Mr. J. Simonds; a Musky Lorikeet (*Trichoglossus concinnus*) from Australia, pre-

sented by Mr. A. H. Jamrach; a Horsfield's Tortoise (*Testudo horsfieldi*) from Afghanistan, presented by Capt. Cotton; two Smooth Snakes (*Coronella lævis*), British, presented respectively by Mr. W. Penny and Mr. Thos. J. Mann; two Yellow-headed Troupials (*Xanthocephalus icterocephalus*) from Mexico, presented by Mr. W. A. Conklin; a Jaguar (*Felis onça*) from Bolivia, two Common Boas (*Boa constrictor*) from Savanilla, deposited; a Ring-tailed Lemur (*Lemur catta*) from Madagascar, a Ludio Monkey (*Cercopithecus ludio*), a Mona Monkey (*Cercopithecus mona*), two Rus's Weaver Birds (*Quelea russi*), two Cinereous Waxbills (*Estrelda cærulescens*), two Crimson-eared Waxbills (*Estrelda phœnicotis*) from West Africa, a Black-footed Penguin (*Spheniscus demersus*), a Levaillant's Parrot (*Pœocephalus robustus*), from South Africa, a Brahminy Kite (*Haliastur indus*) from South Asia, a Brown Crane (*Grus canadensis*) from North America, a Double-crested Pigeon (*Lopholæmus antarcticus*) from North Australia, two Swift Parrikeets (*Lathamus discolor*) from Tasmania, two Victoria Crowned Pigeons (*Goura victoriæ*) from the Island of Jobie, four Bengal Weaver Birds (*Ploceus bengalensis*) from India, a Red Lory (*Eos rubra*), an Ornamental Lorikeet (*Trichoglossus ornatus*) from Moluccas, a White-billed Parrakeet (*Tanygnathus albirostris*) from Celebes, a Noble Macaw (*Ara nobilis*) from Brazil, two Yellow-fronted Amazons (*Chrysotis ochrocephala*) from Panama, a White headed Parrot (*Pionus senilis*) from Mexico, two Black-headed Conures (*Conurus nanday*) from Paraguay, two Silky Marmosets (*Midas rosalia*) from South-East Brazil, a Leucoryx Antelope (*Oryx leucoryx*) from North Africa, a Common Otter (*Lutra vulgaris*), British, three Chinchillas (*Chinchilla lanigera*) from Chili, an Upland Goose (*Bernicla magellanica*) from the Falkland Islands, three Ashy-headed Geese (*Bernicla poliocephala*) from South America, purchased; an Anoa (*Anoa depressicornis*) from Celebes, received in exchange; an Axis Deer (*Cervus axis*), a Japanese Deer (*Cervus sika*), a Geoffroy's Dove (*Peristera geoffroii*), a Wonga-wonga Pigeon (*Leucosarcia picata*), a Turquoisine Parrakeet (*Euphema pulchella*), bred in the Gardens.

OUR ASTRONOMICAL COLUMN

FAYE'S COMET.—Dr. Axel-Möller commences his ephemeris of Faye's comet for the present year on July 1, when its distance from the earth will be 2·005, and that from the sun 2·53; the perihelion passage will not take place till January 22, 1881. The intensity of light corresponding to the comet's distances on July 1 is 0·039; in 1844 it was observed with sensibly the same intensity, the value for the last observation with the 15-inch refractor at Pulkowa being 0·035. The comet attains its greatest brightness in the middle of October, when the value corresponds to that at the last observation in 1858, with the 9·6-inch refractor at Berlin on October 16. At discovery by M. Faye in 1843 the theoretical intensity of light was 0·54, which has not been approached at any of the subsequent returns. The following positions are taken from Dr. Axel-Möller's ephemeris, which is calculated for Berlin midnight, or about 11h. G.M.T. :—

	Right Ascension.	Declination.		Right Ascension.	Declination.
	h. m. s.	° ′		h. m. s.	° ′
July 1	23 5 25	+7 53·5	July 17	23 13 17	+ 9 34·5
3	23 6 38	8 7·7	19	23 13 57	9 44·8
5	23 7 47	8 21·4	21	23 14 32	9 54·6
7	23 8 52	8 34·8	23	23 15 2	10 3·6
9	23 9 54	8 47·7	25	23 15 27	10 12·0
11	23 10 51	9 0·1	27	23 15 47	10 19·7
13	23 11 44	9 12·1	29	23 16 2	10 26·6
15	23 12 33	+9 23·6	31	23 16 12	+10 32·8

The comet will arrive at its least distance from the earth (1·09) on October 3. So far as can be foreseen without calculation of the perturbations the comet is not likely to exhibit a degree of brightness approaching that in the year of its discovery by M. Faye, until 1903.

While Faye's comet is followed up by Dr. Axel-Möller in the same admirable manner as for many years past, calculations relating to other comets of short period are in the hands of the following astronomers according to the last Report of the *Astronomisches Gesellschaft*:—Dr. Backlund of the Imperial Observatory, Pulkowa, proceeds with the perturbations of Encke's comet, taking up the work where it was left by the late Dr. v. Asten; Brorsen's comet is undertaken by Prof. R. Schulze of Döbeln; D'Arrest's by M. Leveau of Paris; Winnecke's by Prof. Oppolzer of Vienna; Tempel's comet of 1867 by M. Gautier of Geneva; Tempel's second comet (1871), by M. Schulhof of Paris; and Tuttle's comet, due in the year 1885, by Mr. Ormond Stone of Cincinnati. The exceptional case of Biela's comet is not provided for.

THE GREAT SOUTHERN COMET OF 1880.—Dr. M. W. Meyer, of Geneva, assuming for the period of revolution of this comet the interval between the perihelion passage of the great comet of 1843 and that of the comet in 1880, corresponding to a semi-axis major of 11·0869, has adapted the other elements of the orbit thereto by means of Dr. B. A. Gould's observations at Cordoba on February 6, 12, and 19, covering an interval which, so far as we know at present, is only one day less than the whole extent of accurate observation: the Cordoba observations of February 5 await the meridional observation of the comparison star, which is not found in our catalogues: it may be well determined at one of the observatories of Southern Europe. Dr. Meyer's results are as follows:—

Perihelion passage, 1880, January 27·44242 G.M.T.

Longitude of perihelion ...	...278 22 47	Mean equinox,
,, ascending node ...	356 16 43	1880·0
Inclination of the orbit	36 52 13	
Log. excentricity (=log. sine ϕ)	9·9997682	or $\phi = 88° 7' 41''·55$
Log. perihelion distance	7·7720095	

Motion retrograde.

The aphelion distance in this orbit is 22·1679 (the earth's mean distance being taken as *unity*), and at aphelion the comet is distant from the orbit of Uranus 13·15. The nearest approach to the orbit of Jupiter, about 3·1, takes place when the true anomaly is about 176° 35′. The comet's orbital velocity at perihelion is 338 miles in a second, and that at aphelion 477 feet in the same interval.

MINIMA OF ALGOL.—The following times of geocentric minima of Algol, observable in this country during the ensuing quarter, are deduced from the elements given by Prof. Schönfeld in his catalogue of 1875. Considerable perturbations of epoch appear to have taken place during the last five years, as we have previously noted in this column, and from the course of the errors of calculation it seems quite possible that the computed times may be nearly a half-hour too late. Systematic observations of this variable are now much to be desired, and it may be hoped that one or more of the many zealous amateur-astronomers here will devote attention to it. The perturbations to which we have alluded were particularly evident in 1876, and the error of the calculated times attained a maximum in the following year, a mean of seven observations by Prof. Julius Schmidt at Athens showing that the computed epoch was too late by forty-eight minutes. The following epochs are directly comparable with observation:—

	h. m.			h. m.	
July 16 ...	12 39·0	G.M.T.	Aug. 25 ...	12 47·9	G.M.T.
19 ...	9 27·5	,,	28 ...	9 36·4	,,
Aug. 2 ...	14 19·6	,,	Sept. 14 ...	14 27·7	,,
5 ...	11 8·2	,,	17 ...	11 16·2	,,
22 ...	15 59·4	,,	20 ...	8 4·8	,,

PHYSICAL NOTES

ACCORDING to our contemporary *l'Électricité*, M. Exner of Vienna has discovered that a bismuth-antimony pair immersed in a gas incapable of acting chemically on either of these metals yields no current when one junction is heated. Also that if two bars of copper are soldered together to form a "pair" no current is produced when either junction is heated in air (as would be expected in a circuit of one metal), not even when both strips are exposed to the action of chlorine; but that if one strip only is exposed to chlorine gas and then one junction be warmed a thermo-electric current is set up. According to Exner therefore, all so-called thermo-electric currents are due to chemical action. It would be easy for some of our ardent young physicists to put to the test this very remarkable announcement, and see whether

it is Herr Exner, or all the authorities on thermo-electricity from Seebeck to Tait, on whom we are to rely for the facts.

In a new capillary electrometer described by M. Debrun in the *Journal de Physique* (May), the microscope is dispensed with, and the requisite sensibility obtained by inclining the tube, which is slightly conical. The capillary tube is bent into a somewhat zig-zag shape, the two turned-up ends opening into larger tubes, and with the mercury in these wires are connected. The support can be turned in a vertical plane, so as to give the middle part of the capillary tube any desired inclination.

M. Crova commends, for photometric purposes (*Journal de Physique*, May), M. Prazmowski's polariser, which is a Nicol, with faces normal to the axis of the prism, the two halves of which are joined with linseed oil. It requires large pieces of spar, and the joining is long and difficult, but there are several advantages. Thus the layer of oil (unlike Canada balsam), causes hardly any loss of light; its index, 1·485, being nearly equal to the extraordinary index of spar, the polarised field is limited on one side, as in Nicols, where the total reflection of the ordinary ray commences, by a red band; but these cond limit, corresponding to total reflection of the extraordinary ray, is thrown out of the field of vision; the angular value of the polarised field is thus increased. The increase of field, the angular separation of the only coloured band, and the direction of its bases, normal to the axis, are qualities to be appreciated in certain cases.

According to some recent experiments of M. Goulier, the coefficient of expansion by heat of a metal is independent of any pressure put upon the metal, and is the same under a stress of traction as under one of compression.

Mr. W. P. Johnson gives an account in the *Philosophical Magazine* of a new use of the telephone. It is sometimes necessary to grapple and lift a faulty cable, and if it lies in the water along with other cables of similar exterior make it has hitherto been impossible to decide, without cutting it apart, on the identity of the grappled portion. To avoid the obvious evil of having to cut and splice the cable unnecessarily, it is now suggested to employ the telephone on an auxiliary parallel wire in which the induction may be sufficiently strong to enable the electricians in charge to read the signals which may be sent into the cable, and so identify it.

The following pretty experiment, devised by Mr. R. H. Ridout, illustrates the surface tension of mercury. A shallow tray, six inches by three, is supported on three levelling screws, and inclined just so that the mercury does not flow over the lipped edge. If now a small quantity of the liquid be set flowing over the edge it will draw the rest of the liquid over with a siphon-like action. It is difficult, however, to get the surface so clean that no adherent trail should be left, marring the completion of the experiment.

The expansion of glass by heat may be demonstrated as follows:—A glass tube of narrow bore and about eighteen inches long is bent round in the shape of a horse-shoe, so that the free ends are within a millimetre of one another. Between these ends a coin may be held, being nipped between the ends of the rod and held there by the grasp due to the elasticity of the glass. If now the *outer* portion of the curved part be warmed, the ends open slightly and the coin drops out. This experiment is also due to the ingenuity of Mr. Ridout.

The phenomenon lately discovered by Hall of the action of a magnet in altering the path of a current of electricity in the conductor which carries it, has formed the starting-point for two investigations, which have appeared separately in the *Wiener Anzeiger*, by Boltzmann and von Ettingshausen respectively, in which they point out that this discovery may be applied to determine the absolute velocity of electricity in a conductor.

M. Loughinin has published in the last fascicule of the *Journal* of the Russian Physical and Chemical Society (vol. xii., fasc. 4) a note on his important work on the heat which results from the burning of several alcohols. The substances experimented on are burnt in a jet of oxygen in a glass vessel which is placed in the water of a calorimeter. The figures are: For normal propylic alcohol, 481·6 calories for one molecule; isopropylic alcohol, 479 calories; isobutylic alcohol, 638·6 calories.

GEOGRAPHICAL NOTES

Mr. Carl Bock has lately returned to London after his journeys in Borneo, bringing with him a magnificent series of portraits of the native tribes of that island,—both Dyaks and forest people—taken in water colours. These, we understand, are to be reproduced, at the expense of the Dutch Government, by chromolithography, and will illustrate his report on the journey, which is to be read in the first instance before the Royal Geographical and Anthropological Society of Holland. Pending the publication of this report, Mr. Bock refrains, at the desire of the Dutch Government, from anticipating it in England even by a preliminary sketch. The varieties of type, the methods of adornment, the manner, and to some extent the religion of these distinct races, are all brought out in Mr. Bock's faithful drawings taken from the life on the spot, which form, over and above the objects for which the journey was taken, a splendid contribution to ethnography, the publication of which will be looked forward to with interest; the greater perhaps if Mr. Bock were permitted to give some further slight outline than has already appeared in the pages of Nature. Mr. Bock has also made an extensive collection of the swords, lances, blowing tubes, and shields (some of the latter covered with human hair), which are used by the natives. He seems to have had the happy knack of making friends of the savages whom others have found murderers, and has brought himself back alive to receive the honour that is his due.

The current number of the Geographical Society's *Proceedings* opens with the Rev. C. Maples' very interesting paper on Masasi and the Rovuma district between Lake Nyassa and the east coast of Africa. The Rev. C. T. Wilson's and Mr. Felkin's brief notes on Uganda and the journey through the Nile region are also published, and are followed by an account of that rare occurrence in Dominica, a volcanic eruption at the Grand Souffrière, which took place on January 4. The geographical notes include a list of latitudes in Central South Africa, Mr. F. C. Selous' explorations on the Zambesi, &c. (of which full accounts are to be published in a later number), and a journey in Damara-land and beyond the River Okavango. An allusion is also made to Mr. Whymper's ascent of Cotopaxi, and to a proposed exploration of some of the unknown affluents of the Purûs. Among the remaining notes is a long account of the country of the Mijjertain Somalis, and of recent exploration in Central Australia. Col. H. Yule furnishes an obituary notice of General Macleod, whose pioneer journey into the interior of the Indo-Chinese Peninsula in 1836-7 is, we fear, now almost forgotten. The map this month is that of the central portion of South Africa, illustrating Dr. Emil Holub's journeys, and constructed in part from his original drawings.

Dr. Emil Bessels, who was with Hall in the *Polaris*, hopes to undertake a new Arctic expedition in 1881 on funds subscribed in America. He will establish a station at the entrance of Jones Sound, where a scientific staff will be located, consisting of an astronomer, a physicist, a geologist, botanist, and zoologist. Intercourse will be kept up with the settlement of North Greenland by means of a yacht, as well as with the whalers.

Signor Cristoforo Negri, President of the Italian Geographical Society, and member of the Geographical Society of London, has just published an interesting pamphlet at Genoa, in which he warmly advocates the proposed Italian Antarctic expedition. He demonstrates the importance not only to science, but probably also to trade, of such an expedition. A special circumstance increases the desirability of this Italian Antarctic expedition. In 1882 the transit of Venus will again occur, but after that not again for a hundred years. The Italian expedition, therefore, finding itself in 1882 at some point of the Antarctic circle, would be able to observe this phenomenon under favourable conditions. Signor Negri believes that the expedition might be made with a single vessel at no very extravagant cost, perhaps 600,000 to 700,000 Italian lire. It would spend two winters, returning to La Plata, if necessary, during that period, to re-provision and re-coal the ship.

At the last meeting of the Russian Geographical Society the Secretary intimated that M. Potanin continues his exploration of North-Western Mongolia. The Society has just received from him a part of his collections, and expects soon to receive his detailed report. M. Tiaghin, who stays on Novaya Zemlya for the exploration of that island, has brought together a very good collection of plants, and has made interesting communications as to the geography of the island. As to new expeditions, the Society proposes to send M. Mereshkovsky to the Crimea for ethnographical and archæological explorations, and M. Malakhoff to the Middle Ural Mountains for zoo-geographical investiga-

tions. M. Maikoff presented a report of the Committee appointed to discuss the subject of a thorough historical and ethnographical exploration of Bulgaria. Col. Lebedeff presented a sketch of the orography of the Balkan peninsula, according to the last geodetical and topographical operations in Bulgaria by officers of the Russian General Staff. The orography of much of the Balkan peninsula has been pretty well studied, a complete trigonometrical report having been completed, and a relief-map on a large scale, like that of the Caucasus, is now in preparation.

A LIVELY controversy having arisen between the cantons of Geneva and Vaud as to the importance of the dam erected at Geneva with reference to the level of Lake Leman, the *Journal de Genève* has published during the past month a series of papers by M. H. de Saussure on Lake Leman, the changes of its level, the destructive action of its waves, and generally on its physical conditions. These papers have a great scientific value. We notice also several papers on the same subject published by the *Gazette de Lausanne* in answer to M. de Saussure's articles.

WE notice an interesting note by MM. Polonsky and Meyer on that part of the eastern shore of the Caspian which is described as Tentiak-sor, and is a former lake now transformed into a series of lagoons separated by muddy spaces. Its origin is explained by M. Meyer by a falling of level of the Caspian. Prof. Lenz having made an incision in a rock at Baku in 1830, the subsequent measurements showed that the level stood—in 1837, 1·6 feet lower; in 1847, 0·7 feet higher; in 1848, 1·3 foot; in 1852, 2·9 feet; in 1853, 2·5 feet; and in 1861, 3·9 feet lower than in 1837. This circumstance would be in complete accord with the general diminution of water in all Asiatic lakes, and would perfectly explain a multitude of important physico-geographical phenomena.

HEFT V. of *Petermann's Mittheilungen* begins with an article by C. Marten, on the Inhabited Part of Chili South of the River Valdivia; Dr. Behm gives some collected information on the gold-fields of Wassa, on the Upper Ankobra, north from the Gold Coast; Dr. Junker narrates his journey through the Libyan Desert to the Natron Lakes; and Herr Bernhard von Struve writes on the history of trade-routes in East Siberia. The Ergänzungheft No. 61 consists of a physico-geographical account of the Portuguese Mountain group, the Serra da Estrella, with special reference to its forestal conditions, by Herr J. Rivoli. In the June number Dr. A. Regel gives an interesting account of a visit he made last year to Turfan, in Central Asia. Dr. Emin-Bey describes his journey from Dufilé to Fatiko in December, 1878, and January, 1879. Herr Lindemann gives some statistical information on the forests of Bavaria in connection with a map of the Bavarian Spessart. Herr E. R. Flegel gives a detailed narrative of his journey in the *Henry Venn* in July and August last year, up the Binué, from Gandé to Djen.

THE *Japan Mail* states that development in the trade between Japan and Corea is confidently anticipated in consequence of the opening of the port of Gensan. The Japanese residents at Fusan, in the south of the Corean peninsula, are said already to exceed 14,000 in number, and we may therefore hope that we shall soon have more detailed information regarding the interior of the country than has hitherto been accessible.

THE Melbourne correspondent of the *Colonies and India* states that Mr. White, of the Reed Beds, near Adelaide, has fitted out the schooner *Elsea*, and has left on an exploring cruise to New Guinea for the purpose of making natural history investigations, which are expected to occupy two years.

IN the introduction to his lately published report on the trade and commerce of the Caucasian Provinces, Mr. Lyall, H.B.M.'s Consul for Tiflis and Poti, gives a succinct account of the geographical features of this region, accompanied by remarks on its climate, resources, communications, &c. Though the information is not perhaps entirely new, it is interesting to be able to take in at a glance so much relating to a tract of country which is daily becoming more and more important.

COL. FLATTERS, who had left Wargla on March 15 with a column of 100 men for an exploration in connection with the intended Trans-Algerian Railway, returned to Wargla on May 20, after having travelled 600 miles in the direction of Raof, without meeting any opposition from the natives. He intends to resume his explorations in the months of September or October, in another direction. He was unable to discover the Ighorghor Wed, which is marked on every map.

FROM August 5 to 10 next the French Geographical Society will meet at Nancy for their triennial meeting.

WE have received Parts 12 to 16, each containing three maps, of the new edition of Stieler's "Hand-Atlas."

THE Russian Department of Estates has just published an interesting atlas of six maps, representing the distribution of soils in Russia. The atlas is accompanied by a text by M. Dokoutchaeff. The maps were drawn five years ago by M. Tchaslavsky, who has studied this subject during many years.

THE ROYAL OBSERVATORY

THE following are the points that seem to us of most interest in the Report of the Astronomer-Royal to the Board of Visitors at their recent Visitation:—

The Admiralty have decided not to proceed with the erection of a new library at present, though the space has been cleared, admitting of the erection of a building fifty by twenty feet. The Astronomer-Royal proposes to erect here a room of one story, but with galleries at mid-height, so that there would never be need to use a ladder. Among other changes occurring in this clearance, he has removed the electrometer mast (a source of some expense and some danger); the perfect success of Sir William Thomson's electrometer rendering all further apparatus for the same purpose unnecessary. With regard to the library the Report states that no change has been made in plan, but in some departments the number of books has increased rapidly. "Fundamental astronomy advances slowly, magnetism is almost stationary, geodesy progresses, photography and spectroscopy increase very fast, and meteorology the most rapidly of all. The Transactions of foreign Academies increase in number. This is owing, I imagine, to the general scientific activity, both of Academicians and of private men of science, in most foreign countries, and to the facilities given for transmission, by the courtesy of publishers and by the extension of book post."

Under the head of Astronomical Observations, the Report says: "The sun, moon, planets, and fundamental stars are the regular subjects of observation on the meridian, special attention being devoted to the moon, which is also observed at every available opportunity with the altazimuth. Other stars are observed from a working catalogue of about 2,500 stars, with which good progress has been made in the past year, though a large number of stars still remain for observation. About 1,100 stars were observed in 1879." Between May 20, 1879, and May 9, 1880, the following observations were made:—With the transit circle 4,164 transits, the separate limbs being connected as separate observations; 3,953 circle-observations; with the reflex-zenith tube, 23 pairs of observation of γ Draconis; with the altazimuth, 713 azimuths of the moon and stars and 352 zenith distances of the moon. A set of micrometer-measures of the outer satellite of Mars and several sets of measures of the satellites of Saturn, were obtained last autumn with the south-east equatorial, and a few drawings of Mars and Jupiter were made near the time of opposition. A remarkable proof of the exceptionally bad weather of last summer is found in the fact that in July it caused the loss of a whole month's observations of the sun.

Under the heading of Spectroscopic and Photographic Observations we find the following statement:—"The sun's chromosphere has been examined on thirty-seven days during the period to which this Report refers, and on thirty-four days prominences were seen. Whenever practicable, the appearance of the prominences as seen on each of the chromospheric lines has been recorded, and on four days a detailed examination of the whole spectrum of the chromosphere was made at twenty-four points of the sun's limb. Three sun-spots have been examined with reference to the broadening of lines in their spectra, and fifteen photographs have been taken of the spectra of three sun-spots. As regards the spectroscopic determination of star-motions, 113 measures have been made of the displacement of the F line in the spectra of 29 stars, 44 of the b_1 line in 19 stars, and 6 of the b_4 line in 3 stars. Of these 51 stars 21 had not previously been examined. In the case of three of the stars a dispersive power equivalent to that given by fifteen prisms of 60° was used. The stars are taken from a working list of 150 stars, which may eventually be extended to include all stars down to the fourth magnitude, and it is expected that in course of time the motions of about 300 stars may be spectroscopically determined. The spectra of comets *c* (Swift's) and *d* (Palisa's)

1879, and of the red spot on Jupiter, have been examined, but no certain results were obtained. Between 1879, May 20, and 1880, May 9, photographs of the sun were taken on 145 days, and of these 270 have been selected for preservation. The photographs show a complete absence of spots on 64 days out of 145, whilst in the preceding year there was a similar absence of spots on 121 days out of 150. The epoch of minimum appears to have occurred about the beginning of 1879, and since last October the outbreak of spots has been very marked." Various spectroscopic and photographic results, it is stated, have been communicated to the Committee on Solar Physics, with whom, the Report states, the Observatory is in friendly communication.

Under Magnetical and Meteorological Instruments we are told that the Thomson electrometer is in excellent order. "In the warm weather of summer, and in winter when much artificial heat is used in the basement, the photographs have been unsatisfactory, but we are endeavouring to remedy this by cutting off all communication with air from the basement. In the winter the register was frequently interrupted by the freezing of the water in the exit-pipe. A basin (with cesspool) has been recently constructed to carry off the water discharged from this pipe. The action of the photographic barometer appears to have been improved by the slight changes mentioned in the last Report, and small movements are in many cases excellently shown. A new pressure-plate with springs has been applied by Mr. Browning to Osler's anemometer, and it is proposed to make such modification as will give a scale extending to 50 lbs. pressure on the square foot. Other parts of the instrument have also been renewed. An arrangement for slow motion of the barrel, which was much wanted in adjusting the recording paper, has been fitted to Robinson's anemometer. It is in contemplation to alter the photographic cylinders of the magnetometers, barometer, thermometers, and earth-currents apparatus, so as to make the time-scales of all the magnetical and meteorological instruments the same."

Some interesting information is given under the head of Reduction of Magnetical and Meteorological Observations.

The following are given as the principal results for magnetic elements in the year 1879 :—

Approximate mean westerly declination	18° 40′
Mean horizontal force	3·911 (in English units). 1·803 (in Metric units).
Mean dip	° ′ ″ 67 36 5 (by 9-inch needles). 67 36 54 (by 6-inch needles). 67 37 47 (by 3-inch needles).

"On the application of the Committee on Solar Physics, the separate daily values of the diurnal range of magnetic declination for the years 1848 to 1858 have been supplied to Prof. Balfour Stewart."

The Report goes on to say:—"The Visitors at their last meeting suggested the advantage of preparing a digested account of the magnetical results obtained at the Royal Observatory from 1841 to 1876, similar in some respects to the account of meteorological results recently published. A beginning was made by preparing the monthly means of diurnal inequality in force and direction through the whole period, and exhibiting their combination in curves. It is known to the Visitors that, in two communications to the Royal Society, I have exhibited numerically and in curves the means of these monthly results (yearly means through all months, and monthly means through all years) as far as the year 1863. In 1864 observations were interrupted by the work in progress for the magnetic basement, so that the reductions now to be made commence with 1865. The monthly results through the whole period being taken as before, the next step, for obtaining exhibitions which the eye and the mind could easily command, was to collect the monthly conclusions into a limited number of groups of years. On inspecting the monthly curves in detail there was no hesitation in fixing upon the following:—First group, 1865 to 1868; second group, 1869 to 1872; third group, 1873 to 1876. In each of these, as before, yearly means are taken through all months, and monthly means through all years. The curves in the second group are strikingly larger than those in the first and third; the linear dimensions of the curves of 1870 are fully $\frac{5}{6}$ of those of 1876 in the east-and-west direction, and fully $\frac{7}{8}$ in the north-and-south direction. In the study of the forms of the individual curves; their relations to the hour, the month, the year; their connection with solar or meteorological facts; the conjectural physico-mechanical causes by which they are produced; there is much to occupy the mind. I regret that, though in contemplation of these curves I have remarked some singular (but imperfect) laws, I have not been able to pursue them. The heavy load on the Observatory, and the limited means (in the present year) of supporting it, will in part explain this."

Under "Chronometers, Time-signals," &c., we are told that during the period to which the Report refers the error of the Westminster Clock exceeded 1s. on 120 days; on 32 of these it was between 2s. and 3s., on 4 days between 3s. and 4s., and on 1 day it exceeded 4s.

"I have reason to believe," the Astronomer-Royal states, "that the use of the time-signals, originating at the Royal Observatory, and distributed automatically from the General Post Office, is becoming more and more extensive, and it seems probable that the same system may be adopted by foreign nations. Very lately an examination of our instruments was made on the part of another country, with the view of establishing something similar in one of their maritime cities; and it was intimated that Greenwich time would probably be used as standard. The establishment of time-balls, &c., at foreign ports is increasing."

With regard to the progress of the operations in connection with the transit of Venus, 1874, it is stated that permission was given by the Treasury to Major Tupman last September to devote his time to the work till the end of June, 1880. The result is (taking the stations or station-groups in the order which the Astronomer-Royal proposes for publication): the observations and calculations of the Sandwich or Hawaiian group are completed; those of the Egyptian group nearly finished; those of Rodriguez completed; those of Kerguelen nearly finished; and also those (which unfortunately are less important) of New Zealand. "In January of the present year I received through the Admiralty the notification of the Treasury that the printing of the observations and calculations might proceed. It has gone on rather languidly; but I have before me in type 128 pages, including the text and the greater portion of the tabular part of the Honolulu work. I propose to take steps for urging on this printing."

"With regard to the transit of 1882," the Report goes on to state, "I have lately placed a memorandum before the Royal Astronomical Society. From the facility with which the requirements for geographical position are satisfied, and from the rapid and accurate communication of time now given by electric telegraph, the observation of this transit will be comparatively easy and inexpensive. I have attached greater importance than I did formerly to the elevation of the sun. For the four principal phases (ingress accelerated, and retarded; egress accelerated, and retarded) I propose to rely mainly on: 1st, the Cape Colony; 2nd, the shores of Canada and the United States, Bermuda, and the West India Islands; 3rd, the same as the 2nd; 4th, the eastern shore of Australia, or New Zealand in preference if telegraph communication be made. I remark that it is highly desirable that steps be taken now for determining by telegraph the longitude of some point of Australia."

The Astronomer-Royal makes the following statement in reference to his own lunar theory:—"The general principle of this is: to adopt for correction the best existing theory; to compute with the severest accuracy the numerical values of the terms produced geometrically by the tabular coefficients, and also the terms really due to the forces which produce them; and to remove the differences between these by corrections of the tabular coefficients, for which corrections proper factors are prepared. It was a special object with me to avoid the use of powers of m (a symbol well known to lunar theorists), and to give easy means of computing, not new absolute values, but corrections of existing numerical coefficients (a principle which I have adopted extensively in other branches of astronomy), and also of computing the effect of small external disturbances or small changes of force. Both these are obtained by my process. The heaviest part of the work is the severe computation to which I have alluded, and this is done entirely by junior computers. The calculations had been carried out in every part to the accuracy of 10^{-7}; but for securing the degree of accuracy which I proposed it was found necessary to extend many parts to 10^{-8}, and some to 10^{-9}. This has caused a very great addition to the labour, but the work has advanced well, and will, I trust, be finished ere long. While waiting for this, which is to give the correction to every coefficient of the ordinary lunar theory, I am employing myself partly in rearranging the whole work for

publication, and in putting calculations in order for that correction of coefficients; and partly on three ramifications or supplements of the theory relating to the effect of the earth's oblateness, the effect of change of position of the ecliptic plane, and the effect of change of excentricity of the earth's orbit, and lunar acceleration. The last of these I have completed to my satisfaction, requiring only an examination of the external factor; the two others are progressing. The Admiralty have assisted me, on estimates, with a moderate grant (of amount named by myself), but much of the expense has been private."

The Report concludes as follows:—"After the details into which I have entered as applying to the present state of the Observatory, and after the remarks which I have made in the two reports last preceding on the question of reduction of printing (which at some fitting time I would willingly again present to the consideration of the Visitors), and the note in the last report on the increase of annual expense, I have only to place before the Visitors, but for no immediate expression of opinion, the impression which frequently weighs upon me as to the ulterior organisation of the Observatory. The determination of places of stars, sun, moon, and planets, was handed down to me from my predecessors; it has in various ways been much extended. The magnetic and meteorological observations (the first originating with myself, the second partly with the movement introduced by the Royal Society and partly by myself) constituted a distinct branch of science, having this property in common with the original astronomical work, that it is incessant and regular. The much later introduction of photographic and spectroscopic astronomy, established at the instance of the Board of Visitors, and carried on with vigour and regularity, has created a third department. All these departments appear at present to be working efficiently and well. But I can easily imagine circumstances which would interfere materially with the successful continuation in one place of this triplicate series of observations. Though I think this possibility of partial failure worthy the contemplation of the Visitors, yet I do not see any necessity for action of any kind at the present time."

INTERCOLONIAL METEOROLOGICAL CONFERENCE AT SYDNEY

A METEOROLOGICAL Conference was held at Sydney in November last, the representatives of the different Colonies being Messrs. James Hector for New Zealand, Charles Todd for South Australia, R. L. J. Ellery for Victoria, and H. C. Russell for New South Wales, the last-named gentleman being chairman. The most cordial unanimity characterised the meeting, which lasted from the 11th to the 14th of the month, and the resolutions arrived at with a view to secure united action in their meteorological investigations and uniformity in the methods and times of observing and forms of publication augur well for the future of meteorology in the Australian Colonies. The whole question of weather telegrams was under anxious consideration. The system in present operation embraces only the Colonies of South Australia, Victoria, New South Wales, and Queensland, but a resolution was passed declaring it desirable to secure the co-operation of the Governments of Western Australia, Tasmania, and New Zealand in the system of inter-colonial weather telegrams. The facts pointed out by Mr. Todd as to the great regularity observed by the atmospheric disturbances in pursuing a course from west to east, and the statement by Dr. Hector that early notices could be sent from Queensland of the origin and progress of the dangerous and suddenly occurring cyclones that cross the northern part of New Zealand, sufficiently attest the practicability of the system of weather warnings and their practical value. For instance, the great storm which wrecked the *Dandenong* in September, 1876, could have been telegraphed in sufficient time to have prevented the great loss of property which took place at the different ports along the coast of New South Wales. We have the greatest pleasure in noting a deliverance by the Conference to the effect that weather telegrams and forecasts shall in all cases depend upon the observations used for general meteorological and climatological statistics. Much emphasis was laid on the establishment of high-level stations with a more special view to the investigation of the winds; and the Conference recommended that there be established in each of the Colonies, upon a high mountain peak, a meteorological observatory for the special study of winds and other meteorological phenomena, the most desirable positions being Mount Lofty, in South Australia, 2,500 feet high; Kiandra, in New South Wales, 4,600 feet; Mount Wellington, in Tasmania, 4,000 feet; Mount Macedon, in Victoria, 3,500 feet; and in New Zealand, Tauhara Taupo, 4,600 feet, and Mount Herbert, 4,000 feet. We hope that the Governments of the different Colonies will vote the small sums which are required to carry out the resolutions of the Conference, the giving practical effect to which will certainly confer substantial advantages on commercial, shipping, and other interests, and contribute materially to a more satisfactory development of the meteorology of this important part of the globe.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE.—At St. John's College Prof. Liveing has been elected to a foundation fellowship, and Dr. Kennedy, Prof. Sylvester, F.R.S., and Prof. Churchill Babington were elected honorary fellows of the society.

The following awards for proficiency in natural science have been made at St. John's College:—A Foundation Scholarship to Samways; a Proper Sizarship to Love, and Exhibitions to Hart (already scholar), Weldon, Edmunds, Love, T. Roberts. Fleming was awarded one of the Hughes Prizes, given to the two most distinguished third-year students in any branch of study, and a Wright's Prize, with augmentation of the year's emoluments to 100*l*. The Open Exhibition was awarded at Easter to Scott-Taylor (City Middle-class School, Cowper Street), and a second Exhibition to Clementson (Newcastle-under-Lyme).

We understand that Mr. W. J. Lewis has been appointed to perform the duties of Professor of Mineralogy at Cambridge until the close of the year, the period to which the election to the chair has been postponed by the University Commissioners.

SCIENTIFIC SERIALS

Zeitschrift für wissenschaftliche Zoologie, May.—Prof. Zygmunt Kahane, on the anatomy of *Tænia perfoliata*, Göze, as a contribution to the knowledge of the Cestoids, with a plate and a woodcut. The actual facts recorded in the paper were originally laid before the Academy of Sciences of Krakau in May, 1878, and were afterwards published in a somewhat altered form, in the Polish tongue, in their *Proceedings*. The investigations were carried on during the summer and autumn of 1877 in the Zoological Institute at Leipzig, under the supervision of Prof. Leuckart. The history of the species is treated at length, and the paper extends over seventy-seven pages.—Dr. G. Haller, Contribution to a knowledge of the Tyroglyphidæ and their allies, with three plates: describes a new species of Listrophorus (*L. pagenstecheri*): On the genus Homopus, Koch. It is not an independent genus, but the forms are only the larval stages of Dermacarus, which is described as a new parasitic genus; *Tyroglyphus megninii* is described as a new species. There is a sketch of a delineation of the internal anatomy of Tyroglyphus and Dermacarus, and of the egg in these genera.—Prof. Ludwig Stieda, on the structure and development of the *Bursa fabricii*, with five woodcuts.—Dr. Hubert Ludwig, on the primary sand canal in the Crinoids, with some remarks on the comparative anatomy of the Echinoderms in general, with two plates.—Dr. H. Ludwig, new contributions to the anatomy of the Ophiuroids, with three plates.

Journal de Physique, May.—Measurement of the electromotive forces of batteries and electromotive forces of contact of metals, by M. Pellat.—Study of polariser-prisms used in photometric observations, by M. Crova.—On the illumination of electrodes, by M. Colley.—On a new capillary electrometer, by M. Debrun.—To determine with the aid of an articulated system the conjugate points of an optical system, by M. Elie.

Archives des Sciences Physiques et Naturelles, May 15.—On the earths of samarskite, by M. Marignac.—Researches on the condensation of gases on the surface of glass, by M. Chappuis.—The Siemens machine and its application to transmission of force, by M. Achard.—Specific heat, latent heat of fusion, and point of fusion of various refractory metals, by M. Violle.

THE *Reale Istituto Lombardo di Scienze e Lettere, Rendiconti*, vol. xiii., fasc. iv. and v.—The phylloxera considered in rural economy, by S. Cantoni.—Geological notes on the basin of Lake d'Orta, by Dr. Parona.—Health and beneficence; their mutual relations, by Dr. Zucchi.

Fasc. vi. and vii.—On the convenience of forming national nurseries of vines resistant to phylloxera, by S. Trevison.—On the chronological determination of Luganese porphyries, by Prof. Taranelli.—On the fundamental equation in the theory of linear differential equations, by Prof. Casorati.—Representation on punctuated space of some forms of the third species composed of straight lines, by S. Archieri.—On the institution of two new genera of arachnida, by Prof. Pavesi.—Electricity and earthquakes, by S. Serpieri.—List of algæ of the province of Pavia, by Dr. Cattaneo.—Second case of peritoneal tranfusion with good success in an oligocitæmic insane person, by Profs. Colgi and Raggi.—On a transformation of the fundamental equations of hydrodynamics, by Prof. Paci.

THE *Revue Internationale des Sciences biologiques*, May, contains:—E. A. Schaefer, on the development of animals.—Carl Hoberland, infanticide among the ancients and the moderns.—L. Pasteur, on the cholera morbus in fowls; on virulent maladies and on vaccination.—M. Debierre, man before and on the threshhold of history, a study of palæontological facts and of comparative archæology and philology.—Notice of learned societies.—The Academy of Sciences, Paris.—The Academy of Sciences, Amsterdam.—The Anthropological Society of Paris.

Morphologisches Jahrbuch, vol. vi., part 2.—Dr. A. Rauber continues his articles on the evolution of form and its transformations in the development of vertebrata, reaching its second section, on the multiplication of axes, pp. 56, with four plates and seven woodcuts illustrating various early stages of monstrous double-axial structures in various species of Salmo and Gallus.—Dr. J. Brock occupies 112 pages, illustrated by two plates, in endeavouring to establish a satisfactory phylogeny of the dibranchiate cephalopods.—Dr. H. von Thering contributes, on the vertebral column of *Pipa*, to the homology of its individual vertebræ and nerves with those of other anura.—Smaller contributions by Prof. Gegenbaur and by C. Rabl (on Planorbis development).—Reviews of German text-books of anatomy.

Gazetta Chimica Italiana, Fasc. iii. and iv.—On the ulmic matter obtained from sugar by action of acids, by S. Sestini.—On some derivatives of β-chlorobutyric acid, by S. Balbiano.—The diffusion and physiological state of copper in the animal organism, first announced by Bartolomeo Bizio, and elucidated by Prof. Giovanni Bizio.—Notice on the chemical constituents of *Stereocaulon vesuvianum*, by S. Paterno.

Bulletin of the United States Geological and Geographical Survey of the Territories, vol. v. No. 3, November 30, 1879.—J. A. Allen, on the species of the genus Bassaris.—W. H. Patton, the American Bembecidæ tribe Stizini; list of a collection of Aculeate Hymenoptera from North-Western Kansas; Generic arrangement of the bees allied to Melissodes and Anthophora.—George B. Sennett, further notes on the ornithology of the Lower Rio Grande of Texas, made during 1878, with annotations by Dr. E. Coues.—Henry Gannett, additional lists of elevations. Among these is a list of the mountain-peaks forming the Cordilleras of North America and of their passes.—Dr. Morris Gibbs, annotated list of the birds of Michigan.—Dr. Le Conte, the coleoptera of the Alpine Rocky Mountain Regions, Part 2.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, May 27.—"On the Structure and Development of the Skull in the Batrachia. Part III.," by W. K. Parker, F.R.S. (Abstract.)

Some of the work brought forward in this paper was in hand before the first part was in print. That initial piece of work dealt only with the formation of the skull in the common frog, but it was followed by another which appeared in the *Philosophical Transactions* in 1876, which treated of the skulls of the *common* and of the "aglossal" toads.

Of the latter types only two kinds are known, viz., the nailed toad of the Cape (*Dactylethra*), and the monstrous toad of Surinam (*Pipa*). All the bulk of the Batrachia are included in the sub-group "Opisthoglossa." These have a tongue, and in most cases it is free *behind* and not in front; the "Proteroglossal" Batrachia are very few in number, and the character itself (as Dr. Günther informs me) is not well pronounced.

I have now worked out the skull, in one or more stages, in about a *tithe* of the known species, and in my second paper in both of the aberrant ("aglossal") types; in them this was done in various stages.

I am not aware that there is any "order" of any "class" in the Vertebrata where so large a percentage of species has been, or indeed *need be*, worked out, either in the skull or in any other part of their organisation.

That which calls for it here is the great and unlooked-for polymorphism of the species; I may explain this by saying that the skull, in really important modifications, differs more in the species of some of the genera than it does in the orders of some of the classes. As an instance, it would be no easy thing to find a malacopterous fish differing from an acanthopterous type, in deep-seated essential matters, so much as the common toad does from the other native species, viz., the *Natterjack*; and the common frog has only about half as many cranial elements as the bull-frog of North America.

If the metamorphosis of a single species be worked out exhaustively, it gives a range of structural characters which rises up from a larval creature on the level of the lampreys to a reptilian form not far below the Chelonia, and evidently related (obliquely, not genetically) to that "order."

Moreover, whilst the "opisthoglossa" have larvæ with suctorial mouths, and a *quasi-petromyzine* structure altogether, the larvæ of the "aglossa" need only to be arrested as larvæ and to acquire a dense bony armature to be very close counterparts of the most *bizarre* forms of the ganoids of the "old red sandstone," such as *Pterichthys* and *Coccosteus*.

The Batrachia show some remarkable things in their metamorphosis, both as to the *size* their larvæ obtain and the *time* during which metamorphosis is taking place.

In the bull-frog (*Rana pipiens*) the larvæ attain the length of about 5 inches, and take two or three years for their transformation; they may be hindered in this, and be made to take twice that time. In these the larvæ bear a moderate relation, as to size, to the adult form, which may be 7 inches long, although tailless.

But in a frog from the neotropical region (*Pseudis*) scarcely larger than our native form, the tadpole attains the length of nearly a foot, the tail acquiring a breadth of 4 inches.

As zoologists well know, it is easy to procure *tadpoles* of this species, but very hard to get an adult. I am of opinion that the adult condition is not attained until after many years; and it suggests itself to me that this species may be the not remote descendant of a type which did not finish its *anural* metamorphosis.

On the other hand, some of the neotropical forms have very small tadpoles. *Bufo chilensis*, a large toad, has them about half the size of those of our common native Batrachia, and the newly-metamorphosed individuals are no larger than a house-fly.

But in *Pipa* the small larvæ are thoroughly metamorphosed in the maternal dorsal pouches, and at first only do they show a trace (and only a trace) of branchial tufts.

These tadpoles, which never see the light as such, have wide mouths (not suctorial), and so also have the tadpoles of the other waif of the sub-order "Aglossa," viz., *Dactylethra*. In that kind, however, the larvæ become large, and are a long while undergoing their transformations, which take place in the water, according to rule.

In the skull of the adults much variation is evidently due to the different *size* to which the species attains; some, as the bull-frog, are as large as the common Greek tortoise; others grow scarcely larger than a bluebottle fly. As a rule these small kinds show two kinds of modification: they are apt to retain certain larval characters, and they are apt to acquire generalised characters such as do not normally appear in this group, which is very remarkable for the *fewness* of the parts or elements composing the adult skull.

Some of the large forms, as *Rana pipiens*, have many investing bones in their skull, such as must be looked for again in archaic and extinct types, whilst others, as *Ceratophrys* and *Calyptocephalus*, have a cranial armature that is dense, extended, and almost "ganoid;" this kind of skull, however, is found in middle-sized types also, as in *Pelobates* and *Nototrema*.

In the terminal suctorial mouth of the larva of the Opisthoglossa the mandibular pier and its free "ramus" are carried to the front of the head. After transformation, in the larger kinds, the gape is carried behind the head, as in the crocodile; it can be guessed how much modification such a change as this will necessitate.

But it is evident that a low suctorial fish, such as the *tadpole*

is, must have altogether a totally different kind of skull and skeleton to that of an active, noisy, intelligent, more or less terrestrial reptile, such as the frog becomes.

This necessarily great change involves some very curious and instructive *anachronisms*, so to speak, in the appearance of various parts and organs.

A low suctorial fish would have no fenestra ovalis or stapes, and in the tadpole it is some time before these appear.

The low (urodelous) Amphibia have, in most cases, the upper hyoid element suppressed, sometimes it is present, serving as a rudimentary "*columella auris*."

In most Batrachia this part does not appear until after transformation, and in some kinds not at all. This part especially shows how the *individual* is gradually changed, and makes it clear why so many variations should occur in genera and even species.

With regard to the geographical distribution of the Batrachia, there are many things of importance which I have rather hinted at than expressed in this paper.

There is a sort of *facies* or character about the allied types of any great geographical region which makes me satisfied that certain external characters repeat themselves again and again in different parts of the world.

Thus the types of frogs that have dilated toes are evidently more nearly related to those with pointed toes of the same region than they are even to the broad-toed types of some distant region.

I should be inclined to derive the *narrow-backed* tree-frogs of Australia from the sharp toed frogs of the same region; the same with those of India, and the same with those of the nearctic and neotropical territories.

The *true* frogs ("Ranidæ") of India have many things in common, as also have the true frogs of North America; the same may be said of the sub-typical frogs, or "Cystignathidæ."

On the whole the European and Indian territories yield the highest kinds; Australia and South America the lowest and most generalised.

Mathematical Society, June 10.—Mr. C. W. Merrifield, F.R.S., president, in the chair.—The following communications were made:—On a binomial biordinal and the arbitrary constants of its complete solution, by Sir J. Cockle, F.R.S.—On the focal conics of a bicircular quartic, by Mr. H. Hart, M.A. —Preliminary note on a generalisation of Pfaff's problem, by Mr. H. W. Lloyd Tanner, M.A.—On the resultant of a cubic and a quadric binary form, by Prof. Cayley, F.R.S.—On the theory of the focal distances of points on plane curves, by Mr. W. J. Curran Sharp, M.A.—Geometrical note, by Mr. H. M. Taylor, M.A.

Linnean Society, June 3.—Prof. Allman, F.R.S., president, in the chair.—The secretary read a paper on the specific identity of *Scomber punctatus*, Couch, with the *S. scomber*, Linn., by Dr. Francis Day. The specimen on which this opinion is founded was captured on the coast of Cornwall in April last.—In a note on the anal respiration in the zœa larva of the decapods, by Marcus M. Hartog, he shows from an examination and study of living larvæ of *Cancer* that the terminal part of the rectum is slightly dilated, and possesses a rhythmic contraction and expansion duly associated with opening and closing of the anus. A clue to the ultimate transference of branchial respiration may perhaps be found in the Entomostraca, where in certain forms food is obtained by a current from behind forwards due to the movement of the setose or flat limbs immediately behind the mouth. Prof. Claus has shown that in *Daphnia* the said limb processes have a respiratory function, while this animal also possesses a well-marked anal respiration.—Mr. G. Murray made a communication on the application of the result of Pringsheim's recent researches on chlorophyll to the life of the lichen. Summarising Pringsheim's labours and taking into consideration the views of Vines, Geddes, and Lankester, Mr. Murray arrives at the following conclusion:—That we have in lichens fungal tissues as the body of the thallus and the chlorophyll screen in the gonidial layer; that is, the chlorophyll is in one system of cells and the protoplasm apparently affected by it in another, which is in contact. The light which traverses the chlorophyll-containing gonidial layer excites in the fungal tissues the decomposition of carbonic acid.—Mr. P. Herbert Carpenter, in giving the results of some researches of his in the form of a paper on the genus *Solanocrinus*, Goldfuss, and its relations to recent *Comatulæ*, stated that Schlüter was perfectly justified in uniting *Solanocrinus* with *Antedon*. The latter author does the same with *Comaster*, though to Mr. Carpenter, Goldfuss's description of this type appears to differ so much from all other Comatulæ that he prefers provisionally to regard it as distinct. Mr. Carpenter's researches on the crinoids in question are based on material obtained from the *Challenger* Expedition and a study of the fossil forms contained in the Woodwardian (Cambridge) and British Museums; he thus finds, on comparison of the living with past Jurassic, Cretaceous, and Tertiary forms, that variations in the development of the basals are useless as generic distinctions.

Chemical Society, June 3.—Prof. H. E. Roscoe, president, in the chair.—It was announced that a ballot for the election of Fellows would take place on June 17. The following papers were read:—On some products of the oxidation of paratoluidine, by W. H. Perkin. The present paper contains a study of the action of chromic acid on the above substance. Some beautifully crystallised products were obtained; one having the composition $C_{21}H_{21}N_3$, melting at 216 – 220°, and giving a magnificent blue colour with sulphuric acid; it has the characters of a base; a second base, rather less soluble, melting at 175° was also separated; it has the formula $C_{28}H_{27}N_3$. By using glacial acetic as a solvent for the chromic acid in the above reaction parazotoluene was formed.—On the detection of foreign colouring matters in wine, by Dr. A. Dupré. The true colouring matter does not dialyse; all the artificial colouring matters except alkanet dialyse freely, so that cubes of gelatine jelly soaked in the wine for forty-eight hours become scarcely tinged below the surface if the wine is pure, but if coloured with magenta, &c., the cube is stained to the middle. Alkanet is easily recognised by its absorption spectrum.—On the action of organozinc compounds upon nitrites and their analogues. I.—Action of zinc ethyl on azobenzene, by E. Frankland and D. A. Louis. In this reaction anilin is formed, much gas being evolved, consisting of 3 vols. of ethylene to 1 vol. of ethylic hydride. 70 grm. of anilin were obtained from 80 grm. of azobenzene.—II. On the action of zinc ethyl upon benzonitrile, by E. Frankland and J. C. Evans. Cyaphenine was the principal product of this reaction; this substance, by the action of strong hydrochloric acid in a sealed tube at 250°, is converted into benzoic acid and ammonia.—On the relation between the molecular structure of carbon compounds and their absorption spectra, by Prof. W. N. Hartley. The author has photographed the spectra of various substances; he concludes that no molecular arrangement of carbon atoms causes selective absorption, *i.e.*, gives absorption bands, unless three pairs of carbon atoms are doubly linked together in a closed chain. The most remarkable substance in this respect is anthracene, which, when diluted one in 50,000,000, gives a considerable and distinct absorption.—On a simple method of determining vapour densities in the barometric vacuum, by C. A. Bell and F. L. Teed. It consists of a modification of Hofmann's apparatus.—Mr. C. T. Kingzett made a verbal communication to the effect that he had recently investigated the question of the slow oxidation of moist phosphorus in air, and had obtained evidence that both ozone and hydroxyl were formed.

Zoological Society, June 1.—Prof. W. H. Flower, F.R.S., president, in the chair.—Mr. Sclater made some remarks on the principal objects he had noticed during a recent inspection of the Zoological Gardens of Berlin, Hamburgh, Amsterdam, the Hague, and Antwerp.—The Secretary exhibited a spider of the genus *Tegenaria*, which had been forwarded to him from Cape Town by Mr. J. H. Payne, of that place. It had been taken within three miles of Cape Town, on the back of a horse, which had subsequently died, as it was said from the effects of the bite. —Mr. G. E. Dobson exhibited some new and rare species of bats, amongst which was an example of a new species of the genus *Megaderma*, from Australia, proposed to be called *Megaderma gigas*, and remarkable for its large size.—Mr. Dobson made some further remarks as to the date of the receipt of the Dodo bones exhibited by him at a former meeting.—Lord Lilford exhibited and made remarks on some nests and eggs of the Flamingo, which had been taken in the marshes of the Guadalquivir, below Seville, in April, 1879.—Lord Lilford also exhibited some fine hybrid pheasants, between males of Reeves's pheasant and hens of the common pheasant.—Mr. E. W. H. Holdsworth read a note on the distribution of the crayfish (*Astacus*) in Spain.—Prof. F. Jeffrey Bell read a paper on some species and genera of the Temnopleuridæ, in course of which he described the method he had adopted in comparing different species, and species at different stages in growth; he also directed

especial attention to the differences in the size of the generation pores in *Amblypneustes formosus*, and discussed the specific characters of *Salmacis globator*.—A communication was read from Dr. A Günther, F.R.S., containing notes on a collection of mammals from Japan.—Mr. G. E. Dobson read a description of a new species of bat, of the genus *Natalus*, from Jamaica, which he proposed to name *N. micropus*.—Mr. A. W. E. O'Shaughnessy read the description of a new species of lizard of the genus *Uromastix*, from Zanzibar, which he proposed to call *U. princeps*.

Geological Society, May 26.—Robert Etheridge, F.R.S., president, in the chair.—Prof. Frederick Guthrie, F.R.S., Rudolf Hænsler, Ph.D., James Hulme, William Jolly, Charles Myhill, and Alfred George Savile, were elected Fellows of the Society.—The following communications were read:—The pre-carboniferous rocks of Charnwood Forest (Part III.; conclusion), by Rev. E. Hill, M.A., F.G.S., and Prof. T. G. Bonney, F.R.S.—In their former communications the authors had paid less attention (from want of time) to the northern part of the forest than to the rest. This district has during the last two years engaged their special attention. They had provisionally retained the name quartzite for the rocks exposed about Blackbrook, &c., probably the lowest visible on the forest. This name proves to be inappropriate, and they propose to call the group, which contains much fine detrital volcanic material, the Blackbrook Series. They have also reason to believe that the anticlinal fault is less than was supposed, and that we have here a fairly unbroken base for the forest rock already described. In this case there ought to be representatives of the great agglomeratic masses on the western side of the anticlinal (High Towers, &c.). The authors believe that they have found these, though as much finer and more water-worn detritus, in the greenish grits above Longcliff and Buckhill. The authors also believe that they have succeeded in tracing a coarse agglomerate with slate fragments round about three-fourths of the circumference of the forest. Further notes upon the district of Bardon Hill, Peldar Tor, and Sharpley are given, and the origin of the remarkable rock of the last, so like some of the Ardennes porphyroids, is discussed; the authors believe it to be a volcanic tuff, altered by the passage of water or of acid gases. Descriptions of the microscopic structure of some of the rock-fragments included in the coarse agglomerate and of some of the slates are given. Also a notice of two small outbursts of igneous rock of the northern syenite type, previously unnoticed, are mentioned.—On the geological age of Central and West Cornwall, by J. H. Collins, F.G.S. The author divided the stratified rocks of this district into four groups, as follows:—1. *The Fowey Beds*, mostly soft shales or fissile sandstones, with some beds of roofing-slate; no limestones or conglomerates. These beds cover an area of not less than eighty square miles, and contain numerous fragmentary fish-remains and other fossils, many as yet undetermined, the whole, however, indicating that the beds are either Lower Devonian or Upper Silurian. The strike of the beds is north-west to south-east, and they are estimated to be not less than 10,000 feet thick. 2. *The Ladock Beds*, consisting of slaty beds, sandy shales, sandstones, and conglomerates; no limestones and no fossils. They cover an area of more than 100 square miles to the west and south of St. Austell, strike from east to west, and overlie Lower Silurian rocks unconformably. They are estimated at from 1,000 to 2,000 feet thick. 3. *The Lower Silurians* consist largely of slates and shales, with some very thick conglomerates (one being at least 2,000 feet thick), some quartzites, and a few thin beds of black limestone. The quartzites and limestones have yielded fossils (chiefly Orthidæ) which are pronounced to be of Bala or Caradoc age by Davidson and others. The total thickness of these beds is estimated at 23,000 feet, and the fossils are found in the upper beds only. Instead of occupying only about twelve square miles, as shown on the Survey maps, they extend over nearly 200 square miles, and reach southward beyond the Helford River, and westward to Marazion. The strike of these rocks is from north-east to south-west. 4. *The Ponsanooth Beds* occur beneath the Lower Silurians, and unconformable with them (strike north-west to south-east); they are often crystalline, and are estimated at 10,000 feet thick. Each of these formations has its own set of intrusive rocks; each has been contorted and in part denuded away before the deposition of its successor. The various granitic bosses have been pushed through this already complex mass of stratified rocks without materially altering their strike, which does not in general coincide with the line of junction. The chemical effects of the igneous intrusions are generally considerable, and somewhat proportioned to their relative bulk.—On a second pre-Cambrian group in the Malvern Hills, by C. Callaway, D.Sc. F.G.S.

Anthropological Institute, May 25.—Edward B. Tylor, F.R.S., president, in the chair.—Dr. H. Woodward read extracts from a paper by Prof. J. Milne, F.G.S., of the Imperial College of Engineering, Yedo, on the Stone Age in Japan. The author described, from personal examination, many of the archæological remains in Japan. Kitchen-middens are abundant, and are ascribed to the Ainos, the ornamentation on the pottery resembling that still used by the Ainos of to-day. The shells and bones found in the middens were enumerated and described. The stone implements found in Japan include axes, arrow-heads, and scrapers. Many of these occur in the middens. The axes are formed generally of a greenish stone, which appears to be a decomposed trachytic porphyry or andesite. The Ainos used stone implements up to a comparatively modern date. Tumuli occur in many parts of Japan, as well as caves, both natural and artificial. Prof. Milne had opened one of the latter, and found the interior covered with inscriptions. The Japanese themselves make valuable collections of stone implements, old pottery, &c., the favourite notion among them being that such things were freaks of nature. Several fragments of pottery, shells, and other remains from kitchen-middens were exhibited.—Mr. C. Pfoundes read an interesting paper on the Japanese people, their origin, and the race as it now exists. Passing over the fabulous period, we find the Japanese commence their era and history about the same time as that of Rome, B.C. 660; the first Emperor, Mikado, or Ruler, established himself in the vicinity of Kiote, not very far from the present treaty ports Osaka-Kiogo. For centuries history teems with accounts of efforts to civilise the people, and the wild and intractable aborigines were gradually driven northward, until they settled in the North Island, where they still exist and form the bulk of the present inhabitants. Mr. Pfoundes exhibited a valuable collection of photographs and drawings in illustration of his paper, together with articles of Japanese manufacture and some fine specimens of tapestry.

Entomological Society, June 2.—Sir John Lubbock, Bart., F.R.S., president, in the chair.—Miss Georgiana Ormerod, of Isleworth, and Mr. Hy. Lupton, of Chapel Allerton, Leeds, were elected Ordinary Members.—Mr. M. J. Walhouse exhibited a collection of moths from Mangalore, on the Malabar coast, many of the species of which resembled palæarctic forms.—Mr. J. A. Finzi exhibited, on behalf of Mr. Lowrey, a bred specimen of *Arctia fuliginosa* which possessed only one antenna. The President stated that he had occasionally bred ants with only one antenna, and on one occasion had possessed a specimen with no antennæ at all.—The President also exhibited specimens of a new Australian ant received from Mr. Waller, which agreed with the genus *Myrmecocystus*, of Wesmael, in having an immensely distended abdomen, so that the insect actually serves as an animated honeypot.—The Rev. H. S. Gorham communicated the concluding portion of his Materials for a Revision of the *Lampyriæ*.

Victoria (Philosophical) Institute, June 8.—Annual Meeting.—The Right Hon. the Earl of Shaftesbury, K.G., in the chair.—Prior to the delivery of the address by Bishop Cotterill, D.D., F.R.S.E., the honorary secretary, Capt. F. Petrie, read the report, from which it appeared that the total number of Members was now 835.—The subject of the annual address was one aspect of the relation between the scientific and the religious view of the universe.

VIENNA

Imperial Academy of Sciences, February 19.—The following among other papers were read:—On the relation of the muscle-current to local chemical changes of the muscle substance, by Dr. Biedermann.—On orthoethylphenol, by Drs. Suida and Plohn.—Theory of conic surfaces of the fourth degree with a double conic section, by Herr Ameseden.—Changes of form of electrical figures by magnets, by Prof. Reitlinger and Dr. Wächter.—On ventilation in schoolrooms, by Herr Nachtmann.—On the decomposition of nitrososulphhydantoin with bases, and on a new acid, nitrosothioglycolic acid, by Prof. Maly and Herr Andreasch.

March 4.—On the orbit of the planet Ino (173), by Dr. Becker.—Determination of the absolute velocity of current electricity from Hall's phenomenon, by Prof. v. Ettingshausen.

—On a law of the stimulation of terminal nerve-substances, by Prof. Mayer.—Contributions to the photochemistry of bromide of silver, by Dr. Eder.—Notices on the formation of free sulphuric acid, and some other chemical relations of gasteropoda, especially of *Dolium galea*, by Prof. Maly.—On the theory of normal surfaces, by Prof. Peschka.—On cinchomeronic acid, by Dr. Skraup.—On aldehyde resin, by Herr Ciamician.—On an extension of the limits of validity of some general propositions of mechanics, by Prof. Simony.—On oxycuminic acid and on the action of nitrous oxide on organic compounds, by Prof. Lippmann and Herr Lange.

March 11.—The orthogonal-axonometric contraction circle, by Prof. Pesar.—Electrolysis of organic substances in aqueous solution, by Prof. Habermann.—Action of oxalic and sulphuric acid on naphthol, by Herr Hönig.—On dipropyloresorcin and some of its derivatives, by Herr Kariof.—On idryl, by Dr. Goldschmiedt.—On direct introduction of carbonyl groups into phenols and aromatic acids, by Herr Senhofer and Herr Brunnen.—Remarks on Cauchy's theory of double refraction, by Prof. v. Lang.—Determination of path of comets discovered at Pola in 1879, by Herr Palisa.

March 18.—Heliotropic phenomena in the plant kingdom (second part), by Prof. Wiesner.—On the projective construction of curves of the second order, by Prof. Binder.—On Sturm's series, by Prof. Gegenbauer.—A hydraulic motor, by Herr Kauer.—The alteration of molecular weight and molecular refractive power, by Prof. Janovsky.—On the tannic acid of oak-bark, by Herr Etti.—On some tertiary echinida from Persia, by Herr Fuchs.—Sulphur compounds of chromium, by Prof. Lieben.—Behaviour of bone gelatine in dry distillation, by Dr. Weidel and Herr Ciamician.—On the determination of the halogens in chlorates, bromates, and iodates, by Herr Fleissner.

April 8.—The following among other papers were read:—Theory of motion on developable surfaces, by Herr Wittenbauer.—The inflorescences of Marchantiaceæ, by Prof. Leitgeb.—On the magnetic action on fluorescence light excited by the negative discharge in a vacuous space, by Prof. Domalip.—On discrete vortex lines, by Dr. Marguess.—Contributions to the photochemistry of bromide of silver, by Dr. Eder.

PARIS

Academy of Sciences, June 7.—M. Edm. Becquerel in the chair.—The following papers were read:—On a bromised derivative of nicotine, by MM. Cahours and Etard. The formula is $C_{20}H_{14}N_2Br_4$.—Geological history of the English Channel (first part), by M. Hébert.—M. Daubrée gave a *résumé* of a study entitled "Descartes, one of the creators of cosmology and geology." Descartes considered all celestial phenomena as simple deductions from laws of mechanics, affirmed the unity of composition of the physical universe, perceived the capital *rôle* of heat in formation of our globe, &c.—M. du Moncel presented a third edition of his work on the telephone, microphone, and phonograph.—M. Chancel was elected correspondent in chemistry in place of the late M. Favre.—Theorems on the decomposition of polynomes, by M. Carrère.—Result of treatments of vines attacked with phylloxera, by M. Boiteau. The vines treated for three years past (with sulphide of carbon) are thriving beautifully. Infected vines over fifteen to twenty years old, which cannot renew their radicular system, should be replaced by young plants. The best method of application is that in parallel lines, with doses of 20 gr. per square metre applied in two or three holes. The sulphide even seems to stimulate the vine.—New generation of the surface of the wave and various constructions, by M. Mannheim.—On ternary cubic forms, by M. Poincaré.—On irreducible functions according to a prime modulus, by M. Pellet.—Remark relative to two integrals obtained by Lamé in the analytical theory of heat, by M. Escary.—On the partition of numbers, by M. David.—Direct measurement of the interior resistance of magneto-electric machines in motion, by M. Carnellas. The induction of the electro-magnets and the metallic cheeks is obviated by rotating the (Gramme) ring mounted carefully with its brushes on wooden supports, and the effects of terrestrial induction are avoided by opposing to each other these effects in two similar Gramme rings, mobile under the same conditions, with axes parallel. The ring (at rest or rotating) is made the fourth side of a Wheatstone bridge formed by Siemens' universal galvanometer. The resistance of the ring in motion (450 turns per minute) shows an increase of 25 per cent. on that of the ring at rest.—Transformation of gunpowder in the metallic cases of infantry cartridges, by M. Pothier. A diminished velocity of balls of cartridges that have been long charged, and diminished accuracy of fire, are accounted for by a proved chemical decomposition of the powder in contact with the metallic case, the quantity altered varying according to atmospheric influences, especially moisture, at the time of manufacture or during storage. Experiment proved zinc to have most action, then followed copper. Lead, tin, and iron affect the powder less. High temperature accelerates the transformation if the powder is moist.—Optical arrangement for firing within covered batteries, by M. de Fraysseix. By means of a lens and screen the artilleryman is enabled to take better aim. M. Ed. Becquerel called attention to previous devices of the same kind.—On colloidal oxide of iron, by M. Magnier de la Source. The composition of the soluble ferric hydrate is that of the normal hydrate.—On a new sulphate of alumina (sesquibasic sulphate of alumina), by M. Marguerite. One method of preparation is decomposition of alum of ammonia by heat. Three others are indicated.—Action of chlorine on sesquioxide of chromium, by M. Moissan.—On a combination of allylic alcohol with anhydrous baryta, by MM. Vincent and Delachanal.—On the fixity of composition of plants; ratio between the fecula, phosphoric acid, and mineral substances in potato, by M. Pellet. While these show constant ratios there are great differences in the proportions of the chief alkalis, lime and potash; but there is equivalent substitution of these alkalis, so that the quantity of sulphuric acid necessary to saturate all the bases is sensibly the same. Silica and nitrogen vary pretty largely.—Analysis of the seeds of beet, by MM. Pellet and Liebschutz.—Disinfection and conservation, from an agricultural point of view, of animal matters, and notably blood, by use of bisulphate of alumina and nitric acid, by M. Vautelet. They act by coagulation, &c.—On the physiological effects of erythrophleine, by MM. Lee and Bochfontaine. It acts both on the heart and the respiratory apparatus, and may prove a useful clinical agent.—On some anatomical characters of Chiroptera of the genus *Cynonycteris*, by M. Robin.—On the metamorphosis of *Perosopestoma*, by M. Vayssière.—On a peculiar modification of a parasitic Acarian, by M. Megnin. The eggs of a *Chevletus*, on an American Grosbeak, were found protected by fine tissue, like that furnished by certain Arachnides.—Helminthological observations and experimental researches on the disease of workmen in the St. Gothard, by M. Perroncito. The numerous workers who have become anæmic have been preyed upon by certain small worms, and this quite explains the anæmia. A similar malady was observed in making the Mont Cenis tunnel.—M. d'Abbadie presented a work by Mr. Knipping on the cyclones of 1878 in the China Seas.

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