THURSDAY, APRIL 10, 1873

INSTINCT

THE very valuable contribution to Psychology made by Mr. Spalding in his paper on Instinct (*Macmillan's Magazine* for February), and the letters and article which have lately appeared in this Journal, will no doubt stimulate research, and lead to some rational explanation of what has hitherto been enveloped in a mist of metaphysics. Mr. Spalding has not only proved himself an acute thinker, he has shown a rare ability in devising experiments, and we may fairly expect that his researches will mark an epoch. I am the more grateful to him because his instructive results, though seeming to contradict, do really furnish experimental confirmation of the views put forth in my work, now in the press, wherein it is argued that Instinct is *lapsed* Intelligence: that what is now the fixed and fatal action of the organism, was formerly a tentative and discriminating (consequently intelligent) action: in a word that what is now a connate tendency was formerly acquired experience.

There is great need of precise definition of terms. What is Instinct? What is Experience? What is Intelligence? Twenty different writers indicate twenty different things by these terms. They do not distinguish between Instinct and Impulse; between Experience acquired by the individual, and Experience transmitted from ancestors; between Intelligence, the discernment of Likeness and Unlikeness in feelings, and Intellect, the discernment of Likeness and Unlikeness in symbols. Above all they seldom make clear whether they are treating any fact from the psycho*logical* or from the psycho*genetical* point of view, *i.e.* whether they are describing the Anatomy or the Morphology of the Mind. It is, for instance, one thing to affirm that our perception of Space is a perception necessarily conditioned by our organism, and in that sense *à priori*; another thing to affirm that this conditioned structure is itself the evolved result of ancestral experiences of Sight, Touch, and Motion, and in that sense the perception of space is *à posteriori.* The point of difference between the empirical and nativistic schools may be got rid of by such a precision in the question. The vital point will then be between the advocates of evolution and the advocates of creation. Those who hold that the Organism is evolved, must hold that its perceptions (and instincts) are evolved through Experience. Those who hold that the Organism is created, and was from the first what we see it now, must hold that its perceptions (and instincts) are pre-ordained, and have no experiential origin whatever.

Having thus cleared the ground of a mass of obstruction, we may now approach the subject of Instinct. In what sense can it be said to be dependent on Experience? Obviously this cannot be answered till we are agreed on the meaning to be assigned to the term Experience. I have defined it the *registration* of Feeling. And what is Feeling? It is reaction of the sentient Organism under stimulus. This reaction has obviously two factors: the structure of the organism, and the nature of the stimulus. It is not every response of the organ that can be a feeling, it is not every feeling that can be an experience. The secretion of a gland is a response, physiologically similar to the response of a sensory organ; but the former is not a feeling, although it enters as an element into the mass of Systemic sensation; and the response of a sensory organ, although a feeling, will not be an experience unless it be *revivable;* and this revival requires that it should be *registered* in the modification impressed on the sentient structure. It is true that rigorously speaking no body, not even an inorganic body, can be acted on without being modified; every sunbeam that beats against the wall *alters* the structure of that wall; but these minute alterations are not only inappreciable for the most part, by any means in our power, they are also mostly annulled by subsequent alterations. In one sense, therefore, no impression ever excites Feeling without modifying the sentient structure; but some impressions, especially when iterated, produce definite and permanent modifications; and these are registrations capable of revival, *i.e.* of the feelings registered, so that when the organism is stimulated its reaction will be determined by those past reactions, and the product will be a feeling more or less resembling the feelings which were formerly produced. Thus we have Feeling as the reaction of the Organism; and the Organism itself as a structure which has been modified by its reactions on external stimuli. What the structure of the Organism is at any stage determines what will be the kind of sentient reactions it will have. Experience is the registration of Feeling, registered in those modifications, which, because they are modifications of structure, must have corresponding activities of Feeling, and from these spring Actions. To trace the history of these modifications or their feelings is Morphology or Psychogeny; to describe their results is Anatomy or Psychology.

We cannot be in doubt then whether Instinct is or is not dependent on Experience; we can only ask: Is a particular action characteristic of a particular animal species, one that the animal has itself *learned* to perform through the adaptation of its organs, under the guidance of sensible impressions reviving the past impressions of *its* experience; or an action inevitably determined by the reactions of the structure inherited from ancestors, so that sensible impressions revive ancestral experiences registered in the modifications impressed on the structure? The answer in each case can only be approximative; and for this reason: until the organism has the requisite degree of development for the performance of the actions, there can be no manifestation of the instincts, and there are few of the instincts manifested at birth.

How, then, shall we define Instinct? How separate the actions which are congenitally determined, from those which are incidentally determined? Both require the indispensable conditions of an appropriate structure and appropriate stimuli. It is obvious that we cannot fix upon the structure alone; and yet the congenital tendencies of that structure must be taken into account; for we see instincts not manifested until long after many other actions have been acquired—as in the case of the sexual instinct. But if congenital tendencies sufficed, we should call the flowering of plants at their normal season when transplanted to a *different* climate, an instinct. Many would say that an action common to an entire group of animals must be an instinct, since it could not be acquired through individual experience. But how if the conditions of acquisition are also common to the whole group? Thus an infant certainly learns to scratch itself; since, however it may itch, some considerable experience is necessary before it learns to localise the sensation. As, however, the conditions of this acquisition are common to all children, all learn to scratch themselves. Now in many animals this is an inherited acquisition; they scratch themselves from the first. Whether the infant also inherits a structure which would develop into one as apt as that of the animal, cannot be ascertained; all we know is that the infant's nervous structure is too immature at first to permit the localisation of sensation. How much of the subsequent aptitude is the result of congenital tendency, and how much of acquisition through incidental experiences acting on a predisposed organism, cannot be estimated.*

That we require some character to distinguish the instinctive from the impulsive actions, may be readily shown. No one calls Breathing, Secretion, Excretion, &c., instincts. Yet these are the actions of congenital tendencies in the organism. "A hungry chick," says Mr. Spalding, "that never tasted food, is able on seeing a fly or spider for the first time, to bring into action muscles that never were so exercised before, and to perform a series of delicately adjusted movements that end in the capture of the insect." Every one would pronounce this a typical case of Instinct. Now compare with it the following, which no one would class among the instincts: A new-born animal that has never breathed before is able on first feeling the stimulus of the atmosphere to bring into action a very complicated group of muscles which never were so exercised before, and to perform a series of delicately adjusted movements which end in the aëration and circulation of the blood.

This contrast may lead us to the character sought. Understanding that every line of demarcation in psychical phenomena must be more or less arbitrary, and only justified by its convenience, we may draw such a line between Impulse and Instinct. Impulses are the actions which from the first were fatal, inevitable, being simply the direct reflex of the stimulated organs. Given the respiratory organs and the atmosphere, Respiration is the inevitable result. Given the secretory organ and the plasma, Secretion is the inevitable result. There is no choice, the action either takes place or it does not.

Instincts *are* also fatal, inevitable, but they *were* not always so; the element of choice intervenes; and although the intelligent discrimination may be *almost* entirely lapsed, it never is wholly lapsed. The guiding sensation is still discriminative, selective. Hence instincts vary with varying conditions. Thus the *nutritive impulse* which when unsatisfied causes the uneasiness of desire, and which moves the animal in search of food, is markedly distinguishable from the *instinct* which selects the appropriate food and rejects all the rest. If an animal eats only certain kinds of food, out of many which would be nutritious, it is because these kinds have been selected by it, or by its ancestors. Every chicken, Mr. Spalding assures us, has to learn not to eat its own excrement. "They made this mistake invariably, but they did not repeat it oftener than once or twice." He also has this remark:—"Chickens, as soon as they are able to walk, will follow any moving object; and when guided by sight alone they seem to have no more disposition to follow a hen than to follow a duck or a human being. Unreflecting onlookers when they saw chickens a day old running after me, and older ones following me miles and answering my whistle, imagined that I must have some occult power over the creatures, whereas I simply allowed them to follow me from the first. There is the instinct to follow; and, as we have seen, their ear, prior to experience, attaches them to the right object."

I should rather say, "there is the *impulse to follow*: and the instinct to follow the mother, or a duck, or the master who feeds them, is the selected action which becomes rapidly an organised habit." It is one of the conclusions of my work that all our involuntary and automatic actions, were originally voluntary, and that all instinctive actions were originally intelligent. In the case now under consideration, the impulse to follow is a fixed tendency; the instinct to follow is facultative at first, and becomes fixed by habit, but is always, even when most firmly fixed, guided by discriminating feeling.

To conclude: where there is no alternative open to an action it is impulsive; where there is, or originally was, an alternative, the action is instinctive; where there are alternatives which may still determine the action, and the choice is free, we call the action intelligent.

GEORGE HENRY LEWES

* The examples of dogs and horses finding their way home, however marvellous, cannot be affiliated on Instinct, since it is very far from common to the species: for one dog who finds his way home, hundreds are helpless when lost.

HANDBOOK FOR THE PHYSIOLOGICAL LABORATORY

Handbook for the Physiological Laboratory. By E. Klein, M.D.; J. B. Sanderson, F.R.S.; M. Foster, F.R.S.; and T. L. Brunton, M.D., D.Sc. (Churchill.)

STUDENTS of chemistry have, for a long time, by means of the works of Fresenius and others, had the opportunity, almost unaided, of verifying for themselves most of the experimental results of which they hear in lectures, and read in text-books; and thus many are able, before they have finished their educational course, to obtain a thorough practical knowledge of the science. Such has not been the case with regard to physiology; the subject is less advanced, and has progressed more slowly; perhaps this is because the descriptions of the methods by which the ends have been arrived at, as given by lecturers and writers, are incomplete and insufficient. The work before us is the first important attempt that has been made to put the commencing physiologist in a fair position to begin original work on the subject, by giving him the necessary directions for himself performing many of the fundamental experiments on which the science is based. Whether physiology in its most comprehensive sense, as understood by the authors of this work in their title, is a single branch of science which can be thus treated in its unity, or whether it ought to be divided up and incorporated with others already established, is a point which has not yet been satisfactorily settled, and which the perusal of this book may assist in proving.

The work is in two volumes, the first, much the larger, being devoted to the text, while the second contains the drawings of the microscopical preparations described, as well as the instruments, diagrams, and dissections referred to.

The histological section, written by Dr. Klein, is, as a whole, far superior to any existing work on the subject, which is saying a great deal, considering the large number of treatises on the use of the microscope, in the study of the tissues of the animal body, which have already appeared. The careful way in which all the many details receive their due consideration, is an example to authors of text-books, and it is rendered evident on every page that the author is himself thoroughly familiar personally with the points he records. Many methods till now comparatively little known and employed in this country are fully discussed, among the most important of which is that of injecting organs by the "method of puncture," introduced by Ludwig, which though it in many cases gives very decided results, has to be used with caution, as their interpretation is often far from easy and sometimes misleading. The minutest details, the omission of which so often mars the results are given in many cases as well as if the teacher himself were by the side of his pupil. The means to be employed for obtaining a view of the stomata of the lymphatic system, as they are seen on the centrum tendineum of the diaphragm, is a case in point to which several pages are devoted, in which also the structure of these little understood organs is excellently entered into. The chapter on embryology is also very complete; the paragraphs on striated muscular fibre are as logical as they are clear, the following being the summary:—"From all these (the previous) facts we learn that the substance of a muscular fibre consists, in the first place, of oblong prisms, *i.e.*, sarcous elements, with their axes parallel to its axes, and formed of a material which refracts light strongly, is stained strongly with silver, slightly with solution of chloride of gold, and swells out in the fresh state on the addition of water; and secondly, of a less refractive transparent interstitial substance occupying the remainder of the space, which is not coloured by silver, but is intensely stained by chloride of gold, and disappears in dilute acetic acid." The illustrations accompanying the descriptions are new, and on a sufficiently large scale to render quite apparent the minutest structural points; much may be learnt from a simple inspection of them. We do not quite like the introduction of so many German synonyms for many of the terms employed, they convey but little meaning to most English students, and though otherwise harmless, they might be taken to indicate that our language is poor in mechanism, or that we are overpoweringly indebted to our worthy relations, neither of which views is strictly correct. A little consideration might have been shown to our microscope makers by the employment of the well-known English nomenclature of objectives (for a man may be a first-class histologist and yet not know the meaning of Hartnack's No. 10), and the systematic ignoring of their excellent workmanship cannot but produce ill-feeling; for though they may be expensive, they have undoubtedly been the originators of most of the greatest improvements in their branch.

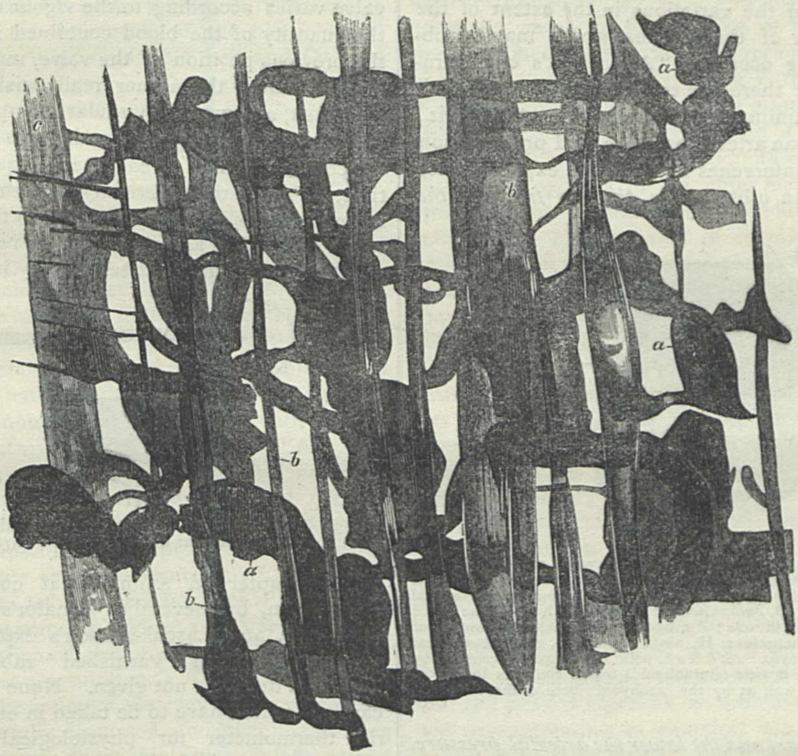


FIG. 1.—Centrum tendineum of rabbit, seen from the abdominal side. Berlin blue had been introduced into the peritoneum by "natural injection." *b*, Straight interfascicular lymphatics between the bundles of tendon of the abdominal side; *a*, lymph vessels of the pleural side, showing the valves, with corresponding dilatations. The last lymph vessels are as completely injected as the first. (Oc., 3 : Obj., 4. Tube not drawn out.)

Dr. Sanderson has undertaken the physiology of the blood, together with that of the circulation, respiration, and animal heat. The chapter on the first of these subjects is excellent and thorough, nothing better could be wanted, the author being able to keep within the region of fact. The German elaborate verifications of the supposed functions of many of the most important nerves, are given in a very lucid and concise manner, and several of the excellent instruments introduced by them are clearly described, together with the principles of their action, and the methods of employing them. But in the other more theoretical subjects, there are many statements to which we must take exception. Most of the theories bearing on some of the main problems in the circulation of the blood, are at the present day in too unsettled a state to find a place in a manual for students, because it is impossible in the permissible space to give the many conflicting results of different authors, which yet remain unproved or unrefuted. The result is, as might be expected, that a one-sided and individual view of the subject is presented, and the student is taught some things which he will have to unlearn. Most of Dr. Sanderson's theories have already appeared, but nevertheless some are based on principles undoubtedly unsound.

Whilst discussing the expansive movements which occur in an artery during the different parts of the pulse beat, and the cause of the variations in the extent of the changes in diameter of the arteries which may be observed, the following occurs :—"A moment's consideration teaches us that there are two circumstances which must diminish the minimum pressure in the arteries, viz., diminution of the mean arterial pressure, and prolongation of the period which intervenes between one expansive act and its successor. In other words, *the less frequent the*

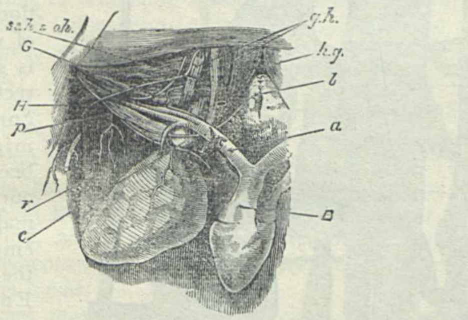


FIG. 2.—Dissection of the parts in relation with the vagus nerve of the frog on the right side. The oesophagus is distended with a glass tube about half-an-inch in width. The object is represented of about twice its actual size. *a*, right aorta ; B, *bulbus aortæ* : *c*, posterior horn of the hyoid bone : *g h*, genio-hyoid muscle ; *hg*, hyo-glossus muscle ; *p*, lowest of the three petrohoid muscles ; H, ninth nerve ; G, glossopharyngeal nerve ; *r*, vagus ; *b*, larynx ; *s* & *h* & *o h*, point to the space occupied by the origins of the large muscle (sternohyoid) which connects the hyoid with the sternum, as well as by the omohyoid ; both of these muscles have been cut away.

contractions of the heart and the lower the arterial pressure, the greater the expansion in proportion to the expanding force which produces it" (the italics are not ours). Dr. Sanderson would undoubtedly thus lead us to believe that this is a self-evident proposition, but that it is so is far from the case. That it should be true it has to be assumed that the escape of blood from the peripheral vessels *between two succeeding pulse beats*, depends on the interval which elapses between them, and no attempt is made to prove this fact, which is not at all necessarily correct, and against which many arguments can be adduced. The same author also adopts a modification of the now antiquated and decidedly insufficient oscillatory hypothesis, to account for the dicrotic beat of the pulse, so clearly seen in the sphygmograph trace : and in so doing he necessarily ignores the great value of the important and very definite results obtained by Chauveau and Lortet, by means of their hæmadromograph ; if he had fully realised the easily demonstrable fact that the second rise in the sphygmograph trace *commences* the later in an artery according as it is farther from the heart, the table on p. 228 referring to the relations of the different elements of the pulse beat in different vessels could not have appeared in its present form. As long as physiologists compare arteries to elastic tubes in air, they must be led into error, for the forces which predominate in them so situated, are very different from those which prevail when they are surrounded by water or any yielding substance, which an artery much more directly resembles, as it is surrounded by, and on most sides in contact with, tissues of a somewhat yielding nature. There is another short sentence we must quote ; in explaining the action of the auriculo-ventricular valve we read : "The time which intervenes between the commencement of the compression and the tightening of the valve varies according to the vigour of the contractions, the quantity of the blood contained in the ventricle, and the previous position of the valve, must always be appreciable." Does the author really wish us to believe that the heart, a powerful muscular pump, which he affirms (though on very slight grounds) acts most powerfully at the commencement of each beat, requires an appreciable time, by which we understand, one that can be measured by instruments at our command, to tighten the auriculo-ventricular valve, against which the resistance is undoubtedly extremely small ? it seems very improbable.

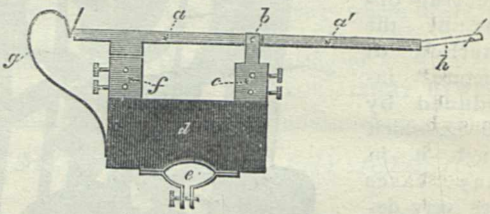


FIG. 3.—The marking lever for indicating graphically on a revolving drum the moment at which an electric current is broken.

The chapter on animal heat contains much useful information, but several of Senator's results are not entered into, and Laschkewitsch's explanation of the fall of temperature in "varnished" rabbits, which are discussed in detail, is not given. None of the special precautions which have to be taken in employing the mercurial thermometer for physiological investigation, are referred to ; and the student will be entirely misled respecting the principle upon which the ordinary clinical thermometer of Phillips is constructed, the author having muddled up with his description Hawksley's method for preventing the index running into the bulb whilst the operator is depressing it, which is entirely independent of, and has nothing to do with, the self-registering power of the instrument. A similar want of knowledge of physics is shown on the same page on which this error occurs, for it is stated that in the thermometric couple the degree of deflection of the galvanometer needle, which is produced when a current results from the unequal heating of its ends, varies with the difference of the temperature of the junctions, which is well known to be incorrect.

Dr. Foster, in undertaking the "Functions of Muscle and Nerve," has undoubtedly had a difficult work to perform, and he has introduced a very clear and simple method of teaching the various, and in many cases, disconnected facts which relate to them. The student will, in this section of the work, find full directions for performing most of the experiments, which will, when all repeated, enable him to advance on a thorough and sound foundation. Great care is taken to render evident the phenomena of electrotonus, and the subject of tetanus is dwelt on in detail, the following being the propositions which are discussed and proved regarding it:—1. "Tetanus from an ordinary interrupted current is a continuous contraction rapidly reaching a maximum, continuing (within limits) in that condition so long as the current is passing, and followed by a gradual relaxation upon the current being cut off." 2. "Tetanus really consists of a series of simple muscular contractions fused together." The apparatus necessary for verifying these and other points in which electricity plays a part, is described as far as is necessary for the wants of the physiological student, and some, as Wippe's double key and Du Bois Reymond's rheocord, are figured. Several of the points insisted on appear to be insignificant in themselves, but they must all, in the long run, have important bearings on future theory.

In undertaking the "Physiological Chemistry," Dr. Brunton has had a somewhat easier task than the two authors last referred to, and his work is excellent. The results of Hoppe-Seyler, and other German chemists, which are as convincing as they are connected, are fully entered into, and the chemistry of digestion and excretion, together with the method of arriving at them, are explained at considerable length. As an instance of the manner in which the subject is handled, the following are the propositions which are demonstrated in connection with the fact that pepsin is not destroyed during digestion. 1. "Although the digestive power of pepsin appears to be indefinite, yet a limited quantity of gastric juice will not dissolve an unlimited quantity of fibrin." 2. "The arrest of digestion in this experiment (the proof of the previous proposition) is not due to the destruction of pepsin, but to the accumulation of the products of digestion in the liquid and to the want of acid." 3. "A stronger acid is required for digestion if the products of digestion are present in quantity in the solution." The theory of digestion, together with the action of the vagus and splanchnics on the stomach are fully discussed, and the unassuming way in which the author states his own opinions carries great weight with it.

We should have liked to have seen a separate chapter on the methods to be used for rendering animals insensible, together with a notice of the relative value of different anæsthetics and the way to exhibit them; as it is, the subject is only incidentally mentioned in connection with special operations. If the drawings of the instruments had been incorporated in the text they would have been more easily referred to, and therefore more frequently looked at; as it is, the one volume without the other is difficult to understand. The anatomical sketches, mostly after Bernard, which illustrate the distribution and relations of the nerves and vessels that so frequently have to be manipulated by operating students, adds much to the completeness of the work, in which every effort has evidently been made to put the student in as good a position with regard to the subject as can be desired.

The three accompanying woodcuts are from the second volume of this work. The largest is an example of the size and character of the excellent illustrations in Dr. Klein's histological section. Dr. Sanderson contributes that illustrating the relations of the pneumogastric nerve in the frog, and the third is one of the several electrical instruments described by Dr. Foster.

WILSON'S INORGANIC CHEMISTRY

Inorganic Chemistry. By the late George Wilson. M.D., F.R.S.E. Revised and enlarged by H. G. Madan, M.A. (London and Edinburgh: W. and R. Chambers.)

LIKE so many of our old friends among the best books on chemistry, the present edition of the late Prof. Wilson's Inorganic Chemistry has undergone somewhat extensive alterations, and received considerable additions, which, in the opinion of its able editor, have been rendered necessary by the recent progress of chemistry. The original plan, which is that adopted in some of our best text-books, has been adhered to, viz. of introducing the student to a knowledge of the more important fundamental laws of chemistry, and to make him familiar with the properties of the chief elementary substances, and their more remarkable compounds. What is generally known by the name of chemical physics occupies about one-fourth of the whole book. This portion is clear and concise, and deserves the highest eulogium. It may be perused with advantage by every chemical student. The theory of atomicity of elements, which is fast giving a new impression to organic chemistry, and which by some of our most eminent chemical teachers has of late been introduced into the domain of inorganic chemistry also, and which promises to reconcile and harmonise both branches of chemical science, has received but scanty recognition at the hands of the editor, although he professes to have brought the chemical nomenclature (in deference to the wishes of the publisher), into accordance with the system adopted by Profs. Frankland and Williamson.

Professor Wilson seems to have felt that physical and chemical laws cannot be studied with advantage without having some physical and chemical facts to work upon, and the pupil is therefore recommended to read the first 108 pages, treating of chemical physics, with some care before proceeding further; but "he is not to expect to understand the introductory portion at once, but must go back from time to time to their study, when he will find them more and more intelligible as he grows familiar with the properties of chemical substances," explained in the later pages. Is not this an admission that the plan upon which the book is constructed is a faulty one? Is it not time to relegate chemical physics to physics proper, especially when we have such excellent elementary textbooks as Balfour Stewart's and others, and to treat of chemical changes in chemical text-books? Not that we would have it inferred that chemical changes can be understood without a knowledge of the general properties of matter, of heat, light, and electricity. By far the greater number of chemical changes being dependent upon chemical affinity, the laws of chemical combining proportions and volume composition can very well be explained by confining the teaching at first mainly to chemical changes. Physical considerations, especially at a time when they undergo such rapid extensions, should form the crowning part of chemical studies, and the interdependence of the two branches of science can only be established upon a sound basis when a thorough knowledge of either science has been acquired.

The main portion of the book comprising the chemistry of the non-metallic and metallic elements, arranged under the usual headings Preparation and Properties of the different elements and their compounds, contains much that will highly recommend itself. The more important compounds are dealt with in a manner which will help the student over most of the difficulties he encounters at first, and will enable him to lay a good foundation for more extensive chemical studies. The classification of the metals according to their atomicity—open to objections as it stands—is not always reconcilable with the analytical summaries or tests given after each group of metals, nor are the analytical explanations always accurate. On p. 393, *e.g.* we notice: "Calcic sulphate cannot produce a precipitate in a salt of calcium, because there is more than enough of water present to retain dissolved all the sulphate that can possibly be formed."

There can be little doubt that the new edition of Wilson's Chemistry will be welcomed by all who desire to get a general insight into the science, and that it may be studied with advantage in preference to many larger and more ambitious text-books.

OUR BOOK SHELF

Verhandlungen der k. k. geologischen Reichsanstalt. Nos. 11 to 18. (Vienna.)

THESE numbers of the Proceedings of the Geological Society contain many useful papers, chiefly, however, of local interest. Felix Karrer notes the occurrence of mammoth remains at Vienna. They were obtained during the sinking of a well in a "diluvial" (glacial) deposit at a depth of 9 fath. 3 ft. from the surface. Dr. Lenz also has a short reference to a similar discovery of the teeth of a young mammoth in a brown laminated loam near Nowakmühle. Dr. Stur gives an interesting account of his own and Baron Petrino's observations on the superficial deposits in the basin of the Dniester in Galicia and Bukowina. A great accumulation of loess covers a wide area in that district, the land shells and mammalian remains in which enable these geologists to correlate it with the loess of the Rhine and other regions. We observe, in No. 11, an important table showing Dr. C. E. Weis's systematic arrangement of the carboniferous formation and the rothliegendes formation of the Saar-Rhine district, which is well worth the attention of English geologists. The usual admirable literary notices, and other miscellaneous matter, are appended to each number of the Proceedings.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

Leaf-Arrangement

THE chief part of the Rev. G. Henslow's objections (NATURE, vol. vii., p. 403) to my condensation-theory of leaf-arrangement are due to a double oversight on his part. First, he has overlooked the condition of *contact* among the balls which I use to represent embryo leaves. Second, he has overlooked the fundamental position, that leaf-order exists for, and is determined in, the *bud*.

The bud requires economy of space. This involves contact among the embryo leaves; and if we experiment with balls attached (as described in my paper) in two rows alternately on either side of a contractile axis, we shall see that when the axis is allowed to contract with a twist, that twist is necessarily limited by the conditions of contact which arise, and that we cannot "cause it to make a complete rotation if we choose." Given the size of the balls and their distance from the axis, the position which they will assume (under contraction with a twist) is necessarily determined by the geometrical conditions of mutual contact. This consideration furnishes the answer to Mr. Henslow's italicised query, and also to his two previous questions (1) and (2). It also gives back a "really explanatory meaning" to my expression "*maxima* of stability," for if we have one sphere standing almost vertically on another and supported by a third and a fourth to right and left, we have therein some statical conditions which admit of maxima and minima of stability. The same consideration also removes the objection that "the positions taken up by the balls must be arbitrary, or at least in proportion to the twist given by the hand—a perfectly arbitrary force." The twist given by the hand in my experiment serves only to determine the direction of the real twist; the subsequent real availing twist is insisted upon by the two ranks of balls-in-contact as the sole condition of obedience to the contractile force of the indiarubber axis; and this twist is limited by the conditions of contact above described. Let the direction of the twist be given, and there is nothing arbitrary in the result.

The objection that "if an axis becomes twisted the *fibres* will be twisted also" loses force if we bear in mind that the leaf-order is imposed upon the embryo leaves in the very earliest stage of their bud-life; and that the formation of fibres, taking place at a subsequent stage, must find itself compromised by an already existing arrangement of the embryo leaves. The elastic band in my experiment, "if it were a pliant shoot," would certainly "contort the vessels and wood-fibres;" but it was not meant to represent a "pliant shoot" except in its earliest embryonic bud-stage, and that at some very remote period in the past.

I must ask Mr. Henslow to bear in mind that he has before him only the abstract of my paper, and that necessary brevity has left some points too bare, and has wholly suppressed others of small importance. Among the latter is some mention of the "secondary series" $\frac{1}{3}$, $\frac{1}{4}$, $\frac{2}{7}$, &c., which, though it may be found in the abnormal variations exhibited by a cultivated plant like the Jerusalem Artichoke, yet cannot be reckoned with examples of normal leaf-order.

Let me take this opportunity of insisting again on the astonishing agreement between the facts of nature and the results which the condensation-theory leads us to expect. Taking one member to start from as 0, we find in nature that the members in contact with 0 belong to the following series, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, &c., and these are the very same members which would necessarily be brought into contact with 0 under successive degrees of condensation with twist from an original order $\frac{1}{2}$.

I have lately met with a striking confirmation of the truth of the condensation-theory. The simplest order of the whorled type is that in which the leaves stand in pairs, decussate. Now if we consider what would be the result of condensation with twist applied to this arrangement, we can see that it would produce a new series of orders, in which the following members would successively come into contact with 0,—2, 4, 6, 10, 16, 26, 42, &c., and would present the phenomenon of 2, 4, 6, 10, &c., spirals alternately to right and left. This result is exemplified in nature. The teazle (*Dipsacus silvestris*) has the decussate order in its leaves; and in its head (where we might expect to find its leaf-order condensed) we count sixteen conspicuous spirals in one direction and twenty-six in the other:—that is to say, we have 0 in contact with No. 16 on one side and No. 26 on the other. No. 42 stands higher between 16 and 26, but inclined towards the former. No. 10 stands next below 26, and No. 6 next below 16. These numbers belong to the new series above mentioned.

This close parallel between fact and theory appears to me to give a value to the latter which it will not lightly lose.

March 30 HUBERT AIRY

The Hegelian Calculus

AS Dr. J. H. Stirling has enjoyed the exceptional privilege of replying contemporaneously, to my paper on Hegel in the current number of the *Fortnightly*, I should desire, with your kind permission, to find in your columns the opportunity of saying without delay the single word which still seems necessary between Dr. Stirling and myself.

Dr. Stirling now holds that the real question between him and me is whether or not Hegel "attempted" to produce "a Hegelian Calculus." And so it seems to him a virtual concession of the entire case when I say that the phrase "Hegelian Calculus" is used by me in irony. Dr. Stirling, I fear, misunderstands me. What Hegel has given us on the subject of the Calculus is, strictly speaking, nonsense. But, as I have shown, this nonsense is not mere metaphysic, but involves mathematical absurdity. It is of course only in irony that one can dignify the paradoxes of mathematical ignorance with the title of a Calculus; and if this admission satisfies Dr. Stirling, then our controversy is at an end. W. ROBERTSON SMITH

Aberdeen, April 3

Meteorology of the Future

I WISH to call the attention of the writer of the article "The Meteorology of the Future," which appeared in NATURE of December 12, 1872, to a little work which appears to have entirely escaped his notice.

In the beginning of 1871 I circulated a small book of twenty-four pages, containing results deduced from the observations made at this Observatory, 1841 to 1870. I have given the decimal and annual variations of all the meteorological elements collected, and have pointed out their mutual interdependence. I have also given on an enlarged scale the curves of variations of annual mean temperature and freedom of the sun's disc from spots, which appeared in the Proceedings of the Royal Society, March 23, 1871.

No one acquainted with the subject would, I presume, believe that periodical variations could exist in the temperature without existing also in the other meteorological elements; vapour as measured by tension, hence barometer humidity and rainfall.

In the introduction to the work referred to, it is stated with regard to the curve of temperature and inverse curve of solar spots:—"There is an agreement between the curves which will probably be regarded as too close to be the result of accident, and which renders it probable that the two phenomena, represented by the curves, result from the action of a common cause connected with changes of mean solar energy." And this established with more or less probability, I proceeded to point out (p. 17)—"That the variations of temperature are borne out by those of tension of vapour," and on page 22—"That the correspondence between humidity and rainfall is strongly marked," and also that—"The correspondence between a curve swept to represent the variations in rainfall and the inverse curve of the variations in mean temperature is of a marked character."

You will perceive, therefore, that the connection between solar spots as an indication of less solar heating power and vapour, and rain, as well as temperature, was in the book referred to explicitly pointed out. I may add to this note, that the rainfall for

1871 was 20·098 inches
1872 was 29·325 inches.

E. J. STONE

Royal Observatory, Cape of Good Hope

Bright Meteor

I HAVE this evening, at 7.40, seen the brightest meteor I have ever beheld: starting from a point about half-way between Cassiopæa and the Pole star, it descended through about 20° of arc, when it was lost sight of behind a cloud: this cloud was a thick white opaque cloud shining brightly in the moonlight, but the meteor behind it illuminated the sky, and made the cloud appear for the moment dark against it.

The colour of the meteor was a decided green; its passage was not very rapid; it appeared far brighter than any star or planet, and seemed to have a short tail. Not only was it a gloriously beautiful object in itself, but it illuminated all the sky in its neighbourhood with its greenish light.

EDMUND H. VERNEY, Commander R.N.

H.M.S. *Growler*, off Cape Matapan, March 5

The Great Meteoric Shower of November 27, 1872

THIS interesting display was also observed in the neighbourhood of the small town of Santa Lucia in Venezuela (10° 12′ N., 68° 57′ W. from Paris), by Dr. A. Alamo. The first meteors were seen at half-past 7, about 100 in 30 minutes. Most of them followed an easterly course, some leaving a luminous track visible for several minutes. From 8 to 12 o'clock their number was too large for counting, but after midnight the weather got misty, and few meteors could be distinguished. The shower, however, continued, and still in the morning some meteors were traceable. Unfortunately Dr. Alamo cannot say anything about the radiant point of the shower. At Carácas the sky was densely overcast, and not even a glimpse of the spectacle could be obtained. DR. A. ERNST

Carácas, Feb. 21

The Antiquity of Man

THE letter of Sir John Lubbock in your issue of March 27, induces me to call attention to what seems to me to be an anomaly in the state of our evidence concerning fossil man. Sir J. Lubbock has insisted, and with much reason, on the parallelism between the condition of existing savage races and that of fossil man; but, I would ask, is there any existing savage race capable of delineating animals in the masterly way in which the elephant is delineated on the plate of bone figured at page 326 of NATURE (February 27, 1873)? Such a life-like representation as is here produced by a few rough scratches would not discredit a modern artist. Unless I am under a misapprehension, the best figures that living savages can produce are but uncouth things, in which case either the parallelism between the intelligence of existing savage races and of fossil man fails in one important particular, or else a suspicion arises as to the contemporaneity of these engraved bones with palæolithic man; and a doubt is thrown on the supposed antiquity of the Troglodytes to whose hands this engraving is ascribed.

We should, I think, until this discrepancy is explained, look with still greater suspicion upon the contemporaneity of engraved representations of animals with so early a form as Miocene man, or accept them as any evidence of his existence at that epoch.

While suggesting the above caution, I would not, however, be understood to dissent from the probability of some form of man having existed as far back as the Miocene period, since eleven years ago, I observed in the *Phil. Mag.* (for April, 1862, last paragraph but one of the paper) that the views there discussed "seemed to me to lead us to the presumption of a far greater antiquity for our race than had hitherto been accorded to it, reaching perhaps far back into the Tertiary period."

Brentwood, Essex SEARLES V. WOOD, JUN.

Skeletons at Mentone

A VERY accomplished geologist, a friend of mine, is now staying at Mentone, for the benefit of his health, and he writes to me under the date of the 25th ult. as follows:

"Another skeleton has just been found here in one of the caverns. It is far less perfect than the former one. The head is crushed and partly wanting, and a considerable portion of the vertebral column is absent. The limbs, however, indicate a person of larger size than the first skeleton. On the arms are bracelets of shells, which are bored for stringing. The parts found are lying in their natural position. With the skeleton are traces of what looks like very fine iron ore. Of this substance there is but a very small quantity, perhaps two or three tablespoonfuls."

With regard to the iron ore, there have been many conjectures, and it is extremely remarkable that about the same quantity of a similar substance was found with the first skeleton. The more general opinion seems to be, that this material was employed in some burial rite. W. T.

Torquay, April 1

[From a cutting from *Les Echos de Cannes* sent us by W. T., we learn further that the head was covered by a network of shells, and that beside the skeleton were found many implements of bone, and even drawings of fish and swans.—ED.]

Instinct

Perception in Ants

THE following fact with respect to the habits of ants, which I believe to be quite new, has been sent to me by a distinguished geologist, Mr. J. D. Hague; and it appears well worth publishing. CHARLES DARWIN

On the mantelshelf of our sitting-room my wife has the habit of keeping fresh flowers. A vase stands at each end, and near the middle a small tumbler, usually filled with violets.

Sometime ago I noticed a file of very small red ants on the wall above the left-hand vase, passing upward and downward between the mantelshelf and a small hole near the ceiling, at a point where a picture-nail had been driven. The ants, when first observed, were not very numerous, but gradually increased in number, until on some days the little creatures formed an almost unbroken procession, issuing from the hole at the nail, descending the wall, climbing the vase directly below the nail, satisfying their desire for water or perfume, and then returning. The other vase and tumbler were not visited at that time.

As I was just then recovering from a long illness it happened that I was confined to the house, and spent my days in the room where the operations of these insects attracted my attention.

Their presence caused me some annoyance, but I knew of no effective means of getting rid of them. For several days in succession I frequently brushed the ants in great numbers from the wall down to the floor; but as they were not killed the result was that they soon formed a colony in the wall at the base of the mantel, ascending thence to the shelf, so that before long the vase was attacked from above and below.

One day I observed a number of ants, perhaps thirty or forty, on the shelf at the foot of the vase. Thinking to kill them I struck them lightly with the end of my finger, killing some and disabling the rest. The effect of this was immediate and unexpected. As soon as those ants that were approaching arrived near to where their fellows lay dead and suffering, they turned and fled with all possible haste. In half an hour the wall above the mantelshelf was cleared of ants.

During the space of an hour or two the colony from below continued to ascend, until reaching the lower beveled edge of the shelf, at which point the more timid individuals, although unable to see the vase, somehow became aware of trouble and turned about without further investigation; while the more daring advanced hesitatingly just to the upper edge of the shelf, where, extending their antennæ and stretching their necks, they seemed to peep cautiously over the edge until beholding their suffering companions, when they too turned and followed the others, expressing by their behaviour great excitement and terror. An hour or two later the path or trail leading from the lower colony to the vase was almost entirely free from ants.

I killed one or two ants on their path, striking them with my finger, but leaving no visible trace. The effect of this was that as soon as an ant ascending towards the shelf, reached the spot where one had been killed, it gave signs immediately of great disturbance, and returned directly at the highest speed possible.

A curious and invariable feature of their behaviour was that when such an ant, returning in fright, met another approaching, the two would always communicate, but each would pursue its own way; the second ant continuing its journey to the spot where the first had turned about and then following that example.

For several days after this there were no ants visible on the wall, either above or below the shelf. Then a few ants from the lower colony began to re-appear, but instead of visiting the vase which had been the scene of the disaster, they avoided it altogether, and following the lower front edge of the shelf to the tumbler standing near the middle, made their attack upon that. I repeated the same experiment here with precisely the same result. Killing or maiming a few of the ants and leaving their bodies about the base of the tumbler, the others on approaching, and even before arriving at the upper surface of the shelf where their mutilated companions were visible, gave signs of intense emotion, some running away immediately and others advancing to where they could survey the field, and then hastening away precipitately.

Occasionally an ant would advance towards the tumbler until it found itself among the dead and dying, then it seemed to lose all self-possession, running hither and thither, making wide circuits about the scene of the trouble, stopping at times and elevating the antennæ with a movement suggestive of wringing them in despair, and finally taking flight.

After this another interval of several days passed during which no ants appeared. Now, three months later, the lower colony has been entirely abandoned. Occasionally however, especially when fresh and fragrant violets have been placed on the shelf, a few "prospectors" descend from the upper nail hole, rarely, almost never, approaching the vase from which they were first driven away, but seeking to satisfy their desire at the tumbler. To turn back these stragglers and keep them out of sight for a number of days, sometimes for a fortnight, it is sufficient to kill one or two ants on the trail which they follow descending the wall. This I have recently done as high up as I can reach—three or four feet above the mantel. The moment this spot is reached an ant turns abruptly and makes for home; and in a little while there is not an ant visible on the wall.

JAMES D. HAGUE

San Francisco, California, Feb. 26, 1873

Perception in Butterflies

THE interesting discussion on this subject in your columns has hitherto been almost entirely confined to facts of extraordinary "perception" with mammalia. But in other classes of the animal kingdom there occur instances perhaps even more astonishing still, showing a power of perception which we needs must attribute to smell, unless we are inclined to talk about natural forces hitherto unknown, to which I should prefer saying that we do not yet understand the matter at all.

In the valuable monthly, "Der Zoologische Garten," v. X. (1869) p. 254, there is a paper on the sense of smell in butterflies, recording, among other cases, the following one.

A well-known collector, the late M. Riese of Frankfort, bred a crippled female of *Lasiocampa pruni*, a species very rare here. M. Riese dwelt in a narrow and densely-peopled lane near the centre of this city. He put the said moth before the window with his other boxes, and soon had the pleasure to find it surrounded by some males, which became the collector's welcome prey. Here, as the writer fitly remarks, the performance of the male in finding out the female was the more surprising, by the latter being confined in the middle of the town as well as by the rarity of the species in general.

If, as the writer adds, there can be any doubt of the males being guided in these cases by smell, what is more to be wondered at, the acuteness of the males (supposed to be located in the large comb-shaped antennæ) or the enormous divisibility of the odour emitted by the females?

I may add that similar and even more striking cases (the females being confined within a room, and the males appearing outside at the windows) have been recorded by that most reliable observer, the late Dr. von Heyden.

Though I am not prepared to follow the whole length of Mr. Darwin's ideas on "Pangenesis," yet I cannot avoid observing how much such facts as these seem to support the fundamental assumption of that "provisional hypothesis," namely that organised matter is capable of a degree of divisibility scarcely conceivable by us, yet retaining in those most minute particles, infinitely smaller than any which can be revealed by our microscopes, all its specific distinctness,—the "gemmulæ" issuing from the female of a particular species reaching and affecting the distant male, and thereby testing their particular, specific nature.

J. D. WETTERHAN

Frankfort-on-the-Maine, April 5

Perception in Fowls

SEEING in NATURE many letters on the instinct of animals I am tempted to send you an incident which fell under my notice and which would seem to denote in domestic fowls a greater amount of reasoning power and of intercommunication than the lower animals are usually credited with.

Three years ago I was staying at a house in Ireland where a good deal of poultry was kept, and a young white duck just feathered being the only one left of a brood was allowed to roost with a hen and a young brood of chickens under the furnace in the back kitchen, to keep it from the rats which infested the out-houses. One evening our attention was called by the servants to a great commotion between the hen and the duck, which had always before been excellent friends, and upon close examination it was discovered that the duck was not the hen's usual companion, but although closely resembling it in age and colour, was a perfect stranger, not even belonging to the premises at all, whilst the proper duck was found quietly resting with the other ducks in the duck-house. The intruder having been ejected, and the ordinary bed-fellow restored to the hen, peace again reigned between the feathered companions; but the singular part of the affair is, how the duck could have met with a stranger so nearly like herself, and induced it to take her own nightly place in a strange house and with a strange hen.—Was it an act of charity towards a stranger wandering in search of a night's lodging? or was the duckling tired of the hen's company, and desirous of joining the birds of her own feather, and so cajoled the stranger so nearly resembling herself to take her place, believing the cheat would not be discovered?

I commend this fact, for which I can vouch, to Mr. Darwin.

A. W. BUCKLAND

Bath, March 31

Acquired Habits in Plants

ON Oct. 24 last, I found by the banks of the little river Aled, in North Wales, a dog-violet, which, in the first place, was in flower at that unusual season, and in the second place, growing in a hedge, had assumed the habit of a climbing plant. Its stem measured $2\frac{1}{2}$ feet in length; it bore sixteen alternate leaves, the flowers being axillary, or rather some axils had flowers in them, and others had branches of leaves with flowers axillary in these. One flower only was actually in bloom, but there were several (five or six) seed vessels. I gathered one plant and have it still.

St. Asaph, N. Wales J. G.

SCIENCE AND THE PRESS IN AMERICA

(FROM A NEW YORK CORRESPONDENT)

THE visit of Prof. Tyndall has given an extraordinary impulse to scientific affairs in this country. It took place at a fortunate moment, just after the heat and turmoil of a presidential election had been transformed into the national sorrow over the death of the defeated candidate; just before the exposures of corruption, which have since disgraced eminent public men, had begun to absorb popular attention. It therefore happened not only that men's minds were not preoccupied, but that, in addition, newspaper columns were not specially crowded. Hence all the leading newspapers gave more space than would have otherwise been possible, to reports of Prof. Tyndall's lectures. In this particular, however, one paper surpassed the rest, giving the lectures verbatim and with illustrations, and afterwards reprinting them in a separate sheet, which, as you are probably already informed, attained a special circulation outside that of the newspaper, of more than 200,000 copies. It is not improbable that this enterprise on the part of the *New York Tribune* originated in a programme for the management of that paper laid down by the late Mr. Greeley. This was printed in its columns the second day after the election, when he resumed his position as editor of the paper. The card specified among other things, first, that thereafter the paper would be enabled to give "a wider and steadier regard to the progress of science, industry, and the useful arts." His successors in the management of the paper have been anxious, for obvious reasons, that it should tread the path he had marked out for it; Tyndall's coming furnished the first opportunity. Other papers have been stimulated by the popularity of scientific topics which the success of these lectures revealed, and there never was a time when such themes found such general acceptance with the newspaper press.

The first manifest benefit to science which has resulted, is an improvement in the treatment of scientific subjects, so far as they are editorially considered. It is not a year since one of the New York newspapers contained an article upon a proposition to light streets and houses by means of hydrogen and oxygen conveyed in separate systems of pipes. In that article there was displayed an ignorance of the commonest facts of chemistry that seemed almost incredible. It teemed with the most ludicrous absurdities. But even its rivals never perceived the blunders—they had a fair share of their own, for the most part, whenever they handled such topics. But of late the writers in the New York newspapers have exhibited some knowledge of such subjects; at all events, special articles in some of the papers betray the touches of a professional hand, that come not with the surface knowledge of journalism.

The second evident benefit has to-day a signal illustration. The efforts of Prof. Tyndall were particularly directed toward impressing upon those of our citizens who have the means for such aid, the benefit that results to the community from the promotion of scientific inquiry This has been also a favourite theme with Prof. Agassiz. A few days ago a Boston correspondent of the *New York Tribune* sent a description to that paper of the work that Prof. Agassiz had undertaken at the Museum of Comparative Zoology; his efforts to obtain State assistance from the Massachusetts legislature; his needs and difficulties, and unsparing, disinterested industry; his project for founding a school of natural history on the coast of Nantucket, where practical work with the dredge might enable the students to become acquainted with marine organisms in a condition of nature. The newspaper commented on the correspondence, pointing out the value of such services, of such researches. The letter and comment interested Mr. John Anderson of this city—a gentleman who has gained wealth as a tobacco manufacturer. Some years ago, finding his health suffering from too close application to business, he selected as a salubrious retreat an island on the New England coast. It is one of the Elizabeth Islands, between Vineyard Sound and Buzzard's Bay. You will best know just where this is, by the fact that New Bedford, the old whaling port of Massachusetts, is on Buzzard's Bay. He expended about 25,000 dols. in improving Penikese Island, and in its delicious climate he regained his health. He refused 75,000 dols. for the island, valuing it at 100,000 dols. Last week, after reading about the aims and efforts of Prof. Agassiz, Mr. Anderson wrote to him, offering him Penikese Island as a gift, and saying to him that he could there establish his Marine Naturalist's School.

To be a little more specific—as such a munificent gift deserves: Penikese is the most northerly of the three western islands of the Elizabeth group. It is of great fertility; it contains a good summer residence; looks out upon a beautiful bay, where there is good anchorage; has a stone dock, and springs of good water. Here is everything that Prof. Agassiz wanted for his semi-nautical enterprise.—Stay! not everything. When Prof. Agassiz first recovered from his surprise, and was thanking the donor, he mentioned a little embarrassment. He had made his arrangements for Nantucket, and there was a little money expenditure involved in the change. "Let not that trouble you" writes Mr. Anderson, and straightway proffers a money-gift in addition—50,000 dols. in cash, "as a nucleus for a permanent endowment fund." And Prof. Agassiz, his heart as well as his coffers running over, says that now his enterprise shall not be merely a summer school, but an institution for all seasons and all time.

The correspondence between Mr. Anderson and Prof. Agassiz will, I am told, be furnished to the press within a few days; but Mr. Anderson is modest; and does not want much fuss about it. It is his first approach toward the hill of science, and he had no personal acquaintance with Agassiz whatever. The scientific sensation of to-day's newspapers is a story that the Natural Bridge of Virginia is burning up. It is told with great detail by eye-witnesses who testify to volcanic burnings and a sulphurous smell, to falling rocks and general danger. Prof. Campbell, of the geological department of the Washington and Lee University, evidently credits the story, and attributes the phenomenon to chemical action, induced by high water acting upon sulphurous and bituminous deposits containing metallic oxides. A New York paper decries the whole story, asserting that the fire proceeds from tar-barrels, and that the whole display is in the interest of hotel-keepers anxious to excite curiosity and attract custom.

ON THE ORIGIN AND METAMORPHOSES OF INSECTS

I.

THE CLASSIFICATION OF INSECTS

NOT many years ago the civil and ecclesiastical authorities of St. Fernando in Chili arrested a certain M. Renous on a charge of witchcraft, because he kept some caterpillars which turned into butterflies.* Most persons, however, are aware that the great majority of insects quit the egg in a state very different from that which they ultimately assume; and the general statement in works on entomology has been that the life of an insect may be divided into four periods. Thus, according to Kirby and Spence* "The states through which insects pass are four: the *egg*, the *larva*, the *pupa*, and the *imago*."

Burmeister,† again, says that, excluding certain very rare anomalies, "we may observe four distinct periods of existence in every insect, namely, those of the egg, the larva, the pupa, and the imago, or perfect insect." In fact, however, the various groups of insects differ very much from one another in the metamorphoses they pass through; in some, as in the grasshopper for instance, the changes consist principally in a gradual increase of size, and in the acquisition of wings; while others, as for

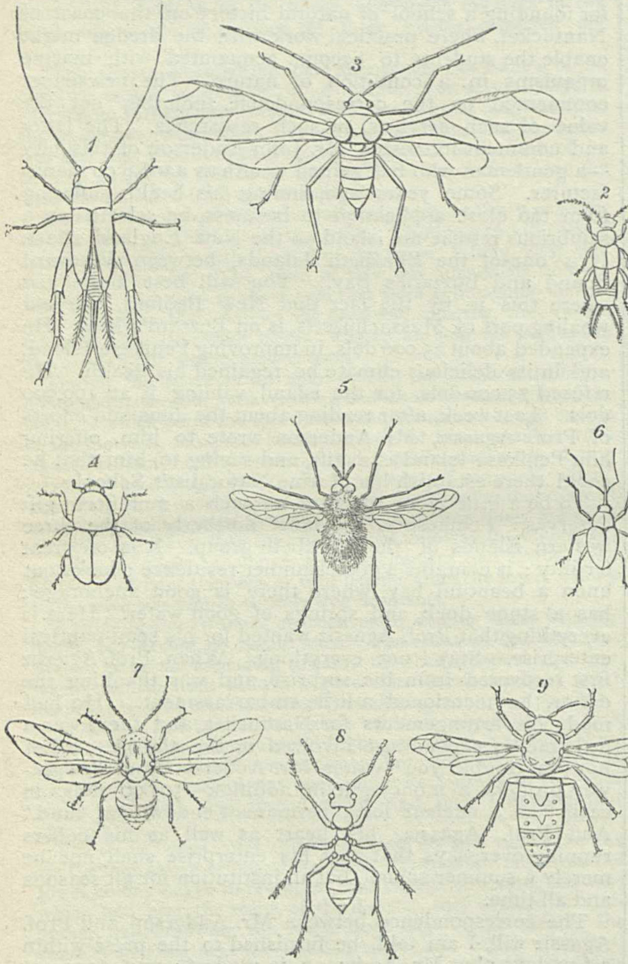


PLATE 1

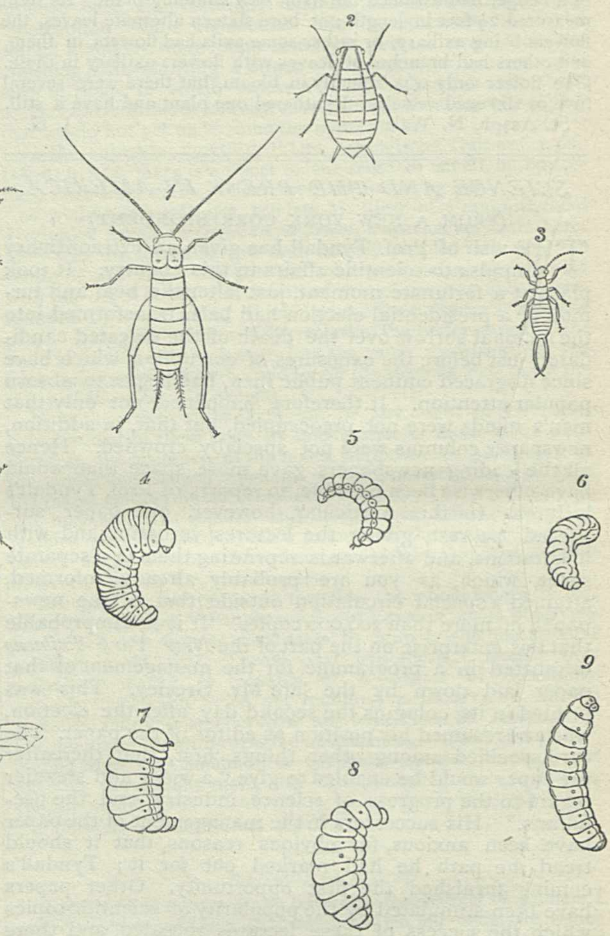


PLATE 2

PL. 1.‡—FIG. 1, Cricket. 2, Earwig. 3, Aphis. 4, Scolytus. 5, Anthrax. 6, Balaninus. 7, Cynips. 8, Ant. 9, Wasp (after Ormerod).
PL. 2.—FIG. 1, Larva of Cricket. 2, Larva of Aphis. 3, Larva of Earwig. 4, Larva of Scolytus. 5, Larva of Anthrax. 6, Larva of Balaninus. 7, Larva of Cynips. 8, Larva of Ant. 9, Larva of Wasp.

instance the common fly, acquire their full bulk in a form very different from that which they ultimately assume, and pass through a period of inaction in which not only is the whole form of the body altered, not only are legs and wings acquired, but even the internal organs themselves, are almost entirely distintegrated and reformed. It will be my object to bring these changes clearly before you, and if possible to throw some light on the causes to which they are due, and on the indications they afford of the stages through which insects have been evolved.

The following list gives the orders or principal groups into which insects may be divided. I will not indeed, as this is not a work on the classification of insects, enter into my own views, but have adopted the system given by Mr. Westwood in his excellent "Introduction to the modern Classification of Insects," from which also, as a standard authority, most of the figures on Plates

* Darwin's "Researches into the Geology and Natural History of the Countries visited by H.M.S. *Beagle*," p. 326.

* Introduction to Entomology vi. p. 50.

† Manual of Entomology, p. 30.

‡ When not otherwise acknowledged, the figures on the first four plates are principally borrowed from Mr. Whetwood's excellent "Introduction to the Modern Classification of Insects."

1 to 4, when not otherwise acknowledged, have been taken. He divides the insects into thirteen groups, with reference to eight of which it may be said that there is little difference of opinion among entomologists. These orders are by far the most numerous, and I have placed them in capital letters. With reference to the other five there is still much difference of opinion. It must also be observed that Prof. Westwood omits the parasitic Anoplura, as well as the Thysanura and Collembola.

Orders of Insects according to Westwood.

1.	HYMENOPTERA	Bees, Wasps, Ants, &c.
2.	Strepsiptera	Stylops, Zenos, &c.
3.	COLEOPTERA	Beetles.
4.	Euplexoptera	Earwigs.
5.	ORTHOPTERA	Grasshoppers, Crickets, Cockroaches, &c.
6.	Thysanoptera	Thrips.
7.	NEUROPTERA	Ephemeras, &c.
8.	Trichoptera	Phryganea.
9.	DIPTERA	Flies and Gnats.
10.	Aphaniptera	Fleas.
11.	HETEROPTERA	Bugs.
12.	HOMOPTERA	Aphis, Coccus, &c.
13.	LEPIDOPTERA	Butterflies and moths.

Of these thirteen orders, the eight which I have placed in capital letters, namely the first, third, fifth, seventh, ninth, eleventh, twelfth, and thirteenth, are much the most important in the number and variety of species. The other five are comparatively small groups. The Strepsiptera are minute insects, parasitic on Hymenoptera. Rossi, by whom they were discovered, regarded them as Hymenopterous; Lamarck placed them among the Diptera; by others they have been considered to be most closely allied to the Coleoptera, but they are now generally treated as an independent order.

The Euplexoptera or Earwigs are only too familiar to most of us. Linnæus classed them among the Coleoptera, from which, however, they differ in their transformations. Fabricius, Olivier, and Latreille regarded them as Orthoptera, but Dr. Leach, on account of the structure of their wings, considered them as forming the type of a distinct order, in which view he has been followed by Westwood, Kirby, and many other entomologists.

The Thysanoptera, constituted of the Linnæan genus Thrips, minute insects well known to gardeners, differ from the Coleoptera in the nature of their metamorphoses, in which they resemble the Orthoptera and Hemiptera. The structure of the wings and mouthparts, however, are considered to exclude them from these two orders.

The Trichoptera, or Caddis worms, offer many points of resemblance to the Neuroptera, while in others they approach more nearly to the Lepidoptera. According to Westwood, the genus Phryganea "forms the connecting link between the Neuroptera and Lepidoptera."

The last of these small aberrant orders is that of the Aphaniptera, constituted of the family Pulicidæ. In their transformations, as in many other respects, they closely resemble the Diptera. Strauss Durckheim indeed said that "*la puce est un diptère sans ailes.*" Westwood, however, regards it as constituting a separate order.

As indicated by the names of these orders, the structure of the wings affords extremely natural and convenient characters, by which the various groups may be distinguished from one another. The mouth-parts also are very important; and, regarded from this point of view, the Insecta may be divided into two series—the Mandibulata and Haustellata, or mandibulate and suctorial groups, between which, as I have already shown,* the Collembola (Podura, Smynthurus, &c.), occupy an intermediate position. These two series would stand as follows:—

* Linnæan Journal, vol. xi.

Mandibulata	*Haustellata*
Hymenoptera	Lepidoptera
Strepsiptera	Diptera
Coleoptera	Aphaniptera
Euplexoptera	Hemiptera
Orthoptera	Homoptera
Trichoptera?	
Thysanoptera?	

Again, and this is the most important from my present point of view, insects have sometimes been divided into two other series, according to the nature of the metamorphoses: Heteromorpha, to use the terminology of Prof. Westwood,* "or those in which there is no resemblance between the parent and the offspring and Homomorpha, or those in which the larva resembles the imago, except in the absence of wings. In the former the larva is generally worm-like and articulated in its form, of a soft and fleshy consistence, and furnished with a mouth, and often with six short legs attached in pairs to the three segments

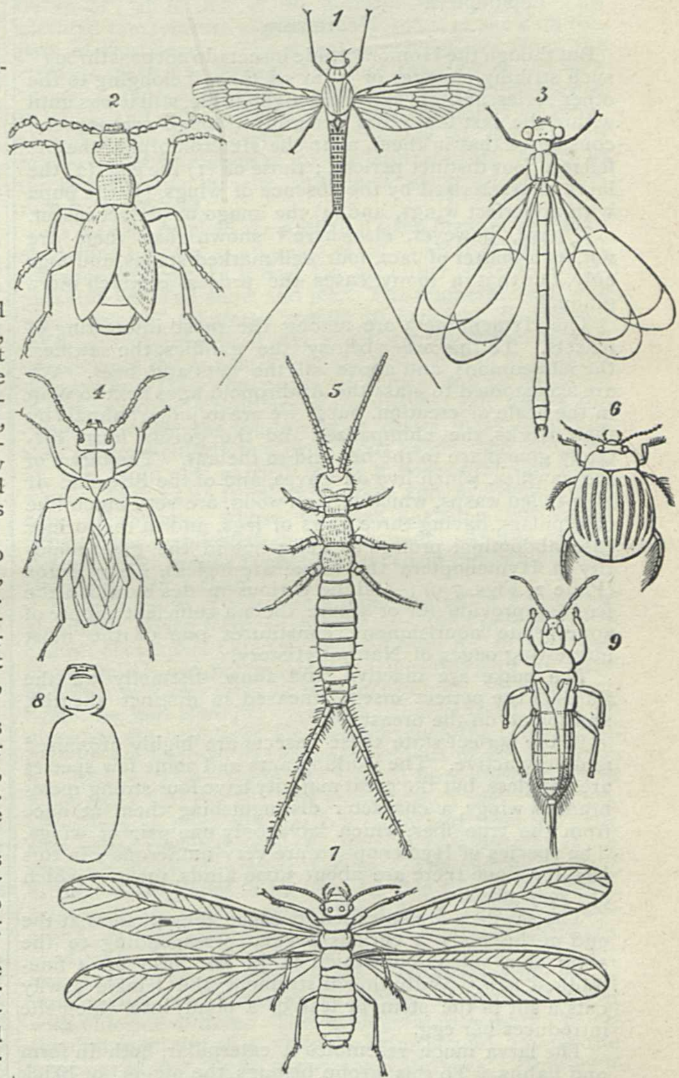


PLATE 3

PL. 3.—FIG. 1, Chloeon. 2, Meloe (after Shuckard). 3, Calepteryx 4, Sitaris (after Shuckard). 5, Campodea (after Gervais). 6, Acilius 7, Termes. 8, Stylops (female). 9, Thrips.

* Introduction to the modern Classification of Insects, p. 17.

succeeding the head. In the latter, including the Orthoptera, Hemiptera, Homoptera, and certain Neuroptera, the body, legs, and antennæ are nearly similar in their form to those of the perfect insect, but the wings are wanting."

Heteromorpha	*Homomorpha*
Hymenoptera	Euplexoptera
Strepsiptera	Orthoptera
Coleoptera	Hemiptera
Trichoptera	Homoptera
Diptera	Thysanoptera
Aphaniptera	
Lepidoptera	

Neuroptera

But though the Homomorphic insects do not pass through such striking changes of form as those belonging to the other series, and are active throughout life, still it was until within the last few years generally (though erroneously) considered that in them, as in the Heteromorpha, the life fell into four distinct periods; those of (1) the egg, (2) the larva characterised by the absence of wings, (3) the pupa with imperfect wings, and (4) the imago or perfect insect.

I have, however, elsewhere * shown that there are not, as a matter of fact, four well-marked stages, and four only, but that in many cases the process is much more gradual.

The Hymenoptera are among the most interesting of insects. To this order belong the gallflies, the sawflies, the ichneumons, and above all, the ants and bees. We are accustomed to class the Anthropoid apes next to man in the scale of creation, but if we are to judge animals by their works, the chimpanzee and the gorilla must certainly give place to the bee and to the ant. The larvæ of the sawflies, which live on leaves, and of the Sirecidæ or long-tailed wasps, which feed on wood, are very much like caterpillars, having three pairs of legs, and in the former case abdominal prolegs as well; but in the great majority of Hymenoptera the larvæ are legless, fleshy grubs (Plate 2, Figs. 7-9); and the various modes by which the females provide for or secure them a sufficient supply of appropriate nourishment, constitutes one of the most interesting pages of Natural History.

The pupæ are inactive, and show distinctly all the limbs of the perfect insect, encased in distinct sheaths, and folded on the breast.

In the perfect state these insects are highly organised and very active. The working ants and some few species are wingless, but the great majority have four strong membranous wings, a character distinguishing them at once from the true flies, which have only one pair of wings. The species of Hymenoptera are very numerous; in this country alone there are about 3,000 kinds, most of which are very small.

The sawflies are so called because they possess at the end of the body a curious organ, corresponding to the sting of a wasp, but which is in the form of a fine-toothed saw. With this instrument the female sawfly cuts a slit in the stem or leaf of a plant, into which she introduces her egg.

The larva much resembles a caterpillar, both in form and habits. To this group belongs the nigger, or black caterpillar of the turnip, which is often in sufficient numbers to do much mischief. Some species of this group make galls, but the greater number of galls are formed by insects of another family, the Cynipidæ (Plate 1, Fig. 7). In this family the female is provided with an organ corresponding to the saw of the sawfly, but resembling a needle. With this she stings or punctures the surface of leaves, buds, stalks, or even roots of various plants. In the wound thus produced she lays one or more eggs. The effects of this proceeding, and particularly of the irritating fluid which she injects into the wound, is to produce a tumour or gall, within which the egg hatches, and on which the larva, a thick fleshy grub, (Plate 2, Fig. 7) feeds. In some species each gall contains a single larva; in others, several live together. The oak supports several kinds of gallflies; one forms the well-known oakapple, one forms a small swelling on the leaf resembling a currant, another produces a gall somewhat resembling an acorn, another attacks the root; the species making those bullet-like galls, which are now so common, has only existed for a few years in this country; the beautiful little spangles so common in autumn on the under side of oak-leaves are the work of another species, the *Cynips longipennis*. When the larva is full grown, it eats through the gall, falls to the earth, and turns into a chrysalis. One curious point about this group is, that in some of the commonest species the females alone are known, no one yet having ever succeeded in finding a male.

Another great group of the Hymenoptera is that of the ichneumons; the females lay their eggs either in or on other insects, within the bodies of which the larvæ live. They are thick, fleshy, legless grubs, and feed on the fatty tissues of their hosts, but do not attack the vital organs. When full grown, they eat their way through the skin of the insect, and turn into chrysalides. Almost every kind of insect is subject to the attacks of these horrid little creatures, which, however, are no doubt useful in preventing the too great multiplication of insects, and especially of caterpillars. Some species are so minute that they even lay their eggs within those of other insects. The larvæ of these genera assume very curious forms.

But of all Hymenoptera, the group containing the ant, the bee, and the wasp is the most interesting. This is especially the case with the social species, though the solitary ones also are extremely remarkable. The solitary bee or wasp, for instance, forms a cell generally in the ground, places in it a sufficient amount of food, lays an egg, and closes it up. In the case of bees, the food consists of honey; in that of wasps, the larva requires animal food, and the mother therefore places a certain number of insects in the cell, each species having its own special prey, some selecting small caterpillars, some beetles, some spiders. *Cerceris bupresticida*, as its name denotes, attacks beetles belonging to the genus Buprestis. Now if the Cerceris were to kill the beetle before placing it in the cell, it would decay, and the young larva when hatched would find only a mass of corruption. On the other hand, if the beetle were buried uninjured, in its struggles to escape it would be almost certain to destroy the egg. The wasp has, however, the curious instinct of stinging its prey just in the centre of the nervous system, thus depriving it of motion, and let us hope of suffering, but not killing it; when, therefore, the young larva leaves the egg, it finds ready a sufficient store of wholesome food. Other wasps, like the bees and ants, are social, and dwell together in communities. They live for one season, dying in autumn, except some of the females, which hybernate, awaking in the spring and forming new colonies. Even these, however, under ordinary circumstances, never live through a second winter. One specimen which I kept tame through last spring and summer, lived until the end of February, but then died. The larvæ of wasps are fat, fleshy, legless grubs. When they are full grown they spin for themselves a silken covering, within which they turn into chrysales. The oval bodies which are so numerous in ants' nests, and which are generally called ants' eggs, are really cocoons, not eggs. Ants are very fond of the honey-dew which is formed by the Aphides, and have been seen to tap the Aphides with their antennæ, as if to induce them to emit some of the sweet secretion. There is a species of Aphis, which lives on the roots of grass, and some ants collect these into their nests, keeping them, in fact, just

* Linnæan Transactions, 1863—"On the Development of Chloeon."

as we do cows. One species of red ant does no work for itself, but makes slaves of a black kind, which then do everything for its masters.

Ants also keep a variety of beetles and other insects in their nests. That they have some reason for this seems clear, because they readily attack any unwelcome intruder; but what that reason is we do not yet know. If these insects are to be regarded as the domestic animals of the ants, then we must admit that the ants possess more domestic animals than we do. But on this and many other points connected with ants we require additional information.

The Strepsiptera are a small, but very remarkable group of insects, parasitic on bees and wasps. The larva (Pl. 4, Fig. 8) is very minute, six-legged, and very active; it passes through its transformations within the body of the bee or wasp. The male and female are very dissimilar. The males are minute, very active, short-lived, and excitable, with one pair of very large membranous wings. The females (Pl. 3, Fig. 8), on the contrary, are almost motionless, and shaped very much like a bottle; they never quit the body of the bee, but only thrust out the head of the bottle between the abdominal rings of the bee.

JOHN LUBBOCK

(*To be continued.*)

COTOPAXI—THE FIRST ASCENT OF THE GREAT VOLCANO*

STANDING fifty miles below the equator, and a hundred west of the meridian of Washington, Cotopaxi is at once the most beautiful and the most terrible of volcanoes. From the valley of Quito it appears like a huge truncated cone, in altitude equal to five Vesuviuses piled upon each other, its summit rising 4,000 ft. above the limit of perpetual snow, its sides presenting alternate ridges and gorges ploughed by descending floods of water, and around the base for miles heaps of ruins—boulders 20 ft. square, and volcanic ashes and mud 600 ft. deep. Very seldom does Cotopaxi wake up to intense activity, for as a rule the higher a volcano the less frequent its eruptions. Generally the only signs of life are the deep rumbling thunders and a cloud of smoke lazily issuing from the crater.

On November 27, 1872, Dr. Reiss—a German naturalist, who, with Dr. Stubel, has been exploring the Valley of Quito during the last forty years—set out from Mulolo with ten peones for the south-west point of the crater. Crossing the river Cutuche at Limpiopungo, where the stream cuts through vast deposits of volcanic ashes, he reached the "Ventanillas," a dry and sterile pampa, since the porous earth retains no moisture. Here the ascent of the cone began. Following the triangular ridge that divides the deep defiles of Manzanaguaico and Pucahuaico, and whose apex reaches the snow limit, he crossed subordinate cerros and pampas, which are so many steps in the grand staircase he was ascending. Vegetation now ceased entirely, and the surface was covered with ashes and black sand. In fact, nearly the whole occidental slope of Cotopaxi, between 12,500 and 16,000 ft., presents the aspect of a dismal black desert. Progress was slow, for at every step the foot sank into the sand, which increased in depth with the ascent.

Suddenly a profound chasm, containing fresh, smoking lava, was discovered on the left. This lava-stream was the lower limit of a vast mass, which from the valley appeared like a long black line. At 2 P.M. our traveller reached the point where the two quebradas unite, marked by an immense pile of rocks. Here he encamped for the night at an altitude of 15,179 feet.

An immense stream of lava came down the cone, and near the place of encampment divided, entering the two quebradas or ravines mentioned. The lava was still warm, clouds of vapour rising along the whole extent of the stream. During the afternoon the thermometer had stood at freezing point; but in the night it fell to twenty-five degrees.

The next day Dr. Reiss attained all his hopes. Cropping out of the lava stream, but mainly disposed along the borders of it, were numerous rough stones, upon which he advanced as on the rounds of a ladder. The greatest width of the lava current before it divided was about 3,000 ft., and the estimated thickness 150 ft. The lava was entirely black and warm in all its course; its temperature being from 68° to 91°, while that of the atmosphere was 32°. This elevated temperature explains the absence of snow on this part of the slope. The gaseous exhalations from the crevices seemed to be nothing more than air mixed with vapour. This is doubtless the lava-stream which flowed in 1854, and which, by melting vast quantities of snow, caused much devastation in the valley by floods. No fissure or accumulation of scoriæ indicates the source of the lava-stream; but the altitude of the point of departure is 18,700 feet.

At 8.45 he reached the arenal, a deep mass of fine sand stretching upward at an angle of 40°. Over this he must advance, difficult as it was, for on either side were impassable fields of snow and ice. The temperature of the sand was 77°. Another stream of lava was discovered, which must have flowed with great velocity, since, instead of following the inclination of the cone, it had descended diagonally. Only the peaks of Iliniza and Chimborazo in the opposite Cordillera were visible; but above the clouds, towards the south-west, a dense mass of smoke rose perpendicularly to a prodigious height, and then by an east wind was carried off in a horizontal line westward. This came from the furious and ever-active volcano of Sangay, whose top was invisible, but whose activity was manifested in this manner. As the clouds shifted, the diversified valley and its royal mountains were spread out like a map.

It was now 10.15 A.M.; thermometer, 28°. Fumeroles abounded, giving forth sulphurous gas. And now followed a sheet of compact blue ice, inclined from 35° to 40°; but fortunately it was not smooth, but covered with myriads of points or icicles three or four inches high. Scrambling over this, and climbing over and between walls, some of immense size, suddenly Dr. Reiss reached the edge of the crater. He had reached the western part of the southern lip. The crater presented an elliptical form, the major axis lying north and south. The stones which were continually falling in from all sides, but especially from the west side, rolled together as to the bottom of a funnel; there were no signs of a level bottom. The depth, roughly estimated, appeared to be 1,500 ft. The side of the funnel least inclined, and by which alone it is possible to descend, is the south-west; but here are large fumeroles sending forth dense masses of vapour charged with gas, and having a temperature of 156°. Around these fumeroles were masses of sulphur and a deposit of gypsum mixed with chloride of lime. This is of great interest as being the first instance of a chloride being found among the products of the South American volcanoes. Humboldt thought that the absence of hydrochloric acid was a characteristic of the New World volcanoes. The barometer gave 19,660 ft. as the altitude, while the doctor's trigonometrical observations, repeated at various times from independent bases in the valley, had given him 19,496 ft. as the height of the north peak, and 19,427 ft. for the southern. Both results exceed the altitude estimated by other travellers. Humboldt made it 18,880 ft.

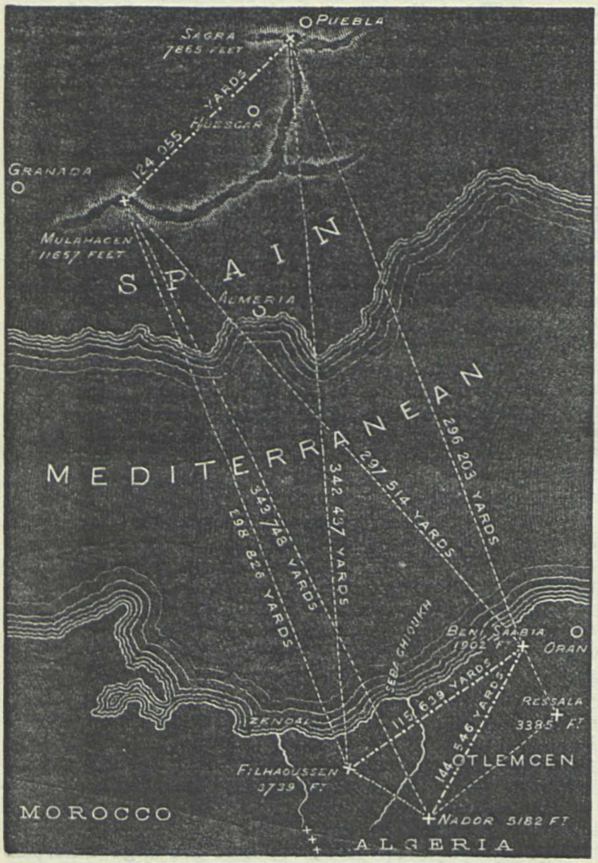
Dr. Reiss left the crater at 1.45 P.M., and reached his encampment at the head of the ridge in three hours and a half, just as a heavy snow-storm began. He says he felt no inconvenience from the rarefaction of the air.

* Abstract of an article by Mr. James Orton in the New York *Evening Post*, March 12, 1873.

CAPTAIN PERRIER'S GEODETIC OPERATIONS IN ALGERIA

THE idea of prolonging the French arc of meridian to Sahara by the direct trigonometrical junction of Spain and Algeria, an idea of undoubted scientific value, presented itself to the mind of Captain Perrier when he was collecting the preliminary materials for the survey of Algeria. That survey was begun at the same time as the conquest, in the middle of military operations.

The design was to calculate two great lines conforming to parallels, and transversely cut by three meridians; quadilaterals would be thus formed, completed by triangles of the first order. Only a linear chain was however drawn, except in the mountainous regions where the operations would have been attended with too many difficulties.



Map showing prolongation of Meridians from Spain to Algeria

This chain, connected with the sea by three excellent bases, would serve the purpose of adjusting and arranging the detailed operations. French geodesy thus measured an arc of latitude cutting the Paris meridian and extending from Morocco to Tunis, with a length of 990 kilometres.

The chain of first-order triangles may be divided into two parts, the first from Blidah to Tunis, measured by Captain Versigny, the other more recent measured by Captain Perrier.

The admirable choice of triangles, stations, and signals is noteworthy. Those signals have been built by the observers themselves, as there were no steeples. The precision obtained is remarkable. In the sum of the three angles of any triangle, the error is about $3''\cdot 12$ (centesimal seconds)* in M. Versigny's operations (who made use of Gambey's repeating circles); the error is about $3''\cdot 07$ in M. Perrier's operations, who made use of Brunner's excellent asimuthal circles. In order to measure the bases, the system of M. Porro, an Italian engineer, has been employed, in preference to the old method of Borda, and it has been followed by the best results.

Colonel Levret proved (in 1869), by very exact calculations, that the passage by Gibraltar could be dispensed with, and that it would be possible to communicate between Spain and Algeria, in spite of the immense distance between the two continents. The entire certainty of that possibility has been proved by Captain Perrier, who has pointed out in a precise manner the names and positions of the visible summits and the length of the sides of the new chain.

It was only on October 18, 1868, that he managed to perceive the Spanish shore: he saw it from Seba Chioukh, near the mouth of the Tafna, very distinctly and without the glass. A serrated ridge was to be seen in the distance, toward the north-west, with five prominent summits. The distinctness was so perfect, that he could discern with his naked eyes the different parts of those mountains, those which were in the shade and those illuminated by the sun. He thus measured azimuths with the summit of the Tessala, the zenithal distances of the two highest points of the ridge, and the zenithal distance of the horizon of the sea.

After his return to France, he compared his measurements with the survey of Spain, made by Colonel Cuello, and concluded that he had observed the Mulahacen of the Sierra Nevada, and the peak of Sagra of the Sierra Sagra, the highest points of the Sierras of the Province of Granada.

In Spain the peaks of Sagra can be seen from Mulahacen; those mountains belong to the primordial geodetic chains of the Iberic peninsula. In Africa the points of the quadrilateral (Bem Saabia, Tessala, Filhaoussen, and Nador) are reciprocally visible, and the three last are situated in the primordial chain of Algeria.

With these points, Captain Perrier was enabled to form a chain common to Europe and Africa. Leaving the station of Seba Chioukh as superfluous, as well as the direction of Nador-Sagra as being too close to the horizon of the sea, he delineated that immense pentagon formed by the five summits of Mulahacen, Sagra, Bem Saabia, Filhaoussen, and Nador, every side and diagonal of which, except one, are the directions that are to be observed. He has even calculated and valued in round numbers the length of the sides of this geodetic chain. He has found—

	Metres.
Mulahacen-Filhaoussen .	273,400
,, Nador . . .	314,500
,, Bem Saabia .	272,200
Sagra-Filhaoussen . . .	313,300
,, Bem Saabia . .	271,000

The length of the terrestrial sides are—

	Metres.
Bem Saabia-Filhaoussen .	109,800
,, Nador . . .	104,800
Mulahacen-Sagra . . .	113,900

With those approximate numbers (and valuing at 0·08 the coefficient of refraction) he has calculated the altitudes of the two Spanish mountains. The measures thus obtained differ little from the real numbers—

	Metres.
Mulahacen	3,994
Sagra	2,398

given by Colonel Cuello, and thus furnish a new verification.

As the geodetic operations are being continued with great activity in Spain and in Algeria, we may hope that in a few years the geodetic bases of Great Britain, of France, Spain, and Algeria, reduced to the same unit of

* One centesimal second = 0'·33 ordinary second.

measure, can be connected by continual chains of triangles; and the meridian line of France already prolonged northward to the Shetland Islands, carried out in Spain by the officers of that country, will reach the African Continent and extend to the Sahara, with a length of 30°.

France will then be able to oppose to the Russian arc and to the one measured in Central Europe the French arc, which, passing over plains and very high mountains, will cross the North Sea and the Mediterranean.

There is thus considerable truth in the words of M. Faye:—"Let us not forget that the French, who are at the present time so often reproached with their geographical ignorance, are the real creators of continental or maritime geodesy, and that they have continually, since Cassini to our days, published admirable geodetic papers, which have served as models to our rivals; the truly learned men abroad have always acknowledged their value."

The map of Algeria will be constructed on the same plan as the map of France, to the scale of $\frac{1}{80000}$, but as it will be coloured, and as level curves will be substituted for hatchings, it will have considerable advantages over the latter.

M. CORNU

NOTES

THE French *Société d'encouragement* have awarded to Sir Charles Wheatstone, F.R.S., the Ampère medal for his remarkable works in theoretic and applied physics. The grand prize of 12,000 francs for the discovery most useful to French industry has been awarded to M. Pasteur, for the improvements he has introduced into the manufacture of silk, of wines, of vinegar, and of beer. A prize of 3,000 francs has been awarded to M. Gramme for the construction of an apparatus giving an electric current constant in direction and in intensity, whose electromotive force and conductibility are equal to those of an azotic acid pile of 60 or 80 elements of ordinary size, and superior both in economy and solubility to the apparatus which are at present in use.

AT the present time there are staying in England two illustrious physiologists, Prof. Kölliker and Prof. Fick, the former the renowned head of the Histological School, and the latter of the Physiological Institute in the University of Würzburg.

THE University of Cambridge has accepted a fund raised by several members of St. John's College for the purpose of founding a prize to be called the Adams Prize, for the best essay on some subject of pure mathematics, astronomy, or other branch of natural philosophy. The prize is to be given once in two years, and to be open to the competition of all persons who have at any time been admitted to a degree in the University. The examiners have given notice that the subject for the prize to be adjudged in 1875 is a Theory of the Reflection and Refraction of Light.

BY the present monthly mail a testimonial, consisting of a silver tea and coffee service, is being sent to Dr. Kirk at Zanzibar, by the Royal Geographical Society. The inscription states that it is given in recognition of the services Dr. Kirk has rendered to his country and to science by his generosity, intelligence, and zeal in the advancement of African discovery.

MR. A. H. GARROD, B.A., has been appointed Lecturer on Zoology and Comparative Anatomy at the Charing Cross Hospital. Mr. Garrod, we believe, intends to give a course of lectures during the summer.

AT the general monthly meeting of the Royal Institution of Great Britain, on Monday, April 7, the special thanks of the members were returned to Dr. Warren De La Rue, for his donation of 100*l*. towards the expense of fitting up the new Laboratories.

THE Report to the Board of Visitors of the Astronomer Royal for Scotland, gives a satisfactory account of the work, astronomical and meteorological, done at the Royal Observatory, Edinburgh. The alterations in the observatory have been completed, and the new equatorial, referred to in NATURE some months ago, is nearly ready for use, though we are sorry to see that its efficient working is very likely to be marred from want of funds. Though much needed for various purposes, Government (with a surplus of nearly five millions!) have absolutely refused to grant any additional aid to the Edinburgh Observatory. Prof. Piazzi Smyth compares his position to that of an "unfortunate artillery officer who should have received a big gun, of perhaps the most approved wrought iron and steel construction in itself, but without means of moving it, without powder and shot; and yet should be expected by the public to be continually firing it with immense success and at all sorts of objects throughout the whole year."

WITH reference to the sum of 500*l*. placed at the disposal of the Council of the Society of Arts, through Sir William Bodkin, by a gentleman who does not wish his name to appear, for promoting, by means of prizes or otherwise, economy in the use of coal for domestic purposes, the Council have decided to offer the following prizes:—1. For a new and improved system of grate, suitable to existing chimneys as generally constructed, which shall, with the least amount of coal, answer best for warming and ventilating a room.—The Society's Gold Medal and Fifty Pounds. 2. For a new and improved system of grate, suitable to existing chimneys as generally constructed, which shall, with the least amount of coal, best answer for cooking food, combined with warming and ventilating the room.—The Society's Gold Medal and Fifty Pounds. 3. For the best new and improved system of apparatus which shall, by means of gas, most efficiently and economically warm and ventilate a room.—The Society's Gold Medal and Fifty Pounds. 4. For the best new and improved system of apparatus which shall, by means of gas, be best adapted for cooking, combined with warming and ventilating the room.—The Society's Gold Medal and Fifty Pounds. 5. For any new and improved system or arrangement not included in the foregoing, which shall efficiently and economically meet domestic requirements.—The Society's Gold Medal and Fifty Pounds.

WE understand that the scientific authorities at Berlin are preparing a manual containing the necessary information for the requirements of the various expeditions sent out by the Imperial Government to observe the transit of Venus. The information given will by no means be confined to astronomical and physical subjects, but will incorporate all the branches of natural history. We hope our Government will follow so excellent a precedent, and associate a certain number of naturalists along with the astronomical observers, especially in situations where their observations are likely to prove of value.

THE forty tanks in the Brighton Aquarium, under Mr. Savile Kent's superintendence, are now well stocked with fishes, and present a most interesting field of study to the Ichthyologist. Eight of them are devoted to fresh-water fishes, and the remaining to the marine forms. Amongst the latter are fine specimens of the herring, lump-sucker, grey, streaked and red gurnets, sting-ray, balan wrasse, cook and cork-wing wrasses, and gold-sinny. Two species of dogfish have deposited eggs in their tanks, and the embryos are in process of development. The most recent addition to the fresh-water fishes is a fine salmon presented by Mr. Berridge, Chairman of the Usk Fisheries. The two porpoises are in excellent health, and feed well on smelts and small whitings. The large tank, 100 feet in length and containing 110,000 gallons of sea-water, gives them ample space for their gyrations.

ON Saturday afternoon last Professor Ansted was thrown with so much violence from a low basket phaeton in which he and another gentleman were driving, near Melton, that his thigh was broken, and a severe scalp wound inflicted. After being attended to by a doctor, he was removed to his house at Melton. Hopes of his recovery are entertained.

ON Saturday last Canon Greenwell, of Durham Cathedral, and Professor Rolleston, of Oxford, completed a series of very interesting excavations among the ancient barrows which exist in the Goodmanham and Etton Wolds, near Beverley, Yorkshire. There is a singular absence in these barrows of the implements so frequently found with ancient human remains in many parts of the country. Not only in the present excavations, but in those formerly instituted by Lord Londesborough, implements usually associated with ancient interments are entirely wanting. Contrary also to the generality of the barrows found on the wolds, which contain chiefly unburnt remains, in this locality they are for the most part burnt. Although this part of the country seems to have been extensively peopled, as these sepulchral remains betoken, there is a singular absence of implements, whereas in the north and middle wolds flint implements are found scattered about in all directions. Stone axes and other rude implements are abundant in the rest of the wold district, but they seem to have been entirely unknown in this locality, as many persons have searched for such remains without result.

THE Geographical Society of St. Petersburg has lately undertaken a new exploration of Russian territory in addition to those already carried on under its auspices. The plan consists in a minute exploration, under the leadership of M. Tschekanowsky, of the area between the lower affluents of the Yenisei and the Lena, embracing the basin of the river Olenek, which represents an important deficiency in the known portion of Eastern Siberia. Two years will be occupied in the exploration. During the first the expedition will descend the Lower Tunguska, and will reach Irkutsk by the Yenisei. During the second year it expects to reach the sources of the Olenek by sledges, to descend that river to its mouth, and then cross over to the Lena, and return by this river to Irkutsk.

THOSE who are interested in the mental advancement of women, should refer to the March number of the *American Naturalist*, in which they will find that the first article, on "Controlling sex in butterflies," is written by Mrs. Mary Treat. This lady has prosecuted her inquiries in a truly scientific spirit, and she records her results with the greatest precision and accuracy. An outline of her argument will be found in our notice of the periodical in which it appears.

DR. BROWN-SEQUARD has started a new journal, the *Archives of Scientific and Practical Medicine*, published at New York and London on the 15th of each month. His sub-editor is Dr. E. C. Seguin. This periodical will chiefly contain original papers on subjects belonging to every branch of the medical sciences. It will also comprise *résumés* of English and foreign papers, reports from the author's laboratory, and reviews of modern works on kindred subjects. The first number for January, which is beautifully printed, contains 100 pages, with one plate. In it Dr. Brown-Sequard contributes a paper on "Effects of Injuries of Nerves," and there are others by Dr. Seguin, Mr. Dupuy, Dr. Sands, Dr. Mary Putnam, and several able medical authors.

PETERMANN'S *Mittheilungen* thus speaks of the refusal of Government to grant an Arctic expedition this year:—"England, with her enormous wealth, her multitude of ships, sailors, and facilities for equipment, but above all with her great experience, could easily have sent out such an expedition, and with more prospect of success than any other nation; but the English Government, which appears to carry parsimony further than any other, has refused the request, at least for this year. But it is to be hoped that the undertaking, for which Government was also petitioned in 1865, will at last be afloat in 1874."

AT the meeting of the French Academy last week, M. Jamin exhibited a magnet which he had constructed to carry upwards of twenty-two times its own weight: it weighs 2 kilogrammes and carries 45. Hitherto the greatest carrying power attained in artificial magnets has been from four to five times their own weight. M. Jamin has obtained this unprecedented result by substituting for the very thick plates hitherto employed, a sufficient number of very thin plates superposed on each other, and all thoroughly magnetised. One result of this achievement will be that the volume and weight of magneto-electric machines can now be diminished to a very great extent.

A VERY full notion of the rapid material progress of Victoria in almost every direction may be obtained from the Official Catalogue of Exhibits of the Victoria Exhibition, opened at Melbourne in Nov., 1872. The entries number 1,682, and though there are very few connected directly with science, it would be unjust to form from this fact a low estimate of the progress made in scientific discovery by the colony; an investigation of the entries in the various departments shows that the principles of science have been abundantly taken advantage of in them all. It is gratifying to find, from the patent statistics, that every year shows an increase in the number of inventions connected with agriculture and manufactures, while the mining resources of the country continue to occupy a large share of the attention of inventors. The compiler of the catalogue claims with justice that Victoria has contributed a considerable amount of valuable data to various departments of science. Appended to the catalogue is an interesting essay on "Mining and Mineral Statistics, with Notes on the Rock Formations of Victoria," by Mr. R. Brough Smyth, F.G.S., Secretary for Mines for Victoria. A preliminary note gives some satisfactory statistics as to the progress of the Industrial and Technological Museum of Melbourne, which was opened in September 1870.

THE *Australian Mechanic*, in an article on "Science in the South," thinks "there is good reason for hoping that the time is rapidly advancing when even in Australia the enthusiasm of science will become a wide-spread sentiment, and when a deep and genuine interest will be taken in questions of a purely abstract kind." The *Mechanic* thinks it possible that ere long the Australians "may have the satisfaction of hearing a Tyndall, a Huxley, an Owen, and their worthy fellow-labourers expounding to delighted audiences in the Melbourne Athenæum, 'the fairy tales of science.'"

THE first number of *Cosmos*, the new Italian geographical journal, is handsome and well printed, and the contents creditable. There is a long article on recent expeditions to New Guinea, illustrated by a well-constructed map; and, of course, another long article on African exploration, also accompanied by a map. Another longish article is the first of a series on the Russian possessions in Central Asia. Altogether the first number of *Cosmos* is satisfactory, and we wish it a long career and a wide circulation.

THE Italian Geographical Society, by a unanimous vote, has conferred upon the Commendatore Negri Christoforo, who has so long and so perseveringly promoted geographical science among his countrymen, the title of perpetual president of the Society.

MESSRS. CHAPMAN AND HALL have sent us an elaborately constructed but perfectly intelligible "Table of British Strata," showing their order of superposition and relative thickness. Although the division into systems, series, and formations are very detailed, the size of the chart is such, and the use of colours is so judicious, that there is little danger of it causing perplexity and confusion to the young student; the plan seems to us admirably clear and useful, and the table is in the highest degree creditable to its constructor, Mr. H. W. Bristow, F.R.S., F.G.S., director of the Geological Survey of England and Wales. It is intended for the use of schools, but we are sure it will be welcomed by many geological students who have long left school.

M. FELIX PLATEAU describes in *Les Mondes*, an ingenious process, of his own invention, for drawing on paper white lines on a black ground—a method so frequently used for scientific illustrations—by means of which both author and artist will be able to judge of the effect of such an illustration before putting it into the hands of the engraver. A piece of thickish paper, as smooth as possible, a little larger than the intended illustration, is heated, say by laying it, with proper precautions against being injured, on the top of a stove, and a piece of bees-wax is rubbed over it until the paper is completely covered with a thin coating. A piece of glass, the size of the paper, is blackened by being held over a candle, and when thoroughly cooled it is laid on the waxed paper and rubbed firmly with the fingers, the result being that a blackened surface is produced on the paper, on which any design can be traced with a needle for the finer lines, or the back of a steel-pen for the thicker ones.

A GREAT international horticultural exhibition is to be held at the Alexandra Palace on May 24 and five following days, on the occasion of the palace being opened to the public.

GENERAL COMSTOCK'S "Annual Report of the Survey of the North and North-Western Lakes" of America for the year ending June 1872, contains the results of much well-planned and thoroughly well-performed work. A well-constructed map illustrates the many typographical and hydrographical data. One point we may mention is that General Comstock has come to the conclusion, as the results of several years' observations, that the moon and sun undoubtedly cause tides in Lake Michigan, though the rise of level is very small indeed; the combination of the two at syzigies giving a tide somewhat less than 0·12 of a foot.

DR. B. W. RICHARDSON, F.R.S., has been elected by the President and Council of the Royal Society, Croonian Lecturer on the subject of muscular motion.

AMONG the Candidates for the professorship of Anatomy to the Royal Academy are Dr. B. W. Richardson, F.R.S., and Mr. John Marshall, F.R.S.

THE *Academy* understands that Mr. Moggridge, author of "Harvesting Ants and Trap-door Spiders," recently reviewed in NATURE, has deposited specimens of the animals and their nests in the British Museum, and that they are exhibited in one of the public galleries.

THE additions to the Zoological Society's Gardens during the last week include a black Cuckoo (*Endynamys sp?*) from Madagascar, and a Seychellean Sternothere (*Sternothaera subniger*) from the Seychelles, presented by Commissioner H. C. St. John; four Spanish Terrapins (*Clemmys leprosa*), and six Greek land-tortoises (*Testudo græca*) from Morocco, presented by Sir J. Drummond Hay, K.C.B.: a Vulpine Squirrel (*Sciurus vulpinus* var *capistratus*) from S. America, presented by Mr. G. Moore; a Barbary Ape (*Macacus inuus*) from N. Africa, deposited by Lord Calthorpe; three Barbary Sheep (*Ovis tragelaphus*) born in the Gardens; a De Filippi's Meadow Starling (*Sturnella defilippi*) from Rio de la Plata, and a Black Kite (*Milvus migrans*), European, purchased; and two variegated Touracons (*Schirorhis africana*) from W. Africa, received in exchange.

PREHISTORIC CULTURE OF FLAX

DR. OSWALD HEER, the eminent botanist, and one who has devoted so much attention to the structure and history of fossil plants, publishes an article upon flax and its culture among the ancients, especially the prehistoric races of Europe. His memoir may be summarised as follows: First, flax has been cultivated in Egypt for five thousand years, and that it was and is one of the most generally diffused plants of that country. It occupied a similar position in ancient Babylonia, in Palestine, and on the Black Sea. It occurred in Greece during the prehistoric period, and at an early date was carried into Italy, while its cultivation in Spain was probably originated by the Phœnicians and Carthaginians. Second, it is also met with in the oldest Swiss lacustrine villages, while, at the same time, no hemp nor fabrics manufactured from wool are there to be found. This is considered a remarkable fact, since the sheep was one of the oldest domestic animals, and was known during the stone period. The impossibility of shearing the fleece by means of stone or bone implements is supposed to have been the reason why woollen fabrics were not used. It is thought probable that the skin, with its attached wool, was probably made use of for articles of clothing. Third, the lake dwellers probably received flax from Southern Europe, from which section fresh seeds must have been derived from time to time. The variety cultivated was the small, native, narrow-leaved kind from the coast of the Mediterranean, and not at all that now raised in Europe. It must, therefore, have been cultivated also in Southern Europe, although Dr. Heer could not ascertain among what people and at what age this took place. If this could be ascertained it would be an important point in the determination of the antiquity of the lake dwellers. Fourth, at the time of the empire both summer flax and winter flax were cultivated in Italy, as now, but in what form it was grown in ancient Egypt is not determined. It is thought probable that the narrow-leaved variety was first introduced, and after that the Roman, and then the common varieties followed. The common plant has doubtless arisen from the cultivation of the narrow-leaved, while the Roman winter flax and the *Linum ambiguum* constitute the intermediate stages. The original home of the cultivated flax was therefore along the shores of the Mediterranean. The Egyptians had probably cultivated it, and from them its use was doubtless disseminated. It is possible that the wild variety and the winter flax were grown elsewhere at the same time, when the cultivated variety had long since driven them out of use in Egypt.

SCIENTIFIC SERIALS

IN the *Journal of Botany* for February Dr. Trimen describes one of the most interesting additions recently made to the British flora, *Juncus pygmæus*, a well-known European species, discovered by Mr. W. H. Beeby in the already very rich locality of Kynance Cove, Cornwall. The article is accompanied by a good drawing. Mr. J. G. Baker gives a description of the little known *Rosa appennina*. In geographical botany Dr. W. M. Hind contributes a list of plants of North Cornwall. Mr. W. Phillips's notes on the blue reaction given by iodine in certain fungi may furnish a useful discrimination of difficult species. In the March number Mr. Worthington Smith gives a description, with coloured plate, of several new Hymenomycetous fungi from stoves; and Mr. J. A. Lees a useful paper on the peculiarities of plant-distribution in the neighbourhood of Leeds. Dr. H. F. Hance has an article on the "Ch'ing Muh Hsiang" or "Green Putchuk" of the Chinese, derived from a species of Aristolochia, the paper being illustrated by a copy of a native drawing. In both these numbers are also a variety of selected articles, short notes, and memoranda. We are glad to see this interesting journal taking so increasingly useful a place among our scientific periodicals.

AMONG the numerous articles of interest in the *Scottish Naturalist* for January (commencing the 2nd volume) we may single out especially, "On the occurrence of the hooded seal (*Cystophora cristata*) at St. Andrews," by Mr. R. Walker; a commencement of an article on Scottish gall-making insects, by Mr. P. Cameron, jun., illustrated by a beautiful coloured plate of *Nematus gallicola*; and a paper on the recent remarkable abundance of *Vanessa Antiopa*, the "Camberwell beauty," in this country, by the editor, who sums up strongly in favour of the native rather than the foreign origin of the insects captured in this country last year. We have also a continuation of the "Insecta Scotica," in instalments of the Lepidoptera of Scotland, by Dr. Buchanan White, and the Coleoptera of Scotland, by Dr. D. Sharp.

THE *Journal* of the Royal Geological Society of Ireland, vol. iii. part 2, N. S. (vol. xiii. part 2) contains :—Reply to the observations in Mr. Kinahan's paper "On the Carboniferous Rocks of Iceland," by Prof. Ed. Hull, F.R.S. (Abstract) ; On *Phaneropleuron Andersoni* (Huxley) and *Uronemus lobatus* (Agas.), by Prof. Traquair, M.D. (plate v.) ; Additional Notes on the fossil Flora of Iceland ; On *Filicites plumiformis* (Baily) from carboniferous limestone near Wexford, by W. H. Baily (plate vi.) ; Notes on the Carrara marble quarries, by Prof. E. Hull ; On a remarkable fault in the New Red sandstone of Rainhill, Lancashire ; and observations on the results determined by the Royal Commission into the Coal Resources of Great Britain and Ireland, by Prof. E. Hull ; Sketch of the physical geology of North Clare, by W. H. S. Westropp ; On tertiary iron ore in the County of Londonderry, by G. H. Kinahan ; and Notes on Woodwardite, by Prof. J. E. Reynolds.

THE *Monthly Microscopical Journal* for April is an excellent number, containing several valuable papers. Mr. Wenham gives his new formula for microscope object-glasses, recently read before the Royal Society. Till recently high objectives have been formed of eight lenses, a front and back triplet with a middle doublet, consequently the rays of light are subject to error arising from sixteen surfaces of glass. The author some time ago substituted a single thick plano-convex for the anterior triplet, and in so doing reduced the number of reflecting surfaces to twelve, improving the instrument so much that his system has been generally adopted. In the new object-glass the number of lenses is still further reduced to five, and the surfaces consequently to ten ; in it the front plano-convex remains, the back triplet is made the centre of the system, and the over corrected rays which leave it are rendered parallel at the point of emergence by a long focus plano-convex glass. In this combination therefore the whole correction is performed by a single concave of dense flint, and therefore two single lenses of crown, whose foci bear a definite relation to each other. Dr. Urban Pritchard's excellent observations "On the structure and function of the Rods of the Cochlean in man and other animals" are given *in extenso*. Dr. E. Hofman's paper on "Hair in its microscopical and medico-legal aspects" is translated, forming a concise summary for the student of forensic medicine. Dr. Maddox makes "Some remarks on a minute plant found in an incrustation of carbonate of lime," which he considers to be of the genus *Botrydium*, and names *B. minutum*.

THE *American Naturalist* for March contains an article by Mrs. Mary Treat, on "Controlling Sex in Butterflies." The authoress, as the result of an accident, observed that the larvæ of *Papilio asterias* when underfed almost invariably developed into male butterflies, but that when freely supplied with their favourite diet, they almost as certainly developed into females. She repeated these experiments on large numbers with the same result, and has verified them on *Vanessa antiopa* and the moth *Dryocampa rubicunda*. Mr. A. S. Packard criticises these results, and shows that the earliest indications of the sexual glands appear when the larva is but little developed, and that they are often fully formed when it is adult. There are papers by Profs. Marsh and Cope on the extinct Ungulata of the Wyoming district, in which some dates of publication are fully discussed. Among the other papers are, Prof. Perkins on "The Flying Squirrel ;" C. Ran, on "Indian Netsinkers and Hammerstones ;" and R. Ridgway, on "The Vegetation of the Lower Wabash Valley."

Ocean Highways, New Series, No. 1.—The new form of this valuable journal is a great improvement on the original unhandy form, though we do not think the increase in bulk is very great. This number is a particularly interesting one. The first article is called forth by the Khiva expedition, and gives a summary of the commercial and political history of the Caspian, and the region to the eastward ; it is illustrated by two good maps. "The Great Rivers of China" is the title of a short article by Dr. F. Porter Smith, while Mr. C. E. Austen, C.E., contributes a useful article, accompanied by an excellent map, on "Railways in Asia Minor." Mr. D. Hanbury has a short article on myrrh, the object of which is to induce travellers to collect data for its botanical elucidation. Prof. Mohn describes the origin and history of the Meteorological Institute of Christiania ; a map by the same gentleman is given, illustrating the explorations by Norwegian Captains about Spitzbergen in 1872 ; accompanying which is a short editorial paper on Wiche's Land, defending the name given to it by Edge in 1617. One very interesting paper is by Mr. T. F. Hughes, on "Formosa and its southern Aborigines." "In this fair island of the distant eastern seas," he says, "there is still a mine of discovery and information awaiting the cunning hand of the scholar and traveller." Reviews, notes, reports, correspondence, &c., complete this interesting number.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, April 3.—"On the Structure of Muscular Fibre," by E. A. Shafer.

"Note on the Synthesis of Marsh Gas, and the Electric Decomposition of Carbonic Oxide," by Sir B. G. Brodie, F.R.S.

"On an Air Battery," by Dr. Gladstone, F.R.S., and A. Tribe.

Chemical Society, April 3.—Dr. Odling, F.R.S., &c., president, in the chair.—A paper on "A method of determining with great exactness the specific gravity of liquids," was read by the author, Dr. Sprengel. The instrument, consisting of a U-shaped glass tube terminating in capillary tubes bent at right angles, is very delicate when proper precautions are taken.—The second paper, entitled "Researches on the action of the copper-zinc couple on organic bodies :—No. II. on the iodides of methyl and amyl," by J. H. Gladstone, F.R.S., and A. Tribe, is a continuation of the authors' researches on this subject, an account of which they communicated to the Society some short time ago.—Dr. C. R. A. Wright then read a memoir "On Cymene from various sources," in which he gives the results of his examination of cymene prepared from eight different sources, showing them to be identical.—The last paper was by Dr. H. E. Armstrong, being No. XI. of "Communications from the Laboratory of the London Institution ; action of the acid chlorides on nitrates and nitrites—Part I. Acetic chloride."

Zoological Society, April 1.—Mr. R. Hudson, F.R.S., vice-president, in the chair.—A communication was read from Dr. J. S. Bowerbank containing a description of the brain and of a portion of the nervous system of *Pediculus capitis*.—A communication was read from Dr. J. E. Gray, F.R.S., containing remarks on the genera of Turtles (*Oiacopodes*), and especially on their skeletons and skulls.—A second communication from Dr. Gray contained the description of the skull of *Sternothaerus*.—Dr. A. Günther, F.R.S., read descriptions of three new species of Flying Squirrels, proposed to be called *Pteromys tephromelas*, from Penang, *P. phæomelas*, from Borneo, and *Sciuropterus pulverulentus*, from Penang and Malacca.—Mr. O. Salvin made some remarks on the tail-feathers of the birds of the genus *Momotus*, and on the mode in which their peculiar form had originally arisen.

Geological Society, March 26.—His Grace the Duke of Argyll, K.T., F.R.S., president, in the chair. The following communications were read :—1. "Synopsis of the younger formations of New Zealand," by Capt. F. W. Hutton, F.G.S., of the Geological Survey of New Zealand. In this paper the author gave a summary of the Tertiary and later Secondary formations of New Zealand. He stated that he had been able to determine 375 species of true Mollusca, 12 of Brachiopoda, and 18 of Echinodermata from the Tertiaries ; and under each of the formations which he recognises he gave the number of species of true Mollusca found in it, indicating the number of recent species, and of those belonging to other formations occurring in each. He also noticed the range and distribution of the various formations. The Tertiary groups of strata distinguished by the author are, in descending order, as follows :—I. Pleistocene. II. Pliocene : 1, the Newer Pliocene or Whanganui group : 2, the Older Pliocene or Lignite group. III. Miocene : 3, Upper or Arvatere group ; 4, Lower or Kanieri group. IV. Oligocene : 5, Upper or Hawke's Bay group ; 6, Lower or Waitewata group, V. Eocene : 7, Upper or Ototara group ; 8, Lower or Brown Coal group. As belonging to the Mesozoic series, the author also described beds of Danian age, under the name of the Waipara formation. A species of *Belemnitella* occurs in beds belonging to the Ototara group, and also in the Waipara formation. Volcanic action commenced in the North Island during the deposition of the Waitewata group, and has since been almost continuous in the northern, western, and central parts of the island. In the South Island the volcanic formations appear to belong to the later Cretaceous, Oligocene, and Miocene periods. The volcanic rocks of the Chatham Islands belong chiefly to the Upper Oligocene.—2. "On the Tree-ferns of the Coal-measures, and their relations to other living and fossil forms," by Mr. W. Carruthers, F.R.S., F.G.S. The author pointed out that there existed in the Coal-measures two very distinct kinds of fern-stems, each represented by several species. The first group had a stem-structure like that of living tree-ferns. In them the vascular elements of the stem formed a closed cylinder round the pith; and the vascular bundles for the leaves were given off from the out-turned edges of the cylinder, where, at regular intervals, corresponding to the position of the leaves, narrow meshes occur for this purpose. In the second group the stems differed from the other group chiefly in having the ends of the vascular plates, as seen in the transverse section, turned inwards, and having the bundles of the leaves formed in a complete condition in the axis of the stem.—3. "Notes on the Geology of Kazirùn, Persia," by Mr. A. H. Schindler. In this paper, which accompanied a series of specimens presented to the Museum of the Society, the author described the section presented by the hills in the neighbourhood of Kaizirùn. The general surface was described as consisting of nearly unfossiliferous Post-tertiary deposits, immediately beneath which is an unstratified marine deposit containing a great abundance of fossils, among which are species of *Ostrea*, *Pecten*, and *Cidaris* (?). Below this deposit is a succession of strata, repeated several times in the hills, and at the bottom of the series in each case is a bed of gypsum. The spaces between the recurrent series are filled up with conglomerates. Beneath the gypseous series is a formation of compact limestone, which rises to a height of about 1500 feet both north and south of the plain of Kazirùn; its beds dip 25°, and their strike is from N.E. to S.W.

Royal Microscopical Society, April 2.—Mr. Charles Brooke, F.R.S., president, in the chair.—A paper was read by Mr. Henry Davis on a new species of *Callidina* (*C. vaga*), the distinctive characteristics of which were fully described and living specimens exhibited. Mr. Davis also detailed a series of experiments upon the dessication of rotifers, the results of which tended to prove that although they could not be revived after having been once actually dried up, it was quite possible for them to survive what was generally accepted as actual dessication, and that they would resist not only a sustained temperature of 200°, but also exposure for a long period in the exhausted receiver of an air-pump with sulphuric acid. He pointed out and proved by experiment, that during the process of drying the gelatinous matter which was secreted by these rotifers contracted around them, forming an impervious envelope and effectually preserving within it sufficient moisture to sustain life.—A communication was read from Mr. Parfitt, of Exeter, descriptive of a presumed new animal, apparently related to the annelids.—A fine preparation of malpighian capsules from the kidney, was exhibited and described by Mr. Stewart.

Anthropological Institute, April 1.—Prof. Busk, F.R.S., president, in the chair. The president read "Remarks on a Collection of Ancient Peruvian Skulls presented to the Anthropological Institute, by Mr. T. J. Hutchinson, H.B.M. consul at Callao." The skulls were collected by the Consul from the "Huacas" near Santos, to the north of Callao, which were considered by him to be those of Chinchas, or Huancas, or perhaps of Quichmas, or Aymaras, all of which tribes are now probably absorbed into the Cholas, a Mestizo race; from Ancon, from Pasamayo, about thirty miles north of Callao, and from Cerro del Oro in the Canete Valley —in all 156 specimens. After giving further detailed descriptions on the authority of Consul Hutchinson, the author passed to the consideration of the characters presented by the crania exhibited. Such of the specimens as he had been able to measure yielded the following results:—"The mean length was about 6·25 in., and the breadth 5·6 in., giving a cephalic or latitudinal index of ·905, only two falling below ·800. In that estimate were included both normally-shaped and artificially compressed skulls. The cephalic index of the supposed normally shaped, was ·873, the greatest being ·935, and the least ·812; and of the clearly artificially deformed, ·979; the greatest being 1·32, and the least ·861. Those figures showed how very much the latitudinal index was exalted by the fore and aft compression of the skull. The altitudinal index of the normal skulls was ·843, that of the compressed ·878. The mean capacity of the larger and male skulls appeared to show a result of about 80 cubic in. equivalent to brain of about 45 oz. roughly estimated, which result indicated that the crania were of small size.—The president communicated a paper by Mr. J. M. Reade, "On a human skull and fragments of bones of the Red Deer found at Birk Dale, Southport."

Meteorological Society, March 19.—Dr. Tripe, president, in the chair—The president informed the meeting that at the last meeting of Council a letter was read containing Mr. Glaisher's resignation of the Secretaryship, and that after much consideration the Council had accepted it with great regret; that they had then appointed Mr. Cator to the vacant office for the remainder of the session, and elected Mr. Glaisher to the seat on the Council thus rendered vacant, which he was glad to say Mr. Glaisher had accepted.—The first paper read was by Mr. R. H. Scott, F.R.S., "On some results of weather telegraphy," in which he laid before the Society some of the special circumstances connected with that service. He stated that the information received was insufficient, both in quantity and quality, to give a complete idea of the weather, and showed how any serious extension of the system would entail greatly increased expenditure, citing the very large cost (50,000*l*. per annum) of the American signal service, the most perfect in existance. He drew attention to the frequency of telegraphic errors, and the serious results arising therefrom. He next proceeded to discuss the probability of our deriving benefit from additional reports from the Azores, &c., and showed by actual investigation that such reports would not be of immediate use to these islands in regard of giving notice of advancing storms. The modes of conveying warnings to ships were next mentioned, and Mr. Scott stated his belief that ultimately Admiral Fitzroy's drum and cones would be adopted, though not perhaps in the significations originally attached to them.—The other paper was by Mr. W. Marriott, "On the Barometric Depression of January 24, 1872." This depression occurring in the early morning hours, very few observations had been made at the time of lowest pressure; but from those which he had received, the depression appears to have first touched the English coast near Falmouth about midnight, and to have passed along the coast to Upwey, which was reached about 3 A.M.; it then took a northerly course and passed near Birmingham at 6 A.M., after which it crossed Derbyshire, Nottinghamshire, and Lincolnshire, and passed out of the Humber between 10 and 11 A.M. He stated, however, that the evidence was insufficient to prove that this was its actual course, or whether it merely passed over England in a N.E. by N. direction at a uniform rate of about 30 miles an hour. The lowest readings of the barometer were 28·18 in. at 4.30 A.M. at Clifton, and 28·179 in. at 5.20 A.M. at Evesham. The paper concluded with a few remarks on former depressions.

Institution of Civil Engineers, March 25.—Mr. T. Hawksley, president, in the chair.—"The Mont Cenis Tunnel," by Mr. Thomas Sopwith, jun., M. Inst. C. E. This communication might be considered as supplementary to a former paper read in 1864—(Min. Proc. Inst. C. E., vol. xxiii., p. 258)—and described, (1) the Tunnel, as completed, with statistics obtained either by actual observation or from the Engineers in charge, or from official publications of the Italian Government; (2) the principal changes which had been introduced in the works and machinery underground and at the surface since the summer of 1863.

MANCHESTER

Literary and Philosophical Society, March 18.—Dr. J. P. Joule, F.R.S., president, in the chair.—"Observations on the Rate at which Stalagmite is being accumulated in the Ingleborough Cave," by W. Boyd Dawkins, F.R.S. He thinks it evident, from his researches, that the value of a layer of stalagmite, in fixing the high antiquity of deposits below it, is comparatively little. The layers, for instance, in Kent's Hole, which are generally believed to have demanded a considerable lapse of time, may possibly have been formed at the rate of a quarter of an inch per annum, and the human bones which lie buried under the stalagmite in the cave of Bruniquel are not for that reason to be taken to be of vast antiquity. It may be fairly concluded that the thickness of layers of stalagmite cannot be used as an argument in support of the remote age of the strata below. At the rate of a quarter of an inch per annum 20 feet of stalagmite might be formed in 1,000 years.—"On Methyl-alizarine," and Ethyl-alizarine," by Edward Schunck, Ph.D., F.R.S.—"On the Transition from Roman to Arabic numerals (so-called) in England," by the Rev. Brooke Herford.—"Notes on the Victoria Cave, Settle," by William Brockbank, F.G.S. For various reasons, he submitted, there is no ground for the theory of glacial action as put forth by Messrs. Boyd Dawkins and Tiddeman, but on the contrary that the filling of the Victoria Cave was the work of long ages, by the action of running water, and that there is no reason to suppose that the remains found in it are older than the glacial epoch.—The President exhibited a syphon barometer, the peculiarity of which consisted in the introduction of a small quantity of sulphuric acid over the ends of the mercurial column.—Mr. Spence, F.C.S., communicated to the Society the result of an experiment in heating a diamond, which will considerably modify the general impression as to that gem being combustible only at an extremely high heat. A friend of his had brought over a number of diamonds from the African mines. Some of these were what is called "off colour," not being purely white, and he put one of these into Mr. Spence's hands to try some experiments for displacing the colour if practicable. This diamond, the size of a small pea, was immersed in fire-clay in a small crucible, the clay being mixed with a little carbonate of soda and hydrate of lime; the crucible was then placed in a muffle, and for three days and nights exposed to a heat, which at no time was beyond a low cherry red. After cooling, the crucible was broken, and the lump of hardened fire-clay was carefully broken up to extract the diamond; after two or three fractures of the lump an impression or hole in the indurated clay was discovered just at the spot where the diamond should have been, but not a vestige of the precious stone remained.

DUBLIN

Royal Irish Academy, March 15.—The Rev. Prof. Jellett, B.D., president, in the chair. The annual report of the council was read by Dr. Ingram, secretary to council. The election of the president and members of council was proceeded with, when the Rev. J. H. Jellett, B.D., was re-elected President.

Royal Geological and Zoological Societies of Ireland. A joint meeting of these societies was held on Wednesday evening, March 12. Colonel Meadows Taylor read a paper on the coal fields of Central India.—Prof. Edward Hull, F.R.S., read a paper on the Microscopical Structure of the Limerick Carboniferous Trap Rocks.—A Geological Map of New Zealand, and a fine recent specimen in spirits of *Pentacrinus Mülleri* Orst were exhibited.

PARIS

Academy of Sciences, March 31.—M. de Quatrefages, president, in the chair.—The following papers were read:—On the theory of the normal magnet, and on the means of indefinitely increasing the force of magnets, by M. J. Jamin.—On the carpellary theory of the Ranunculaceæ, by M. A. Trecul.—On the proposed apparatus for pumping out and elevating water by means of the action of waves on the shores of the Mediterranean, by M. A. de Caligny. The author has suggested a means of utilising the force of the waves for the above purposes.—New papers on the shock of earthquake in Italy, observed on the 12th of March, 1873, by M. P. de Tchihatchef.—The Academy then proceeded to elect a member in the place of the late Marshal Vaillant. After two votings, in which no candidate obtained an absolute majority, a ballot was proceeded with, when M. Cosson obtained 31 and M. de la Gournerie 30 votes. M. Cosson was then declared duly elected.—A report on two memoirs on the silicified vegetables of the Autun coal measures, by M. B. Regnault, was then read, and followed by M. Roger's fourth memoir on capillary phenomena, which dealt with the mathematical nature of the subject.—On a new method of optically determining the velocity of projectiles, by M. M. Deprez. The method consists in attaching a magnesium fuse to the projectile and observing its flight by means of two telescopes. The method is an application of that used for meteors.—The Secretary read a number of extracts from a paper on a new classification of clouds, by M. Poey.—On certain points in M. Faye's theory of the solar spots, by M. Tacchini. Father Tacchini thinks that the hydrogen carried down by cyclones, according to M. Faye's theory, would become so violently heated that it would rush back with such force as to destroy the cyclone, and also that if such a process really occurred the gas would carry up with it metallic vapours; as these are not generally visible in prominences, he thinks the explanation untenable.—On the foci (*faisceaux*) of circles, by M. Ribaucour.—On the spectrum of boric anhydride, by M. Lecocq de Boisbaudran.—On alcohol and normal acetic acid from milk considered as products of the functions of microzymes, by M. A. Béchamp.

DIARY

THURSDAY, April 10.

Mathematical Society, at 8.—On Systems of Porismatic Equations, Algebraical and Trigonometrical; Note on Epicycloids and Hypocycloids; Locus of point of concourse of perpendicular Tangents to a Cardioid; Elliptic motion under acceleration constant in direction: Prof. Wolstenholme.—On the calculation of the Value of the theoretical unit-angle to a great number of decimal places: Mr. J. W. L. Glaisher.

SATURDAY, April 12.

Royal Botanic Society, at 3.45.

TUESDAY, April 15.

Statistical Society, at 7.45.

WEDNESDAY, April 16.

Society of Arts, at 8.—On the Condensed Milk Manufacture: L. P. Merriman.

Meteorological Society, at 7.—On a proposed new form of Rain Gauge, "The Atmospileometer:" J. J. Hall.—Discussion on the Report of the Proceedings of the Meteorological Conference at Leipzig.

London Institution, at 7.—Third Musical Lecture: Prof. Ella.

THURSDAY, April 17.

Linnean Society, at 8.—Burmese *Orchideæ*, from the Rev. C. P. Parish: Prof Reichenbach.—Perigynium of *Carex*: Prof. McNab.

Chemical Society, at 8.—On Heat produced by Chemical Action: Dr. Debus, F.R.S.

Numismatic Society, at 7.

Zoological Society, at 4.

BOOKS RECEIVED

English.—A Manual of Photography. 8th edit.: G. Dawson (Churchill).—Electricity and Magnetism. 2 vols: C. Maxwell (Macmillan).—Flies and Fly-fishing: Capt. St. J. Dick (R. Hardwicke).—A Catalogue of the Collection of Cambrian and Silurian Fossils in the Geological Museum of the University of Cambridge: J. W. Salter, Prof. A. Sedgwick, Prof. Morris (University Press, Cambridge).—Fever and Cholera from a new point of view: A. Smith (Calcutta).—Illustrated Guide to the Fish Amphibian, Reptilian and supposed Mammalian remains of the Northumberland Carboniferous Strata, with Atlas; T. P. Barkas (Hutchings).—A Journey through the Caucasus and the interior of Persia: A. H. Mounsey (Smith and Elder).—A Journey to the Source of the River Oxus. 2nd edit.: Capt. J. Wood (Murray.)—Turning for Amateurs.—Birds of the Humber District: J. Cordeaux (Van Voorst).—A General System of Botany, Descriptive and Analytical: Emm. de Mout and J. Decaisne. Translated by Mrs. Hooker, Edited by Dr. Hooker (Longmans).—The Principles of Animal Mechanics: The Rev. S. Haughton (Longmans).—Field and Forest Rambles: A. L. Adams (H. S. King & Co.).

PAMPHLETS RECEIVED

English.—The Agricultural Returns of Great Britain for 1872.—Quarterly Weather Report of the Meteorological Office, Pt. 2, April–June, 1872.—A Message to the British Entomologists by the Ghost of the Rector of Barham: E. W. Janson.—Journal of Mental Science, No. 49, April: H. Maudsley and Thos. Clouston, M.D. (Churchill).—The Potato Disease, its cause and its remedy: S. Smith (Smart & Allen).—General Report on the Operations of the great Trigometrical Survey of India during 1871-2: Major Montgomerie, R.E., F.R.S.

Foreign—Anales del Museo Publico de Buenos Aires, 1872-73.—Report of the Commissioners of Fisheries of the State of New York.—Recherches expérimentales sur l'influence que les changements dans la pression barometrique exercent sur les phenomenes de la vie (8th note): M. P. Bert.

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