THURSDAY, JULY 2, 1874

ON OSTEOLOGICAL MONOGRAPH-WRITING

IN biological Societies, and in others which have any biological interests, there is a question which is daily becoming more and more prominent; one that if not fully investigated shortly will lead to results which are far from advantageous to the science itself, and will throw discredit on its votaries; whilst, if some decided opinion is expressed in such a manner that no doubt can be entertained as to its true meaning, much hard work and unnecessary disappointment may be easily saved.

Some half century or so ago, when zoology was just commencing a new lease of life, as it may be termed, the opportunities afforded to those who were studying the anatomy and physiology of the animal kingdom were comparatively few. Museums were scarce; most of those existing being very incomplete in an educational point of view, and it was almost impossible to procure specimens of any desired species by means of a pecuniary offer. The case is now, however, extremely different. Museums are numerous, and are daily becoming more so. The facilities for locomotion make it easy for anyone anxious to see what cannot be obtained nearer, to visit the British Museum or that of the Royal College of Surgeons; there are dealers who are able to offer typical specimens at a moderate price, and to obtain the rarer forms if necessary. Such being the case it must be evident that a certain change ought to have come over zoological literature, in order that it should progress with the science itself. What was then indispensable is now no longer required, and that which was then unknown takes its place. Nevertheless there are a few comparative anatomists who do not seem to realise the change which has so gradually and so markedly occurred. They think and write with the ideas of fifty years ago, and, what is more, expect us to appreciate their productions as if they were not the least *de trop*.

Formerly, no doubt, it was extremely valuable to have descriptions given in print of the detailed anatomy of particular species. Of their osteology this was especially the case. These descriptions drew attention to previously scarcely recognised characters, and, what was perhaps still more important, did much to fix the nomenclature of the skeleton generally; because, though this had been previously accomplished as far as human anatomy is concerned, there are many reasons, known to all practical students, which make the names adopted in anthropotomy unsatisfactory and incomplete when they have to be applied to the lower vertebrata.

The case is now very different. Skeletons of almost all known animals being contained in museums, and those of common species being abundant, any student prosecuting his investigations in the spirit which insures successful results, will find no difficulty in obtaining opportunities of handling and comparing the bones themselves, and will have but little or no need to refer to plates or descriptions, which are never so satisfactory as the specimens themselves, and are often as difficult to obtain as they are expensive to purchase.

It therefore becomes a question, and a not unimportant one either, as to whether it is to the best interests of our learned Societies to expend their funds in encouraging the further publication of long and exhaustive descriptions of the osteology of common types, and the execution of a large number of elaborate drawings of bones, whose intrinsic worth is considerably less than the cost of their putting on wood or stone. In several instances within the last two or three years, lengthy papers, without doubt the result of much time and attention, have been presented to different Societies, evidently with a full idea on the part of the authors that their monographs will be published, unopposed, in the form in which they send them in; and yet these many pages are found to contain nothing more than the monotonous and unsuggestive descriptions of the bones, one by one, and surface by surface, profusely illustrated, of animals as common as some of the best-known Marsupial mammals or Struthious birds.

A full account of the myology, neurology, or visceral anatomy of almost any animal has a value which no one would wish to depreciate in the least, because these parts are difficult to preserve, and it requires a special training, together with considerable experience in one direction, before such investigations can be undertaken, as they are but too infrequently. But as bones are so easily preserved in a state which cannot shock the most delicate hands or the most sensitive nose, there is no excuse for any student not practically knowing the most important peculiarities of any skeleton, nor for his not prosecuting his investigations to any degree of minuteness when occasion requires.

It has been remarked that these fully illustrated monographs are of especial value in palæontological investigations; that the study of the Pleistocene remains of Australia, for instance, can be conducted on the spot with greater facility when comparisons can be made with existing forms. But, we may ask, where can it be easier, than in Australia itself, to obtain the skeletons of now living Marsupials? and we all know how much better it is to have the bones themselves than drawings of them, however well executed. Further, it has been said that after a certain time it is impossible for any author, however able, to continue to develop generalisations and theories from any number of fresh facts; and such being the case, can those who really like their subject do better than devote themselves to the careful description, uncomplicated with any attempt at inductive reasoning, of what they have the opportunity of observing? We think they can, for we see no reason why the inferior productions of an able man should, on account of his previous reputation, be allowed to be placed on a level with the better work of others, and above those productions of the same quality, the attempts of less known authors.

The fact, however, is that the time is passed for the publication as simple statements of the commonplace facts of osteology; the subject is more than overloaded with them already. What is now wanted is the application to them of some methods by which, like the doctrine of evolution, or the vertebrate theory of the skull, those at present on hand may be turned to better account in determining the true affinities of different animals, or the means by which the present state of things has been arrived at. The comparison of simple fact-accumulation to the introduction of fresh methods of research, or lines of thought, is so insuperably in favour of the latter, that the former has quite descended below the level of that quality of work which needs the distinguishing encouragement afforded by the publication of the results obtained in the "Transactions" of any learned Society.

PICKERING'S "PHYSICAL MANIPULATION"

Elements of Physical Manipulation. By Edward C. Pickering, Phayer Professor of Physics in the Massachusetts Institute of Technology. Part I. (London: Macmillan & Co., 1874.)

TO write a satisfactory text-book for students in physical laboratories is a task beset with difficulties; and although Prof. Pickering has had the advantage of no small experience and judgment in the composition of the work the title of which is given above, we do not think that he has entirely overcome them.

There can be little doubt that oral teaching is that which is best suited to students who are beginning experimental work of any sort, and that as much may often be learnt in five minutes by seeing another perform an experiment as would be acquired in as many hours with the aid of a book alone to explain the construction and use of the apparatus; and Prof. Pickering is therefore right in aiming at supplementing rather than superseding the efforts of an instructor.

The work is divided into sections, each of which relates to one or more experiments, and comprises two parts, the first of which, entitled "Apparatus," gives a description of the instrument required, and is designed to aid the instructor in preparing the laboratory for the class, while the second, headed "Experiment," explains in detail to the student what he is to do.

The subjects treated of in the first volume, the only one at present published, are Mechanics, Sound, and Light, an arrangement that does not agree with the order in which they would probably be studied in the laboratory, as the elementary parts of heat ought certainly to be taken with mechanics; but the plan adopted has the advantage that heat and electricity, the subjects in which tables are most required for reference, will be placed together in the second volume, in which also, we presume, sets of tables will be included among the "matters of general interest to the physicist" that are promised in the preface.

Apart, however, from any detailed criticism, we must notice the important preliminary question, how far a work of this sort is likely to fulfil the object with which it is written, of enabling an instructor to superintend a larger class than he could otherwise attend to at once? The members of the class, according to the method of instruction pursued in the Massachusett's Institute, and described in the preface, are not informed precisely what experiments will be allotted to them until they enter the laboratory, and as such is the plan probably generally adopted where the number of pupils is large, it is absolutely necessary for the instructor to have at hand, either in a text-book or in manuscript, short papers on the theory of the different experiments. We do not, however, feel sure that the descriptions of apparatus and methods of performing experiments will prove so valuable as might at first sight appear probable. The instruments required for physical work are often so costly as to make constant supervision necessary over those who are not accustomed to them, and their construction is so various, at all events in minor particulars, that directions for their use which might be all that could be desired in one laboratory might be misleading in another. Another difficulty arises in describing experimental proofs of the simpler laws of Mechanics and Physics which do not require elaborate apparatus for their exhibition, as a choice has often to be made between several different methods, an account of all of which would make the text-book unwieldy in bulk, while the omission of any is apt to make it less useful in laboratories other than that for which it was originally intended. The selection of experiments of this sort must in great measure depend upon the time the pupil is able to devote to the study of physics, the objects he has in view in pursuing it, and in many cases upon his knowledge of mathematics; and we regret that Prof. Pickering seems occasionally to have chosen those which are likely to give the best numerical results, in preference to others which, depending more upon skill, are not indeed so suitable for the exact verifications of physical laws, but have a greater educational value in improving the powers of observation.

The method selected, for instance, for illustrating the laws of falling bodies is that of suspending a ball to a spring, which, when the connecting thread is severed and the ball allowed to fall, completes a galvanic circuit in which a chronograph is included, and which is again broken by the impact of the ball on a plate placed below to receive it. This method is well adapted to show the relation between the time of falling from rest and the distance traversed; but Attwood's machine, of which no account is given, illustrates the fundamental laws of dynamics much more completely, is capable, if fitted with proper electric arrangements, of giving extremely good results, and is better suited for use by the pupil, as in our opinion all such instruments ought at first to be used, with some means of measuring time, such as the stop-watch, water-clock, or metronome, dependent upon skill, and not upon a purely mechanical arrangement.

Some of the experiments described are avowedly given as a preparation to those who may have to give lectures on physics, and others are, we presume, inserted with the same intention, as it would hardly be necessary for those possessing that "moderate familiarity with the general principles of physics" which "the class is supposed to have previously attained" to spend time over the experimental proofs given of the laws of the composition of forces, or the equality of the angles of incidence and reflection.

The earlier pages of the book are devoted to general remarks on physical measurements, and on methods of working up the results of experiments, and they will prove very useful.

The knowledge of mathematics assumed throughout is small, and in several instances the line has in this respect been drawn too tightly, no account being given of the method of determining the coefficient of torsion by means of the torsion pendulum, or of the determination of gravity by the reversible pendulum, probably on account of the small amount of rigid dynamics required in these problems.

In a book, however, which must necessarily be intended for use by pupils of very different attainments, it would be difficult to avoid criticisms of this kind, and we think the experiments on the whole judiciously selected and clearly explained. We shall look with interest for the appearance of the second volume, and when finished "Physical Manipulation" will no doubt be considered the best and most complete text-book on the subjects of which it treats. A. W. R.

OUR BOOK SHELF

Mineralogy. By F. Rutley, F.G.S. (Murby's Text Books.)

MR. RUTLEY'S little treatise on mineralogy has the merit of expressing in a clear and simple form the facts that are most wanted to be known by the general student of a science for which a small elementary English book is needed. The descriptions are concise, and the selection of the matter under each mineral generally good. Mr. Rutley, furthermore, gives some fifty pages of preliminary matter, which, though not always put in the most intelligible form, yet embodies a considerable amount of useful technical teaching in regard to the physical properties of minerals. Mr. Rutley even enters, and very rightly does so, on the subject of optical characters. But in these pages, as in the page on thermo-electricity, the author does not seem to have carefully revised what he wrote, or he would not have followed other authors in speaking of boracite as a uniaxal crystal, and would hardly have classed the dispersion of light by a diamond with the play of colour exhibited by an opal. Nor is an optic axis correctly described as the only direction by looking along which the doubly refracted images of a spot can be got to coincide, as Mr. Rutley will see if he looks at the spot through two opposite faces of the hexagonal prism of a calcite crystal. He ingeniously endeavours to indicate the nature of the faces of his crystals by a sort of heraldic hatching and marking. The use of small letters always indicating the character of the faces, as in Des Cloizeaux and other French treatises, might have done this usefully; Mr. Rutley's puzzling figures will probably only serve to scare away the English student, who needs every allurement to the study of the neglected science of crystallography—a science neglected merely because the rudiments of geometry and trigonometry are not made a necessary part of every scientific student's education. And it is a significant circumstance in connection with this neglect of scientific crystallography, that the geometrical methods and simple notation introduced forty years ago by our distinguished fellow-countryman, the first living crystallographer, Prof. Miller, are, we believe, untaught in any single lecture-room in London. Is England to be the last country to adopt a system made European by Sénarmont, Sella, Beer, and Grailich, and which is fast overcoming even in Germany itself a natural prejudice in favour of the more unwieldy, though in its time useful and ingenious, notation of the great Leipsig Professor?

Sanitary Arrangements for Dwellings, intended for the use of Officers of Health, Architects, Builders, and Householders. By William Eassie, C.E., &c. (Smith, Elder and Co. 1874.)

THIS volume gives, in a collected form, a series of papers published originally in the *British Medical Journal*. Its object, the author states, is to give "an account of the most ordinary sanitary defects in dwelling-houses and public institutions, in respect to drainage, water-supply, ventilation, warming, and lighting;" and "to set forth,' what he believes, "the most simple and effective means of *preventing* or *remedying* such defects." He thinks it necessary to say further:—"The purpose of this small work is to point out, in the plainest language, what ought to be done to render ancient and modern houses healthy. I will eschew all extraneous matter, as much as possible, and will not fall into the common practice, better honoured in the breach than the observance, of heading the chapters, or interlarding the matter, with lines from the poets." It is but due to the author to say that he has faithfully avoided this tendency "to drop into poetry" on the subject of house-drains, sewers, &c.; on the plainness of the language, however, we cannot speak very highly. Many householders, it is to be feared, will find some difficulty in recognising an S-shaped pipe under the name of a "sigmoid"; or in appreciating the beauty of a description in which the overflow sewage from a cesspool is said to "debouch into the fields."

The greater part of the book is occupied with a description of the various sanitary appliances for buildings which have from time to time been proposed, or which have been brought into actual use: such as drain-pipes, of which twenty-two different kinds are figured and described; traps, of which thirty-six are given; fire-grates and stoves, &c. In many places, indeed, it reminds us of nothing so much as a manufacturer's or tradesman's catalogue. On the whole, however, this work contains much useful information and many excellent suggestions. On the subject of house-drainage, we are glad to see that Mr. Eassie has adopted and advocates the principle of leading all house-drains into one collecting drain, outside the house if possible, and placing in this main drain an efficient trap, properly ventilated, so as to prevent any of the sewer gases finding their way into the house through the drains or pipes.

LETTERS TO THE EDITOR

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

Robert Brown and Sprengel

IN the notice of Mr. Darwin (vol. x. p. 80, bottom ot 2nd col.) a mishap has somehow occurred which blunts the point intended to be made prominent and renders the statement untrue. I supposed that I had written "*And* we know from another source that he (Mr. Brown) looked upon Sprengel's ideas as *by no means* fantastic. Yet instead," &c. The object was to show how very near Mr. Brown came to reaching the principle that Nature abhors close-fertilisation in plants, and yet did not reach it at all. The authority for the statement I wished to make will be found in a footnote in Mr. Darwin's book on the "Fertilisation of Orchids," p. 340. ASA GRAY

Cambridge, Mass., June 19

On the Physical Action taking place at the Mouth of Organ-pipes

THE most interesting, and perhaps the most important, fact disclosed in the experimental study of the organ-pipe on the air-reed theory is this—that the aeroplastic reed has a law of its own, unique amongst the phenomena heretofore observed in musical vibrations. It may be stated thus—*As its arcs of vibration are less, its speed is greater*. All our knowledge of rods and strings, of plates and membranes, would lead us to expect the usual manifestation of the law of isochronism, that in the air-reed considered as a free rod fixed at one end and vibrating transversely, the law would be observed, "though the amplitude may vary, the times of vibration will be the same." Yet here we meet with its absolute reversal, viz.—*the times vary with the amplitude*. This information does not rest on theory; every eye may verify it. A principle so strange, when first its action was observed, might well lead to disbelief in one's senses, although the mind had by its reasonings led up to the fact and sought for it as the one thing needed to give consistency to theory and make it a perfect whole. Familiar as the air-reed had been to me, the one secret had been hidden from my eyes; seeing, they saw not. Faith in the known mode of activity of the transversely vibrating rod had blinded me, and it was only after long reasoning, forced upon me by the presence of independent harmonics, not upon any theory belonging to a reed (whose first harmonic would be higher than an octave twelfth), that my faith was shaken. Then, conceiving the idea of this principle of action, I looked, hoping to find my reasoning confirmed; yet, let me confess it, the first sight of the reality startled me not a little with self-confusion. Here was an every-day fact, constantly before me it had been, beautiful in its simplicity, waiting to be acknowledged, and I so stupidly blind as not to see it. Vary the experiment, repeat it again and again, and the fact will be confirmed beyond possibility of doubt, that, the length of reed remaining unaltered, if by extraneous influence the pitch of the note is lowered whilst the pipe is speaking, correspondingly with the changing sound the path of the air-reed will be lengthened; or conversely if the pitch be raised, simultaneously with the quickened velocity, the air-reed will be seen to shorten its stroke; no swelling of tone gaining power with gain of amplitude; not the counterpart of a metallic reed, nor acting as a tuning-fork. The creature of air, it times itself to the element that sustains it. This aero-rhythmic law provides the only way possible to the air-reed to work out the transmutations of energy essential to its functions; the constitution of air necessitates the conformity in mechanical relations.

Another remarkable demonstration falls to this theory—that the note of every open organ-pipe is not single but is a concord, always consists of a duality of tone; the two distinct tones of the air-reed and of the pipe may be separated and again blended at pleasure.

Also that the harmonics or over-tones may in favourable pipes be brought on at will without alteration of the pressure of blowing; that likewise, when a pipe, instead of continuing to sound its fundamental, is unsteady, and gives its harmonic, the pipe being said to "fly off to its octave," the notion implied is erroneous; it can be rendered visible that the air-reed leaps back to its octave speed, and by its superior strength compels the pipe to follow in accord. The expression "leaps back," is deliberately used, for the native pitch of the air-reed is far higher than the harmonics of the pipe.

Add to these the still more singular feature of three different velocities concurring to produce in an open organ-pipe the one fundamental tone, which we call its pitch, the super-nodal wave having one velocity, and the sub-nodal wave having for its course and recourse two differing rates of progression. *The motion of vibration is an activity tempered by rests.* In every wind-instrument we perceive intimations that the period of rest is originally governed by the special structure of each, and experiment shows that we can arbitrarily limit or prolong it; this variable ratio of rest to activity is to be taken into account in all calculated times and velocities. In forming a true conception of the behaviour of musical reeds, and in tracing out the process of tone-making in organ-pipes and other wind-instruments, the modifying influence of the "rest" between the vibrations announces itself as of vital importance. If the doctrine is strange, it is not unnatural. The action of the heart furnishes a parallel instance—contraction, dilatation, pause—the three making up the rhythmic period of the heart's beat, and their relative duration varying with the individual organisation.

The foregoing affirmations are preparative. It will not be possible to condense into one letter the evidence and arguments supporting them, but if they are borne in mind during the progress of the exposition, the bearing of each new fact on theory will be more readily seen, and the aim and purpose of the reasoning be apprehended even in its incomplete stages.

There is one significant question which it occurs to me has never yet been asked; that the node is to be found in all longitudinal vibration of rod or pipe is undoubted; that there is a displacement of a node in an open organ-pipe is an accepted fact—but why, in rod or pipe, why is there a node at all? The question will wait.

Now to the experimental pipe. Suppose we have before us an open diapason organ-pipe, of section rectangular, length 7 ft. 6 in., interior breadth $4\frac{1}{2}$ in., depth 6 in., area of mouth $4\frac{1}{2}$ in. by 4 in., pitch C.C.—the half wave-length for this pitch is 8 ft. 8 in. in the atmosphere. The wind-way is a narrow fissure, barely the twenty-fourth of an inch wide; on the inner margin of this wind-way we place a card or plate, covering interiorily the whole area of the embouchure, and then we admit the wind-current at the foot of the pipe from the organ-bellows.

Premising that the swift sequence of action is delayed for convenience of our analysis, we notice that the stream of air, and as yet it is nothing more, is directed slightly diverging from the vertical, and sufficiently to cause it to glide up the inclined plane of the lip. This stream is the life-force of the sound. "That everybody knows." True they may. But how many ever think, if they know, that its force is that of a storm-wind driving along at the rate of sixty miles an hour. The anemometer or wind-gauge proves it to be so, and that moreover in some stops of large organs the pressure per foot given by the bellows is equal to that of a hurricane.

If now the plate be removed from the back of the embouchure, the stream is instantaneously transformed into an air-moulded reed. There is gradation in the change, the order of which may be worked out, leaving the sound as Shelley says "waiting to be born."

The velocity *of passage* is to become endowed with a new power, the velocity *of vibration*. How is this investiture accomplished? How afterwards does the transversal vibration of the aeroplastic reed call into existence the longitudinal vibration of the air-column of the pipe?

The isolated reed, before any change takes place, has no innate tendency to swerve from uprightness, of itself it can neither blow in nor out, nor can the atmosphere influence it, for that is equal on both sides; the air-column within the pipe is at rest, it has no self-stimulating power of vibration, and to disturb its equilibrium some internal exciting cause is needed which shall produce, with determination of priority, condensation or rarefaction. It is obvious that the reed as it now stands has no power to produce a condensation, it does not strike against the sharp edge, it simply asserts its own upward-rushing force. The reed must be bent before it will vibrate. To cause this flexure the only alternative is rarefaction. The act of rarefying occupies time, it takes place within the pipe, is not spontaneous, but is induced by some previous act, therefore the provocation belongs to the reed. In velocitous rush over the mouth, its dense stream making around itself a rarefied atmosphere, it causes the approach of the quiescent column, carries off all the particles of air lying in the nearest layers, and would go on abstracting indefinitely if there were no counterbalancing causes coming into operation, but it brings down upon itself the power that bends it; *suction by velocity* has created a partial vacuum; the air-column, pressing outwards with the impetus of expansion, begins to bend the reed over, the excited air-particles of the interior not only press forward to fill the places of the lost, but eagerly crowd out upon the top of the reed, irresistibly sucked into the zone of rarefaction around the mouth, a region where velocity has ensured least pressure, and through this same "law of least pressure," there is a loss of support to the under surface of the reed, favouring the curve of flexure, the pressure varying and diminishing from the root upward.

As yet we have no vibration, for simultaneously with the exterior action the interior rarefaction is extending high upward, the air-particles are rallying from further distances, awakened by the agitation of those in advance, throughout the whole length and breadth of the pipe, uneasy as bees in a hive; whilst the particles are swarming toward the mouth, they are drawing away from the main body of their supports, their own elastic energy is diminishing, they are more and more thinned in numbers, and the new levies come up to the front exhausted of their early vigour. Now is the supreme moment of the reed's advantage, its watchful ally, the external air, pierces the weakest line just under the sharp edge of the lip, and dashing in as a wave of condensation with cumulative pressure, drives back the outflowing wave, and would restore equilibrium but that the air-column, still advancing, and pressed forward in consequence by the inroad of the upper air, meets it in full shock ere it has reached midway; meanwhile the air-reed, rising with vigour to recover its upright position, and following after its ally in the wake of the retreating column, slightly overpasses its own line, enters the pipe momentarily to be cast out again, for the wave of rarefaction is returning and vibration is established. The invading wave has been repulsed at the spot hereafter memorable as *the node*, and the conflict renewed and continued will chronicle no victory to either unless other and foreign forces are brought in, for, as I shall show, we have resources within command enabling us to sway the equipoise and give supremacy to the reed.

"I do suppose," as Dr. Hooke says in his talk on "springy bodies," "I do suppose the particles" behave, and that the action takes place in the manner I have described; the analogy is not strained, nor have I used one phrase in association of ideas which I do not think fully justified by the physical relations of the process. Therefore do not dismiss this as the sketch of a fancy battle. Watch for yourselves; place within the pipe at the back of the mouth some fine filaments of cotton, or fluff or down; advance them from the interior to the inner edge of the windway, and you will see them shot with energy not upward into the pipe, but outward full in your face with an unmistakeable trajectory. Do we not bring into activity the same force, "suction by velocity," when we blow through one little tube over another tube leading down to a well of perfume and draw up thereby scent-laden globules caught in the belt of wind passing over the tube's orifice, dispersing fine odour-sprays into the atmosphere? When a train of carriages loosely coupled is starting out of a railway station, should the engine suddenly back a little we see the hindermost portion of the train with its acquired momentum meeting the foremost portion advancing to it with reversed direction of impetus, and the central carriages receive a double compression, a rude kind of node is thus formed starting a reaction of bufferage in opposite directions; so when trains come into collision or are suddenly stopped in career, the distribution of weight, the gradients and relative velocities determine which portion feels most the influence of the shock. Again an analogy. There is a country custom, when the bees swarm to dredge them with flour as a means of identification, if the flour *travels* you will know the bees have journeyed likewise. Take a piece of white tissue paper (a banknote answers it admirably), fold it so that a portion will occupy very nearly the space of the embouchure of the diapason pipe, by using a card it may be held level on the outer edge of the windway, it is in fact a paper reed but flaccid and inanimate; as you advance it to the windway no sooner is it caught in the current than it darts upright and becomes incorporated with the air-reed,

"Grows with its growth and strengthens with its strength."

This same crisp little bit of paper will reveal to your eyes the treasured secret of the organ-pipe, tell you how its wealth of varied tone is wrought, show you its fine arcs of flexure, how it bends less for its inward than for its outward stroke, and how its free curves are moulded to your will; listen, and you shall hear the domestic wrangle of the reed and pipe; look, and you shall witness how in its high caprice it transmutes in a flash to harmonic speed and leaps exultant to its octave. Truly an Ariel imprisoned, endowed with form, and clothed with a white vesture making it in all its motion visible as bees.

On the supposition that the theory herein advanced is justifiable, the work of the aeroplastic reed is to be considered, specifically, *to abstract*. By reason of abstraction rarefaction ensues, condensation correlates therewith, the latter springing out of the former, and the product is vibration. The reed is the generator of the power and the node is the fulcrum of vibration, the place of reaction, with this peculiarity that it affords an elastic fulcrum sensitive to the encroaches of the column of air above it; in the stopped pipe on the contrary there is a stable unyielding fulcrum, and the results of this difference are very remarkable, as will be seen in another paper necessary to complete this exposition, but at present I can only allude in passing to one of these results which it seems desirable not to omit here. Admitting my affirmations so far as they can be proved by other eyes, objections will be taken to the imaginary description of the action of air-particles and waves in the interior of the pipe, as opposed to received doctrine. Novelty is often held to be outrage. It is an essential feature of my hypothesis that the initial movement, or prelude to vibration in the pipe, is distinct from successive movements both in its course and character; it extends throughout the pipe, is continuous but diminishing in degree, and is without a node, which is only fully established at the second course. Without entering now into further details it is important to notice that this interval between the first effort or gasp of the pipe and the full possession of its power, is distinctly perceived by the ear. All musicians acquainted with organs are conscious of this, and it is matter of usual comment with them how that stopped pipes are on the contrary remarkably quick of speech, instantaneous in articulation. They feel this without reasoning of why or wherefore. As in stopped pipes there is no supernodal column, no requirement for an effort similar to that awakening motion to perfect vibration in open organ-pipes, the verdict of the ear is in both cases consistent with and corroborative of the hypothesis. Experiments with a very peculiar pipe called the "German Gamba" will throw invaluable light on the process of tone-making in organ-pipes.

HERMANN SMITH

The Degeneracy of Man

WITH regard to the culture of savages in Brazil the evidence of facts will be more esteemed by Mr. Tylor than the opinion of Dr. Martius, for Mr. Tylor has brought together a wealth of facts on the history and conditions of culture.

There is one class of facts which to my mind bears particularly on this question of the tribes of Brazil and the Amazons, and that is language.

The Kiriri and Sabuyah of Bahia as also the Ge have affinities with the Shoshoni and other dialects of the Rocky Mountains, and it is difficult to believe a language of this kind can belong to an epoch of high culture.

The dialects of the Tocautius have affinities of a like character with the Ankaras and Wun of Africa, and with that of the Akka pigmies just discovered in the Nile region.

The Purus, Coroado, and Corope of Rio Janeiro appear to belong to the Carib directly, and thereby also to Africa.

In the present state of our materials and information it is impossible to define exactly the members of each class. Thus the two groups last mentioned appear to be connected by the Baniwa and the Carib.

The main body of the population of Guarani, Tupi, Omagua, have by me been long since pointed out as having a language similar in roots and grammar to the Agaw of the Nile region. This is the highest development of language known to me in Brazil.

If the tribes of Brazil have fallen from a higher estate it is strange they should have become endowed with languages of the Prehistoric epoch.

HYDE CLARKE

June 29

THE gradual degeneracy of savage man from a higher type is a fact which an eminent author states in his letter in NATURE (vol. x. p. 146) to be difficult of belief. He wonders that Dr. Martius should say "the Americans are not a wild race, they are a race run wild and degraded."

The following facts seem to me to support the view held by Dr. Martius, Alex. von Humboldt, Abp. Whately, the Duke of Argyll, and others.

In the Ilium now laid bare by Dr. Schliemann, the lower strata contain more copper and fewer stone implements than the upper. "In other words, we have the very 'unscientific' fact of an 'age of stone' above an 'age of copper'" (Quart. Rev., April 1874). "The newly opened mound of Hissarlik stands as a lasting witness to a progressive decay of civilisation, industry, and wealth, among the successive races of its inhabitants" (Quart. Rev.).

Among the forest tribes of Brazil Dr. Martius found traces of the village community with its tribe-land common to all, while huts and patches of tilled ground were treated as acquired property, the recognised owners not being individuals but families. This may be well explained as a custom brought by Asiatic immigrants into the American continent. The Chinese anciently divided the land of a village into nine parts. The division was made by two perpendicular and two horizontal parallel lines. The middle square was common land. The eight remaining squares were assigned to eight heads of families, who cultivated the common square, giving the produce to the Government: they constituted a village. This principle of revenue collection based on land distribution existed for many centuries in ancient China, and was afterwards changed for a grain tax in kind about the time of the building of the Great Wall. Agricultural emigrants to America at any date before 200 B.C. would be familiar with this mode of doing things, and would naturally carry with them the knowledge of this and other customs existing at the time in eastern Asia. The appearance of a principle of land distribution resembling that of the old Teutons, among American tribes, cannot then be taken as proof that they were progressing and not degenerating, for it may, when our knowledge of ancient America becomes more accurate, be seen to be one of the lingering remains of an older civilisation which in a tropical climate favourable to indolence would easily decline. The religious beliefs and social customs of Asiatic and American races are in many respects so similar that there is abundant ground for questioning the originality of any civilised custom found among American tribes. Why should not comparative ethnology one day find the key to solve all such questions?

This fact, looked at from the eastern Asiatic point of view, is so far then from supporting the theory of progressive development, that it may rather be used as an additional buttress for the theory of degeneracy.

Names of number among Malayan and Polynesian tribes may be referred to as a proof of degeneracy. The sound "man" is 10,000 among the natives of Samoa and Tonga, as it is in Chinese, but it is 4,000 in the Sandwich islands, and 1,000 in New Zealand. Islanders avoid high numbers, and allow the significance of a name of high numbers to sink. This is proof of degradation. The reason why the arithmetical faculty among the New Zealanders has become weaker than elsewhere is because of their enormous distance from the continent of Asia. Samoa and Tonga are much nearer, and accordingly in those islands the religious traditions, *e.g.* circumcision, resemble those of Asia very closely. The Polynesians formerly had a decimal arithmetic, now it has sunk in Australia to quaternary or quinary arithmetic. In Ponape, one of the Caroline group, and comparatively near to the continent, *apuki* is 100 of men, trees, or yams, but 1,000 of eggs, cocoanuts, or stones. In Chinese *pak* is 100. After centuries of use high numbers fluctuate in value, because the intellect of islanders declines in power as the effect of long-continued isolation. The ideas, names, and usages of civilisation are gradually lost, and with them the human intellect becomes dwarfed.

Prof. F. Müller, after showing that the Polynesians could originally count to 100, adds, "Dies ist gewiss ein Zeugniss für die nicht geringe geistige Begabung und frühzeitige Entwicklung dieser Völker." * The Polynesians, then, have sunk in power, and were, when visited by Capt. Cook, in a state of progressive degradation.

The question raised by Mr. Tylor was only—"Did Dr. Martius change his opinion about the degeneracy of Brazilian tribes?" Dr. Peschel thinks he did, but has not yet given sufficient proof. While I venture to think that the question—"Is savage man a degenerated being?" can be solved in the affirmative by the careful comparison of facts, without our needing to know that each scientific traveller holds this view, it would be most interesting to be assured that all such men are agreed upon it.

JOSEPH EDKINS

Disuse as a Reducing Cause in Species

IN a letter of mine (NATURE, vol. ix. p. 361), entitled "Natural Selection and Dysteleology," there occurs a footnote upon the above subject. As this footnote was rather carelessly written, I wish to explain my meaning more clearly.

In the first place, it is evident that the fact of disuse causing atrophy in individuals is no proof that it likewise causes atrophy in species; for if it does so, the laws under which it operates in the two cases must be quite different—the one set being as exclusively related to Inheritance, as the other set are independent of this principle. The primary question therefore is: Does inheritance here reproduce the character of immediate ancestors, as in congenital atrophy, &c.; or of distant ancestors, as in mutilations, &c.? I think there can be no reasonable question that it does the former, and so have no doubt that disuse is a cause of atrophy in species. The question as to degree, however, remains.

One sentence in the footnote I am explaining may be taken to imply that the effects of disuse are exhausted in a few generations. Nothing can be further from my meaning. If disuse acts at all in species, its *modus operandi*, as just stated, must be that of *causing* variations which are capable of being inherited; consequently, if disuse acts thus at all, it is impossible to assign limits to its operation in time. The question, however, is, In what proportion are the effects of disuse in the parents reproduced in the offspring? Variations caused by disuse certainly differ from congenital variations, in that they are not fully inherited; and it is the degree in which they are inherited that must determine the rate at which disuse here operates. This degree, however, is unknown: we only know that it is something very small. Now as disuse is in competition with other reducing causes, the rapidity of its action is an important factor in the estimation of its probable effects.

By the omission of the word "proportional" near the end of the footnote, I appear to institute an absolute comparison between the effects of disuse in wild and in tame species. This, of course, would be absurd. What I mean is, that supposing disuse to be the chief cause of atrophy in wild species, it has not produced so much effect in tame species as we should antecedently expect; for, although the facts are very scanty, so far as they go they tend to prove, that when an organ is disused for several generations only, the rate of its reduction is much greater than it ought to be, supposing disuse to be the main cause of atrophy in our domestic animals, and supposing the action of this cause to be uniform.

It will be asked, If we thus in part reject this cause, what other have we to substitute? This, of course, is a collateral issue; but as it is an important one, it may here be discussed. I would suggest the cessation of selection (see NATURE, vol. ix. p. 440) as a co-operating cause, for it seems to me that this *must* have acted here to some extent, and if no other causes have been at work, this extent must be the complement of the effects due to disuse. For the sake of definition, therefore, we shall assume disuse to be in abeyance. Now, on this assumption, we should expect to find that atrophy proceeds more rapidly during the initial stages of reduction than subsequently. But without dwelling upon this point, what may we infer from the existing degree of atrophy in the affected organs of our domestic animals? Supposing the cessation of selection to be the only cause at work, what degree of atrophy should we here expect to find? Before I turned to the valuable measurements given in the "Variation," I concluded (Cf. NATURE, vol. ix. p. 441) that from 20 to 25 per cent. is the maximum of reduction we should expect this unassisted principle to accomplish, in the case of natural as distinguished from artificially-bred organs. Now on calculating the average afforded by each of Mr. Darwin's tables, and then reducing the averages to parts of 100, I find that the highest average decrease is 16 per cent., and the lowest 5; the average of the averages being rather less than 12. Only four individual cases fall below 25 per cent., and of these two should be omitted (Cf. "Variations," p. 272). Thus, out of eighty-three examples, only two fall below the lowest average expected. Moreover, we should scarcely expect disuse alone to affect in so similar a degree such widely different tissues as are brain and muscle. The deformity of the sternum in fowls also points to the cessation of selection rather than to disuse. Further, the fact that several of our domestic animals have not varied at all is inexplicable upon the one supposition, while it affords no difficulty to the other. We have seen that disuse can only act by causing variations; and so we can see no reason why, if it acts upon a duck, it should not also act upon a goose. But the cessation of selection depends upon variations being supplied to it; and so, if from any reason a specific type does not vary, this principle cannot act. Why one type should vary, and another not, is a distinct question, the difficulty of which is embodied by the one supposition, and excluded by the other. For, to say that disuse has not acted upon type A, because of its inflexible constitution, while it has acted on a closely allied type B, because of its flexible constitution, is merely to insinuate that disuse having proved itself inadequate to cause reduction in the one case, it may not have been the efficient cause of reduction in the other. But the counter-supposition altogether excludes the idea of a casual connection, and so rests upon the more ultimate fact of differential variability, as not requiring to be explained. Lastly, it is remarkable that those animals which have not suffered reduction in any part of their bodies are likewise the animals which have not varied in any other way, and conversely; for as there is no observable connection between these two peculiarities, the fact of the intimate connection between them tends to show that special reduction depends upon general variability, rather than that special variability depends upon special reducing causes.

Dropping, however, our argumentative assumption, it will be remembered that I deem it in the last degree improbable that disuse should not have assisted in reducing the unused organs of our domestic animals; and the effect of this remark is to show that the cessation of selection is not able to accomplish so much reduction as I antecedently expected. On the other hand, it seems to me no less improbable that the cessation of selection should not have here operated to some extent; but in what degree the observable effects are to be attributed to this cause, and in what degree to disuse, I shall not pretend to suggest.

No doubt the above considerations are of a very vague description; but this only follows from the scarcity of the data at our disposal, and it is to this very scarcity that I am principally desirous of calling attention; for although it is with reluctant diffidence that I venture thus, even in part, to dispute the doctrine of one whom most of living men I venerate, yet, for the reason just given, I cannot help feeling that the time has not yet arrived for a final quantitative decision upon this subject. However, as before remarked, "the question thus raised is of no practical importance; since whether or not disuse is the principal *cause* of atrophy in species, there is no doubt that atrophy *accompanies* disuse."

GEORGE J. ROMANES

* "Reise der Novara." Linguisticher Theil, 1867, p. 287.

Longevity of the Carp

LAST autumn, being at Fontainebleau, I was told by the servant of the Palace there that the German soldiers while in occupation of the place during the last war caught many of the carp in the pond of the Palace garden called "Jardin Anglais," and that some of these carp carried, attached by silver wire to their gills, little silver plates bearing inscriptions purporting that the plates were attached to the fish in the time of Francis I. and Henry II.—*i.e.* about 300 years ago.

Some of your German readers could easily ascertain by inquiry of the corps in occupation whether such fish were in fact caught. If it should turn out that they were, then, although the well-ascertained proof desired by Mr. Suffield (NATURE, vol. x. p. 147) would not of course be given, yet the fact would be evidence worth noting. F. G.

Cannes, June 28

THE "CHALLENGER" EXPEDITION*

V.

INACCESSIBLE AND NIGHTINGALE ISLANDS

THE first of these islands, the area of which is about four square miles, is situated about twenty-three miles W. by S. of Tristan d'Acunha. The cliffs rise to the height of about 1,000 feet in a perpendicular range on the north-east side. The tract beneath the cliffs is covered with *débris* of fallen rocks. On the cliffs themselves the plants are similar to those found in the same situation in Tristan. On the lower land are dense thickets of *Spartina arundinacea* Carm., a tall, reed-like grass, which here forms an extensive penguin rookery; patches of *Phylica arborea* Th. also grow on the summits of slight elevations; and under the shelter of the cliffs the trees attain a height of twenty feet, or even more. The trunks are seldom or never straight, but mostly lean over, or become partly procumbent, starting upright again towards the top. The largest trunk seen by Mr. Moseley measured a foot in diameter, but the trees on the upper plateau are said to measure 18 inches across, they do not, however, grow so high, being stunted by the force of the gales. The wood of the *Phylica*, though brittle, is said to be useful when properly dried, but in exposed situations it rapidly decays. Underneath the trees are ferns, mosses, and sedges, also *Acæna sanguisorbæ* Vahl., the leaves of which are used in New Zealand both as a tea and as a medicine. *Chenopodium tomentosum* Th., the tea-plant of Tristan, also grows in abundance, forming bushes with woody stems. A species of *Sphagnum*, *Carex insularis* Carm., and *Hydrocotyle capitata* Th. grew in a swamp near the penguin rookery. From the two Germans who were discovered on the island a good deal of information was obtained about the vegetation, more especially of that of the higher land, to which it was found impracticable to ascend from the side of the mountain where the ship anchored. The plants found there were similar to those which grew below, but in addition grew the species of *Empetrum*, found on the other islands, *Lomaria boryana* Willd., which in some instances attained a height of four feet, *Lycopodium insulare* Carm., and *Lagenophora commersonii* Cass., a small Composite plant with a daisy-like flower. The Tussock grass, which appears closely similar to *Dactylis cæspitosa* Forst., of the Falklands, grows in patches of considerable size on the upper plateau, and straggles up the cliffs to the summit. *Nertera depressa* Banks also grows on the plateau, and its berries form a favourite food of the *Nesocichla eremita*, the native thrush of the Tristan group; while the Bunting (*Emberiza brasiliensis*) feeds on the fruits of the *Phylica*.

The two Germans had cultivated the ground in the neighbourhood of their dwelling, growing potatoes, cabbages, and other European vegetables. Two species of clover also introduced by them were spreading rapidly, and a convolvulus was growing in quantity on the cultivated ground.

The other island of the Tristan group is named Nightingale Island, and is distant 20½ miles from Tristan d'Acunha, and 12 miles from Inaccessible Island. It is, comparatively speaking, a mere speck about one square mile in extent, and to the west are two small outlying islands covered with Tussock grass. A rocky peak 1,100 ft. high rises on the north side of Nightingale Island and is continued into a ridge stretching across the island, a valley separating this from a lower ridge which runs nearly at right angles. On the lower tract *Phylica arborea* occurs in patches, and on the high ground was seen *Lycopodium insulare* and a species of *Cotula* different from that found in Tristan and not seen at all in Inaccessible Island. *Sonchus oleraceus* L., which grows abundantly on the other islands, is, together with several other plants, absent from this. The Tussock grass forms a dense growth over nearly the whole island, growing in thick tufts or clumps to a height of five or six feet, and so matted together near the base of the clumps as to be almost impenetrable. The abundant growth of this grass causes the island to become an enormous penguin rookery, and the thick deposit of the excrement of the birds imparts a greater vigour to the plants, so that the lower parts or bases of the clumps become of a peaty character, beds several feet in thickness, of a black peaty richly-manured soil, being thus formed. It was with the greatest difficulty that a way was made through this thicket, the grass being too high to allow the planning of any definite track, and the screaming and biting of the penguins, together with the stench from the thick deposit of dung, being anything but agreeable. Indeed Mr. Moseley says that the specimens of Tussock grass which he gathered on Inaccessible and Nightingale Islands were lost in the continued fight with the penguins and the long grass. In one place a quantity of the trees of *Phylica arborea* had been blown down by the wind, and the trunks were lying dead on the ground. Lichens, as well as two fungi, were found on these dead trunks.

A dark green ulva forms a thin coat on the rocky shelves of the coast near the caves of the seals, which, when dry, as was the case during the *Challenger's* visit, has a peculiar metallic appearance. The island is never visited except during the sealing season.

Though it has been stated that the vegetation of the Tristan group knows no change of seasons, it is proved that some of the plants mentioned in these notes have their periods of flowering; thus the *Pelargonium* is said to flower in the middle of the summer, when a large number of the flowering plants are at their best, and the shore is covered with the fallen petals. At the time of the *Challenger's* visit in October few plants were in flower, but the phylica trees all bore fully developed green fruits.

From the geological as well as the botanical similarity of the three islands forming this interesting group, it may be surmised that a former connection existed between them. The different currents which sweep the Tristan group bring with them many foreign seeds, which are cast up on the shore. Amongst them was seen those of *Guilandina*, which are sometimes washed up on the Irish coast by the Atlantic current. These seeds are known in Tristan d'Acunha, as well as in Bermuda, where they are also occasionally cast up, as the sea-bean, the popular belief in the islands being that they are the seeds of a plant which grows at the bottom of the sea.

* These Notes are founded on letters addressed to Dr. Hooker by Mr. H. N. Moseley. Continued from vol. ix. p. 486.

THE FIGURE OF THE EARTH IN RELATION TO GEOLOGICAL INQUIRY

THE elevation and depression of different parts of the surface of the earth above or below a mean ocean level has frequently formed the subject of communications to NATURE, but in no instance, as far as I am aware, have any of these changes been referred to the remarkable shape of the equatorial circumference of the earth, and to the changes which it is not improbable are constantly but slowly taking place in the position of the major and minor axes of the equatorial circumference. On p. 98 of the second edition of "The Heavens," by Amedée Guillemin, edited by J. Norman Lockyer, F.R.S., the following note is introduced in brackets by the editor :—

"The most recent results arrived at by geodesists have taught us that the earth is not quite truly represented by an orange, at all events, unless the orange be slightly squeezed, for the equatorial circumference is not a perfect circle, but an ellipse, the larger and shorter equatorial diameters being respectively 41,852,864 and 41,843,896 ft. That is to say, the equatorial diameter which pierces the earth from long. 14° 23′ east to 194° 23′ east of Greenwich is two miles longer than that at right angles to it."*

The history of these "results" may be briefly stated as follows :—

Capt. Clarke, R.E., in a communication to the Royal Astronomical Society, read April 6, 1860, and published in vol. xxix. of the "Memoirs," investigates the figure of the earth resulting from the best existing data. He concludes :—

"The result of our investigations then is this : that the ellipsoid which best represents the existing meridian measurements has its major (equatorial) axis in longitude 13° 58′·5 east from Greenwich."

The greatest and least values of the meridian compression are—

$$\frac{a-c}{c} \quad . \quad . \quad . \quad . \quad \frac{1}{286{\cdot}779} \text{ in longitude } 13^\circ\ 58'{\cdot}5 \text{ E.}$$

$$\frac{b-c}{c} \quad . \quad . \quad . \quad . \quad \frac{1}{309{\cdot}364} \text{ in longitude } 103^\circ\ 58'{\cdot}5 \text{ E.}$$

and the length of the polar semi-axis, 20,853,768 ft. "The difference of the equatorial semi-axis is 5,308 ft., or, in round numbers, just one mile."

The investigation from which result the above figures was undertaken by Capt. Clarke, in consequence of remarks by the Astronomer Royal in the "Monthly Notices" of the Royal Astronomical Society, vol. xx. p. 104 (January 1860), on General Schubert's "Essai d'une détermination de la véritable figure de la terre." The results arrived at in General Schubert's memoir is that the earth is an ellipsoid, whose elements are—

Polar semi-axis	20,855,605 ft.	
Maximum compression . .	$\frac{1}{292{\cdot}109}$	
Minimum „ . .	$\frac{1}{302{\cdot}004}$	
Longitude of major axis of equator . . .	41° 4′	221° 4′
„ minor axis of equator . .	131° 4′	311° 4′

the longitudes being measured from Greenwich eastwards.

For the dimensions of the earth on the elliptic hypothesis, Capt. Clarke prefers the following values, given at p. 773, of the "Account of the Principal Triangulation (Ordnance Survey)," viz.—

Equatorial . .	20,926,348 ft.	Compression $\frac{1}{293{\cdot}76}$
Polar . .	20,855,233 ft.	
Mean degree .	364,613·33 ft.	

The volume was published in 1858.

It appears, then, that somewhere between long. 13° and long. 41° east of Greenwich the major equatorial axis is about two miles longer at the present day than the equatorial axis at right angles to it ; and during earlier geological epochs, when the crust of the earth was in a more plastic condition, these differences may have been considerably greater, and the effect on the geological structure of the earth intensified.

The point to which I wish to draw the attention of those who have studied the successive variations in the level of certain parts of the earth's surface, relates to the effect which this equatorial "bulge" must have produced upon various geological phenomena, and particularly if the longitude of the bulge varies according to a determinable law.

* Mem. R.A.S. vol. xxix. 1860.

It will be readily seen that its influence will be felt—

1. On the elevation and depression of the land, especially near the equator.
2. On simultaneous elevation and depression on opposites sides of the earth.
3. On ocean currents, consequently on climate, &c.
4. On the thickening and thinning of formations to the east and west.
5. On the flow of rivers, hence on river and lake terraces, beaches, &c.

Observed facts, especially in North America, appear to show that the subsidence and subsequent elevation of that continent has always taken place very gradually and with a progressive motion from west to east and from east to west. In other words, these changes of level have assumed the form of a vast equatorial undulation progressing with extreme slowness, at one epoch in an easterly, and at another in a westerly, direction. This appears to be shown by the very gradual thinning out, or the very gradual thickening, of Tertiary, Cretaceous, and even Palæozoic formations. In Post-tertiary times, where we are brought nearer to the records of past changes, and may compare antipodal illustrations, it is apparently manifested by the stupendous escarpments which for 1,000 to 1,700 miles rear their wall-like fronts from 200 to 600 ft. above the Ontario, Red River, and Saskatchewan plains ; and it is further indicated by the symmetrical river terraces and lake beaches which are developed to a very remarkable extent throughout the whole of the northern part of North America.

These occur both on the east and west flanks of the Rocky Mountains, and are found in the various passes *through* that great range. To enumerate examples would be to select any large river issuing from the Appalachian Chain, the Laurentides, or the Rocky Mountains, at elevations varying from 400 ft. to 4,000 ft. above the present level of the sea. I hope that some of your correspondents may supply illustrations of similar geological phenomena occurring as near as it may be possible to find records on opposite sides of the earth and during the same geological period of time.

To the supposed motion of the equatorial bulge may also be partly attributed the changes in the direction of the flow of certain rivers, and the elevation of an axis across the North American continent from east to west between lat. 35° and 45° N., by which the drainage of the great Canadian Lakes (excepting Ontario) was diverted from the Gulf of Mexico into the Gulf of St. Lawrence. The ancient river channels through which the great lakes sent their waters to the sea are now filled with drift to a depth varying from 200 ft. to 600 ft. During the period of depression the great lakes were in direct communication with the sea, and their waters were brackish or salt. The dredging operations which have been conducted in Lake Michigan show the former marine character of the fauna of the waters of this lake.

The origin of beaches and terraces appears to be intimately connected with an easterly or westerly progress of elevation simultaneously with a northerly and southerly elevation, such as would be produced by the slow movement of an equatorial bulge in an east or west direction. In North America, where terraces and beaches exist in perfection at altitudes varying, as already stated, from 400 ft. to 4,000 ft. above the ocean, the phenomena may be studied with some prospect of elucidation.

I have been credibly informed that data do not at present exist which would enable astronomers to state definitely that the bulge in the equatorial circumference of the earth between longitudes 13° and 41° east of Greenwich is stationary, or whether it has an easterly or westerly motion, and thus partakes of the character of an undulation. Perhaps, on consideration of the causes which produce this ellipsoidal form of the equatorial circumference of the earth, we may assume that the longitude of the major axis is constantly changing and progressing from west to east within certain limits, and then returning from east to west; in other words, oscillating through a determinable space.

I have ventured to bring this interesting subject under the notice of the readers of NATURE in the hope that it may receive the attention which it appears to merit, and that satisfactory illustrations will be forthcoming to show that the differences between the equatorial major and minor axes of the earth are competent to explain or throw light on many disputed points in geological inquiry, and to lead to a rational solution of some difficult problems. On the other hand, it does not appear unreasonable to suppose that known geological facts may serve to point out a line of investigation which may lead to a more correct knowledge than we appear to possess at present of the figure of the earth, the probable changes which are slowly taking place, and the relation which these bear to geological inquiry. HENRY Y. HIND

Windsor, Nova Scotia

REPORT OF PROF. PARKER'S HUNTERIAN LECTURES "ON THE STRUCTURE AND DEVELOPMENT OF THE VERTEBRATE SKULL" *

V.

WHEN the investing bones, mentioned in the last paper, are removed, the chondro-cranium of the axolotl is seen to have a far lower structure than that of the salmon. The hinder part of the skull-floor is constituted by a flat plate of cartilage (Fig. 13, B.O) formed from the investing mass, and answering to the basi-occipital, but unossified. From this rises up on each side a narrow cartilaginous pedicle, which, uniting above with its fellow, forms the occipital ring inclosing the foramen magnum. An ossification—the exoccipital—is formed on each side of this arch where it bears the occipital condyles; but, as in all amphibia, the supra-occipital, like the basi-occipital region, remains cartilaginous.

From the front edge of the basilar plate proceed two cartilaginous rods, uniting between the nose capsules as an expanded inter-nasal plate (I.N) and rising up to form the walls of the brain-case, but leaving its floor and roof to be covered in by the investing bones—the parietals and frontals above and the para-sphenoid below. These rods are, clearly, the very slightly altered trabeculæ; they bear a single pair of ossifications, placed considerably in front of the optic foramen, and answering to the lateral elements of the "os en ceinture" or "girdle-bone" of the frog. The nasal capsules, situated immediately outside the expanded cornua trabeculæ (hypo-trabeculars), are as far apart as in the ray.

The auditory capsules are largely cartilaginous, but contain three bones—the prootic, the epiotic, and a small ossicle nearly filling up a membranous space in the capsule between the prootic and opisthotic regions; the space is the first appearance of a *fenestra ovalis*, the bone of a *stapes*, so that in the tailed Amphibians is seen the earliest foreshadowing of the delicate apparatus by means of which vibrations of the air are communicated to the membranous labyrinth. The apparatus is, however, in a very rudimentary condition, there being neither tympanic membrane nor external meatus, and the stapes being connected, not with a chain of ear-bones, but with a band of fibres, the stapedio-suspensorial ligament (s.s.l), which unite it with the hinder part of the suspensorium.

The upper end of the mandibular arch is not let down to a considerable distance from the skull like that of the salmon, but forms the whole of the suspensory apparatus of the lower jaw, thus taking on the function performed in the fish by the proximal portion of the hyoid arch. The suspensorium is a stout cartilage sloping downwards and forwards, rounded below into an articular surface for the jaw, and divided above into three processes, the pedicle (p) or true apex of the arch, the ascending process (a), and the otic process (o). The two former are coalesced with the hinder ends of the trabecula, the latter with the auditory capsule; the first division of the fifth nerve passes out between the pedicle and the ascending process. A granular deposit of calcific matter (Qu) in the lower part of the suspensorium is the only representative of the bony quadrate of the fish, the meta-pterygoid region remains wholly unossified.

The pterygo-palatine arcade is very rudimentary, being represented only by a thin bar of cartilage (Pl.Pt) passing forwards from the front edge of the suspensorium, but not coming into contact with the ethmoidal region. Two bones are, however, developed in connection with this cartilage—the small tooth-bearing palatine, and the enormous triangular pterygoid.

As in the salmon, the lower jaw, stripped of its investing bones, consists of an articular and Meckel's cartilage; the latter, however, is large and stout, and not reduced to a more slender root on the inner side of the dentary.

The hyoid apparatus (Fig. 12) is a strong bar of cartilage connected by ligament with the suspensorium and mandible; it is divided into cerato- and hypo-hyal, but is entirely unossified, and never comes into relation with the auditory capsule. The branchial arches are four in number; the two hinder are split up into a long epi-branchial, a short cerato-branchial, and a small wedge-shaped basi-branchial.

One of the most important points to be noted in the development of the skull is the formation of the stapes; this was formerly believed to be the apex of the hyoid arch, but its true nature—as a separated portion of the wall of the ear capsule—has been demonstrated in the frog, and confirmed in the newt, axolotl, and other forms. In the axolotl of about an inch long a crescentic slit is seen in the auditory capsule, formed by the degeneration of its cartilage into fibrous tissue; the ends of this slit extend and meet, and thus cut off a circular plug of cartilage set in a ring of fibre, producing at once the stapes and the fenestra ovalis.

The investing mass remains long in the condition of indifferent tissue, and even after chondrification has set in the two halves remain separate until a very late period, thus approximating to the state of things found in Menobranchus and Proteus, in which the two parachordals are permanently united only by fibre.

The trabeculæ are at first parallel with the post-oral arches, and only at a comparatively advanced stage come to lie almost at right angles to them, as in the first stage of the salmon. The pterygo-palatine process is very late in its development, arising as a bud from the mandibular arch, and growing forwards towards the trabeculæ, with which, however, it never actually unites. The minor changes which the arches undergo will not be described here, as they have been worked out at far greater length in the frog.

VI. *Skull of the Frog* (Rana temporaria).—As far as its general aspect is concerned, the skull of this well-known Batrachian is by no means unlike that of the axolotl: it presents, however, many important differences, and shows a marked advance towards the sauropsidan and mammalian type.

Among the most important of these characters may be mentioned the backward slope of the suspensorium (see Fig. 14), the large size of the maxilla and its connection, through the intermediation of a small separate bone (the quadrato-jugal, Q.Ju), with the quadrate, the union of the palato-pterygoid cartilage with the ethmoidal region, the disappearance in adult life of the branchial arches, and, most important of all, the separation of the upper end

* Continued from p. 108.

of the hyoid arch as a chain of auditory ossicles, for the purpose of communicating the vibration of the tympanic membrane to the stapes.

Certain noteworthy peculiarities may be mentioned, with regard to the investing bones, the chief being the fusion of the parietal and frontal into a single bone (Fr.Pa), the dagger-like form of the para-sphenoid, and the addition of a horizontal bar to the upper end of the squamosal which

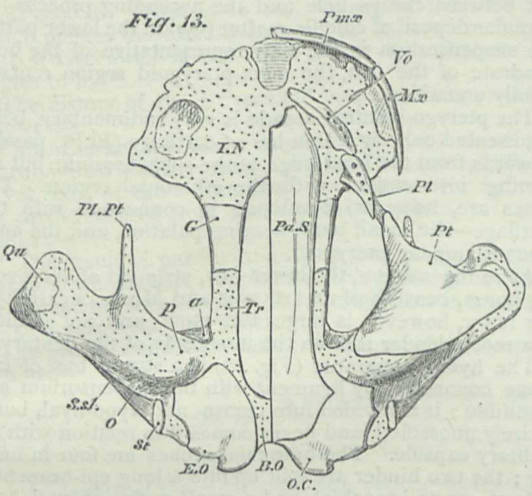

Fig. 13.—Skull of fully adult Axolotl, under view (× 2 diam.), the investing bones being removed from the right side. I.N, inter-nasal plate; p, pedicle, a, ascending process, and o, otic process of the suspensorium.

seems to answer to one of the bony plates developed in ganoids in the temporal region, while the vertical portion is clearly the homologue of the pre-opercular. An extremely small membrane-bone is also developed in connection with the external nasal opening: this is the septo-maxillary (S.Mx), which is interesting from its reappearance in lizards, snakes, and birds.

In the cartilaginous brain-case the form of the trabeculæ is entirely lost by the complete union of those arches below, so as to form a solid floor of cartilage within the para-sphenoid, and by the formation of a roof of like character beneath the fronto-parietals: the latter is interrupted by a large anterior and a pair of small posterior fontanelles. Just behind the inter-nasal plate a stout dice-box-shaped ossification is developed (G) overlaid above

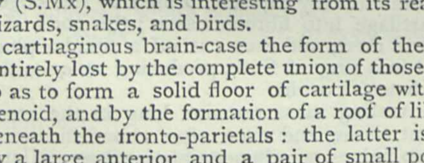

Fig. 14.—Skull of Common Frog (× 2). Ty, tympanic membrane; A.T, annulus tympanicus; M.Mck, mento-meckelian.

by the frontals and below by the para-sphenoid; this is the girdle-bone ("os en ceinture" of Cuvier), and answers to the hinder part of the ethmoid, the fore part of the pre- and orbito-sphenoids, and the pre-frontals. In its posterior half this bone contains a single cavity, in which are lodged the olfactory lobes of the brain, but in its anterior moiety a vertical partition (mesethmoid) divides it into two chambers, through which the nerves of smell pass to the nasal sacs.

Only a single bone occurs in the auditory capsule—the prootic, which extends backwards, so as almost to meet the exoccipital; the opisthotic, epiotic, and stapes remain entirely cartilaginous.

The palatine (Fig. 15, Pl) is a slender bone not provided with teeth; the pterygoid is 3-ranged, having an anterior process coming into relation with the palatine, a posterior articulating with the auditory capsule, and a descending bar which runs along the inner side of the suspensorial cartilage; the two latter help to inclose the eustachian opening (Eu). The suspensorium does not present that clear

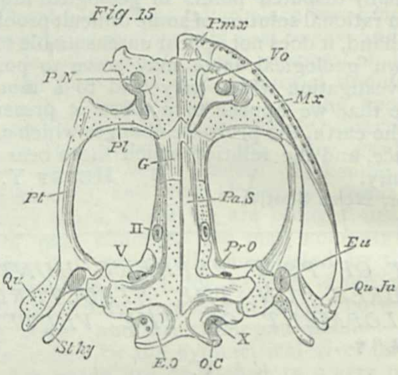

Fig. 15.—Skull of Frog, under view (× 2). the investing bones removed from the right side. P.N, posterior nares; Eu, aperture of eustachian tube.

division into pedicle, ascending process, and otic process which is observable in the axolotl; the second of these is, in fact, represented only by fibrous tissue, while the pedicle and the otic process are completely fused with the auditory capsule.

There is no articular bone in the mandible, but an interesting ossification (M.Mck) of Meckel's cartilage takes place at the point of union of the two rami. This is the symphysial ossification or "mento-meckelian" bone; it has been found in the sturgeon and also in early stages of the human subject.

The hyoid arch is divided into two portions, an upper, which subserves the function of hearing, and a lower, which supports the tongue. The first of these (Fig. 16) is a hammer-shaped apparatus, partly cartilaginous, and partly bony, the handle of which articulates with the stapes (St), while the head is fitted into the drum-membrane (Fig. 14, Ty).* The parts of this ossiculum auditûs have been named by Prof. Huxley, in their relation to the stapes, inter-, medio-, extra-, and supra-stapedial; taken together they answer to the hyo-mandibular and symplectic of a fish. The medio-stapedial (M.St) is ossified; the other portions of the apparatus are

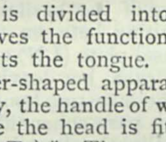

Fig. 16 —Ear-bones of Frog (× 4). i,st, inter-stapedial; m.st, medio-stapedial; e.st, extra-stapedial; s.st, supra-stapedial.

cartilaginous. The tongue-cartilage is a shield-shaped plate consisting of basi-hyal in its anterior and basi-branchial in its posterior part, and connected with the skull by two slender, spring-like rods, the stylo-hyals (St.Hy), which are fused with the auditory capsule; these answer to the anterior or lesser horns of the hyoid bone of man, the greater horns being represented by the ossified first hypo-branchials or thyro-hyals (H.Br. 1) which embrace the larynx.

* The annulus tympanicus (A.T), or ring of cartilage which supports the drum-membrane, would seem to answer rather to the external ear of a mammal than to the tympanic bone.

FERTILISATION OF PAPILIONACEOUS FLOWERS—CORONILLA

IN NATURE, vol. vi. pp. 478 and 498, you inserted a paper of mine in which an attempt was made to draw certain general conclusions concerning the fertilisation of papilionaceous flowers from the examination of a few genera, chiefly English: and in that paper I stated that the foreign genus *Coronilla* presented peculiar difficulties. I have since then been stimulated by Mr. Darwin's kind interest to examine *Coronilla* more carefully, and now send you the results.

The ultimate result of these generalisations was that in all the following particulars, viz. the position and motion of the flowers and the peduncle, the cohesion of the petals, the cohesion of the stamens (so remarkable a feature in this tribe); the structure and character of the filaments, of the anthers, and of the pollen, the structure of the style and stigma; and the place where nectar is secreted; the parts and functions are so organised and correlated as to induce and compel insects, generally bees, in visiting the flowers for nectar, to carry away with them pollen from one flower and bear it to another.

One, perhaps the most striking, of the generalisations in question was as follows:—

"The degree to which the cohesion of the stamens is carried, so remarkable a feature in this tribe, seems to depend on the necessity for access to nectar. In those

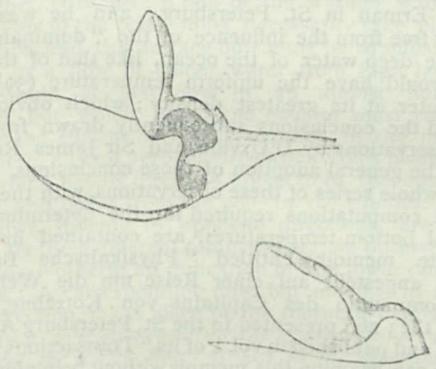

FIG. 1.—Coronilla varia.

flowers in which the stamens are monadelphous, viz. Ulex, Sarathaumus, Genista, Cytisus, Ononis, Lupin, there is no symptom of nectar within the staminal tube, no space for it, and no access to the interior. In some, at any rate, of these, viz. Ulex, Ononis, and Lupin, the bees certainly resort to other parts of the flower. On the other hand, where the tenth stamen is entirely free or where it is separated from the others at the base, so as to give an insect access to the interior of the staminal tube, there is nectar within this cavity."

To this generalisation the two species of *Coronilla* which I had examined, viz. *C. varia* and *C. glauca*, seemed to form an exception. In them the tenth stamen was always separate; but there was no aperture at the base of the staminal tube, no nectar within the staminal tube, and no space for it, the base of the staminal tube fitting as closely round the pistil as it does in those papilionaceous flowers in which the tenth stamen is not separated from the rest.

I have since had an opportunity of examining several species of *Coronilla*, and of watching large plants of *C. varia* (Fig. 1) and *C. emerus* (Fig. 2) in full flower. In all these flowers there is a peculiar structure of the petals. The claw of the vexillum is thin, sometimes prolonged and straight as in *C. emerus;* sometimes shorter and curved as in *C. varia*. The claws of the other petals cohere so as to form a channel, in which the staminal tube lies. But in all cases there is, immediately above the calyx, a large open space between the claw of the vexillum and the claws of the other petals so as to have free access from the outside to the inside or the inside to the outside of the flower.

One hot day last August I watched a bee rifling the flowers of *C. varia* in the regular way. He settled as usual on the lower flowers of the crowded umbel first, resting on the wings and keel, and went rapidly round and up the umbel. The plant was a large one, and he must have been there more than half an hour. He did not seem to be taking pollen. What could he be doing? for there was no semblance of nectar either inside the base of the petals or calyx or inside the staminal tube. On examining the flower carefully with a glass the *outside* of the calyx, which is thick and fleshy, appeared to be covered with shining glands or vessels, sometimes I think moist, but always yielding copious liquid on very slight pressure. Could this be what the bee was seeking? On a subsequent day I again watched a similar bee rifling the flowers, and at last distinctly saw his proboscis, which had entered as usual by the front of the flower, protruded outwards through the gap between the claws of the petals and sweep the outside of the calyx. Here then was an answer to my difficulty. The nectar for which the bee sought the flower, and in getting which he benefited the plant by carrying pollen from flower to flower, was not in any of the usual places inside the flower, but outside the calyx, while there was a very peculiar construction of the petals giving access to it. Instead of proving an anomalous exception to the generalisations I have quoted above, it turns out to be another curious illustration of the various ways in which the same

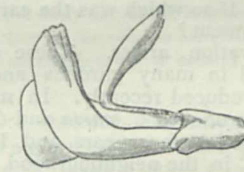

FIG. 2.—Coronilla emerus.

function of secreting nectar and of attracting the bee to it in the manner requisite for fertilising the flower is effected by different organs. That the outside of the calyx should secrete nectar and that there should be a peculiar window, out of which the bee, having entered by the regular door, and having in so doing dusted himself with pollen, should be able to get at the nectar, is surely a remarkable specialisation, and also a remarkable confirmation of the result of generalisations I had previously made.

Since then I have examined some other species or varieties of *Coronilla*, viz. *Coronilla emerus*, a very pretty free flowering garden shrub or creeper, a variety of this named *Coronilla emerus lutescens*, *C. montana*, and *C. minima*.

In *Coronilla emerus* the claws of the petals are much prolonged, so as to make the whole flower much longer than in the other species (see Fig. 2). The structure of the staminal tube is like that of Pisum, Lathyrus, Robinia, &c., in having a large cavity at the base filled with water, and large apertures on each side of the base of the tenth stamen, by which the bee's proboscis can reach the nectar. The long tube or channel formed by the claws of the petals is such as to lead the bee's proboscis directly to these apertures; and I have this spring distinctly seen a humble-bee getting the nectar in this way. The aperture between the claws enabled me to see the bee's proboscis going right down to the base of the staminal tube. On the other hand there is no appearance whatever of nectar or of glands containing nectar outside the calyx.

In *C. emerus lutescens* the structure is the same, except that there is a curious little excrescence on the inside of the claw of the vexillum just above the calyx. Does it guide the bee's proboscis to the apertures in the staminal tube, which it is to be remembered are on each side of the central tenth stamen? Mr. F. Darwin has suggested a function of this kind for a somewhat similar structure on the free tenth stamen of Phaseolus.

C. montana is a small plant, very like *C. glauca* in structure. The flower forms compact umbels; the claws of the petals are short, with a wide opening above the calyx; the tenth stamen is free, but the staminal tube is close-fitting, and there is no nectar inside the flower. *Per contra*, there are distinct glands or bubbles of liquid on the outside of the calyx, which is much infested by aphis.

C. minima is similar in structure; and both these species or varieties are similar to *C. glauca*.

We have then in this genus a number of species or varieties, all of which have their tenth stamen free, but which differ widely in other respects.

1. In *C. emerus* and *C. emerus lutescens* the nectar is in the base of the staminal tube, and is accessible by the separation of the tenth stamen in the usual manner.

2. In *C. varia, C. montana, C. glauca,* and *C. minima* the staminal tube is barren of nectar, but the nectar is secreted outside the calyx, and the access to it is provided for by a special gap between the petals.

In both cases, however, the flower is so constructed that the bee in getting the nectar which he wants dusts himself with and carries from flower to flower the pollen.

Some questions remain. The separation of the tenth stamen and the gap between the petals and the separate stamen both exist in all the species; where one is of use the other is useless. Why do they co-exist? Did one exist before the other? and is one of them now useless and rudimentary? If so which was the earlier and which the later in development?

A further observation arises. These *Coronillas* are foreign plants, and in many gardens and greenhouses have only been introduced recently. In my own garden in Surrey I have introduced *C. varia* and *C. emerus* from London within these last four years, and I am not aware of any other plants in the neighbourhood. But the bees seem quite to understand how to get the nectar from both. In *C. emerus* this is not surprising, for there are many other common flowers—Robinia, Pisum, Vicia, Lathyrus, &c.—similarly constructed. But I know of no flower common in England which is like *C. varia* in having the nectar outside the calyx, with the peculiar access to it through a gap in the petals. And yet the Surrey bee found his way to it at once. Does not this look as if the bee had sufficient intelligence to adapt his doings to a perfectly new and unknown structure?

T. H. FARRER

LENZ'S DOCTRINE OF OCEAN CIRCULATION

A VERY elaborate memoir was presented to the Royal Society at its last meeting, by Mr. Prestwich, containing a digest of all the observations made upon deep-sea temperatures previously to the *Lightning* cruise of 1868, which was the starting-point of all those recent researches that have excited so strong and general an interest. Of these observations, some of the most important were quite unknown to the scientific men of the present day, until brought to light by Mr. Prestwich's patient research; and I would take the earliest opportunity of particularly calling attention to those of Emil. Lenz, an eminent German physicist, formerly settled in St. Petersburg,* who accompanied Kotzebue in his second Circumnavigation Voyage in 1823–26. Of this voyage, the obtaining of deep-sea temperatures was one of the special objects; and, with a view to accuracy of observation, experiments were previously instituted by Parrot upon the influence of pressure on self-registering thermometers, of the same kind as those made by Mr. Casella under the late Prof. W. A. Miller and myself in 1869. And the St. Petersburg professors satisfied themselves by their experiments (as we did by ours nearly fifty years later), that any observations taken by sending down ordinary thermometers to great depths must be seriously vitiated by the pressure of the superincumbent water.

Instead of attempting, however, to improve his thermometers by the protecting outer bulb* which made our instruments thoroughly trustworthy, Lenz devised a method of obtaining deep-sea temperatures, which must have been very difficult to work, and which required a good deal of mathematical computation to bring out its results; yet this in his able hands gave temperatures which prove to be in close accordance with the thermometric observations of the *Challenger*. He also made throughout the voyage a careful series of observations on the temperature of the ocean at the surface and at moderate depths below it, which proved to be of the greatest value in the establishment of his general doctrine. And he further made an important series of observations on the salinity of ocean-water as indicated by its specific gravity. The increase of the density of sea-water with the reduction of its temperature down to the freezing-point, was known to Lenz through the experiments of Dr. Marcet in this country, and of Erman in St. Petersburg; and he was consequently free from the influence of the "dominant idea" that the deep water of the ocean, like that of the Swiss lakes, would have the uniform temperature (39½° F.) of *fresh* water at its greatest density; which obviously influenced the conclusions subsequently drawn from their own observations by D'Urville and Sir James Ross, and led to the general adoption of those conclusions.

The whole series of these observations, with the mathematical computations required for the determination of the real bottom-temperatures, are contained in a most elaborate memoir, entitled "Physikalische Beobachtungen, angestellt auf einer Reise um die Welt, unter dem Commando des Capitains von Kotzebue, in den Jahren 1823-26," presented to the St. Petersburg Academy in 1829, and published in vol. i. of its "Transactions" (1831). No one can examine this memoir without being impressed with the remarkable ability it displays; a peculiarly competent judge, Prof. Debus, whose attention I have directed to it, assures me that it is a model of admirable physico-mathematical investigation.

It was not until 1845, however, that Lenz gave forth the general conclusions to which he was led by his own observations and those of others (so far as known to him) in his admirable "Bemerkungen über die Temperatur des Weltmeeres in verschiedenen Tiefen," published in the "Bulletin" of the St. Petersburg Academy for 1847. He there shows that his own conclusions as to the low temperatures obtained at great depths are not invalidated by the observations of others, indicative of higher temperatures taken with ordinary thermometers; but may still be taken as indicating the presence of glacial water on the bottom of each of the great oceans, even under the equator. And from a discussion of the numerous temperature-observations taken at the surface and at small depths beneath it, Lenz deduces the important conclusion *that there is at and under the equator a belt of water cooler than the water to the north and south of it.* Of this striking phenomenon, he says, the explanation flows directly from the form of the isothermal curve which represents it; and this explanation I shall presently reproduce in his own terms, which will be found singularly accordant with those used by myself in the notice I

* The list of Lenz's papers occupies four columns of the Royal Society's Catalogue. A large proportion of them consist of original researches, both experimental and mathematical, in electricity and magnetism. And I am assured by Sir Charles Wheatstone that these are of the highest merit, and were greatly esteemed by Gauss and Jacobi, the two great masters in this department of investigation.

* It is right to recall the fact that this "protection" was first devised by Admiral Fitzroy, and was practically worked out by Messrs. Negretti and Zambra, as far back as 1857.

gave of the *Challenger* observations in the *Athenæum* of May 16.

As I have never claimed any originality in regard to the doctrine of oceanic circulation, which I have advocated solely as an important scientific truth, it has afforded me nothing but the most unalloyed satisfaction to find that the doctrine which appeared to me, as to Sir John Herschel (when I brought the case fully before him), the "common sense of the matter," was put forward nearly thirty years ago by one of the most eminent physicists of his day, as a necessary deduction from the facts of observation. That Lenz's Doctrine of Oceanic Circulation (for so it should now be termed) did not then obtain the general acceptance which I now confidently anticipate for it, seems principally due to the little attention formerly paid to Ocean Physics; it being only in recent years that the relation of deep-sea temperatures to the distribution of animal life on the ocean bottom, and the consequent importance of this knowledge in geological research, has made the inquiry one of general interest. This is the point of view in which the study of the subject has been pursued by Mr. Prestwich, whose exhaustive memoir will constitute a most valuable preface to the full discussion of the *Challenger* observations, when these shall have been brought to a conclusion two or three years hence.

"The mass of water in the tropics," says Lenz, "warmed down to a certain depth by the sun's heat, cannot maintain its equilibrium with the colder water of the middle and higher latitudes; a flow of the warmer water from the equator to the poles must necessarily take place on the surface, and this surface-flow must be supplied at the equator by a flow of colder water from high latitudes, which would at first flow in an almost horizontal direction, but which under the equator must rise from below to the surface. In this manner, in the northern hemisphere, a great vertical circulation takes place in the ocean, which has its direction above from the equator to the pole, and below from the pole to the equator. Since these flows, moving in opposite directions, are distinguished by their different temperatures, we observe in the submarine isotherm an indication of the lower portion of this flow. A corresponding flow, but moving in the opposite direction, takes place in the southern hemisphere; so that *in a zone surrounding the equator, where the two flows meet, the water flows almost in the direction from below up to the surface.*"

Lenz further adduced the low salinity of the surface-water of the equatorial belt, compared with the high salinity of tropical water, as an additional indication of the continual ascent of polar water from the bottom. And after remarking that water moving in the north and south direction must have its course influenced by the rotation of the earth, he continues, "It is a point which has been determined by Humboldt, John Davy, and others, that the water of the ocean is colder at the surface over shallows, than at some distance beneath over very great depths. This phenomenon, the explanation of which hitherto has not been found to be satisfactory, is a simple consequence of the movement of deep cold water from the pole to the equator. For if this runs against any obstruction, such as a shallow would present, it will rise along it, as upon an inclined plane, and approach nearer the surface, which in this manner will be cooled down." Thus Lenz explicitly propounded the principle on which I have explained the "cold band" between the Gulf Stream and the United States sea-board, the similar cold band on the east coast of Japan, and the cold stratum on the east side of the Dogger Bank. And I venture to believe, therefore, that here, too, the "common sense of the matter" has led me to a right conclusion.

I learn also, from Mr. Prestwich's memoir, that Arago, in 1838, in his instructions for a scientific expedition to Africa, not only distinctly recognised the existence of an underflow of glacial water from the poles towards the equator as the cause of the reduction of oceanic temperature with depth, and explicitly repudiated the doctrine of the uniform deep-sea temperature of 39½°; but also remarked upon the comparatively high temperature of the deeper stratum of the Mediterranean (first ascertained by D'Urville) as indicating that the polar flow does not find its way into that basin through the Strait of Gibraltar; thus anticipating the argument which I have based on my own investigations into the comparative thermal conditions of the Atlantic and the Mediterranean, as to the existence of a polar underflow in the former.

WILLIAM B. CARPENTER

NOTES

WE greatly regret to announce that Prof. Ångström died on the 21st ult.

MR. JOSEPH PRESTWICH, F.R.S., F.G.S., has been appointed to the office of Professor of Geology in the University of Oxford, as successor to the late Prof. Phillips.

THE Chair of Human Physiology in University College, London, in future to be called the Jodrell Professorship, after the name of its endower, has been filled by the appointment of Dr. J. Burdon Sanderson, F.R.S., who is now Professor of Physiology, including Practical Physiology and Histology. We have reason to believe that Mr. E. A. Schäfer will be appointed Assistant Professor under Dr. Sanderson.

M. A. DE CANDOLLE has been elected a Foreign Associate of the French Academy in the place of the late Prof. Agassiz.

THE death, at the early age of 28, is announced of Mr. Charles Tyrwhitt Drake, one of the officers in charge of the survey of Palestine. He succumbed to a second attack of malarious fever.

ENTOMOLOGISTS generally, and Coleopterists in particular, have experienced a great loss in the death of Mr. George Robert Crotch, M.A., of St. John's College, Cambridge. Mr. Crotch graduated in 1863, obtaining honours in the Natural Science Tripos. Until 1872 he was one of the Under Librarians at the University Library, when, besides his excellent work in that Institution, he devoted his spare time to his favourite subject. Mr. Crotch sailed for America in 1872, *en route* for Australia, for the purpose of studying the entomology of parts which he considered incompletely known, and on several occasions he has transmitted collections to England. He had added considerably to our knowledge of the entomology of California, Vancouver's Island, Oregon, and other districts; and on two occasions the Senate of Cambridge, recognising the importance of his work, voted him a sum of money from the University chest to aid him in sending collections to the University Museum.

TWO scientific expeditions are to set out from Archangel next summer—one into Russian Lapland, for the purpose of exploring the traces of ancient glaciers; the other, to the shores of the White Sea, has for its object zoological investigations. Dr. Yarjinsky, *La Revue Scientifique* states, who explored the district two years ago, discovered in the White Sea and the glacial ocean fishes and crustaceans till then quite unknown.

MR. JAMES LICK, of San Francisco, California, having in the course of his life accumulated a large fortune, has recently concluded a deed by which he conveys all his property to seven persons upon trust to be applied to various worthy objects. Among these, 700,000 dols. are to be applied to the construction of a more powerful telescope than any yet made, to be erected at an observatory in California, and 300,000 dols. to found, in California, a school of the mechanical arts.

THE last but one of the Government expeditions for observing the transit of Venus sailed from Plymouth for Christchurch, New Zealand, in the clipper ship *Merope*, on Saturday. The party consists of Major H. S. Palmer, R.E., chief astronomer in charge; Lieut. L. Darwin, R.E., assistant-astronomer and photographer; Lieut. H. Crawford, R.N., assistant-astronomer, and three non-commissioned officers of the Royal Engineers trained in the use of the photoheliograph.

A CORRESPONDENT writes that he has tried, with almost complete success, Prof. Helmholtz's remedy for Hay Fever, referred to in the paper (NATURE, vol. x. p. 26) sent us by Prof. Tyndall. Our correspondent gives the details of his treatment in a letter to the *Manchester Examiner* of the 30th ult., which also contains a letter from another sufferer who has tried Helmholtz's remedy with success. Our correspondent also asks,—"Could any of your readers give any information as to Weber's nose douche?—a more effective method of administering the remedy than by means of the pipette is desirable."

MR. SAVILLE KENT, Curator of the Manchester Aquarium, seems resolved to do his best to make that institution subserve the purposes of scientific instruction. Last Friday he gave the first of a series of lectures on subjects connected with aquaria to a fairly numerous audience; it is intended, we believe to continue the lectures on Friday afternoons during the summer.

DR. JOHN KIRK has received a letter from Lieut. Cameron dated Ujiji, Feb. 25, reporting his safe arrival at that place; he was just about to start for Unyanyembe. He heard from the people of Ujiji that the Lualaba from Nyangwé goes into the Mwootawzige or Bahari Unyoro, "so that," he says, "it must be the Nile after all."

MR. FORSYTH, the leader of the Yarkund Mission, arrived at Leh on the 17th. ult. He is expected in Calcutta about the 15th inst. Dr. Stoliczka is reported to have died on the 19th ult. at Shyok, above the Saser Pass.

THE prospectus is issued of a series of Positivist publications, *La Bibliothèque Positiviste*, to be written by M. André Poëy, having for its object the popularisation of the positive philosophy. The prospectus is mainly an eloquent eulogy of the Positivist doctrines, and an attempt to show that since Comte began to write they have gradually penetrated everywhere. The *Bibliothèque Positiviste* will consist of 30 monographs, to be published at intervals, in which the principles of Positivism will be expounded in relation to every sphere of human thought and action. The first part is entitled "La Bibliographie Positiviste," and will contain a list of 750 publications in favour of or opposed to Positivism, all of which have been published since Comte began to write. The publisher is Ernest Leroux of Paris.

THE Turners' Company, unlike most of the antiquated City guilds, seems to be alive to the fact that there are other kinds of merit worthy of honour besides the distinguished one of being a prince of the blood, a foreign potentate, a conquering hero, or one of her Majesty's ministers. It requires distinction of a very blazing kind indeed to attract the attention of most of our obtuse City Companies. The above Company is, however, a creditable exception in this respect to most of the others. Shortly before his death it conferred its freedom upon the late Prof. Phillips, and last week it did itself the honour of marking in a similar way its appreciation of the work which has been done by Sir Charles Lyell, Bart., F.R.S. The Turners' Company is evidently awake to the fact that after all the Useful Arts, Manufacture, and Commerce may derive some benefit from the results of non-utilitarian scientific research. The arts represented by the Turners' Company use, as part of their material, various sorts of stones, and Mr. Jones, the Master, showed in his really eloquent and well-informed address last week, that these arts have been greatly indebted to Sir Charles Lyell for having done much in their behalf by spreading a knowledge of the materials with which they work. Sir Charles, in his reply, spoke of the storm of opposition raised against many of the geological doctrines propounded in his first work, half a century ago, as compared with their almost universal acceptance at the present day.

WE have received a copy of a very able address delivered by Dr. Julius Haast, F.R.S., before the Philosophical Institute of Canterbury, New Zealand, in which he comments on several points connected with the geology of that country, maintaining his own theory as to the glacial origin of the Canterbury Plains in opposition to that of their marine formation, as supported by Capt. Hutton. In speaking of the extinct Struthious birds whose remains are so abundant, he is disposed to divide them, contrary to Prof. Owen, into two main families: the Dinornithidæ with a long metatarsus, no hallux, and a bony scapulo-coracoid bone; and the Palapterygidæ with a short metatarsus, with a fully-developed hallux, and no ossified scapulo-coracoid bone; the last-named character being one of particular interest, and supported by several arguments, the strongest of which depends on the absence of any coracoid articular grooves on the anterior margin of the sternum.

A RATHER strong shock of earthquake was felt at Constantinople on Friday, lasting two seconds. No accident is reported.

THE French Government has recently voted the sum necessary for the formation of a great inland sea in Algeria, 190 miles long by 36 broad, to the south of Biskra. A chain of chotts (*Chott* implying the bed of a lagoon) considerably below the level of the Mediterranean, is to be utilised for the purpose. A full account of the project is given in the first June number of the *Revue des Deux Mondes*.

THE meeting which was to have been held this month in London in connection with the Edinburgh University Buildings Extension Fund, has been postponed until November next.

MR. SANDERSON, from Lancing College, has been elected to a Natural Science Scholarship in Worcester College, Oxford. Messrs. Hugh Brocas-Price, from University College, London, and Mr. Henry H. Robinson, from Magdalen College School, have been elected to Natural Science Demyships in Magdalen College.

MR. W. J. NOBLE, of Epsom College, has been elected to a Natural Science Scholarship in Keble College, Oxford.

A MEANS of preventing the spread of the vine-pest, the *Phylloxera vastatrix*, is said to have been found, in the spreading of a layer of fine sand on the ground round the stems of the plants. The sand is said to be too loose for this insect to pass through, and the consequence is that it is intercepted in its passage from one plant to another. We are sorry to hear a report that this plague has found its way into Australia. The vine-growing districts of our Australian colonies are becoming so important that we trust this report may be unfounded. At all event steps should be taken to prevent its introduction into any of our colonies: such a measure will be easier than its destruction, should it ever gain a footing in them.

IN view of the scarcity and high price of oysters in this country it is alarming to hear that the celebrated beds of Arcachon, Concarneau, and other places in the west of France, are thought to be less productive than formerly. The want of accurate knowledge concerning this bivalve is probably at the root of this scarcity, and it may also be possible that the changes which are constantly taking place in the position and even in the nature of the sea-coast, may have a serious effect on the productiveness of the oyster beds all over the world. It is a well-known fact that oysters will not grow in certain localities where the conditions are apparently exactly similar to other localities where they will thrive; and the gradual change wrought by the sea in certain parts of the coast may account, quite as much as overfishing, for the gradual extinction of oysters. All beds are, however, fished much more extensively now than they were a few years ago, and whenever one is discovered, it is quickly worked out, without any consideration being given to the question of its extent, and whether it is a newly-established bed or not. America now largely supplies us with oysters either in a fresh state or preserved in tins, and it is calculated that in Maryland State alone, 5,282 persons are employed in dredging, and 10,947,803 bushels of oysters were taken in 1870-71; while the waters of Virginia are said to be equally productive. In the great oyster markets of Baltimore, where immense quantities of oysters are tinned, over 10,000 hands are employed in this branch of the trade.

A VALUABLE contribution to zoology is furnished by a paper published by Mr. Dall, on the birds of the Aleutian Islands, especially of that portion of the region to the west of Oonalaska, embracing the result of observations made during 1873 on board the U.S. Coast Survey vessel, the *Yukon*. As might have been expected, the great majority of the species are water-birds, particularly *alcadæ*, upon the natural history of which Mr. Dall throws much light, having been the first to collect eggs of several of the species, and observe their habits during the breeding season. The land-birds on this island are very few in number, consisting of two kinds of hawks, one owl, a swallow, and a wren, five finches, the raven, and ptarmigan. The total number of species enumerated is forty-five.

WE have received the prospectus of a work entitled "The Dominion of Canada; comprehending a General Description of the Confederated Provinces of British North America, and the North-west Territories," by Henry Youle Hind, M.A. (Montreal: John Lovell.) The following are the leading subjects:—I. Physical Geography of the Dominion. II. Climate and Climatic Effects. III. Geological Features. IV. Travel and Transportation. V. Agricultural, Forest and Mining Industries. VI. Commerce, Manufactures, and Fisheries. VII. The Inhabitants. VIII. Government. IX. Social Status. X. Miscellanea. The illustrations will consist of upwards of 250 engravings on steel, chromoxylographs, woodcuts, &c.

AT present the principal source of income to the United States from its acquisition of Alaska, and that which pays the larger part of the interest on the original investment of 7,000,000 dols. in its purchase, is derived from the fur-seal islands of St. Paul and St. George, which constitute the Pribylov group, in the Behring Sea. It is from these islands that the greater number of the skins of the fur seal as known in commerce are derived, the animals resorting to them in immense numbers every spring for the purpose of bringing forth their young. In 1870, an Act was passed by Congress limiting the number to be killed at 100,000. The Alaska Commercial Company secured the lease of the fishery, and has carried out the contract in apparent good faith. The condition of the islanders has been considerably improved. Congress has authorised the appointment of a commission to investigate the natural history and geographical distribution of the fur seal.

FROM the *Monthly Notices* of the Royal Society of Tasmania for June, July, and August, 1873, we learn that the Society has been making an inquiry in reference to the stone implements of the Tasmanian aborigines, especially as to whether the natives made use of these implements fastened to handles, after the manner of axes or tomahawks. All inquiries on the subject tend to prove that no true tomahawks were known to or fabricated by the natives; they merely used sharp-edged stones as knives. These were made sharp, not by grinding or polishing, but by striking off flakes with another stone till the required edge was obtained. As a very general, if not invariable, rule, one surface only was chipped in the process of sharpening. They were made from two different kinds of stone—the one apparently an indurated clay rock, the other containing a large proportion of silex.

A WRITER in the *Times* complaining of the want of labels in the Bird Gallery of the British Museum, states that "A young and active Naturalist has been appointed specially to look after this part of the collections." It is hoped that he will see that all the specimens are furnished with labels.

SOME experiments of particular interest physiologically have been undertaken by Dr. Worm Müller, and are described by him in Ludwig's *Arbeiten* (vol. viii. p. 159), an abstract of which paper will be found in the *London Medical Record* for last week. The author finds that the transfusion into the circulatory system of an amount of blood three times as much as that normally contained in the system does not cause any rise in the arterial blood pressure, though the pulse-rate is reduced. The reduction of the quantity of blood after transfusion, however, causes a rapid fall in the blood-pressure, even when only half that added has been removed. We think that the former of these results is not difficult to explain, for the heart, being an engine with only a limited capacity for work, it can only maintain a certain determinable blood-pressure, depending on the bulk of its muscular parietes. The introduction of an excess of blood to be circulated can therefore act only in filling the system at the expense of the velocity of the current, with a diminution in the rapidity of the cardiac action.

IT may be of some interest with reference to the demand of ladies to be admitted to the ordinary degrees of the University of London, to note that at the recent distribution of prizes at University College the first and second places in the mixed class of Jurisprudence were both occupied by ladies, Miss E. Orme, who two years ago took the prize in the class of Political Economy, coming out first, while in the mixed class of Political Economy a lady this year took the fourth certificate.

DR. W. G. FARLOW has published in the *American Journal of Science and Arts* an account of some investigations carried on in the botanical laboratory of the University of Strasburg, illustrating a remarkable asexual development from the prothallus of *Pteris serulata*. In the centre of the cushion or thickest part of the prothallus were a number of scalariform ducts, the prothallus bearing a number of antheridia, but no archegonia. From these ducts a leaf is developed directly, after which a root is also developed, and last of all a stem-bud. A comparison was drawn between this growth, which was observed in this species only, and the buds produced in the ordinary way from the protonema of a moss. Normally the prothallus of a fern is entirely destitute of vascular tissue of any kind.

DR. McKendrick (*Brit. Med. Journ.*, June 27, 1874) has made a contribution to the subject of the physiological antagonism of medicines which has been so elaborately illustrated by the works of Fraser and Crum Brown. He finds that while Bromal causes an excessively copious secretion of saliva, Atropine quickly arrests it, in rabbits. Possible practical applications of this discovery in the treatment of various kinds of ptyalism in man are at once thought of, and already cases of so-called success in the salivation of pregnancy are recorded.

IN the Bulletin of the Buffalo Soc. Nat. Sci. No. 4, vol. i., will be found a paper by Prof. Hartt on the geology of the Lower Amazons. He determines, on palæontological evidence, that the great plain of the Serra of Ereré is of Devonian age.

AMONG recent additions to the Manchester Aquarium are the following:—1 Smooth Hound or Skate-Toothed Shark (*Mustelus vulgaris*); 2 Topers or White Hound (*Galeus canis*); 2 Picked Dog-fish (*Acanthias vulgaris*); 4 Lesser Spotted Dog-fish (*Syllium canicula*); 4 Greenland Bullheads (*Cottus grœnlandicus*); 3 Gemmeous Dragonets (*Callionymus lyra*); 5 Cat or Wolf-fish (*Anarhicus lupus*); 2 Tadpole Fish (*Raniceps trifurcus*); Zoophytes—*Actinoloba dianthus*, *Sagartia bellis*, *S. nivea*, *S. viduata*, *S. miniate*, *Tealia crassicornis*.

THE additions to the Zoological Society's Gardens during the past week include a Black-backed Jackal (*Canis mesomelas*) from South Africa, presented by Captain Webster; two Rhesus Monkeys (*Macacus erythœrus*) from India, presented by Mr. W. Dunn; a Chinese Turtle Dove (*Turtur chinensis*), from India, presented by Major F. Gildea; a Canadian Beaver (*Castor canadensis*) and a Virginian Deer (*Cervus virginianus*), born in the Gardens; a Lanner Falcon (*Falco lanarius*), from east Europe, purchased.

SCIENTIFIC SERIALS

Transactions of the Norfolk and Norwich Naturalists' Society, 1873-74 (Norwich: Fletcher & Son).—This Society is now in the fifth year of its existence, and is in a satisfactory condition as to members. The chief features of the present number of its "Transactions" are Parts IV. and V. of the "Fauna and Flora of Norfolk," which the Society has undertaken to publish. Part IV., by Dr. John Lowe, embraces a list of the fishes known to occur in the Norfolk waters; and Part V. (forming a separate supplement), the Norfolk Lepidoptera, by Mr. C. G. Barrett. Both lists appear to have been done with great care and caution, and we should think that Dr. Lowe and Mr. Barrett have left very little to be added. The catalogues reflect the greatest credit both upon the compilers and on the Society, a few of the wealthier members of which have contributed the greater part of the expense of printing the present supplement. The next instalment of this important work of the Norfolk Society will contain the flowering plants, by Mr. H. D. Geldart. The president's address gives a *résumé* of the year's work of the Society, and discusses the question of Biogenesis.—Mr. F. D. Wheeler contributes a paper On breeding Lepidoptera in confinement, giving the results of the author's own experience; and Mr. F. Kitton one On Empusca and other micro-fungi.—In a short paper by Mr. J. B. Bridgman On the nidification of the Prosopis, the author concludes that this bee forms its "nest in any suitable situation, whether in soft earth or wood, not even despising ready-formed holes, and that it collects and carries home pollen in its mouth, after working it up in a pellet."—Mr. John Quinton contributes notes On the meteorological observations recorded at Norwich during the years 1870 73.—A variety of interesting miscellaneous natural history notes conclude the number. Altogether this Society must be congratulated on its year's work; its first object is "the practical study of natural science," which it seems to be carrying out with considerable faithfulness.

Proceedings of the Bath Natural History and Antiquarian Field Club, vol. iii. No. 1. 1874. This Society, to judge from this number of its "Proceedings," seems to devote itself mainly to antiquarian research, "Natural History," though it comes first in its title, seeming to find but small favour among the members. This defect the secretary animadverts strongly upon in his "Summary of Proceedings," stating, moreover, that the club was originally started for the purpose of botanical research. We do not undervalue antiquarian research, but we think it a pity that a club containing so many intelligent and well-educated members should fritter away almost its entire time and strength in a department that could be very satisfactorily worked by a small proportion of its members, to the almost entire neglect of the rich field presented by the district around Bath for Natural History investigation. We hope that the next number of its Proceedings will show that the suggestions of the secretary have been adopted. The only two natural history papers in this number are by Mr. C. E. Broome, F.L.S., On some of the fungi found in the Bath district, the present paper including Order 10, Myxogasters, and a short note by the Rev. Leonard Blomefield, F.L.S., On the occurrence of the Land Planaria (*Planaria terrestris*) in the neighbourhood of Bath. Dr. Bird was the first to discover this animal (supposed to be the only species of Land Planaria in western Europe) in the Bath district, and Mr. Blomefield is inclined to believe it to be carnivorous, making a prey of the smaller land molluscs. The secretary gives an extremely interesting summary of the meetings and excursions of the Society during 1873-74.

Zeitschrift der Oesterreichischen Gesellschaft für Meteorologie, June 1.—The observations of M. Marié Davy on the diminution of certain river waters in France are here closed with a discussion on the influence of different kinds of vegetation growing in their basins. It is shown that waste open land evaporates the least amount of rain-water, and forests less than corn or other farm produce. The increase of high farming and artificial meadow-land, absorbing and evaporating much moisture, must diminish the size of streams by robbing them of part of their supply, and to keep up the summer flow of a river it might be thought desirable to plant its upper basin with forests. Comparison of different rivers shows, however, that no valuable addition would thus be gained. Whatever be the origin of the river, geological conditions are alone effective. Therefore, although as a measure of national economy, for fixing soil on slopes, mitigating floods and changes of level, and providing cheap fuel, the maintenance of forests would be beneficial, we must look forward to a time when the art of storing some of the excess of winter rainfall to supply the needs of summer will be adopted in agriculture.—Among the "Kleinere Mittheilungen," Prof. Prestel deduces from twenty years' measurement of ozone a result similar to that of Herr Karlinski at Krakau, showing a minimum in November or December and a maximum in the spring.—The work of Herr Edlund on the mean temperature of Sweden, and a delicate form of Goldschmidt's aneroid, are here noticed.

Schriften der Naturforschenden Gesellschaft in Danzig, 1873.—The history of the population in the eastern provinces of Prussia is still involved in much obscurity, while that of the remaining provinces is pretty accurately known. In one of the papers in this volume Dr. Marshall considers the evidence obtainable from early writers—Pliny, Tacitus, &c. —from names of persons and places, and more especially from the archæological collections, of which there are two, imperfectly arranged, in Königsberg. From a study of grave-relics, Dr. Marshall is led to the conclusion that, at one time, in these eastern provinces two distinct races lived together. Several races having come from the east and settled in the coast-lands of the Baltic, more than 1,000 years B.C., this land was, later, overrun by Goths from central Russia, many of whom pressed on to Scandinavia and the Danish Islands, and to western and southern Europe; but a number remained on the amber coast, especially in the Weichsel region, and became fused with the Aestian or Wend race, already there; they were together known as *Pruzzen*.—Among the papers is another giving an account of a chemical analysis (made by direction of Dr. Friederici) of certain empty grave-urns of the ancient Prussians, the significance of which has not been clearly ascertained. Dr. Friederici thinks they were in themselves sacred vessels; they are made not from clay, but from ashes, firmed probably with blood of animals killed in sacrifice. In heating, the blood and the carbon particles at the surface had been turned to ashes, presenting a reddish-yellow appearance, while the internal substance was merely carbonised, and darker in colour.—Dr. Lissauer gives an account (with excellent photographs) of some more of those curious face-urns that have been found in large numbers in certain parts of Pomerania; and M. Kasiski describes a number of antiquities of various kinds discovered in Pomerania during 1872.—Dr. Lebert, who has been experimenting on the fluorescence of some specimens of Sicilian amber, finds the phenomenon in these much more marked and frequent than in Prussian amber; in the case of the latter he has observed, with strong sunlight, not only the existence, but the manifold character of the cone of light.—A valuable paper on new and extended employment of the level for astronomical and geodetic measurements is contributed by M. Kayser, and M. Menge continues a list and description of Prussian spiders.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, June 18.—On the Forces caused by Evaporation from and Condensation at a Surface, by Prof. Osborne Reynolds, of Owens College, Manchester.

It has been noticed by several philosophers, and particularly by Mr. Crookes, that, under certain circumstances, hot bodies appear to repel and cold ones to attract other bodies. It is my object in this paper to point out and to describe experiments to prove that these effects are the results of evaporation and condensation; and that they are valuable as evidence of the truth of the kinetic theory of gas, viz. that gas consists of separate molecules moving at great velocities.

The experiments of which the explanation will be given were as follows:—

A light stem of glass, with pith-balls on its ends, was suspended by a silk thread in a glass flask, so that the balls were nearly at the same level. Some water was then put in the flask and boiled until all the air was driven out of the flask, which was then corked and allowed to cool. When cold there was a partial vacuum in it, the gauge showing from $\frac{1}{4}$ to $\frac{3}{4}$ of an inch pressure.

It was now found that when the flame of a lamp was brought near to the flask the pith-ball which was nearest the flame was driven away; and that with a piece of ice the pith was attracted.

This experiment was repeated under a variety of circumstances, in different flasks and with different balances, the stem being sometimes of glass and sometimes of platinum; the results, however, were the same in all cases, except such variations as I am about to describe.

The pith-balls were more sensitive to the heat and cold when the flask was cold and the tension within it low, but the effect was perceptible until the gauge showed about an inch, and even after that the ice would attract the ball.

The reason why the repulsion from heat was not apparent at greater tensions was clearly due to the convection currents which the heat generated within the flask. When there was enough vapour, these currents carried the pith with them; they were, in fact, then sufficient to overcome the forces which otherwise moved the pith. This was shown by the fact that when the bar was not quite level, so that one ball was higher than the other, the currents affected them in different degrees; also that a different effect could be produced by raising or lowering the position of the flame.

The condition of the pith also perceptibly affected the sensitiveness of the balls. When a piece of ice was placed against the side of the glass, the nearest of the pith-balls would be drawn towards the ice, and would eventually stop opposite to it. If allowed to remain in this condition for some time, the vapour would condense on the ball near the ice, while the other ball would become dry (this would be seen to be the case, and was also shown by the tipping of the balance, that ball against the ice gradually getting lower). It was then found when the ice was removed that the dry ball was insensible to the heat, or nearly so, while that ball which had been opposite to the ice was more than ordinarily sensitive.

If the flask were dry and the tension of the vapour reduced with the pump until the gauge showed $\frac{3}{8}$ of an inch, then, although purely steam, the vapour was not in a saturated condition, and the pith-balls which were dry were no longer sensitive to the lamp, although they would still approach the ice.

From these two last facts it appears as though a certain amount of moisture on the balls was necessary to render them sensitive to the heat.

In order that these results might be obtained it was necessary that the vapour should be free from air. If a small quantity of air was present, although not enough to appear in the gauge, the effects rapidly diminished, particularly that of the ice, until the convection currents had it all their own way. This agrees with the fact that the presence of a small quantity of air in steam greatly retards condensation and even evaporation.

With a dry flask and an air-vacuum, neither the lamp nor the ice produced their effects; the convection currents reigned supreme, even when the gauge was as low as $\frac{1}{4}$ inch. Under these circumstances the lamp generally attracted the balls and the ice repelled them, *i.e.* the currents carried them towards the lamp and from the ice; but by placing the lamp or ice very low the reverse effects could be obtained, which goes to prove that they were the effects of the currents of air.

These experiments appear to show that evaporation from a surface is attended with a force tending to drive the surface back, and condensation with a force tending to draw the surface forward. These effects admit of explanation, although not quite as simply as may at first sight appear.

Although there must always be reaction corresponding to the visible motion, whenever vapour is driven off from a surface, this visible motion is too small to account for the forces under consideration. But, although it appears to have escaped notice so far, it follows as a direct consequence of the *kinetic* theory of gases that whenever evaporation takes place from the surface of a solid body or a liquid, it must be attended with a reactionary force equivalent to an increase of pressure on the surface, which force is quite independent of the perceptible motion of the vapour. Also condensation must be attended with a force equivalent to a diminution of the gaseous pressure over the condensing surface, and likewise independent of the visible motion of the vapour. This may be shown to be the case as follows:—

According to the kinetic theory the molecules which constitute the gas are in rapid motion, and the pressure which the gas exerts against the bounding surfaces is due to the successive impulses of these molecules, whose course directs them against the surface, from which they rebound with unimpaired velocity. According to this theory, therefore, whenever a molecule of liquid leaves the surface henceforth to become a molecule of gas, it must leave it with a velocity equal to that with which the other particles of gas rebound—that is to say, instead of being just detached and quietly passing off into the gas, it must be shot off with a velocity greater than that of a cannon-ball. Whatever may be the nature of the forces which give it the velocity, and which consumes the latent heat in doing so, it is certain, from the principle of conservation of momentum, that they must react on the surface with a force equal to that exerted on the molecule, just as in a gun the pressure of the powder on the breech is the same as on the shot.

The impulse on the surface, from each molecule which is driven off by evaporation, must therefore be equal to that caused by the rebound of one of the reflected molecules (supposing all the molecules to be of the same size), that is to say, since the force of rebound will be equal to that of stopping the impulse from a particle driven off by evaporation will be half the impulse received from the stopping and reflection of a particle of the gas. Thus the effect of evaporation will be to increase the number of impulses on the surface; and, although each of the new impulses will only be half as effective as the ordinary ones, they will add to the pressure.

In the same way, whenever a molecule of gas comes up to a surface and instead of rebounding is caught and retained by the surface, and is thus condensed into a molecule of liquid, the impulse which it will thus impart to the surface will only be one-half as great as if it had rebounded. Hence condensation will reduce the magnitude of some of the impulses, and hence will reduce the pressure on the condensing surface.

This explanation is then put in a mathematical form, and the paper proceeds.

Applying these results to steam, we find that at a temperature of 60° the evaporation of 1 lb. of water from a surface would be sufficient to maintain a force of 65 lbs. for one second.

It is also important to notice that this force will be proportional to the square root of the absolute temperature, and consequently will be approximately constant between temperatures of 32° and 212°.

If we take mercury instead of water, we find that the force is only 6 lbs. instead of 65; but the latent heat of mercury is only $\frac{1}{30}$ that of water, so that the same expenditure of heat would maintain nearly three times as great a force.

It seems, therefore, that in this way we can give a satisfactory explanation of the experiments previously described. When the radiated heat from the lamp falls on the pith its temperature will rise, and any moisture on it will begin to evaporate, and to drive the pith from the lamp. The evaporation will be greatest on that ball which is nearest to the lamp, therefore this ball will be driven away until the force on the other becomes equal, after which the balls will come to rest, unless momentum carries them further. On the other hand, when a piece of ice is brought near the temperature of the pith it will be reduced, and it will condense the vapour and be drawn towards the ice.

The reason why Mr. Crookes did not obtain the same results with a less perfect vacuum was because he had then too large a proportion of air or non-condensing gas mixed with the vapour, which also was not in a state of saturation. In the experiments the condensable vapour was that of mercury, or something which required a still higher temperature, and it was necessary that the vacuum should be very perfect for such vapour to be anything like pure and in a saturated condition. As soon, however, as this state of perfection was reached, then the effects were more apparent than in the corresponding case of water. This agrees well with the explanation; for, as previously shown, the effect of mercury would for the same quantity of heat be three times as great as that of water; and besides this, the perfect state of the vacuum would allow the pith (or whatever the ball might be) to move much more freely than when in the vapour of water at a considerable tension.

Of course the reasoning is not confined to mercury and water; any gas which is condensed or absorbed by the balls when cold in greater quantities than when warm would give the same results; and as this property appears to belong to all gases, it is only a question of bringing the vacuum to the right degree of tension.

There was one fact connected with Mr. Crookes' experiments which, independently of the previous considerations, leads me to the conclusion that the result was due to the heating of the pith, and was not a direct result of the radiated heat.

In one of the experiments exhibited at the Soirée of the Royal Society, a candle was placed close to a flask containing a bar of pith suspended from the middle; at first the only thing to notice was that the pith was oscillating considerably under the action of the candle; each end of the bar alternately approached and receded, showing that the candle exercised an influence similar to that which might have been exercised by the torsion of the thread had this been stiff. After a few minutes observation, however, it became evident that the oscillations continued instead of gradually diminishing, as one naturally expected them to do; and, more than this, they actually increased, until one end of the bar passed the light, after which it seemed quieter for a little, though the oscillations again increased until it again passed the light.

The explanation given is that, owing to the slowness with which the pith takes in and gives out heat, its ends will on the whole be hotter while receding from than while approaching the candle, and hence the force, as a mean, will be greater on that end which is receding, and there will be a continual oscillation.

Since writing the above paper, it has occurred to me that, according to the kinetic theory, a somewhat similar effect to that of evaporation must result whenever heat is communicated from a hot surface to gas.

The particles which impinge on the surface will rebound with a greater velocity than that which they approached, and consequently the effect of the blow must be greater than it would have been had the surface been of the same temperature as the gas.

And in the same way whenever heat is communicated from a gas to a surface the force on the surface will be less than it otherwise would be, for the particles will rebound with a less velocity than that at which they approach.

It is then shown mathematically, that for every English unit of heat communicated to steam at a temperature of 60°, the reaction on the surface is equivalent to ·38 lb. acting for one second; and in the same way for air the force is equivalent to ·55 lb. It is also pointed out that since the diffusion of heat within a gas is inversely proportional to its density, the amount of heat communicated from a surface to the surrounding gas is independent of the density of the gas, and hence, that the reaction on the pith in Mr. Crookes' experiments would remain constant as the vacuum improved, while the counteracting forces would diminish and leave the balls more free to move. It is therefore assumed that the results obtained in those experiments might have been at least in part due to such forces.

Linnean Society, June 19.—Dr. G. J. Allman, F.R.S., president, in the chair.—Mr. D. Hanbury, treasurer, exhibited branches of olive grown in the open air at Clapham, some bearing flowers, others nearly ripe fruit; also a specimen of *Rheum officinale* Baill., now grown in this country for the first time, the source of the true medicinal Turkey rhubarb, and pointed out the characters in which it differs from other species of the genus.—Dr. Hooker made a communication on the subject of some India *Garcinias* to the effect:—(1) That the *G. indica* Chois. (*purpurea* Roxb.), had been placed in a wrong section in Anderson's review of the genus in the "Flora of British India." (2) That the plant described in the same work as *G. griffithii* is proved to be the true Gamboge plant of Siam, *G. pinella*, var. *pedicellata* of Hanley, which Dr. Hooker regards as a distinct species, and proposes that the name of *G. hanburyi* should be given to it. (3) That the *G. brevirostris* of Scheffer is identical with *G. eugeniæfolia* of Wallich. (4) That the name of *G. ovalifolia* Hook. f., must give place to the previously published *G. ovalifolia* of Oliver's "Flora of Tropical Africa;" and the Indian plant must take the name of *spicata*, it being a form of *Xanthochymus spicatus* W. et A.—Prof. Thiselton Dyer exhibited a young oak-plant with three cotyledons, which had been sent to him by Mr. Cross, of Chester; also a pitcher-like development of a leaf of the common cabbage, from Harting, Sussex, sent by Mr. H. C. Watson to the Kew Museum.—Mr. A. W. Bennett exhibited drawings of the style, stigma, and pollen-grain of *Pringlea antiscorbutica* Hook. f., describing the remarkable manner in which the pollen of *Pringlea* differs from that of other nearly allied Crucifers, being much smaller and perfectly spherical, instead of elliptical with three furrows. This he considered a striking confirmation of Dr. Hooker's suggestion that we have here a wind-fertilised species of a family ordinarily self-fertilised, a hypothesis which is again confirmed by the total absence of hairs on the style of *Pringlea*.—An extract was read of a letter from Mr. Harry Bolus to Dr. Hooker, F.RS., dated Graaf Reinet, April 4, 1874, in which he comments adversely on some of the reasonings contained in Grisebach's "Vegetation der Erde" in favour of the theory of "independent centres of creation." Grisebach, relying chiefly on an observation of Burchell's, makes the Orange river the boundary between the Cape and Kalahari provinces, a boundary which Mr. Bolus shows to be untenable, at least in certain portions. Grisebach unites the Kanoo flora with that of the Cape province; while Mr. Bolus doubts whether it does not differ more from this than from the Kalahari. The Roggeveld, and indeed the whole Kanoo, by its predominance of shrubby Compositæ, seems to incline more to the desert type of plants than to the richer Cape flora.—The following papers were then read, viz.:—On the resemblances between the bones of typical living reptiles and the bones of other animals, by Harry G. Seeley. —On the Auxemmeæ, a new tribe of Cordiaceæ, by J. Miers. —A revision of the sub-order Mimoseæ, by G. Bentham, LL.D.—On some fungi collected by Dr. S. Kurz in Yomah, Pegu, by F. Currey.—Notes on the letters from Danish and Norwegian naturalists contained in the Linnean correspondence, by Prof. J. C. Schiödte, of Copenhagen.

Geological Society, June 10.—John Evans, F.R.S., president, in the chair.—The following communications were read:—On the occurrence of Thanet-beds and a crag at Sudbury, Suffolk, by William Whitaker. After referring to some passages in papers by Mr. Prestwich, in which the probable existence of Thanet-beds in North Essex is mentioned, the author described certain sections near Balingdon, on the right bank of the Stour, which exhibit sands belonging to this series. The crag-beds described by the author are found on the left bank of the Stour, in Suffolk, and consist of ferruginous dark reddish-brown sand, with layers of ironstone, slightly false-bedded, with here and there light-coloured grit with broken shells.—Notes on the phenomena of the Quaternary Period in the Isle of Portland and around Weymouth, by Joseph Prestwich, F.R.S. Commencing with the oldest drift-beds, the author showed that the remains of one, formerly more extensive, had been found in the Isle of Portland at a height of 400 ft. above the sea; that it contained the remains of the *Elephas antiquus*, *Equus fossilis*, &c.; and that he found in this bed a number of pebbles of sandstone and ironstone of Tertiary age, and of chert from the Greensands, whence he inferred that, as such pebbles could not now pass over the plain of Weymouth, they must have done so before that area was denuded, and when bridged over by the Portland and Purbeck beds; for the pebbles are derived from beds which are only *in situ* to the north of the Weymouth district, and at a distance of eight to ten miles from Portland. Further, this transport must have taken place before the elevation of the north end of Portland, and when the slope from the Bill to the Ridgeway was uniform and gradual. The anticlinal line, which has elevated the intermediate area, must be of later date than the drift-bed. The author next proceeded to notice the raised beach at the Bill of Portland, in which he had, with the assistance of Mr. Jeffreys, determined twenty-six species of shells, two of them not now living in the British Channel, and one new. This beach contains pebbles of the Devonshire and Cornwall rocks. The raised beach Mr. Prestwich found to abut against an old cliff that had been swamped at a later geological period by a land-wash, which had levelled it and the old sea-land with the adjacent land-surface. The mass which had thus swamped the cliff and buried the beach consisted of loam and angular *débris*, the latter being in larger proportion at top. In the loam he found several species of land and fresh-water shells and fragments of bones. The angular *débris* consisted of pieces of the local rocks, together with a number of specimens, which by their organic remains were shown to belong to the Middle Purbecks, a part of the series not now existing in Portland. A similar bed, but much thicker, was then described at Chesilton, in the north of the island. It is there 60 ft. thick, and contains large blocks of Portland stone and Portland chert, the greater number of which are in the upper part of the deposit, which is here on the sea-level, and 400 ft. lower than the Portland escarpment which rises above it. This loam and angular *débris* the author was disposed to attribute to a temporary submergence of the land to a depth exceeding the height of Portland, and by which the land as it emerged was swept, and its *débris* carried down to the lowest levels, with the remains of its land-animals and land and fresh-water shells, which latter, where protected by large masses of loam and suddenly entombed, have been preserved uninjured. To this deposit, which is common over the raised beaches on the south coast, the author proposed to apply the term "land-wash." The paper concluded with a short notice of the drift-beds formed subsequently to the denudation of the Weymouth district, and therefore never on the high-level Portland drift.—On the character of the diamantiferous rock of South Africa, by Prof. N. Story Maskelyne, F.R.S., Keeper, and Dr. Flight, Assistant, of the Mineralogical Department, British Museum. In this paper the authors confirmed certain statements made by one of them from a superficial examination of specimens brought to this country by Mr. Dunn. The specimens examined and analysed by Dr. Flight were obtained from various diggings and from different depths, down to 180 ft. in the case of one mass from Colesberg Kopje. Their characters throughout are essentially the same. The rock consists of a soft and somewhat pulverulent ground-mass, composed of a mineral (soapy to the touch) of a light yellowish colour in the upper, and of an olive-green to bluish-grey colour in the lower parts of the excavations. Interspersed in the mass are fragments of more or less altered shale, and a micaceous-looking mineral of the vermiculite group, which sometimes becomes an important constituent of the rock, which also contains bright green crystals of a ferruginous enstatite (bronzite), and sometimes a horn-blendic mineral closely resembling smaragdite. A pale buff bronzite occurs in larger fragments than the green form of the mineral; and in the r[illegible] of Du Toit's pan an altered diallage is present. Opaline silica, in the form of hyalite or of hornstone, is disseminated through the greater part of the rock-masses, and they are everywhere penetrated by calcite. The analyses of the component minerals (given in detail in the paper) show that this once igneous rock is a bronzite rock converted into a hydrated magnesium silicate, having the chemical characters of a hydrated bronzite, except where the remains of crystals have resisted metamorphism. Except in the absence of olivine and the small amount of augitic mineral, it might be compared with the well-known Lherzolie rock. The diamonds are said to occur most plentifully, or almost exclusively, in the neighbourhood of dykes of diorite which intersect the hydrated rock, or occur between it and the horizontal strata through which the igneous rocks have been projected. The authors compare the characters of the diamonds found in different positions, and come to the conclusion that their source is not very remote from that in which they are now found. The mineral above-mentioned as resembling vermiculite is described by the authors as a new species under the name of Vaalite.—Note on a modified form of Dinosaurian ilium, hitherto reputed scapula, indicative of a new genus, or possibly of a new order of reptiles, by J. W. Hulke, F.R.S. The author re-examines Mantel's "Scapula of an unknown reptile" = Owen's "Scapula of Megalosaurus?" and adduces reasons for considering it to be a modified Dinosaurian ilium. He describes two new examples of the bone in Dr. Wilkins's collection, contrasts them with undoubted scapulæ of sundry Dinosaurs and existing reptiles, and proves their essential correspondence with the ilia of known Dinosaurs.—Note on a reptilian tibia and humerus (probably of *Hylæosaurus*) from the Wealden formation in the Isle of Wight, by J. W. Hulke, F.R.S. In this communication the author describes two saurian limb-bones, remarkable for the great expansion of their articular ends, and the shortness and smallness of their shaft. The features of the tibia are more like those of the tibia of *Hylæosaurus* than of any other Dinosaur. This resemblance, and the suitability of the humerus to the very massive articular end of the Hylæosaurian scapula, dispose the author to refer the bones to this saurian.

Royal Horticultural Society, June 17.—Scientific Committee.—Dr. J. D. Hooker, C.B., P.R.S., in the chair.—Specimens of *Puccinia malvacearum* (the hollyhock disease) were exhibited from Mr. Fish.—Dr. Masters showed a large slab of the wood of the Encine (*Quercus humilis*).—Mr. Worthington Smith exhibited a woodcut block of ebony which he pronounced nearly as good as box, but objectionable on account of its dark colour.—Dr. Denny showed flowers of a scarlet Pelargonium raised by him, in which the petals were remarkably persistent. He had obtained this horticulturally desirable quality by continuous breeding and selection from a variety originally manifesting it in a smaller degree.

General Meeting.—W. A. Lindsay, secretary, in the chair.—Prof. Thiselton Dyer commented on the interesting series of lilies exhibited by Mr. Barr, which illustrated four distinct geographical races all belonging in a wide sense to the same species. *Lilium bulbiferum*. *L. bulbiferum* proper was wild in Austria and Sweden; *L. croceum* in France, Switzerland, and North Italy; *L. davuricum* in Siberia, *L. thunbergianum* in Japan. It could not be doubted that these were all derived from a common parentage, and had been gradually differentiated as they migrated in different directions and became isolated.—He also described the coffee blight of Ceylon and South India (*Hemileia vastatrix*). A dried bush exhibiting the effects of the disease was shown on the table.—Dr. Hooker illustrated in some detail the light which the theory of a common parentage threw on the geographical distribution of closely allied species, varieties, or forms. He pointed out as particularly striking cases the cedars and the 5-leaved pines. As to the *Hemileia* it could not be doubted that it was a most serious enemy for the planters to contend with. He thought, however, that there was some hope that particular kinds of coffee might be found to be less liable to its attacks than others, and at Kew he had been making great efforts to procure and raise from seed the remarkably large-seeded West African kind with a view to its transmission to Ceylon.

Anthropological Institute, June 23.—Prof. Busk, F.R.S., president, in the chair.—Mr. Robert Dunn read a paper On ethnic psychology. The author dwelt on the importance of carefully studying the cerebral organisation of the typical races as the only way of elucidating the psychological differences which exist among them. Notwithstanding the labours of Gratiolet in that field of inquiry, a vast deal remained to be done. The author's convictions rested on the postulate that the brain is the instrument of the mind, and the consequent corollary was that the distinguishing psychical differences existing between various peoples depend greatly, if not altogether, on the structural differences of their brains.—A paper, by Mr. Rooke Pennington, was read, On the relative ages of cremation and contracted burial in Derbyshire in the Neolithic and Bronze ages. The object of the paper was to show that the impression that stone implements and contracted burial, bronze implements and cremation, are usually associated is quite erroneous as tested by the results of barrow-opening in the Peak of Derbyshire. The researches of Messrs. Bateman and Carrington on being tabulated proved that. Of "finds" containing stone implements, 65 per cent. were cases of contracted burial, 34 per cent. were burnt. In the Bronze, 58 per cent. were contracted, 38 per cent. were burnt. It was clear that those who deposited stone implements in the graves of the dead, and those who placed there articles of bronze, shared pretty equally the differences of custom in the interment of the body: so that out of 150 contracted entombments, 50 per cent. were accompanied by stone only, 12 per cent. by bronze; and out of 86 burnt cases, 46 per cent. afforded stone only, 14 per cent. bronze. The conclusion was fully borne out by examination of the contents of each tumulus. Several instances were given as showing that the Neolithic and Bronze peoples alike used both modes of burial.—A paper, by Miss A. W. Buckland, was read, On mythological birds ethnologically considered. The chief object of the author was to prove that in tracing the bird-legends to their sources, valuable ethnological results might be obtained, and a clue afforded to the migrations of man in Prehistoric times.—The president took the opportunity on this, the last ordinary meeting of the session, of announcing that the appeal of Council to the body of members at the anniversary had been so successful that the Institute was now out of debt.

Geologists' Association, June 5.—Henry Woodward, F.R.S., president, in the chair.—On the lower cretaceous beds of Folkestone, by F. G. H. Price, F.G.S. The town of Folkestone is situated upon the Folkestone Beds of the Upper Neocomian. These the author divides into four lithological groups, commencing with a sandy bed, which contains many phosphatic nodules, and which he considers to form the true division between the Folkestone and underlying Sandgate beds. The *Rhynchonella sulcata* bed, an important fossiliferous zone, lies at the base of the latter. The general character of these Folkestone beds is that of a loose yellowish sand parted by seams of coarse calcareous sandstone. Masses of branching sponge are especially plentiful in these rocks. The last bed of the Folkestone series is a very remarkable one, consisting of an irregular seam of large nodular masses, composed of coarse grains of quartz, glauconite, jasper, lydian-stone, and phosphatic nodules. Four feet of loose sand succeeds, capped by a band of pyritous nodules; and then occurs a seam of dark greensand (containing two lines of phosphatic nodules), largely charged with *Am. interruptus*, and other fossils in the form of rolled casts. The argillaceous beds of the lower gault, which follow, are frequently very dark in colour, and more or less parted off by lines of nodules, marking certain zones of life. The thickness of this sub-formation is about 28 ft. From the grey marl or upper gault it is separated by a nodule or passage bed of much importance; as this nodule bed marks the extinction of lower-gault forms and the introduction of others. The base of the upper gault may be known by the large quantities of *Inoceramus sulcatus*. The upper fifty feet consists of a pale grey marl, of which the portion subjected to analysis yielded 26 per cent. of lime carbonate.—On a collection of fossils from the U.G.S. of Morden, Camb., by H. George Fordham, F.G.S.

Entomological Society, June 1.—Sir Sidney S. Saunders, president, in the chair.—Mr. McLachlan exhibited specimens of the White Ant (*Calotermes* sp.), recently bred at Kew from a sample of the wood of the tree (*Trachylobium hornmannianum*) that produces the gum-copal of Zanzibar.—Mr. Stainton read a letter he had received from the Rev. P. H. Newnham, of Stonehouse, Devon, stating that he had taken two living specimens of *Deiopeia pulchella* on the Cornish side of the River Tamar. Mr. Stainton remarked on the early period of the year when the insects were captured as very unusual.—Mr. C. O. Waterhouse sent for exhibition a living specimen of a Mantid (*Empusa pauperata*) in the larva or pupa state, brought from Hyères by the Rev. Mr. Sandes of Wandsworth.—Mr. W. D. Gooch communicated a detailed account of his experiences with regard to the Longicorn Coffee-borers of Natal. Dr. Horn, of Philadelphia, stated that European Conifers, Limes, &c., planted in a public park at Philadelphia, were all killed by the larvæ of native species, such as *Callidium antennatum* and *Monohammus dentator*, though apparently in a healthy condition, whilst the native trees were not perceptibly affected. He was inclined to believe that the insects attacked healthy trees, but Mr. McLachlan stated that, according to the observations of most European entomologists, the European species of Longicorns did not attack living wood in a perfectly healthy state.—Mr. Butler communicated a paper On new species and a new genus of diurnal Lepidoptera in the collection of Mr. Druce.—Mr. Smith read a revision of the Hymenopterous genera *Cleptes*, *Parnopes*, *Anthracias*, *Pyria*, and *Stilbum*, with descriptions of new species of the genus *Chrysis*, from North China and Australia.

PARIS

Academy of Sciences, June 22.—M. Bertrand in the chair.—M. Dumas stated, in the name of the *Phylloxera* Commission, that after the theoretical researches of the Commission this body had commenced a practical study of the subject in the field. Agricultural police had been appointed for the preservation of those parts of France not yet invaded by the scourge.—The following papers were read:—Researches on solution, by M. Berthelot; a continuation of thermo-chemical investigations.—Presentation of some specimens of photography obtained with an apparatus constructed for the Japanese expedition, by M. J. Janssen. The photographs presented were of the sun taken with an objective (of 5 in. aperture and 2 metres focus), constructed of flint and crown glass in achromatic combination.—A mechanical note was presented by M. R. Clausius, entitled "On a special case of the Viriel."—Theory of the collision of bodies, with consideration of the atomic vibrations, by M. A. Ledieu.—Communication on the bitter lakes of the Isthmus of Suez, by M. Ferdinand de Lesseps. The author exhibited a block of salt cut out from the salt bank still existing in the centre of the great basin. This bank is calculated to have contained 970,000,000,000 kilogrms. of salt, and has now dissolved away to the extent of $\frac{1}{10}$ since the admission of the water of the canal. The superficial area of the salt bank is about 66,000,000 square metres, and it is composed of horizontal layers varying in thickness from 5 to 25 centims. The bank is believed to have been formed by the evaporation of Red Sea water poured into the lake basin during successive inundations; the amount of Red Sea water evaporated is about 21,000,000,000 cubic metres. The lake basin contains 2,000,000,000 cubic metres of water, giving an annual evaporation of 200,000,000 cubic metres. Twenty years ago rain hardly ever fell in the isthmus, but now tiles are obliged to be sent from France to roof the houses there. The author holds out great hopes of the practicability of filling a great basin in the interior of Algeria. A valuable table of numerical results accompanied the communication.—Geological topography of the environs of Aigues-mortes, a letter from M. Ch. Martins to M. Elie de Beaumont.—Observations on the subject of the reply of M. Faye to the criticism concerning his addition to Pouillet's memoir on solar radiation, by M. A. Ledieu. The author insisted that there was still a difference in the *principles* of thermodynamics between him and M. Faye.—Analysis of twenty-one samples of salt water from the maritime canal of Suez, sent by M. F. de Lesseps, by M. Durand-Claye. While Mediterranean water contains a solid residue of about 40 kilogrms. per cubic metre, the canal water contains, in some parts, 75 kilogrms., and never falls below 65 kilogrms. This fact is explained by the solution of the great salt bank before referred to. At Port Said the water is less salt than in the Mediterranean (24 to 26 kilogrms.) owing to admixture with Nile water.—On the employment of phenic acid for the preparation of wood, by M. M. Boucherie.—On the Cycadaceæ of the Paris basin, a note by M. Robert. Among a number of rolled flints from the confluence of the Nesle and Aisne between Ciry-Sermoise and Chasemy, the author found a number of stems which he considers to belong to the order named.—On the systems of quadratic forms, by M. C. Jordan.—M. G. Darboux made an addition to his note read on June 8, On friction in the collision of bodies.—Hydrographic map of Algeria, a note by M. E. Mouchez.—Phenomenon of mirage observed in Yffiniac Creek (North coast), by M. J. Girard.—Action of heat on the isomeric carbides of anthracene and their hydrides, by M. P. Barbier.—Chlorobromides of propylene: normal propyl-glycol, by M. E. Reboul. Only one chlorobromide of propylene has been known up to the present time, viz. $CH_2Br-CHCl-CH_3$ (Friedel and Silva). The author now makes known the four others, $CH_2Br-CH_2-CH_2Cl$ (normal), $CH_3-CClBr-CH_3$, $CH_3-CH_2-CHClBr$, and $CH_3-CHBr-CH_2Cl$.

BOOKS RECEIVED

COLONIAL.—Report of Progress of Geological Survey of Victoria, &c.: R. Brough Smyth (Melbourne).—Report upon the Rainfall of Barbados, and its Influence upon the Sugar Crops: Governor Rawson (Barbados).

FOREIGN.—L'Astronomie Pratique et les Observations en Europe et en Amérique: C. André et G. Rayet (Gauthier Villars, Paris).—Die neue Sternwarte der Wiener Universität: Carl von Lithow.—Jahresbericht des Physikalischen Central Observatoriums for 1871-72: H. Wild (St. Petersburg).—Annalen des Physikalischen Central Observatoriums: H. Wild, 1872 (St. Petersburg).—Spectres Lumineux: M. Lecoq de Boisbaudran. 2 vols. 8vo. (Gauthier Villars).—Repertorium für Meteorologie Kaiserlichen Academie, Redigirt: Dr. Heinrich Wild. Band iii.—Bulletin de l'Academie Imperiale des Sciences de St Petersbourg, t. xviii., Parts iii. iv. v.—Bulletin de l'Academie Imperiales des Sciences de St. Petersbourg, t. xix., Parts i. ii. iii.

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