THURSDAY, JULY 22, 1875

THE LIFE OF LANGUAGE

The Life and Growth of Language. By William Dwight Whitney, Professor of Sanskrit and Comparative Philology in Yale College. The "International Scientific Series," vol. xvi. (London: King and Co., 1875.)

THIS is certainly a disappointing volume. When the editors of the *International Scientific Series* offered us a treatise on Language by the side of such works as Tyndall's "Forms of Water in Clouds and Rivers," Bagehot's "Physics and Politics," Bain's "Mind and Body," Spencer's "Study of Sociology," we had a right to expect something substantial, if not original. Instead of this, Prof. Whitney presents us with what is to all intents and purposes an abstract of his "Lectures on the Study of Language," delivered in 1864 in Washington and other places, lectures which in themselves contained hardly more than a popular summary of some of the results obtained by the researches of German, French, and English scholars on the origin, the development, and the classification of languages. "The old story," to let Prof. Whitney speak for himself, "is told in a new way, under changed aspects and with changed proportions, and with considerably less fullness of exposition and illustration." But why simply tell us the old story over again? Has the science of language made no progress since 1864? Has Prof. Whitney himself worked up no new materials? Has he no discovery of his own to record in his own special fields of labour? Has he brought none of the problems which, as he told us in 1864, still perplexed the students of the science of language, nearer to a solution? Or, at all events, has he not found some more felicitous illustrations than those with which he entertained his hearers ten years ago? If any one who knows the Professor's lectures, should read his new treatise on what he strangely calls the "Life and Growth of Language," we doubt not which of the two volumes he will keep on the shelves of his library, and which he will assign to the corner of ephemeral literature. Prof. Whitney has set forth his good wine at the beginning, and gives us now that which is worse. To judge from other numbers of the *International Series*, the rules imposed on the contributors do not seem to have prevented them from treating their subjects in a thorough, if not in an exhaustive way. Besides, there are in this volume several lengthy discussions as to whether the science of language should be called a physical or an historical science, whether it deserves the name of a science at all, whether a knowledge of psychology is essential to the student of language or not; discussions which, as far as we are able to judge, contain an "infinite deal of nothing," and add very little to what had already been written on these subjects.

In one respect, however, we have to congratulate Prof. Whitney most warmly on a great improvement in these his second and more sober thoughts. From beginning to end his new book is free from spite and personal invective. Neither Humboldt, nor Bopp, nor Renan, nor Schleicher, nor Bleeck, nor Steinthal, nor Goldstücker are held up to ridicule as ignorant of the A B C of grammar and logic. There is here and there a groundswell and a distant rumble, but on the whole the sea is between moderate and smooth, and we arrive at Calais with a feeling of relief and sincere thankfulness. It may be that these feelings are not shared by all readers. Man is by nature a pugnacious animal, and though in later life but few like to use the cudgels themselves, they still like to look on where there is a row. Prof. Whitney's new book therefore may seem to some people more dull than any of his former compositions; yet his true friends will rejoice that for once he has chosen the better part of valour, and in showing regard to others has shown respect for himself.

In making this laudable effort, however, Prof. Whitney seems to us to have fallen, involuntarily, no doubt, into a mistake which we hope he will forgive us for pointing out. Prof. Whitney, it is true, has not in this volume, as far as we can trust our memory, abused anybody by name. He himself takes credit for it at the end of his preface, where he says: "I have on principle avoided anything bearing the aspect of a personal controversy." But neither has he thought it necessary to add any references where he avails himself of the work done by other scholars. On this point, too, we shall quote his own words:—"And I have had to leave the text almost wholly without references, although I may here again allege the compendious cast of the work, which renders them little called for. I trust that no injustice will be found to have been done to any. The foundation of my discussion is (*sic*) the now generally accessible facts of language, which are no man's property more than another's."

This is not the first time that Prof. Whitney makes these curious excuses. In the preface to his Lectures the same or a very similar plea was put forth. We quote again his *ipsissima verba*:—"The principal facts upon which my reasonings are founded have been for some time past the commonplaces of comparative philology, and it was needless to refer for them to any particular authorities. When I have consciously taken results recently won by an individual, and to be regarded as his property, I have been careful to acknowledge it. It is, however, my duty and my pleasure here to confess my special obligations to those eminent masters in linguistic science, Professors Heinrich Steinthal, of Berlin, and August Schleicher, of Jena, whose works I have had constantly upon my table, and have freely consulted, deriving from them great instruction and enlightenment, even when I have been obliged to differ most strongly from some of their theoretical views. Upon them I have been dependent, above all, in preparing my eighth and ninth lectures; my independent acquaintance with the languages of various type throughout the world being far from sufficient to enable me to describe them at first hand. I have also borrowed here and there an illustration from the 'Lectures on the Science of Language' of Prof. Max Müller, which are especially rich in such material."

Now, what we wish to point out with reference to these repeated reservations on the part of Prof. Whitney is this. Because an author refrains from personal invective, it does not seem to us to follow that he may also dispense with giving honour where honour is due. No doubt there are a good many facts in the science of language which by this time have become public property, nay, where it would be extremely difficult to say who was their original discoverer. That Sanskrit *asti* is the same as Latin *est*, that Sanskrit *trayas* coincided with Latin *tres*, was probably seen by every scholar who ever opened a Sanskrit grammar. In such cases it can be merely a matter of historical interest to find out who was the first lucky observer. It seems to us one of the chief merits, for instance, of Curtius's Principles of Greek Etymology, that he tells us in most cases, with the greatest conscientiousness, who were the scholars that first proposed or afterwards defended and substantiated the etymology of different words. Such references involved, no doubt, considerable trouble, and we have no right to expect in a popular work the same learned *apparatus*. But there are limits here as everywhere else, which no one can overstep with impunity. Every writer, unless his memory is growing weak, knows perfectly well what comes out of his brain, and what comes out of his pockets; what he has found out himself by dint of hard work, and what he has simply borrowed from others. A large array of footnotes and references may be in many cases a mere pedantic display of learning, but to omit all indications of sources and authorities is hardly defensible, nor can it be excused on the ground of "the compendious cast" in a book where we find, on the second page, references to two of Prof. Whitney's own writings. This is really not a matter of sentiment only, but a matter of serious import in the world of letters. Dates are easily forgotten, and of late it has happened several times that one writer has actually been blamed for having borrowed from another without acknowledgment, whereas he was the creditor and the other the debtor. This leads to awkward explanations, sometimes to angry controversies, all of which can be avoided by a frank compliance with rules long recognised in the republic of letters.

If we confine ourselves to some of the principal subjects treated in Prof. Whitney's new work, would it not have been interesting to know who first pointed out the two motive powers in the growth of language on which Prof. Whitney dwells so largely—*Phonetic Decay*, and *Dialectic Growth* or *Variation?*

Again, when an intelligible and sufficient cause was wanted for what was vaguely and metaphorically called Phonetic Decay, who was it that first ventured to suggest that there was nothing mysterious in that process, and that it could be explained in a very homely way as the result of laziness, or of economy of muscular energy?

There is one question which Prof. Whitney has treated more fully in this than in his former work, viz., the true meaning of dialect, and the relation between dialects and languages. He exhibits most ably the inevitability of dialectic variety in the very beginning of human speech, and the gradual elimination of dialectic forms in the later growth of language. Were there not others who had strongly insisted on the dialectic nature inherent in language, and had borne the brunt of the battle against numerous unbelievers?

We still remember the time when the leading philologists in Germany protested against the introduction of scientific Phonetics into Comparative Philology. If at present phonetic and physiological discussions form the introduction and groundwork to every treatise on Comparative Philology, is it not well to remember the names of those who were once ridiculed as the founders of the *Fonetik Nuz?*

It may be, as Prof. Whitney asserts, that though Germany is the home of Comparative Philology, the scholars of that country have distinguished themselves much less in that which *We* have called the Science of Language. It may be easy, as he says in another place, to note remarkable examples of men of the present generation, enjoying high distinction as comparative philologists, who, as soon as they attempt to reason on the wider truths of linguistic science, fall into incongruities and absurdities. But who were the first to conceive a Science of Language as different from Comparative Philology, though beholden to it for its most valuable materials? Who first drew the outlines of that science, collected the facts required for its illustration, and established the leading principles for its study? Prof. Whitney could have answered all these questions better than anybody else, whereas, by his reticence, he may now leave on many of his readers the impression, though no doubt very much against his own will, that the science of language had its cradle in America, and that German, English, and French scholars have added nothing to it, except "incongruities and absurdities."

After having made these reservations in favour of the founders of and former contributors to the science of language, let us now see in what Prof. Whitney's own contributions to that science consist. We shall have no difficulty in doing this, for he tells us frequently in the course of his writings what he himself has done for rescuing the science of language from the "incongruities and absurdities" of European scholars.

His first discovery is that *Language is an Institution.* No one, we believe, would feel inclined to controvert this statement. Language is an institution, and a most excellent institution.

We therefore pass on to the next discovery, which is that *Language is an Instrument.* This again is not a very startling assertion. It is well known that Plato, in trying to find out in his own Socratic method what language is, begins with the same assertion.

"*Soc.* That which has to be cut has to be cut with something?

"*Her.* Yes.

"*Soc.* And that which has to be woven or pierced has to be woven or pierced with something?

"*Her.* Certainly.

"*Soc.* And that which has to be named has to be named with something?

"*Her.* That is true.

"*Soc.* What is that with which we pierce?

"*Her.* An awl.

"*Soc.* And with which we weave?

"*Her.* A shuttle.

"*Soc.* And with which we name?

"*Her.* A name.

"*Soc.* Very good. Then a name is an instrument."

The only difference between Plato and Prof. Whitney is this, that with Plato this crude definition is but the first link in a long chain of argument, a proposition made simply in order to show its insufficiency; while Prof. Whitney seems to look upon it as free from all objections.

The third discovery which Prof. Whitney considers as peculiarly his own is, that *everybody learns his language from his parents.* While other writers on the origin of language have "aimlessly expended a surprising amount of sapient philosophy," Prof. Whitney solves the whole question on the first page. We must again quote his own words:—

"There can be asked, respecting language, no other question of a more elementary and at the same time of a more fundamentally important character than this: How is language obtained by us? how does each speaking individual become possessed of his speech? Its true answer involves and determines well-nigh the whole of linguistic philosophy. There are probably few who would not at once reply that we learn our language; it is taught us by those among whom our lot is cast in childhood. And this obvious and common-sense answer is also, as we shall find on a more careful and considerate inquiry, the correct one."

This third discovery, too, will hardly meet with any objections. Prof. Whitney says, indeed, that two different answers are conceivable, viz., that language is inherited as a race-character, like colour, or that it is independently produced by each individual; but though we do not deny the conceivableness of such propositions, we doubt whether any being endowed with the gift of language ever made them, and whether they required "the crushing weight of facts" which Prof. Whitney brings out against them. We do not blame an author, who for argument's sake sets up what in German is called a *Strohmann*, in Sanskrit a *Púrvapaksha;* but when we read on p. 145, "There are those still who hold that words get themselves attributed to things by a kind of mysterious natural process, in which we have no part; that there are organic forces in speech itself, which by fermentation, or digestion, or crystallisation, or something of the sort, produce new material and alter old," Prof. Whitney would appear to have allowed himself to be carried away a little too far by his dramatic imagination.

To most people, however, be they scholars or philosophers, it would seem that to be told that a child learns his language from his mother, does not help them very much towards a real insight into the origin of language. We should go on from child to mother, from mother to grandmother, and so forth, but this retrogression *in infinitum* would land us exactly at the same point from which we started, viz., How did the first mother get her language? Let us hear what Prof. Whitney has to say in answer to this ever-recurring question. He tells us to look around us and to see what takes place at present. Thus, after explaining the recent discovery of a new tar colour, which by its discoverer was called *magenta*, he says:—"The word *magenta* is just as real and legitimate a part of the English language as *green*, though vastly younger and less important; and those who acquire and use the latter do so in precisely the same manner as the former, and generally with equal ignorance and unconcern as to its origin." And again, after referring to the wholly arbitrary formation of the word *gas* by Van Helmont in A.D. 1600, Prof. Whitney writes:—"We cannot follow so clearly toward or to its source the word *green*, because it is vastly older; but we do seem to arrive by inference at a connection of it with our word *grow*, and at seeing that a *green* thing was named from its being a *growing* thing; and this is a matter of no small interest as bearing on the history of the word."

Here then we have arrived at last at what Prof. Whitney would call the *pivotal* fact. The word *green* and all other words were made in the same way in which Van Helmont made the word *gas*, and the inventor of aniline colours the word *magenta*. *Green* was made from *to grow*. But, as we ventured to ask before in the case of the child, the mother, and the grandmother, would it be impertinent to ask what *to grow* was made from?

We have endeavoured to give as full an account as possible of what Prof. Whitney offers us as his own science of language, free from all the "incongruities and absurdities" of German scholars. If we have left out some facts on which he himself may lay great stress, and which he may consider as his own discoveries, we have done so from no unkind motive. He dwells, for instance, very strongly on the fact that men speak because they wish to communicate, a theory which again will hardly rouse violent opposition. However, in order to be quite just, we shall once more quote the professor's *ipsissima verba*:—

"Nor is it less plain what inaugurates the conversion and becomes the main determining element in the whole history of production of speech; it is the desire of communication. This turns the instinctive into the intentional. As itself becomes more distinct and conscious, it lifts expression of all kinds above its natural basis, and makes it an instrumentality; capable, as such, of indefinite extension and improvement. He who (as many do) leaves this force out of account, cannot but make utter shipwreck of his whole linguistic philosophy."

We should think he would. We only question whether anybody was ever ignorant of the fact that speech was meant for speaking.

On all the points hitherto mentioned, which Prof. Whitney considers as fundamental or pivotal in his Philosophy of Language, there can be little difference of opinion, nor will they excite much alarm among scholars or philosophers. There are, however, some other points of real interest and importance where we should have been extremely grateful to Prof. Whitney if he had given us not only his opinions, but the ground on which these opinions are based. It is well known that most scholars count the Mongol language as a member of the Ural-Altaic family. Prof. Whitney excludes Mongolic and Tungusic, not on linguistic, but on ethnological grounds, from that family which he calls the Scythian, a name, as Prof. Pott has already remarked, "more nebulous than Turanian." He assures us that it is not undue scepticism that leads him to limit the Scythian family for the present to its demonstrated branches, but that in this direction there has been such an excess of unscientific and wholesale grouping, the classification of ignorance, that a little even of over-strained conservatism ought to have a wholesome effect. If one considers that this reproof is administered to scholars, such as Castren, Schott, and Boller, who have devoted the whole of their lives to the study of these Turanian dialects, one cannot but look forward with the deepest interest to the publication of the results of Prof. Whitney's own studies in Mongol and Mandshu. But while we admire his conservatism on this question, we are still more struck by the boldness with which he decides questions on which the most competent scholars have hitherto spoken with great hesitation, arising not from sentiment, whether conservative or liberal, but from a thorough appreciation of the weight of conflicting evidence. Crawfurd and others notwithstanding, Prof. Whitney assures us that the Malayan, the Polynesian, and the Melanesian languages may henceforth be safely treated as one family, as more closely related, therefore, than Mongolic and Tartaric. One more instance. The Annamese or Cochin Chinese, the Siamese, and the Burmese, whatever their differences, are all alike, we are told, in the capital point, that they are uninflected, and this cannot but be regarded as a strong indication of ultimate relationship. Provisionally, therefore, they are to be classed together as the South-eastern Asiatic, or Monosyllabic Family. All we can say at present is that we hope this is the classification of knowledge, and not of ignorance, and that we shall soon have the *pièces justificatives*, particularly with regard to the Burmese and Siamese. Some new light may also be expected from Prof. Whitney with regard to Chinese, the literature of which, we are told, goes back to 2000 B.C., whatever sceptics may say to the contrary. On all these points our expectations are raised to the highest pitch, and we hope that the professor will soon find leisure to give us not only his conclusions, but the facts on which they are founded. As we said in the beginning, we are disappointed by his present book; we are quite willing, however, to look upon it as a promise, and we have no doubt that the American scholar wil soon redeem the pledges which he has given, and thus not only relieve the science of language from "the incongruities and absurdities" of English, German, and French scholars, but enrich it by truly original American discoveries.

We may point out a few of the inaccuracies as to matters of fact which struck us in the Professor's new book.

Prof. Whitney thinks that *green* may be derived from *to grow*. Is not the root really HAR, and the transition of meaning, to be bright, to be green, to grow (grünen)? See Curtius, *s.v.* χλόη.

Agra, as a Sanskrit word corresponding to ἀγρός, is probably a misprint only. The true Sanskrit word is *Ajra*, field, with the palatal media, whereas *agra* means point.

The nasals are not formed by exit through the nose (p. 63); on the contrary the more we shut the nostrils the more nasal becomes our pronunciation. One of the earliest phoneticians, De Brosses (1709-1778), remarked very truly: "On s'exprime à contre-sens, quand on dit, *parler du nez;* c'est une espèce d'antiphrase: on parlerait du nez si on n'en avait point. S'il est bouché, si l'air n'y passe pas librement, on parlera, on chantera du nez."

The derivation of *luna* from *lucna* (p. 83) is no longer tenable, because we have to take into account the dialectic form *losna*, presupposing an original *loux-na* as in *illustris* for *inluxtris*.

On p. 215, in discussing words like *brother* and *sister*, *bull* and *cow*, *ram* and *ewe*, Prof. Whitney says: "*Man* in its distinctive sense indicates a male animal, and we have a different word, *woman*, for a female of the same kind." The choice of the illustration is not quite happy, considering that *woman*, as is well known to Prof. Whitney, is only a corruption of *wîf-man*.

M. M.

DARWIN ON CARNIVOROUS PLANTS *

II.

Insectivorous Plants. By Charles Darwin, M.A., F.R.S., &c. With Illustrations. (London: J. Murray, 1875.)

IN the Venus's Fly-trap, *Dionæa muscipula* (Fig. 5), we have a further differentiation of the organs of assimilation. The sensibility or irritability resides in three hairs—termed by Mr. Darwin "filaments"—on each half of the upper surface of the bilateral leaf; while the function of absorption appears to belong only to a number of small purplish almost sessile glands which thickly cover the whole of the upper face. These glands have also the power of secretion; but only—and here we have another variation from *Drosera*—when excited by the absorption of nitrogenous matter. The filaments are sensitive both to sudden impact and to contact with other substances, except water; the lobes of the leaf closing together, in the former case very suddenly, in the latter more slowly. If the leaf has closed in consequence of sudden impact or of the contact of non-nitrogenous matter, the two lobes remain concave, enclosing a considerable cavity; shortly re-open in perhaps twenty-four hours; and are at once again irritable. When, however, the irritating foreign substance contains soluble nitrogenous matter, the lobes of the leaf become gradually pressed closely together, and remain closed for a period of many (from nine to twenty-four) days; and when they again open, if they ever do so, are at first scarcely sensitive to renewed irritation. The mode in which (as Mr. Darwin shows) this arrangement is serviceable to the plant by securing the capture of large and permitting the escape of small insects, is highly curious, but too long to quote. The absorption of nitrogenous matter by the glands is accompanied by an aggregation of the protoplasm in the cells of the filaments, similar to that observed in *Drosera*, but this result does not follow the simple irritation of the filaments. The series of experiments described appears to prove the existence of an actual process of digestion in *Dionæa*, the closed leaf forming a temporary stomach, within which the acid secretion is poured out. The plant seems to be subject to dyspepsia, which is even fatal when it has indulged too freely in the pleasures of the table, or rather of the leaf. These observations, however, come from America, where, in its native land, its habits may possibly be more intemperate than in this country. Mr. Darwin believes the motor impulse to be transmitted in *Dionæa* as in *Drosera*, through the parenchymatous tissue of the leaf.

Aldrovanda, an aquatic, perfectly rootless genus, also belonging to the order Droseraceæ, presents phenomena similar to those of *Dionæa*, possessing sensitive hairs which cause the leaf to close, and glands which secrete a digestive fluid and afterwards absorb the digested matter. The order embraces, in addition, only three other genera, *Drosophyllum*, *Roridula*, and *Byblis*, all of which are provided with secreting glands, possessed, in all probability, of similar properties.

When the painful rumour gained circulation, not many months ago, that *Pinguicula* must be added to the list of predatory plants, it was received with even greater incredulity than the stories about *Drosera*. The facts are, however, as patent as in the plants already described.

* Continued from p. 209.

We have here no sensitive hairs, as in the Droseraceæ. The upper surface of the leaf is studded with glandular hairs of two kinds, one with longish stalks, the other nearly sessile, both of which secrete an extremely viscid fluid; and the dull irritability resides in the blade of the leaf itself,

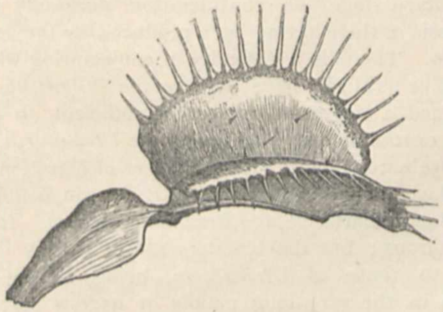


FIG. 5.—*Dionæa muscipula.* Leaf viewed laterally in its expanded state.

which becomes slowly incurved at the margins over substances that excite its sensibility (Fig. 6). This movement of the margin of the leaves (not the apex) is caused either by continued pressure from a foreign solid substance, or by the absorption of nitrogenous matter; water or a solution of sugar or gum produces no curvature; and although the latter, if sufficiently dense, excite a copious increased flow of the viscid secretion, this has no acid reaction. The increased secretion, occasioned by contact of nitrogenous solids or liquids with the glands, is, on the contrary, invariably acid, and possesses the power of rapidly dissolving and digesting insects and other nutrient substances. Some vegetable substances containing nitro-

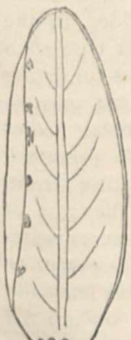


FIG. 6.

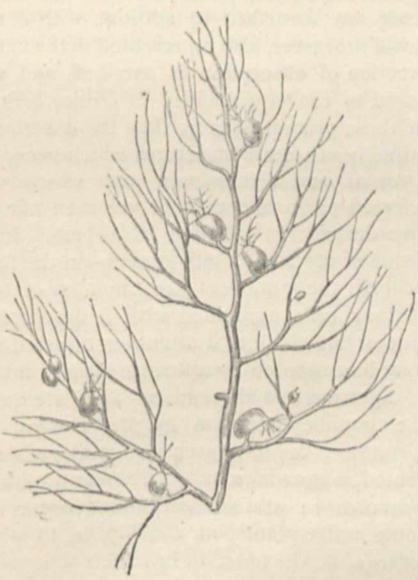


FIG. 7.

Fig. 6.—*Pinguicula vulgaris.* Outline of leaf with left margin inflected over a row of smal flies.

Fig. 7.—*Utricularia neglecta.* Branch with the divided leaves bearing bladders; about twice enlarged.

gen, as some seeds and pollen-grains, are acted on in a similar manner, so that the butterwort is a vegetable as well as an animal feeder. The secretion appears to be again absorbed into the glands, together with the nutrient substance dissolved in it.

Until the publication of the present volume, very little was known about the habits of the singular genus *Utricularia* or Bladderwort (Fig. 7), of which several species are natives of ditches, especially of very foul water, in this country. The very finely divided leaves bear a number of minute bladders about one-tenth of an inch in length, the form

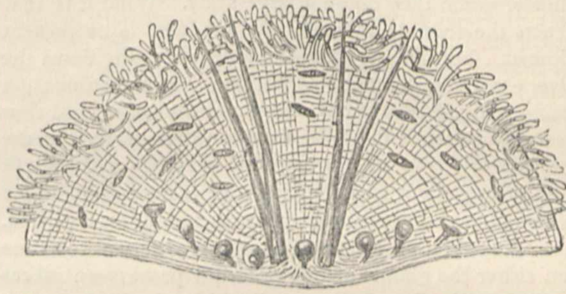


FIG. 8.—*Utricularia neglecta.* Valve of bladder; greatly enlarged.

of which, as Mr. Darwin points out, bears a very singular resemblance to that of a minute Entomostracan Crustacean. Each bladder is furnished near its mouth with two long prolongations, which Mr. Darwin calls "antennæ," branching into a number of pointed bristles. On each side of the entrance to the bladder are also a number of bristles; and the entrance is itself almost entirely closed by a movable valve (Fig. 8), which rests on a rim or collar (the "peristome" of Cohn), dipping deeply into the bladder, and can only open inwards. The surface of

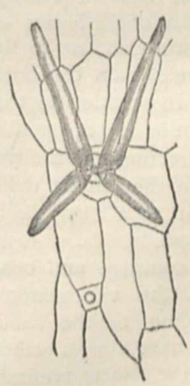


FIG. 9.

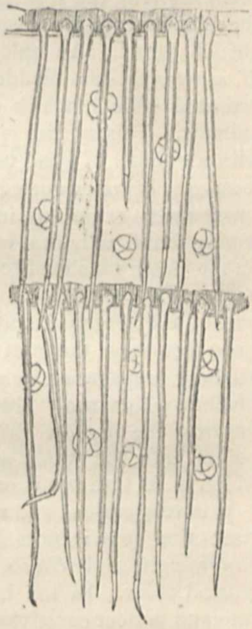


FIG. 10.

Fig. 9—*Utricularia neglecta.* One of the quadrifid processes greatly enlarged.

Fig. 10.—*Genlisea ornata.* Portion of inside of neck leading into the utricle, greatly enlarged, showing the downward pointed bristles, and small quadrifid cells or processes.

the valve is furnished with a number of glands endowed with the power of absorption, but apparently not of secretion. The whole internal surface of the bladder, with the exception of the valve, is covered with a number of minute bodies—the "quadrifid processes" (Fig. 9)—consisting of four divergent arms of unequal length and grea flexibility; the collar itself being furnished with similar but two-armed bodies.

The use of these bladders is not merely, like the air-bladders of *Fucus*, to support the plant in the water; they are employed to capture small aquatic insects and other animals, which they do on a large scale. What it is that attracts the animals to enter the bladders is at present unknown; but, having once entered by pressing down the valve, escape is almost impossible; they sometimes get closely wedged between the valve and the collar, and thus miserably perish. But the most mysterious part of the structure of *Utricularia* is that this beautiful and complicated arrangement for capturing prey is not accompanied by any correspondingly perfect arrangement for its digestion. No secretion whatever has been observed to exude from either the glands or the quadrifid processes; pieces of meat and albumen inserted within the bladders remained absolutely unchanged for three days; and it is only when the bodies of the captured animals begin to decay that the products of decomposition are slowly absorbed by the quadrifid processes; and of even this fact the evidence can only be said to be indirect, depending on a change observed in the appearance of the protoplasmic contents of the cells of the quadrifids and of the glands on the valve and bifids on the collar, similar to that which takes place in the tentacles of *Drosera* during digestion.

The above description is taken from the rare *Utricularia neglecta*, the species first observed by Mr. Darwin; the phenomena are essentially the same in the other British forms. An epiphytic South American species, *U. montana*, bears bladders of a similar structure in all essential points, which capture a quantity of minute animals. This species is also furnished on its rhizomes with a number of small tubers, which appear to serve as reservoirs of water during the dry season. Several other species were examined, including the Brazilian *U. nelumbifolia*, found only in a very remarkable habitat, floating on the water which collects in the bottom of the leaves of a large *Tillandsia* that inhabits abundantly an arid rocky part of the Organ Mountains at an elevation of about 5,000 feet above the level of the sea. In addition to the ordinary propagation by seed, this plant is said to put out runners which are "always found directing themselves towards the nearest *Tillandsia*, when they insert their points into the water and give origin to a new plant, which in its turn sends out another shoot."

It is very curious and suggestive to compare and contrast the contrivances displayed in the two genera, *Pinguicula* and *Utricularia*, belonging to the same natural order. In the latter case we have a most elaborate and perfect contrivance for capturing insects, reminding one of what Mr. Darwin describes elsewhere as "transcending in an incomparable degree the contrivances and adaptations which the most fertile imagination of the most imaginative man could suggest;" but, when the insects are once captured, there is no contrivance for hastening the decay of their tissues, or anything comparable to animal digestion. In *Pinguicula*, on the other hand, the digestive apparatus is most complete; but there is no means whatever of capturing insects, except the very perfectness of the digestive substance itself, the extremely viscid nature of the secretion from the glands. What was the primitive form which has developed into such very diverse structures in these nearly-allied genera? Here we have a problem for the evolutionist to work out; and another for the natural selectionist—what benefit to the plant were these contrivances in their elementary rudimentary stage?—a consideration necessary to the hypothesis of their having been produced by the action of selection. There is a difficulty in conjecturing what use a digestive fluid can have been to the *Pinguicula* before it attained a degree of perfection sufficient to capture insects, or rudimentary bladders to the *Utricularia*, seeing they were not endowed with the power of digestion.

The last genus examined by Mr. Darwin belongs also to the Lentibulariaceæ, the Brazilian *Genlisea*. It is also utriculiferous; but the bladders are of a very different nature to those of *Utricularia*, being simply hollow cavities in the very long petiole or narrow part of the lamina of certain leaves specialised for this purpose. The bladders are not more than $\frac{1}{36}$th of an inch in diameter, and are surmounted by a long tube fifteen times as long and only $\frac{1}{100}$ inch in diameter, which branches at the extremity into two arms coiled in a spiral manner. Very little is known of the habits of the plant, of which only dried specimens have been examined in this country. It is probable that insects creep down the long tube into the bladders, where their remains have been found, and there perish; but whether there is any process of digestion is unknown. The escape of insects once captured is prevented, not by a valve, as in *Utricularia*, but by rows of long thin hairs pointing downwards and springing from ridges which project from the inside of the tube, as shown in fig. 10. The inside of the utricle and of the neck are furnished in addition with a number of quadrifid processes, also represented in the figure, to which the function of absorption is ascribed, and which are compared to the "quadrifids" of *Urticularia*. The drawing of these processes, more than the description, reminds us strongly of certain structures which occur in the leaves of *Drosera* and *Pinguicula*, and which we do not find referred to in the present volume; nor do we know of any description of them elsewhere. Imbedded in the tissue of the leaf of both genera—in the former case often beneath the tentacles—are a number of bodies consisting of four cells and filled with a brown matter; and we cannot but think that attention directed to these bodies may be rewarded by a further insight into the processes of digestion and absorption. They are quite distinct from the papillæ described by Mr. Darwin in the case of *Drosera*. We have seen also analogous structures represented in drawings by Dr. Hooker of either *Nepenthes* or *Sarracenia*; and similar bodies occur in the leaves of some water-plants, as *Callitriche*, to which we are not aware that any function has been assigned.

We have attempted in this notice to introduce our readers only to some of the salient points of Mr. Darwin's researches; and cannot hope to give any idea of the unwearying labour, the precision of the experiments, and the wealth of illustration, for which we must refer all interested in the subject to the volume itself. The novelty of the results arrived at does not lie in the fact of plants being found to feed on organic matter whether animal or vegetable; physiologists have long been familiar with this power in the case of parasites and saprophytes, the former deriving their nourishment entirely from living organic matter, in some cases animal, in others vegetable; the latter from organic matter in a state of decay; but neither having the power of "assimilating," or obtaining their food-materials direct from the atmosphere and the inorganic constituents of the soil. *Saprolegnia* and *Cordiceps* are as fully entitled to the designation of carnivorous or even insectivorous plants as *Dionæa* or *Drosera*. The difference lies chiefly in the localisation of the power of absorption, which we have not generally considered to reside in the foliar organs. By far the most interesting facts brought out in this volume—and we think they are amongst the most important published for many years—are the changes from neutral to acid in the nature of the secretion poured out by the glands of Drosera on their excitement by contact with soluble nitrogenous substances; and the alleged "reflex" excitement of the tentacles of *Drosera*. It is impossible to foretell to what these discoveries will lead. We cannot but think that this volume will serve, as the previous ones from the same hand have done, to act as finger-posts to direct future observers in those lines of research which are likely to be the most fruitful and profitable.

ALFRED W. BENNETT

OUR BOOK SHELF

Progress-Report upon Geographical and Geological Explorations and Surveys west of the 100*th Meridian in* 1872, *under the direction of Brigadier-General A. A. Humphreys, Chief of Engineers, U.S. Army*. By First Lieutenant G. M. Wheeler.—Also *Topographical Atlas to illustrate Geographical Explorations west of the* 100*th Meridian*. (Washington: Government Printing Office, 1874.)

OUR readers are no doubt aware that a large area of the Western States of America is overrun by a number of expeditions intended mainly for the topographical and geological survey of that immense region. Some idea of the number and constitution of these parties will be obtained from two articles in NATURE, vol. viii. pp. 331 and 385. The "Progress-Report" for 1872 of that under charge of Lieut. G. M. Wheeler contains only brief notes of the work done by the various parties; detailed reports will, no doubt, be published eventually, and will occupy several volumes, besides atlases. The present brief report comprises notes of work done, not only in geology and topography, but also in astronomy, meteorology, natural history, ethnology, and photography. Some idea of the amount of work done may be obtained from the fact that the areas covered topographically during the summer months of 1872 exceeded 50,000 square miles lying in Utah, Nevada, and Arizona. The length of lines in the vicinity of which surveys were made is 6,127 miles, in addition to which other 2,067 miles had to be travelled for various purposes. A large portion of the present publication is occupied with reports on the numerous mining-stations which have been established in the district surveyed, as also on irrigation, agriculture, routes of communication, timber lands, and Indians; from the latter the expedition met with no interference, though of course it was accompanied by a military escort. One of the principal features of this report are the lithographic illustrations from camera-negatives of some of the magnificent cañons on the Colorado River; one of these illustrations gives a fine idea of a rain-sculptured rock at Salt-Creek Cañon, Utah.

The atlas which accompanies this Report is a magnificent work and reflects great credit on the U.S. Government and especially on the topographic section of Lieut. Wheeler's Expedition. Besides a general map, it consists of eight sectional maps in photo-lithography on the scale of one inch to eight miles, sufficiently large to give one an excellent idea of the nature of the country which has been surveyed. The maps are the results of the expeditions under Lieut. Wheeler in the years from 1869 to 1873, and embrace parts of California, Nevada, Utah, and Arizona. Every important feature is shown by characteristic and intelligible signs—mountain ranges, plateaux, cañons, bluffs, hills, craters, salt beds, sands, marshes, rivers, creeks, springs, &c., not to mention artificial features, as roads, trails, railroads, towns, &c. We understand that maps of the whole region west of the 100th meridian are to be published on this scale, and in some cases on a more extended one. It will be a magnificent work when complete, a work of which any country might be proud.

Nach den Victoriafällen des Zambesi. Von Edouard Mohr. 2 vols. (Leipzig: Hirt und Sohn, 1875.)

NOTWITHSTANDING that Herr Mohr went over ground that had been traversed previously, a considerable part of it being included in Livingstone's earlier travels, yet his book contains a great deal that is new and well worth publishing. From the time that he left Bremen in November 1868 till his departure from Africa in the beginning of 1871, the interest of his narrative never flags; the book contains frequent passages of genuine eloquence, quite free from bombast or affectation. During part of his journey, Mohr had as his companion the geologist Adolf Hübner, and their starting-point for the Victoria Falls was Durban. From this point they went almost directly to the falls, Hübner, however, leaving his companion before the Zambesi was reached, in order to visit the recently discovered South African diamond fields. Mohr, as we have indicated, tells the story of his journey and its many interesting incidents, particularly well, although, as might be expected, there were none of the dangers to be encountered which face explorers in less frequented parts of Africa. The book is full of valuable information of all kinds concerning the places touched at or visited both on the voyage out and on the journey from Durban to the Zambesi. The book must be considered as a specially valuable contribution to our knowledge of the natural history and geology, as well as to the geography of the district passed through. To the geographer the narrative will be found of very great value, as it contains a record of the carefully ascertained latitude and longitude of the principal points at which halts were made. Appended is a valuable paper by Hübner on the South African Diamond Fields. The work is illustrated by many good woodcuts and a few brilliant chromo-lithographs. There is also a small but clear map of South Africa, showing not only Mohr's route, but the routes of the principal travellers from Livingstone (1841) downwards. Altogether, the work must be considered a really valuable contribution to our knowledge of the region traversed, and seems to us well worth translating into English.

LETTERS TO THE EDITOR

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

Spectroscopic *prévision* of Rain with a High Barometer

THAT the spectroscope should play a part in the prediction of weather for the common purposes of life was an early thought with many; but I have not heard of its resources being very distinctly appealed to in the late series of most memorable *μετέωρα* of the atmosphere which have passed over this country, setting nearly at naught most other methods of prediction.

If the instrument has been so used please to correct me. Otherwise permit me to say for myself, that being in Paris on Wednesday July 7, when the great physical and astronomical mathematician of the age, M. Leverrier, stood up in his place in the Academy of Sciences to explain how it had come about that the official predicter of the weather in the *Observatoire* had announced a fine dry period just before the destructive inundations in the South of France with all their train of frightful national calamities began,—I paid attention to the conclusion of his speech, which wound up with announcing "that all the bad symptoms had now (July 7) passed away, that the barometer was high in England, and that all the probabilities united pointed to a fine time coming."

Every day after that for a week the weather only became worse and worse, darker and wetter, in the usually gay city of Paris; and then I transferred myself to London, and was there on the 14th, 15th, and part of the 16th of July, a witness to, if possible, still worse weather, growing darker and wetter all the time. So much, then, for the failure of the ordinary methods of prediction, even in able hands; and let us be lenient to them, for who would or could have expected such deluges of rain with a high barometer, and in the month of July?

Now, however, comes an indication of where the spectroscope seems capable of saying something meteorologically useful: for in all that dark and wet weather in London a pocket spectroscope showed me from every part of the sky a broad dark band on the less refrangible side of D, and partly in the place of it. This band was so intense as to be the chief feature of the whole spectrum; and though no doubt "telluric" in its origin, was very different from the standard telluric effects seen at sunset in ordinary weather.

I feared at the time that this grandly dark spectral band might be of base artificial origin, such as an absorption effect by London smoke; and when journeying northward by rail on July 16, it was certainly charming to find that in proportion as we left London the rain ceased, the dark spectral band decreased, the clouds (amongst which, by the way, there were some remarkable counter-motions chiefly from north to south) diminished, and by the time we reached York fine weather prevailed. The ground there was dry, the rivers low, and the sky spectrum not only presented no dull bands, but the true D line was seen exquisitely fine and neat, as the thinnest imaginable spider-line in a telescope's illuminated field: so thin, fine, and clear indeed, as to offer a delight to the eye, such as none but an earnest spectroscopist can have any idea of.

Thus far, it is true, we have only had dark nebulous bands in place of fine sharp lines as *accompaniments* of rain, London rain too, with a high and steady barometer in the pleasant month of July. But mark, if you please, what follows.

The morning of the 17th of July, in Edinburgh, was glorious with pure blue sky, transparent atmosphere, delicious temperature, and light N.E. Wind. So, too, it continued all the day through, to the delight of thousands upon thousands in the streets. No smoke either was issuing from any of the factory chimneys, for there was a half-holiday or something more, and the usually working population was enjoying itself in the open air. The only clouds were a few brilliant and picturesque currents along the northern horizon, giving something like Alpine mountain snowy tops to the lovely undulations of the Scottish hills.

Simply beautiful were those bright cloud forms as an artistic feature in the general landscape; but in the spectroscope—why, good gracious! I could only say, what is the meaning of this? It was only a little pocket spectroscope, remember, without scale, and with small dispersion; but there was the D line appearing in seven times its usual strength, and with the London smoky band, too, beginning on its less refrangible side. Of the utterly abnormal intensification of D (or rather of some peculiar telluric lines so very near D as not to be separable from it in so small a spectroscope) in the light reflected from those clouds, there could not be the slightest doubt; for whenever the spectroscope was applied to a higher altitude than these clouds, there was little or nothing of the kind; only the usual Fraunhofer lines, fine and clean as generally seen in fine weather. The effect, too, was very different, both in spectrum place and distribution, from what is characteristic of a low sun; while the sun was at the time not low, no sunset colours had visibly begun, the clouds which gave the black intensification of the D line were almost absolutely white, and it was as yet only two o'clock on a fine bright July afternoon.

So I merely made comparative drawings of the spectrum given by these low white clouds, and that afforded by the general sky above them in the Polar neighbourhood, inked them in, and then waited to see what would follow.

And it was this. At 10 P.M. of that very fine day, and without any sensible falling of the high barometer, the sky clouded over completely. At 11 P.M. settled rain began. At 1.30 A.M. it was still raining, and I have reason to believe that it continued all night. It was certainly still raining in the morning of the next day, Sunday, and continued more or less all that day and all that night; while this morning, Monday, July 19, after a heavy thunderstorm, fog and heavier rain began and have proved the order of the day. All this with a barometer still nearly uninfluenced in its serene height and steadiness,* but not so the spectroscope, for, excepting the E line, all the other lines have disappeared in dull bands which occupy their places very nearly, and the London band on the less refrangible side of, and over D, is the main characteristic of all the visible spectral range.

15 Royal Terrace, Edinburgh, July 19 — PIAZZI SMYTH, Astronomer Royal for Scotland

OUR ASTRONOMICAL COLUMN

THE TRIPLE-STAR, SOUTH 503.—In *Astron. Nachr.*, No. 2,045, Baron Dembowski has published measures of this star made in 1873-75, which exhibit large changes in the relative situation of the components, as compared with the measures of Sir James South early in the year 1825. Thus we have for A and B:—

South.........	1825·1	Position	134°·1	Distance	39″·94
Dembowski.	1873·80	,,	120 ·3	,,	8 ·24
,,	1875·21	,,	118 ·8	,,	7 ·07

And for A and C:—

South.........	1825·1	Position	337°·3	Distance	201″·76
Dembowski.	1875·21	,,	335 ·4	,,	232 ·04

Lalande observed A and C on Jan. 23, 1798; Bessel observed all three components on March 6, 1823; and Argelander has an observation of B on Feb. 16, 1856.

On inspecting the above measures there will arise at first sight a suspicion that the change of distance between A and C and in both elements between A and B may be caused by proper motion of A nearly in the line joining A and C. To put this to the test we may take a mean between South's measures of 1825 and the angle and distance of A and C deduced from Bessel's meridian observations in 1823, and compare it with the mean of Dembowski's measures of A and C in 1875. Assuming the differences to be due to proper motion of A, we find for the annual values:—

P.M. in R.A. ... ... + 0″·389
P.M. in Decl. ... ... – 0 ·461

And, if with this proper motion we reduce Dembowski's mean of measures of A and B in 1875 to the epoch of South's observations there results:—

For 1825·1 ... ... Position 136°·5 Distance 36″·5

Considering that the P.M. adopted is only an approximation, there appears to be little doubt that the changes to which the Baron Dembowski has drawn attention in his

* *Meteorological Journal at Royal Observatory, Edinburgh, for* 1 P.M. *each day.*

1875.	Barometer reduced to sea-level.	Attached Thermometer.	Exterior Thermometer.	Direction of wind.
July 14	29·961	56°·2	58°·4	N.E.
,, 15	30·060	56·3	55·4	E.N.E.
,, 16	30·098	57·1	58·1	N.E.
,, 17	30·043	59·0	59·6	N.E.
,, 18	—	—	—	—
,, 19	29·995	58·3	57·0	N.E.

interesting note are really due to the proper motion of the principal component of this triple star.

LALANDE 23726 (CORVUS).—With reference to the query as to actual brightness of this star, which has been noted as high as a fifth magnitude by Heis (NATURE, vol. xii. p. 27), Mr. J. E. Gore writes from Umballa, under date June 8 :—" I last night examined its place and found the star in question to be barely visible in an opera glass or about mag. 8." It is evidently variable to a considerable extent, and should be closely watched. Mr. Gore adds that " L. 23675-76 rated 7, 7½ by Lalande, is now about 6m., and brighter than the stars L. 23463 (6m.) and 23446 (6m.), a little to the west ;" the observations in the *Histoire Céleste*, however, do not belong to the same object, but to the two components of a double-star, which is Σ 1669, and in the Dorpat scale were both estimated 6·5 in *Mensuræ Micr.*, and 6·0 in *Positiones Mediæ;* their distance about 5½″. Bessel also observed both components, judging them of equal brightness and of the seventh magnitude in his scale. The appearance of the object to the naked eye as a bright sixth, remarked by Mr. Gore, is thus accounted for.

HORIZONTAL REFRACTION ON VENUS.—In May 1849' near the inferior conjunction of Venus with the sun, Clausen having remarked that the crescent extended beyond a semicircle, Mädler observed it with the Dorpat telescope, with the view of approximating to the amount of horizontal refraction in the planet's atmosphere. Measures, properly so called, he found were hardly feasible, owing to the extreme faintness of the cusps and proximity of the planet to the sun, but estimations with a position-wire in the field of view were made on six days at distances varying from 3° 26′ to 7° 37′ ; [the mean gave for the horizontal refraction, 43′·7. In 1866 Prof. C. S. Lyman, by similar observations, obtained 45′·3 ; he remarked : " The planet was then (for the first time, as it appears) seen as a very delicate luminous ring. The cusps of the crescent, as the planet approached the sun, had extended beyond a semicircle, until they at length coalesced and formed a perfect ring of light." Last December Prof. Lyman repeated these observations, making use of a five-feet Clarke telescope of 4⅝ inches aperture, and by measures of the extent of the crescent on four days, deduces for the horizontal refraction of the atmosphere of Venus, 44′·5, a value which is also the mean of the three sets of observations. (*American Journal of Science and Arts*, January 1875). At the next inferior conjunction of Venus, she will have the following angular distances from the sun's centre, at Greenwich noon :—

1876, July 11 ...	6° 28′	July 14	5° 8′
,, 12 ...	5 35	,, 15	5 33
,, 13 ...	5 5	,, 16	6 23

The formula used for finding the horizontal refraction may be thus written, putting C for the observed extent of the crescent, d for the angular distance of Venus from the sun at the time of observation, s for the sun's semidiameter, which we may express in minutes of arc, and r for the planet's radius-vector :—

$$\text{Hor. Refr.} = \frac{1}{2}\left\{ \text{Arc sin } d \sin \tfrac{1}{2}(C - 180°) - \frac{s}{r} \right\}$$

THE SUN'S PARALLAX.—We have received Prof. Galle's *Bestimmung der Sonnen-Parallaxe aus correspondirenden Beobachtungen des Planeten Flora* (Breslau, 1875), which contains the full details of his reduction of the observations taken in both hemispheres near the opposition of the planet in 1873, when it approached the earth within about 0.87 of our mean distance from the sun. The final result for the parallax 8″.873, as already stated in this column, corresponds to 23,247 equatorial semi-diameters of the earth, or, according to Galle, 19,979,000 geographical miles of 15 to the degree of the equator.

SCIENCE IN SIAM.

WHEN the invitation of the King of Siam to observe the late total eclipse of the sun reached the Royal Society, it was hailed with delight by those who took an interest in the expedition. A few Europeans professing to know something about the country wrote letters to newspapers discouraging astronomers from accepting the invitation. Happily no notice was taken of these anonymous letters, and the result was that the members of the expedition were surprised, not only by the good reception they met with everywhere in Siam, but also by the great interest the Siamese themselves took in the eclipse and in science generally. The late king was well known for his love of astronomy, but many might suppose that this was a solitary case, and that with the death of the king science would be left unprotected in the country. A short account of our experience will show that the interest the Siamese take in science is rather on the increase than on the decrease.

On our way to the observatory, which was erected at Bangtelue, near Chulie Point, we had to stop twenty-four hours in Bangkok until the steamer which was to take us was ready. It happened that the evening of that day the "Young Siamese Society" met in the house we were staying at, and I was asked by the members to give a lecture on spectrum analysis and its application during solar eclipses. Mr. Alabaster, aided by the King's private secretary and Prince Dewan, acted as interpreter. The Siamese listened with the greatest interest, and by the questions they asked after the lecture was over showed that they fairly understood the subject. There exists a Siamese translation of a book on chemistry, and they had read up the subject in that book. H.R.H. Chowfa Maha Mala, uncle of the King, is the chief astronomer of the Siamese at the present time. He showed me the way in which he had determined the time and duration of the eclipse at Bangkok. Taking the sun and moon's apparent diameter from the *Nautical Almanac*, he determined by means of the projection of their paths and their apparent velocity the time of the different contacts. The drawing was neatly executed and, I am told, the time thus determined came very near the truth.

On the day of the eclipse several telescopes, one of which had been lent to the King by Dr. Janssen, were set up on the lawn in the front of the palace. The local time was determined by Mr. Alabaster and Capt. Bush, in order to find the exact time of the different contacts. As totality approached, the King made a speech to the members of the Royal Family, who were all assembled, telling them why solar eclipses were observed, and why large sums of money were spent for that purpose. During totality, his Majesty observed the corona and the protuberances through a telescope, carefully noting down what he saw and making a sketch of the protuberances. He had ordered one of the princes to take photographs of the corona. Two photographs were thus secured, which by no means are inferior to those taken at the Observatory of Bangtelue. The original negatives of these photographs have been sent to England as a present from the King to the Royal Society.

At our camp the Siamese also showed a great interest in the eclipse. The eagerness with which the ex-Regent looked through his telescope contrasted in a characteristic way with the quiet indifference with which his European secretary went to sleep during totality.

The King of Siam informed us that he did not profess to be an astronomer, and I was therefore rather surprised to hear afterwards that on his journey to Calcutta he had taken regular sights with the sextant, and calculated himself the position of the steamer.

But the taste of the Siamese for science is not merely confined to astronomy. Wangna, the second king, is a mineralogist. The country in which he lives gives him ample opportunity to work at his favourite subject. He has a large mineralogical collection and a nice chemical laboratory, in which he makes his analyses.

Let us now turn from what the Siamese have done for science to what they are going to do.

The King has instructed Dr. Gowan to erect an observatory in which regular barometric and thermometric measurements are to be made. The rainfall and the tides will also form a subject of measurements. Other instruments will be added in time. As the Siamese have a great fancy for photography, we shall perhaps soon see regular photographs of the sun taken in Bangkok. Various spectroscopes and telescopes are at the present moment on their way out from England. It is also intended to build a chemical laboratory in the palace. The King's bodyguard are being instructed by Mr. Alabaster in taking surveys. At the moment I write this, they are out on a surveying expedition.

All this shows that the inhabitants of Siam have a great fancy for science, if it does not show more. Strong liking for a subject is generally accompanied with, if not caused by, the ability to deal with it and to overcome its difficulties. Let us hope that some of the Siamese will take up their favourite subject, not as amateurs merely, but with all the seriousness of a profession. Many of them visit Europe for several years. If some of these were to go through a course of science, the knowledge thus gained, added to their natural intelligence and love of science, would soon make them good observers and able experimenters.

In the meantime it will be interesting to watch the growth and development of a country in which science is the recognised and favourite study. English men of science cannot refuse their sympathy to a king who, under great difficulties, does his best to improve his country, and who readily accords to science the position which they are striving to obtain for it in their own land.

ARTHUR SCHUSTER

THE RESTING-SPORES OF THE POTATO FUNGUS

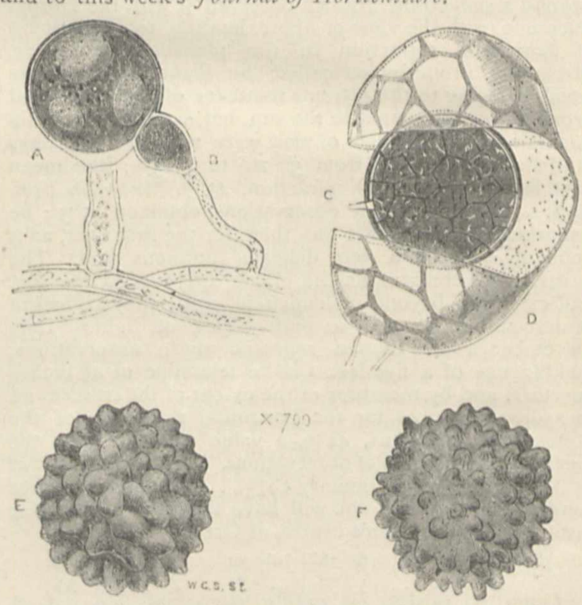
FOR some reason unknown to me (but probably owing to meteorological conditions pertaining to this season or the last) the potato fungus began its ravages this summer a month or six weeks earlier than usual. It not only appeared out of season, but it came in a different form from anything within the memory of the younger botanists of the present generation. It is considered probable that the present condition of the disease is similar with that long ago known as "the curl," a pest known a considerable time before *Peronospora infestans*, Mont., was described as European.

At the beginning of June I had potato-leaves sent to me for examination from the office of the *Journal of Horticulture*; these leaves were badly diseased, spotted and fœtid, and from certain of the stomata a few threads of the *Peronospora* were emerging; this fact, from the unusually early appearance of the fungus, I made a special note of.

On June 16 Mr. Berkeley brought leaves sent to him for examination by Mr. Andrew Murray, (which were spotted in an exactly similar manner with mine), to the meeting of the Royal Horticultural Society. At the same time Mr. Berkeley exhibited a sketch of two rather large nodulose (or reticulated) bodies found by him within these leaves, as a possible species of *Protomyces*, but since then known to be the resting-spores of *Peronospora infestans*, Mont., here illustrated.

The presence of these warted bodies in the leaves, as seen by Mr. Berkeley, led me to make a searching examination of the Chiswick plants then greatly suffering from the pest, and I at once found similar bodies very sparingly diffused amongst the tissues of the leaves, with a few branches of *Peronospora* and threads of mycelium, and two semi-transparent bodies of different sizes which were new to me. On attempting to disengage these presumed specimens of *Protomyces* from the black, hard, and corroded spots on the leaves by maceration in water, I found the continued moisture greatly excited the growth of the mycelium. After the lapse of a week the threads bore (amongst the intercellular spaces of the leaves) the semi-transparent bodies of two sizes which I had before seen and measured, and which I now refer without doubt to the oogonium and antheridium of the potato fungus. It is very uncommon to find a fungus bearing sexual and asexual fruit at the same period of growth, and in this instance the old asexual fruit was very sparingly produced. I, however, afterwards found the fungus with both forms of fruit and with ripe free resting-spores, inside the cavities of the putrid stems, and I found the ripe resting-spores and the sexual organs sometimes in conjugation within the tissues of the potato tubers when the substance was reduced by decomposition to the softness and semi-transparency of butter.

By keeping the potato-plants closely under observation from that time to this, a period of from six to seven weeks, I have seen and figured these bodies in every stage of growth, and have been able to preserve some of the best material for future careful mounting. Those who may care to know in detail how, from the slightest clue at first, the subject was worked out to its present aspect may refer to the *Gardener's Chronicle* for July 10, 17, and 24 last, and to this week's *Journal of Horticulture*.



Oogonium antheridium and mature resting spore of *Peronospora infestans*, Mont.

The antheridia, oogonia, and oospores (or resting-spores) in *Peronospora infestans*, Mont. are very similar, with the same bodies in other species of *Peronospora*, in fact when they are drawn to scale and placed side by side there is very little difference to be detected. The accompanying illustration shows the oogonium (A) and antheridium (B) in contact as taken from the tissues of the leaf. At C is shown a semi-mature resting-spore with its fecundating tube attached and its coat of cellulose accidentally pushed aside by maceration in water, as taken from a putrid potato-stem. At E is illustrated the perfectly mature resting-spore, free from its coat of cellulose taken from a tuber in the last stage of decomposition. At F is shown the resting-spore of *Peronospora arenariæ*, Berk, drawn to exactly the same scale to show similarity in size and conformation. The figures in the cut are uniformly enlarged seven hundred diameters, and the mature oospore or resting-spore measures on the average ·00142 inch in in length, and ·00114 inch in breadth.

WORTHINGTON G. SMITH

ELECTRICAL RESISTANCE THERMOMETER AND PYROMETER*

THIS paper consists of three parts. The first treats of the experiments made by Dr. Siemens, with a view of determining the law of the variation of electrical resistance in metallic conductors, with variation of temperature, through a greater range than had been before attempted. The second describes certain instruments, by whose use this law is applied to the measurement of temperature. The third treats of a simple method of measuring electrical resistance by means of the differential voltameter.

Our author first refers to the previous experiments made by Arnsted, by his brother, Dr. Werner Siemens, and by Dr. Matthiessen, and to the law deduced by Clausius, "that the electrical resistances of metals are directly proportional to their absolute temperatures." The maximum range of these experiments was 100° C. Dr. Siemens's experiments were made upon copper, iron, steel, silver, aluminium, and platinum; the last of these has received the most attention at his hands, as, having the highest melting point, it is the most valuable from a practical point of view.

The method employed in one series of experiments was to wind metal wire upon pipe-clay cylinders, having helical grooves to prevent contact between the convolutions of the wire, and to place these, together with three delicate thermometers, in a copper vessel enclosed in a larger one containing linseed oil, and having hollow sides packed with sand to diminish sudden variation of temperature. The bath was gradually heated by means of Bunsen's burners to 340° C., or close to the boiling point of mercury, and the readings were made with a Wheatstone's bridge and delicate galvanometer. A second series of experiments was made in a heated air vessel having a metallic screen to prevent irregular losses of heat by radiation or by atmospheric currents, the other conditions being similar to those in the first series. The results obtained were found to accord generally with those of Matthiessen and the other observers within the limits of their experiments, but pointed to a different law of increase beyond those limits. The formula hitherto known as Matthiessen's is—

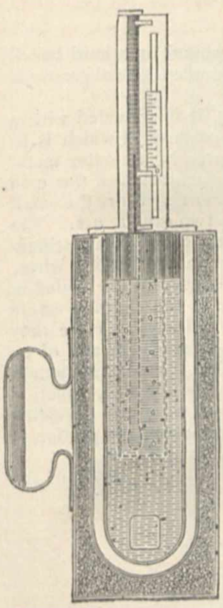


FIG. 1.

$$R_t = \frac{R_v}{1 - \cdot 0037647\,t + \cdot 00000834\,t^2}$$

and was the mean of the results obtained on various metals. This formula is shown to give discordant results at the higher temperatures, as the calculated resistance at 300° C. is 1·61 nearly of what it is at 0° C., whilst at 2000° C. it is ·0373, showing clearly that the formula is reliable only between very narrow limits.

We quote the author as to the law of resistance which he proposes: "Now, if we apply the mechanical laws of work and velocity to the vibratory motions of a body which represent its free heat, we should define this heat as directly proportional to the square of the velocity with which the atoms, or may be the molecules, vibrate.

"We may further assume that the resistance which a metallic body offers to the passage of an electrical impulse from atom to atom, or from molecule to molecule, is directly proportional to the velocity of the vibrations which represent its heat. In combining these two assumptions, it follows that the resistance of a metallic body increases in the direct ratio of the square root of the free heat communicated to it. Algebraically, if r represent the resistance of a metallic conductor at the temperature T, reckoning from the absolute zero, and α, an experimental coefficient of increase peculiar to the particular metal under consideration, we should have the expression—

$$r = \alpha T^{\frac{1}{2}}.$$

This purely parabolic expression would make no allowance for the probable increase of resistance, due to the increasing distance between adjoining particles with increase of heat, which would depend upon the coefficient of expansion, and may be expressed by βT, which would have to be added to the former expression. To these factors a third would have to be added expressing an ultimate constant resistance of the material itself at the absolute zero, and which I call γ. The total resistance of a conductor at any temperature, T, would, therefore, be expressed by the formula—

$$r = \alpha T^{\frac{1}{2}} + \beta T + \gamma.$$

Diagrams are given in which this hypothetical law is graphically represented, and in which its results are compared with those obtained by the experiments already cited, and by this means the following formulæ are arrived at for the different metals named:—

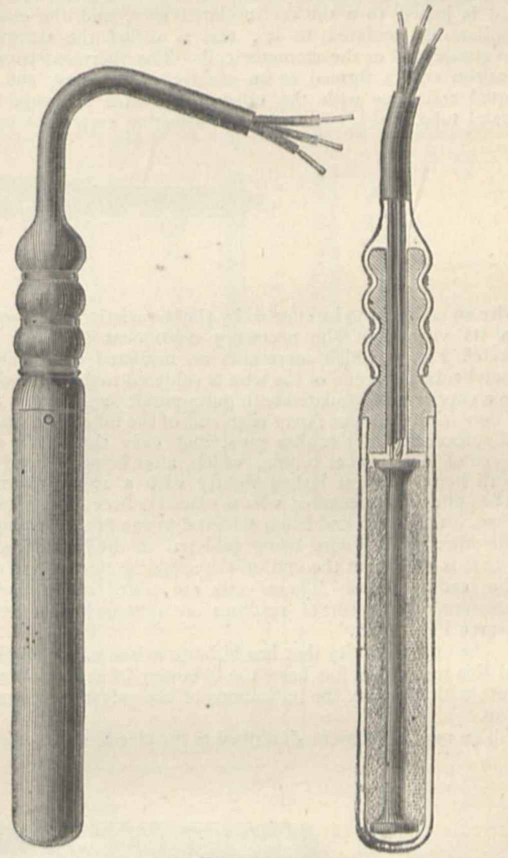


FIG. 2.

For platinum		$r = \cdot 0021448\ T^{\frac{1}{2}} + \cdot 0024187\ T + \cdot 30425$
		$r = \cdot 039369\ T^{\frac{1}{2}} + \cdot 00216407\ T - \cdot 24127$
		$r = \cdot 092183\ T^{\frac{1}{2}} + \cdot 00007781\ T - \cdot 50196$
For copper	...	$r = \cdot 026577\ T^{\frac{1}{2}} + \cdot 0031443\ T - \cdot 29751$
,, iron	...	$r = \cdot 072545\ T^{\frac{1}{2}} + \cdot 0038133\ T - 1\cdot 23971$
,, aluminium		$r = \cdot 05951436\ T^{\frac{1}{2}} + \cdot 00284603\ T - \cdot 76492$
,, silver	...	$r = \cdot 0060907\ T^{\frac{1}{2}} + \cdot 0035538\ T - \cdot 07456$

Dr. Siemens, however, has not been satisfied with limiting his experiments to temperatures within the boiling point of mercury, but compared the law he had deduced with experimental results at higher temperatures obtained by the use of the metal ball pyrometer shown in Fig 1. Its principal parts are a metal ball, whose heat capacity equals one-fiftieth of that of an imperial pint of water, a copper vessel containing a pint of water, and a thermometer having a fixed and sliding scale with divisions of equal size, but each division in the latter being equivalent to fifty in the former. The zero of the sliding scale is fixed to coincide with the position of the mercury level in the thermometer. The ball, having been heated, is dropped into the water, whose temperature is the sum of those indicated on the fixed and sliding scales. By the use of this instrument, whose readings were compared with those of the mercury thermometer

* Abstract of a Paper read at the Society of Telegraph Engineers by C. William Siemens, D.C.L., F.R.S., &c.

up to the boiling-point of the latter metal, results at higher temperatures were obtained. The first part concludes with several pages of tabulated results of experiments, which results are laid down in a sheet of diagrams.

In the second part, Dr. Siemens describes the instruments he has designed for the measurement of temperature by electrical resistance, having first referred to the coils of silk-covered copper wire, by which he was enabled to detect a dangerous rise of temperature in the Malta and Alexandria Telegraph cable, coiled in ship's hold, and saved that cable from being destroyed. The simplest of these arrangements is shown in Fig. 2, and is employed for the measurement of temperature not exceeding the boiling point of water. Insulated wire is wound round a cylindrical piece of wood and is enclosed in a metal casing: one end is joined to a thicker insulated wire, and the other to a similar one soldered to it; this is called the thermometric resistance coil or thermometer coil. The thermometrical comparison coil is formed of an exactly similar wire, and has an equal resistance with the other. The wire is wound upon a metal tube, and is enclosed in a protecting capsule of metal, in the open end of which is fitted a vulcanite stopper through which are passed the leading wires attached to the coil. This is placed in a movable tube having a flanged bottom and containing a mercury thermometer; the tube is immersed in a cylindrical vessel of water, wherein it is moved up and down, the flange agitating and thus equalising the temperature of the water. The thermometer coil, which may be at a distance from the place of observation, is connected with the comparison coil through a pair of equal resistances and a galvanometer. When electrical equilibrium is obtained, by adding hot or cold water to the vessel containing the comparison coil until the galvanometer needle is at the zero of its scale, it is evident that $\frac{A}{B} = \frac{T + l}{T' + l'}$ A and B representing the equal resistances, l and l' the equal resistances of the leading wires, and T T′ those of the thermometer and resistance coils, or T = T′, and the temperature of the water in which the comparison coil is placed will be that of the distant station.

In measuring deep-sea temperatures the coil must be so protected as to be perfectly insulated at the greatest depths, and the

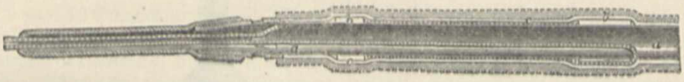


FIG. 3.

wire so coiled as to be effected by slight variations of temperature in its vicinity. The necessary instrument is shown in the sketch Fig. 3, which represents an insulated wire coiled on a metal tube; one end of the wire is soldered to the tube, the other to a copper wire insulated with gutta percha, and carried through a hole to the interior: over each end of the tube is drawn a piece of vulcanised india-rubber pipe, and over the whole a larger piece of india-rubber tubing, which, after being padded outside with hemp yarn, is lashed tightly with a stout binding wire. The gutta-percha covered wire is placed between the india-rubber pipes *b* and *c*, its end being soldered to one of the leading wires, the other leading wire being soldered to the brass tube. The whole is carried at the end of the sounding line, which contains the leading wires. These coils are tested under hydrostatic pressure, and accurate readings are obtained to a tenth of a degree Fahrenheit.

The only difficulty that has hitherto arisen in the employment of this instrument has been the obtaining of skilled observers to note with accuracy the indications of the galvanoscope on board ship.

The next instrument described is the electrical pyrometer, the coil of which is made of platinum wire, wound on a hard baked pipe-clay cylinder in which a doubled threaded helical groove is formed, and which is shown in Fig. 4.

At each end of the spiral portion B B, it is provided with a ring-formed projecting rim *c* and *c′*, the purpose of which is to keep the cylinder in place when it is inserted in the outer metal case, and to prevent the possibility of contact between the case and the platinum wire. Through the lower ring *c′* are the small holes *b b′*, and through the upper portion two others, *a a*. The use of the upper holes *a a′* is for passing the ends of the platinum wires through, before connecting them with the leading wires. From these two holes downwards platinum wires are coiled in parallel convolutions round the cylinder to the bottom, where they are passed separately through the holes *b b′*. Here they are twisted, and by preference fused together by means of an oxyhydrogen blow-pipe. At this end also the effective length and resistance of the platinum wire can be adjusted, which is accomplished by forming a return loop of the wire, and providing a connecting screw-link of platinum, L, by which any portion of the loop can be cut off from the electrical circuit.

The pipe-clay cylinder is inserted in the lower portion of the

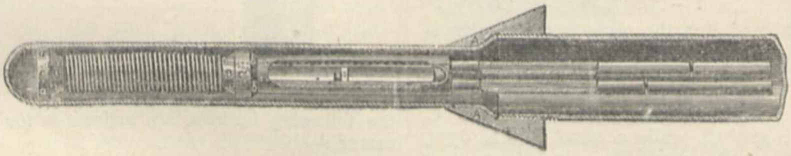


FIG. 4.

protecting case seen in Fig. 6. This part of the case is made of iron or platinum, and is fitted into the long tube, which is of wrought iron, and serves as a handle. When the lower end of the casing is of iron, there is a platinum shield to protect the coil on the pipe-clay cylinder. The purpose of the platinum casing is to shield the resistance wire against hot gases, and against accident. At the points A A, Fig. 4, the thick platinum wires are joined to copper connections, over which pieces of ordinary clay tobacco-pipe are drawn, and which terminate in binding screws fitted to a block of pipe-clay, closing the end of the tube. A third binding screw is provided, which is likewise connected with one of the two copper connecting wires, and which serves to eliminate disturbing resistances in the leading wires. The pipe-clay cylinder is, when cold, highly insulating; its conducting power increases with heat, but not to an extent to produce error, as the variation is inappreciable until a white heat is reached, but in measuring temperatures above a white heat, the indications of the instrument are slightly below the true value. In measuring temperatures with this instrument the differential voltameter is employed, a wide range of resistances being obtained; this instrument forms the subject of the third part o this paper, to which we now refer. The theory of differential mea surement and the instrument employed are thus described by Dr. Siemens:—

Faraday established the law that the decomposition of water in a voltameter in an unit of time is a measure of the intensity of the current employed; or, that

$$I = \frac{V}{t};$$

—I being the intensity, V the volume, and t the time.

According to Ohm's general law, the intensity, I, is directly governed by the electro-motive force, E, and, inversely, by the resistance, R, of the electric circuit, or, it is

$$I = \frac{E}{R}.$$

Combining the two laws we have

$$V = \frac{E}{R} t,$$

which formula would enable us to determine any unknown resistance, R, by the amount of decomposition effected in a voltameter in a given time, and by means of a battery of known electromotive force.

Practically, however, such a result would be of no value, because the electromotive force of the battery is counteracted by the polarisation, or electrical tension, set up between the electrodes of the voltameter, which depends upon the temperature and concentration of the acid employed, and upon the condition of the platinum surfaces composing the electrodes. The resistance to be measured would, moreover, comprise that of the voltameter, which would have to be frequently ascertained by other methods, and the notation of time would involve considerable inconvenience and error. For these reasons the voltameter has been hitherto discarded as a measuring instrument, but the disturbing causes just enumerated may be eliminated by combining two similar voltameters in one instrument, which I propose calling a "differential voltameter," and which is represented in the accompanying drawing.

It consists of two similar narrow glass tubes, A and B, of about 2·5 millimetres in diameter, fixed vertically to a wooden frame, F, with a scale behind them divided into millimetres or other divisions. The lower ends of these tubes are enlarged to about 6 millimetres in diameter, and each of them is fitted with a wooden stopper saturated with paraffin and pierced by two

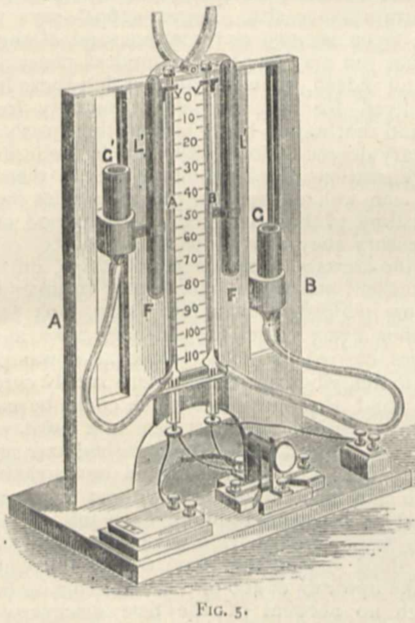


FIG. 5.

platinum wires, the tapered ends of which reach about 25 millimetres above the level of the stopper. These form voltametric electrodes.

From the enlarged portion of each of the two voltameter tubes a branch tube emanates, connected, by means of an india-rubber tube, the one to the moveable glass reservoir G, and the other to G', Fig. 5. These reservoirs are supported in sliding frames by means of friction springs, and may be raised and lowered at pleasure. The upper extremities of the voltameter tubes are cut smooth and left open, but weighted levers, L and L', are provided, with india-rubber pads, which usually press down upon the open ends, closing them, but admitting of their being raised, with a view of allowing the interior of the tubes to be in open communication with the atmosphere. Having filled the adjustible reservoirs with dilute sulphuric acid on opening the ends of the voltameter tubes, the liquid in each tube will rise to a level with that of its respective reservoir, and the latter is moved to its highest position before allowing the ends of the tubes to be closed by the weighted and padded levers.

The ends of the platinum wire forming the electrodes may be platinised with advantage, in order to increase the active surface for the generation of the gases.

Fig. 6 represents the connections of the voltameter with the pyrometer. One electrode of each voltameter is connected with a common binding screw, which latter may be united, at will, to either pole of the battery, whilst the remaining two electrodes are, at the same moment, connected with the other pole of the same battery; the one through the constant resistance-coil, X, and the other through the unknown resistance, X'. This unknown resistance, X', is represented to be a pyrometer-coil.

By turning the commutator seen at Fig. 5 either in a right or left-hand direction from its central or neutral position (in which position the contact-springs on either side rest on ebonite), the current from the battery flows through the two circuits, causing decomposition in the voltameters; and the gases generated upon the electrodes accumulate in the upper portions of the graduated tubes. By turning the commutator half round every few seconds, the current from the battery is reversed, which prevents polarisation of the electrodes, as already stated.

The relative volumes, v and v', of the gases accumulated in an arbitrary space of time within each tube must be inversely proportional to the resistances, R and R', of the branch circuits, because—

$$v : v' = \frac{E}{R} t : \frac{E}{R'} t,$$

and, therefore,

$$v : v' = R' : R.$$

The resistances R and R' are composed, the one of the resistance

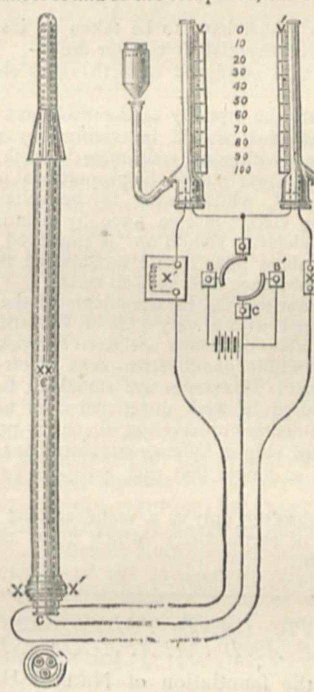


FIG.

C, plus the resistance of the voltameter A, and the other of the unknown resistance X, plus the resistance of the voltameter B. But the instrument has been so adjusted that the resistances of the two voltameters are alike, being made as small as possible, or equal to about 1 mercury unit, to which has to be added the resistances of the leading wires, which are also made equal to each other, and to about half a unit; these resistances may therefore both of them be expressed by γ.

We have, then—

$$v' : v = C + \gamma : X + \gamma,$$

or—

$$X = \frac{v}{v'}(C + \gamma) - \gamma \quad . \quad . \quad . \quad . \quad . \quad (1)$$

which is a convenient formula for calculating the unknown resistance from the known quantities C and γ, and the observed proportion of v and v'.

The constant of the instrument (γ) is easily determined, from time to time, by substituting a known resistance for X, and observing the volumes, v and v', after the current has been acting during an arbitrary space of time, when in the above formula, γ, has to be separated as the unknown quantity, giving it the form—

$$\gamma = \pm \frac{v' X - v C}{v - v'} \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

The condition of equality between the internal resistances of both voltameters is ascertained by inserting equal known resistances in both branch circuits, when

$$v = v'$$

should be the result. Failing this, the balance is generally re-established by reversing the poles of the battery, the reason being that hydrogen electrodes are liable to accumulate metallic or other deposit upon their surfaces, which is effectually removed by oxygen.

When the instrument is to be worked between wide ranges of temperature, it is requisite that C should be variable, and nearly equal to X, and that γ should be very small compared with X.

By equating the values of the equations

$$X = \frac{v}{v'}(C+\gamma) - \gamma = r = \cdot 039369\, t^{\frac{1}{2}} + \cdot 00216407\, t - \cdot 24127,$$

C and γ in the instruments constructed being equal to 17 and 2 units, we arrive at

$$t^{\circ}\text{Cent.} = \left\{ \left(877 \cdot 975 \times \frac{v}{v'} + 101 \cdot 80877\right)^{\frac{1}{2}} - 9 \cdot 0960553 \right\}^{2} - 274^{\circ},$$

from which a table has been prepared to be used with the pyrometer.

The precautions which have to be taken to insure reliable results in using the Differential Voltameter are:—

1st. The dilute acid employed in both tubes should be of equal strength.

2nd. After disuse, the equality of the resistances of the voltametres and connection should be verified by passing the current through them with equal resistances in each branch.

3rd. The battery power should be proportional to the resistances to be measured, whilst owing to the voltameter exercising an opposing electro-motive force by polarisation, less than five Daniell's elements should not be employed.

4th. The india-rubber pads should be smeared from time to time with a waxy substance such as resin cerate.

With these precautions the measurements of the instrument have been compared with a very perfect Wheatstone bridge arrangement, and tables of results are given showing that it can be relied upon to within one-half per cent. of error of observation. Its principal advantages are stated to be: that the resistance is measured in work done, and does not therefore depend upon a momentary observation, that it is not influenced by motion on board ship or by magnetic disturbances, and that its construction is so simple that each part can be easily examined and verified.

It is regarded, however, only as a useful adjunct to the more important subject of thermometry, which forms the principal object of this paper.

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*THE GIGANTIC LAND TORTOISES OF THE MASCARENE AND GALAPAGOS ISLANDS**

EVER since the foundation of Natural History Collections in Europe, naturalists had their curiosity excited by shells of Tortoises of enormous size that were brought home in vessels coming from India. From the accounts of travellers as well as from the great convexity of their shell, these tortoises were known to be terrestrial in their life, and totally distinct from the other giants of the Chelonian order, the marine Turtles. Various localities having been given as their habitat, such as the Cape of Good Hope, the Coast of Coromandel, Malacca, China, &c., the impression prevailed that they were found in many parts of India, and consequently nothing could have been more appropriate than the name given to them, *Testudo indica*.

It is not the object of the present article to treat in detail of the divergent views held subsequently by zoologists, some distinguishing several species from the difference of the form of the shell alone, others maintaining that there was one very variable species only which had been carried by ships from its native place into various parts of the globe where it became acclimatised, until Dr. Gray, the principal advocate of the latter opinion, himself was compelled to admit that there must be at least two kinds, one with a convex and the other with a flat skull. The scientific study of these tortoises may be said to have commenced with this distinction, but it commenced at a time when the work of disturbance and extermination by man had already reduced the amount of evidence so far as to well nigh bring the subject into the domain of palæontological research.

From the accounts of voyagers of the sixteenth and seventeenth centuries we learn that these tortoises were found at two most distant stations, one being the Galapagos group in the Pacific, the other comprising some of the islands of the Indian Ocean; Mauritius, Rodriguez, Aldabra, and probably Réunion. Widely different as these stations are in their physical characteristics, they had that in common, that they were, at the time of their discovery, uninhabited by man or even by any large terrestrial mammal. There is not the slightest trace of evidence that any of the intervening lands or islands have ever been inhabited by them.

At first the Tortoises were found in immense numbers and of extraordinary size. Leguat (1691) says that in Rodriguez "you see two or three thousand of them in a flock, so that you may go above a hundred paces on their backs;" and indeed, when we consider that these helpless creatures lived for ages in perfect security from all enemies, and that nature has endowed them with a most extraordinary degree of longevity, so that the individuals of many generations lived simultaneously in their island home, we can well account for the multitudes found by the first visitors to those islands. For a period of more than a century they proved to be a source of great benefit to the crews and passengers of ships, on account of their excellent and wholesome meat. In times when a voyage, now performed in a few weeks, took as many months, when every vessel, for defence's sake and from other causes, carried as many people as it was possible to pack into her, when provisions were rudely cured and but few in kind, these tortoises which could be captured in any number with the greatest ease in a few days, were of the greatest importance to the famished and scorbutic ship's company. The animals could be carried in the hold of the ship for many months without food, and were slaughtered as occasion required, each tortoise yielding from 80 to 300 pounds of fresh wholesome food; and we read that ships leaving the Mauritius or the Galapagos used to take upwards of 400 of these animals on board.

Although no account of the first discovery of the Galapagos Islands appears to have been published, so much is certain that it is due to the Spaniards, who applied the Spanish word for tortoise to this group of islands. It became the regular place of meeting and refitting to the buccaneers and whalers, who provisioned themselves chiefly with tortoises and turtles. But numerous and constant as these visits were, the reckless destruction of animal life was limited chiefly to the coast-belt, and numbers of the animals inhabiting the interior escaped; no regular or extensive settlement being attempted, the condition of the islands and of the animals inhabiting them remained in the main unaltered until the earlier portion of the present century. From the accounts of that period I select that given by Porter, a Captain in the United States Navy, as the one which contains by far the most interesting observations (Journal of a cruise made to the Pacific Ocean, New York, 1822, 8°). He found, in the year 1813, the tortoises in greater or less abundance in all the larger islands of the group which he visited, viz., Hood's, Narborough, James, Charles, and Porter's Islands. On Chatham Island he found only a few of their shells and bones, which appear to have been lying there for a long time, and possibly may have belonged to individuals transported from some other island. On Albe-

* The substance of this article is contained in a paper read by the author before the Royal Society in June, 1874, which will appear in the forthcoming volume of the "Philosophical Transactions," and to which I must refer for the scientific portion and other details. Some facts which have come to my knowledge subsequently to the reading of this paper, are added.

marle Island, the largest of the group, none were observed by him, evidently because he landed here only for a few hours on the south-western point. Abingdon, Binloe's, Downe's and Barrington Islands were not visited by him. He describes the steps of the tortoises as slow, regular, and heavy; they carry their body about a foot from the ground, frequently erecting their neck, which is from eighteen inches to two feet long, and very slender; also their head is comparatively small. In the daytime they appeared remarkably quick-sighted and timid, drawing their head into the shell on the slightest motion of any object; but they are said to be entirely destitute of hearing, as the loudest noise, even the firing of a gun, did not seem to alarm them in the slightest degree. At James Island Porter took on board as many as would weigh about fourteen tons, the individuals averaging about sixty pounds, that is, about 500 individuals; and he states that among the whole there were only three males which he distinguished by their great size and by the greater length of the tail. As the females were found in low *sandy* bottoms, and all, without exception, were full of eggs, he presumed that they came down from the mountains for the purpose of laying; the few males had been taken at a considerable distance from the shore, in the hilly interior of the island. The eggs are perfectly round, white, with a hard shell of a diameter of $2\frac{1}{2}$ inches. He found the blood of the tortoises to possess constantly a temperature of 62°, whilst the general temperature of the air in the Galapagos varies from 72° to 75°.

Very significant are Porter's remarks as regards the differences of the tortoises from different islands. Those of Porter's Island he describes as being generally of an enormous size, one (not by any means the largest) measuring $5\frac{1}{2}$ feet in length, $4\frac{1}{2}$ feet in width, and 3 feet in depth. The form of the shell of the race inhabiting Charles's Island is elongate, turning up forward in the manner of a Spanish saddle, of a brown colour and of considerable thickness, whilst the tortoises of James Island are round, plump, black as ebony, and remarkably thin-shelled. The tortoises of Hood's Island, one of the smallest of the group, were small, and as regards form, similar to those from Charles's Island.

Twenty-two years had passed since Porter's Cruise, when Darwin visited the Galapagos Archipelago in the *Beagle*, in the year 1835. On his excursions in the interior he still met with large individuals, but a change by which the existence of these animals was much more threatened than by the visits of whalers, &c., had taken place. The Republic of Equador had taken possession of the Archipelago, and a colony of between two and three hundred people banished by the Government, had been established on Charles Island, who reduced the number of tortoises in this island so much that they were driven by necessity to send parties to other islands to catch tortoises and salt their meat. Also, pigs had multiplied and were roaming about in the woods in a feral state, no doubt destroying the offspring of those which hitherto had escaped.

After an interval of not quite eleven years H.M.S. *Herald* followed the *Beagle* on a voyage of discovery and survey. The naturalist of this expedition, which reached the Galapagos in the year 1846, found that the progress of civilisation had been great, or, in other words, that the displacement of the indigenous fauna by man and his companions had proceeded apace. On Charles Island the cattle had increased wonderfully, and were estimated at 2,000 head, beside wild pigs, goats, and dogs; the wild dogs keeping the goats and pigs very much down, whilst the tortoises had been exterminated between the visits of the *Herald* and *Beagle*. On the other hand, they were met with on Chatham Island, but the largest individual measured only two feet two inches in length.

Recent accounts of visits to the Galapagos do not give us the particulars of the present condition of the indigenous fauna, nor do they contain any information as regards the survivors of its Chelonians. The specimens which at rare intervals reach Europe *viâ* Panama, are young individuals not exceeding twenty inches in length or about twenty-five pounds in weight. The giants of their race appear to be extinct or nearly so, and it is scarcely to be expected that (except under most favourable conditions) any of the surviving comparatively young and small individuals of so slow-growing a form of animal life will be allowed, by an increasing lawless population, to live long enough to reach the dimensions of the individuals of former generations. Therefore, there is but little hope that valuable additions will be made to the scanty and incomplete material in our collections; and any information as regards the present occurrence of the several races in the various islands, is to be received with caution, as evidently the original distribution of the races has been much interfered with in the course of time by the carriage of tortoises from one island to the other.

The original condition and the fate of the tortoises of the Mascarene Islands were precisely the same as in the Galapagos. Their extreme abundance in the small island of Rodriguez * has been referred to above. Down to 1740 they continued to be numerous in the Mauritius; for Grant ("Hist. Maurit.," p. 194) writes in that year—"We possess a great abundance of both land- and sea-turtles, which are not only a great resource for the supply of our ordinary wants, but serve to barter with the crews of ships who put in here for refreshment on their voyage to India." But they appear to have been much more scattered in the larger islands than in Rodriguez; and, according to Admiral Kempinfeldt, who visited the latter island in 1761, small vessels were constantly employed in transporting these animals by thousands to Mauritius for the service of the hospital. Soon, however, their number appears to have been rapidly diminished; and to the causes which worked their destruction in the Galapagos, here another was added, viz., widely spreading conflagration, by which the rank vegetation of the plains was destroyed to make room for the plantations of the settler. They did not long survive the Dodo or Solitaire, and early in the present century the work of extermination was accomplished; there is at present not a single living example either in Rodriguez or Mauritius.

Our knowledge of the indigenous fauna of the Island of Réunion is still extremely meagre. If we can trust to tradition, a gigantic land-tortoise once inhabited this island; and if this be really the case, it must have become extinct long before the Mauritius and Rodriguez species, nor is there any evidence to show its affinity to one of the other races. The Seychelles do not appear to have been inhabited by these animals, certainly not within historical times, all the individuals found there having been imported from Aldabra and kept in a semi-domesticated condition.

The Island of Aldabra, the only spot in the Indian Ocean where this Chelonian type still lingers in a wild state in small and gradually diminishing numbers, lies in lat. 9° 25′ S., long. 46° 20′ E. In reality it consists of three islands, separated from one another by a deep channel about half a mile wide. They are covered with verdure, low tangled bushes interspersed with patches of white sand; two of the islands are rather low, hummocky near the centre. The middle island is slightly the largest, extending six or eight miles in length and three or four miles in breadth; it is much higher than the others, and partly covered with very high trees that may be seen eight or nine leagues from the deck of a moderate-sized ship.

ALBERT GÜNTHER

(*To be continued.*)

* Again amply testified by the rich collection of tortoise-bones made by Mr. Slater, one of the naturalists appointed by the Royal Society to accompany the Transit of Venus Expedition to Rodriguez.

NOTES

An attempt has been recently made to supply a great desideratum for naturalists residing in or visiting London, in a reading-room, in a central situation, where they may consult recent publications and current periodical literature, English and foreign. The Linnean Society has taken advantage of the excellent accommodation now afforded it in Burlington House, Piccadilly, to utilise its council-room for this object when not required for the purposes of the Society. The room is open from ten to six (or four on Saturdays) to Fellows of the Society and others properly introduced, and several tables are well supplied with the newest literature in the two branches of Biology, and others are furnished with accommodation for writing, &c. It is also in immediate proximity to the very fine library of standard works in natural history possessed by the Society, where the librarian is always in attendance. If we might make a suggestion to the Council of the Society for the further development of this very useful movement, it would be that means should be taken for a more prompt and regular supply of some of the leading foreign scientific journals, as, for instance, the *Comptes Rendus* of the French Academy, in which respect the reading-room of the Linnean Society still contrasts unfavourably with that of the Royal College of Surgeons; but the longer hours are a great advantage. The room ought to become the recognised *rendezvous* for naturalists in London.

The Royal Horticultural Society has awarded Mr. Worthington G. Smith its Gold Banksian Medal for his discovery in connection with the potato disease which we recorded last week. We refer our readers to an article by Mr. Smith on the subject in this week's Nature.

Dr. R. B. Walker, F.R.G.S., is on his way home from Gaboon (where he has resided for the last ten years) with the view of publishing his "Twenty-five years experience in Equatorial Africa." Extensively engaged in commerce and geographical research, and having visited all the principal colonies and stations on the West Coast, his contributions to our knowledge of the fauna and flora, anthropology, dialects, and natural products of commerce, ought to be valuable and certainly more trustworthy than those of transient visitors.

The International Geographical Exhibition at Paris, which was opened on the 15th inst., promises to be a decided success. An immense number of visitors have already passed through the galleries, although several nations have not yet completed their preparations, and the annexes on the Terrace du bord de l'eau are far from being ready. The objects exhibited are classed into seven groups. Group 1 has to do with geographical mathematics, geodesy and topography, and the instruments pertaining to them. Group 2 deals with hydrography and maritime geography. Group 3 embraces physical geography, general meteorology, general geology, botanical and geological geography, and general anthropology. Group 4 is rich in ancient treatises, printed and in manuscript, on geographical subjects; fantastically-designed old maps, old instruments, ethnographic collections, and geographical dictionaries. Group 5 is devoted to statistics and to social, political, and agricultural economy. Group 6 has to deal with the teaching and diffusion of geography; and Group 7 with explorations, scientific and commercial voyages, and tours in search of the picturesque. The following are some of the objects which have proved most attractive to the public:—In the Salle des Etats, where the general meeting will be held, is the map of France constructed by the staff. This map is about sixty feet high by forty wide, and many people look at it with telescopes from a distance in order to find the details which interest them. In the English section is a large map of the polar regions, showing the route which the English expedition is to follow; also a large map of the Anglo-Indian Empire, the collection of the proceedings of the Royal Geographical Society and the magnificent instruments employed by the Indian Trigonometrical Survey. The American section, in a remote part of the building, is notable for the admirable collection of the maps of the U.S. Signal Office, and the physical atlas constructed by the venerable Prof. Henry. In the Russian department are exhibited the jewels of the Khan of Khiva; a large map of Asia showing the itineraries of 150 Russian explorers who have travelled in that part of the world during the last twenty years; specimens of the map of the frontier between Russia and China; specimens of the topographical maps drawn by officers during the last Khivan expedition; a map of the Oxus, showing the old tract of the stream when it sent its waters into the Caspian as well as into the Aral Sea; a magnificent map of the Aral Sea, and a collection of geodetical and meteorological instruments. In the French section an attractive object is the complete French station used in observing the Transit of Venus at Saint Paul by Mouchez, with several specimens of photographs of the transit. There is expected from Sweden a meteorite so large that it will have to be placed outside in the Terrace du bord de l'eau; also an artificial representation of the aurora borealis, which is likely to prove of great interest. Dr. A. B. Meyer will exhibit a manuscript map of his explorations in New Guinea. This will doubtless be of great interest to geographers, as it is the first map of that region which goes into detail.

We learn from the *Scotsman* that a meeting of the General Committee appointed in Glasgow to make the necessary arrangements for the meeting of the British Association to be held at Glasgow next year, was held on Wednesday week. A letter from the assistant-secretary of the Association to Sir William Thomson was read by Prof. Young, and in the course of it the name of Prof. Sir R. Christison, of Edinburgh, was mentioned as president-elect.

The Paris Academy of Sciences on Monday last elected Capt. Mouchez to fill the place in the Section of Astronomy vacated by the death of the late M. Mathieu. The contest was unusually severe, every member of the Academy having taken part in the vote. Capt. Mouchez obtained 33 votes, and M. Wolf 26; one vote was given to M. Tisserand, the Director or the Toulouse Observatory.

General regret will be felt at the death,—which took place on Sunday,—of Lady Franklin, at the age of 83 years. Jane Griffin, for such was her maiden name, was married to the great and unfortunate Arctic explorer on Nov. 5, 1828, and accompanied him almost constantly in the fulfilment of his duties until his departure on his last Arctic voyage of discovery in 1845. She has naturally ever since taken the deepest interest in Arctic exploration, and has herself directly done much to forward it by fitting out expeditions either entirely or partly at her own expense. It was she who sent out the *Fox* which in 1857–9, under Sir Leopold M'Clintock, did important service in Arctic exploration and in the discovery of the records and relics of the unfortunate Franklin expedition. That her interest in Arctic enterprise was strong to the very last is shown by the fact that she helped to equip the *Pandora* which so recently left our shores to attempt the N. W. passage under Captain Allen Young. For her services in this direction she received on the return of the *Fox* the Gold Medal of the Royal Geographical Society; she was the first woman on whom it was conferred, the only other one who obtained such a distinction being the late Mrs. Somerville. Until within the last few years, when incapacitated by old age and illness, Lady Franklin was herself an almost constant traveller; she had made a voyage round the world and visited many of the principal places in Europe, North and South America, Asia, and Australasia. She was, as might be surmised, a woman of superior intelligence, clear-sightedness, and great determination; her name will no doubt live alongside of that of her renowned husband.

FROM a circular letter of M. Leverrier to the Presidents of the Meteorological Commissions of the Departments of France, we learn that the "Atlas Météorologique" for the years 1872 and 1873 is in the press, and that concerted action of several departments by regions is, if slowly, yet gradually being inaugurated in different directions, particularly in the valleys of the Seine, Gironde, Rhône, and Meuse, and the Mediterranean sea-board. M. Fron resumes the discussion of thunderstorms, and M. Belgrand undertakes that of the rainfall.

IN connection with the recent disastrous inundation of the Garonne, the following heights, above low-water, of the floods of that river from 1804, as given by M. W. de Fonvielle in the *Bulletin Hebdomadaire* of the Scientific Association of France, Nos. 400 and 402, will be interesting:—July 1804, 21·7 feet; August 1809, 11·8 feet; May 1810, 21·8 feet; April 1812, 12·5 feet; June 1813, 17·8 feet; May 1815, 17·6 feet; April 1816, 16·7 feet; February 1817, 16·7 feet; November 1819, 10·9 feet; March 1821, 15·4 feet; May 1824, 16·4 feet; October 1826, 18·9 feet; May 1827, 23·3 feet; May 1830, 11·5 feet; October 1833, 17.4 feet; May 1835, 24·6 feet; March and April 1836, 13·1 feet; February 1839, 15·4 feet; April 1842, 17·1 feet; June 1845, 19·4 feet; February 1850, 18·4 feet; June 1853, 16·7 feet; June 1854, 18·0 feet; June 1855, 23·6 feet; and on the 24th June, 1875, 26·2 feet, the last being thus a foot and a half higher than any flood that has occurred in this valley during the past seventy-one years, and 3·3 feet higher than the historic flood of 1772.

PETERMANN'S *Mittheilungen* for July contain a map of Asia Minor, which by means of different colours shows the various levels of that region in metres. The map is, moreover, a useful one for general purposes, and is accompanied by a descriptive article by Freiherr v. Schweizer-Lerchenfeld.

THE same number of this Journal contains the continuation of Dr. Chavanne's valuable paper on the condition of the ice in the polar seas and the periodical changes to which it is subject. This paper is the result of a minute and careful examination of the reports of the most trustworthy observers, and contains two valuable tables, one showing the normal value of the winter and summer temperatures in fifteen of the principal polar basins, and the other the variation from the normal mean temperatures in summer and winter of the same basins for the period 1800–74. The paper is accompanied by a graphic chart illustrative of these tables, and also showing the secular variation in the condition of the ice in the Dwina at Archangelsk from 1734 to 1854, in connection with the secular variations in intensity of the Aurora Borealis from 1722 to 1870.

PETERMANN'S journal for August will contain a valuable paper by Dr. G. Nachtigal, giving a historical and descriptive account of the new Egyptian province, Dar Fur, and a brief sketch of the traveller's journey from Kuka to Khartoum. A map of the region referred to will accompany the paper, showing not only Nachtigal's route, but those of Von Heuglin and Schweinfurth.

IN connection with the Arctic papers of the Geographical Society, we recently referred to speculations on the condition of the interior of Greenland. The August number of the *Mittheilungen* will contain a paper by Dr. Rink on this subject, and on the possibility of crossing Greenland. The following are his principal conclusions:—1. The so-called interior ice is probably only a wall or rind, inside which may be found valleys free from snow and ice, and possibly even wooded. 2. All Greenland, probably, consists of a number of islands soldered together by the universal ice covering. 3. Most probably in two or three places, where the ice-fjords still disembogue, in earlier times a sound must have extended right across from the west to the east coast. 4. Glaciers and permanent snow are probably on the increase all over the land. 5. Floating icebergs are detached from the land by a sort of fall or downflow of the land-ice glaciers. Dr. Rink thinks that by means of properly constructed sledges drawn by men, and by carefully selecting a route and establishing suitable stations, the Greenland continent might be crossed from coast to coast.

WHILE so much is being done for Arctic exploration, the Germans in recent years have not been neglecting the exploration of the Antarctic seas. In 1873 the German Arctic Society of Hamburg, presided over by Albert Rosenthal, who has contributed so much to the equipment of polar expeditions, sent out an expedition to the south polar region under the command of Capt. Dallmann. Some of the results of this expedition will be found in the recently published expedition of Stieler's "Hand-Atlas," and a few details will be found in the August number of Petermann's *Mittheilungen*, especially with reference to Capt. Dallmann's exploration of Graham Land, discovered by the whaling Captain Biscoe, in 1832. Capt. Dallmann deserves credit for having added considerably to our knowledge of this hitherto little-known land. At the place where Biscoe saw nothing but what appeared a continuous coast line, Dallmann has discovered a strait from fifteen to eighteen nautical miles wide, with highlands between as far as the eye could reach, and an Archipelago of islands of about sixty nautical miles in extent, which has been named after Kaiser Wilhelm. Two other deep bays and many islands have been discovered and named, and will be found on the map already referred to.

THE prizes of the French Geographical Society have this year been awarded as follows:—A gold medal to Father Armand David, for his explorations in China and Mongolia; a gold medal to Dr. G. Schweinfurth, for his travels in North Africa; a silver medal to Abbé Émile Petitot, for his exploration of the North American region which extends from Great Slave Lake to the mouth of the Mackenzie; a silver medal each to MM. de Compiègne and Marche for their journey to the Gaboon and up the River Ogové; and the la Roquette gold medal to the family of the late Capt. Hall of the *Polaris* Arctic Expedition.

M. ADRIEN GERMAIN in the *Bulletin* of the French Geological Society discusses the propriety of having a common meridian for all nations, and comes to the conclusion that the French should decidedly not abandon the meridian of Paris as their first, as it presents all the advantages which a first meridian should have.

MR. E. W. PREVOST has succeeded Mr. Clowes as Science Master at Queenwood College, Stockbridge.

IMPORTANT changes are contemplated in the organisation of the French National University, as a new law has been adopted by the Assembly allowing, under certain conditions, the opening of free Universities.

WITH regard to Mr. Barrington's query in last week's NATURE (p. 213), relative to the sudden scarcity of blackbirds and thrushes, Mr. G. Lingwood, of Alnwick, writes that in the district where he resides, and with which he is well acquainted, there is no such scarcity. Mr. J. Preston, writing from Belfast, likewise testifies to their superabundance in that neighbourhood.

IN an octavo volume of some eight hundred pages, the U.S. Government has recently issued a handbook of the ornithology of the region drained by the Missouri River and its tributaries, entitled "Birds of the North-west, from the pen of Dr. Elliott Coues." There are no illustrations.

WE are glad to see that among the Supplementary Estimates just issued is a re-vote of 1,000*l.* for the Sub-Wealden Exploration.

ON Tuesday, the inaugural meeting of the Royal Archæological Institute took place at Canterbury.

A FINE male Chimpanzee, which has cut its front permanent incisors and its anterior true molars, has just been presented to the Zoological Society by Captain Lees, Governor of Lagos, West Africa.

THE recently issued part of Dr. H. G. Bronn's *Thierreich* contains an account of the lower jaw and the teeth in the different orders of the Mammalia, together with numerous excellent outline drawings of the skulls of the same groups.

MESSRS. LONGMANS are preparing for publication, in three volumes, copiously illustrated, a treatise on galvanism and electro-magnetism, by Prof. Gurtav Wiedemann, translated from the second German edition, with the author's sanction and co-operation, by G. Carey Foster, F.R.S., Professor of Physics in University College, London.

THE same publishers will issue in the autumn, a text-book of Telegraphy, by W. H. Preece, C.E., and J. Sivewright, M.A., forming one of their series of "Text-books of Science."

AMONG the works Mr. John Murray will publish during the ensuing season, the following will probably be found of interest to our readers:—"Habits and Movements of Climbing Plants," by Charles Darwin, F.R.S.—"Eastern Seas, Coasts, and Harbours," being the cruise of H.M.S. *Dwarf* in China, Japan, Formosa, and Russian Tartary from the Corea to the River Amur, by Commander B. W. Bax, R.N. This book will be illustrated by a map and engravings.—"A School Manual of Modern Geography," edited by Dr. William Smith.—"A Popular Account of Dr. Livingstone's Second Expedition to Africa; the Zambezi, Lakes Shirwa and Nyassa, with illustrations."—A new edition, being the twelfth, of Sir Charles Lyell's "Elements of Geology," in two octavo volumes; and "A Natural History of Mammals, including Man," by Prof. St. George Mivart, F.R.S., forming the first part of an introduction to Zoology and Biology.

IN yesterday's *Times* will be found an extremely interesting account from Australia of a Frenchman, Narcisse Pierre Peltier, of about thirty years of age, who has been living for seventeen years among the savages of Night Island, off the north-east coast of Queensland, in lat. 13° 10′ S., long. 143° 35′ E. He was left on the island by some shipwrecked sailors when twelve years old, was treated kindly by the savages, and soon became identified with them in every respect. He is recovering rapidly the use of his mother-tongue both in speaking, reading, and writing, though he still retains some marked characteristics of savage life. He has given much information concerning the tribe among whom he lived so long; their language does not seem to have anything in common with the Malay or with any of the Papuan dialects. If judiciously treated, Narcisse might be made to yield valuable material to the anthropologist.

THE additions to the Zoological Society's Gardens during the past week include two Suricates (*Suricata zenik*) from South Africa, presented by Mr. F. Ward; two Golden Eagles (*Aquila chrysaëtos*) from Scotland, presented by Lord Lilford; a Chinese Water Deer (*Hydropotes inermis*) from China, a Sumatran Rhinoceros (*Rhinoceros sumatrensis*) from Malacca, two Scarlet Ibises (*Ibis rubra*), a West India Rail (*Aramides cayennensis*), a Common Boa (*Boa constrictor*), a Tuberculated Lizard (*Iguana tuberculata*) from South America, deposited; three Spotted Tinamous (*Nothura maculosa*) from Buenos Ayres, and two Guiana Partridges (*Odontophorus guianensis*) from Guiana, received from Southampton; a Black-billed Sheathbill (*Chionis minor*) from the Kerguelen Island, purchased; a Collared Fruit Bat (*Cynonycteris collaris*), born in the Gardens.

SCIENTIFIC SERIALS

THE *Quarterly Journal of Microscopic Science* may, at the present time, be looked upon as the representative of the most modern phase of biological thought. The current number contains articles of much more than ordinary importance. The first is by Mr. F. M. Balfour, being "A comparison of the early stages in the Development of Vertebrates." The plate which accompanies the memoir is coloured in a particularly instructive manner, which illustrates the ultimate destination of the different elements of the cellular layers of the blastoderm. Mr. Balfour's observations are in favour of the blastopore becoming neither the mouth nor the anus of the adult animal, but of its cicatrix being a weak spot at which one or the other may subsequently be more easily formed than elsewhere. The gap between the observed structure of the developing amphibian and selachian is made more simple by the introduction of a hypothetical intermediate form in which the segmentation cavity is represented as if "it were sunk down so as to be completely within the *lower layer cells*," a condition not quite easy to comprehend. Many other very important theoretical points are discussed in this particularly interesting paper.—The second paper is a reprint from the Privy Council Reports, of Dr. Klein's observations on the pathology of sheep-pox.—Mr. W. H. Jackson describes and figures a new Peritrichous Infusorian, named *Cyclochaeta spongilla*, found in a sponge from the river Chirwell.—Mr. A. A. W. Hubrecht of Leyden makes "some remarks about the minute anatomy of Mediterranean Nemerteans," including notes on the dermal tissues, nervous system, &c., of species of *Meckelia*, *Polia*, *Lineus*, *Ommatoplea*, and *Drepanophorus* (n.g.)—Prof. Lankester publishes in full his observations read before the Linnean Society, "On some points in the structure of Amphioxus, and their bearing on the morphology of vertebrata." The exact homology of the atrial chamber and of the perivisceral cavity in the Lancelet has been a fruitful source of discussion, and Prof. Lankester's study of the question throws considerable additional light on the subject. The conclusions to which his investigations lead are "first that the peritoneal cavity of the vertebrate is the same thing as the coelom of the worm and of Amphioxus; second, that the earlier vertebrate ancestors (represented in a degenerate form by Amphioxus) developed epipleura, which coalesced in the median line postorally to form an atrium; third, that whilst Amphioxus retains this atrium in functional activity, the other vertebrata have lost it by *the coalescence* of its outer and inner bounding wall, respectively epipleura and somatopleura; fourth, that whilst the indications of the earlier historical steps of this process are suppressed in all craniate vertebrata at present investigated, yet the Elasmobranchs do continue to present to us an ontogenetic phase in which the somatopleura and the epipleura are widely separated; thus enclosing between them an epicoel (the atrium of amphioxus)."—Mr. F. R. Lewis writes on Nematode Haematozoa in the dog, closely allied to *Filaria sanguinolenta*, found in the walls of the aorta. These are figured, as are the parts of *Amphiporous spectabilis* and other Nemerteans, described by Dr. M'Intosh in considerable detail.—There is an admirable paper by Prof. Thiselton Dyer, containing a review of the various modes of sexual reproduction known among Thallophytes, with a sketch of the classification of that section of Cryptogams—including Algæ, Lichens, Fungi, and Characeæ—recently proposed by Prof. Sachs.

SOCIETIES AND ACADEMIES

LONDON

Geological Society, June 23.*—Mr. John Evans, V.P.R.S., president, in the chair.—On the superficial geology of the Central Region of North America, by Mr. G. M. Dawson, Geologist to H.M. North American Boundary Commission.

Physical Geography of the Region.—The region under consideration is that portion of the great tract of prairie of the middle of North America from Mexico to the Arctic Sea, which

* Continued from p. 221.

lies between the forty-ninth and fifty-fifth parallels, and extends from the base of the Rocky Mountains to a ridge of Laurentian rocks that runs north-west from Lake Superior towards the Arctic Sea, and is called by the author the "Laurentian axis." This plateau is crossed by two watersheds; one, starting from the base of the Rocky Mountains at about the forty-ninth parallel, runs due east to the 105th meridian, when it turns to the south-east, dividing the Red River from the Missouri; the other crosses from the Rocky Mountains to the Laurentian axis near the fifty-fifth parallel. The whole region between these two transverse watersheds slopes gradually eastward, but is divisible into three prairie steppes or plateaus of different elevations. The lowest includes Lake Winnipeg and the valley of the Red River; its average altitude is 800 feet. The second, or the "Great Plains," properly so called, has an average elevation of 1,600 feet. The third or highest is from 2,500 to 4,200 feet above the sea, and is not so level as the other two.

Glacial Phenomena of the Laurentian Axis.—The neighbourhood of the Lake of the Woods is taken by the author as furnishing an example of the glaciation visible in many parts of the Laurentian axis. This lake is seventy miles long, and has a coast line of three hundred or four hundred miles. The details of its outline closely follow the character of the rock, spreading out over the schistose and thinly cleavable varieties, and becoming narrow and tortuous where compact dioritic rocks, greenstone, conglomerate, and gneiss prevail. The rocks both on the shores and the islands in the lake are rounded, grooved, and striated. The direction of the striæ is from north-east to south-west.

Drift Plateau of Northern Minnesota and Eastern Manitoba.—This plateau consists of a great thickness of drift deposits resting on the gently sloping foot of the Laurentian, and is composed to a depth of sixty feet or more of fine sands and arenaceous clays, with occasional beds of gravel and small boulders, probably reposing throughout on boulder-clay. The only fossil found was a piece of wood apparently of the common cedar (*Thuja occidentalis*). The surface of the plateau is strewn with large erratics, derived chiefly from the Laurentian and Huronian to the north; but there are also many of white limestone. The fossils in some of the latter being of Upper Silurian age, the author is inclined to believe, with Dr. Bigsby, that an outcrop of Upper Silurian is concealed by the drift deposits in the Lake of the Woods region.

Lowest Prairie Level and Valley of the Red River.—This prairie presents an appearance of perfect horizontality. The soil consists of fine silty deposits arranged in thin horizontal beds resting on till or boulder-clay. Stones were exceedingly rare. The western escarpment was terraced and covered with boulders. It is therefore probable that this prairie is the bed of a pre-glacial lake.

The *Second Prairie Plateau* is thickly covered with drift deposits, which consist in great part of local débris derived from the underlying soft formations, mixed with a considerable quantity of transported material, especially in the upper layers. Large erratics are in places abundant; they consist mainly of Laurentian rocks, but Silurian limestone also abounds. The following is the percentage of the boulders from the different formations present in the drift:—Laurentian, 28·49; Huronian, 9·71; Limestone, 54·01; Quartzite Drift, 1·14. The last is derived from the Rocky Mountains, the other three from the Laurentian axis. There are also on the surface of this plateau some remarkable elevated regions, apparently entirely composed of accumulated drift materials.

Edge of the Third Prairie Plateau, or the *Missouri Coteau*, is a mass of glacial débris and travelled blocks averaging from thirty to forty miles in breadth, and extending diagonally across the country for a distance of about 800 miles.

Third or Highest Plateau.—There is a marked change in the drift on this plateau, the *quartzite drift* of the Rocky Mountains preponderating, seldom showing much glaciation. Its general character may be seen from the following percentage of its composition:—Laurentian, 27·05; Huronian, ?; Limestone, 15·84; Quartzite drift, 52·10. Some of the lower parts of this steppe show thick deposits of true till with well-glaciated stones, both from the mountains and the east, and débris from underlying tertiary beds, all in a hard yellowish sandy matrix. On the higher prairie sloping up to the Rocky Mountains the drift is entirely composed of material derived from them.

The *Rocky Mountains* themselves show abundant traces of glaciation. Nearly all the valleys hold remnants of moraines, some of them still very perfect. The harder rocks show the usual rounded forms, but striation was only observed in a single locality, and there coincided with the main direction of the valley. The longer valleys generally terminate in *cirques*, with almost perpendicular rock-walls, and containing small but deep lakes.

State of the Interior Region of the Continent previous to the Glacial Period.—The author considers that previous to the glacial epoch the country was at about its present elevation, and that its main physical features and river-drainage were already outlined. Subaërial denudation had been in operation for a vast period of time, and an enormous mass of tertiary and cretaceous strata removed.

Mode of Glaciation and Formation of the Drift Deposits.—The author did not find any evidence rendering the supposition of a great northern ice-cap necessary, but suggests that local glaciers on the Laurentian axis furnished icebergs laden with boulders, which were floated across the then submerged prairies towards the Rocky Mountains.

On some important facts connected with the Boulders and Drifts of the Eden Valley, and their bearing on the theory of a Melting Ice-sheet charged throughout with rock-fragments, by D. Mackintosh. In this paper the main object of the author is to defend generally received opinions, especially as regards the great glacial submergence, in opposition to the theory announced in the Quart. Journ. Geol. Soc. for last February (vol. xxxi. p. 55). He brings forward a number of facts and considerations, founded on repeated observations, to show that the dispersion of Criffell granite-boulders is so interwoven with that of boulders of porphyry and syenite from the Lake-district as to be incompatible with the theory of transportation by currents of land-ice: and that the limitation of Criffell boulders along the S.E. border of the plain of Cumberland to about 400 feet above the sea-level is inconsistent with the idea of a boulder-charged ice-current 2,400 feet in thickness. His main argument against the theory of land-ice "charged throughout with rock-fragments of all sizes," is derived from the purity of the interiors of existing ice-sheets; and he quotes Prof. Wyville Thomson in support of his statements.

Observations on the unequal distribution of Drift on opposite sides of the Pennine chain, in the country about the source of the River Calder, with suggestions as to the causes which led to that result, together with some notices on the high-level drift in the upper part of the valley of the River Irwell, by John Aitken. The author, in calling attention to the unequal distribution of the drift on the opposite sides of the Pennine chain in this district, points out that on the western side of that range an extensive series of drift-deposits is found, spreading over the great plains of Lancashire and Cheshire down to the Irish Sea. It also occurs on the west flanks of the chain at elevations of from 1,100 to 1,200 feet, thus rising several hundred feet above the watersheds of some of the valleys penetrating that elevated region. On the eastern side, however, there is, with one or two slight exceptions, an entire absence of such accumulations, even in the most sheltered and favourable situations, for a distance of twelve or fifteen miles from the water-parting of the country. This absence of drift on the eastern side might, the author considers, be satisfactorily accounted for by supposing that the transverse valleys of the chain were, during the glacial epoch, completely blocked up with congealed snow or ice, by which means all communications between the opposite sides of the range would be entirely cut off. The southward flow of the ice, which was probably not so thick as to cover the higher portions of the chain, would, on encountering such an obstacle to its progress, be deflected westwards, and finally debouch into the plains of South Lancashire, and would there deposit on its retreat the débris it contained.—(*To be continued.*)

Geologists' Association, July 2.—Mr. Wm. Carruthers, F.R.S., president, in the chair.—On some of the causes which have contributed to shape the land on the North Wales border, by D. C. Davies. In a series of diagrams the author showed the probable results of an upheaving force acting upon different kinds of strata; and, in the second part of his paper, gave a detailed account of several instances, along the Welsh border, where important physical features now existing had been determined by faults and anticlinals. These were shown in a second series of diagrams in which the actual relation of numerous valleys, gorges, &c., to faults, &c., was pointed out. The various agents of erosion such as sea-water, rain-water, and ice had modified, and in some cases altered, the features due to disturbance; but the author claimed that a proper regard should be had to all the forces of nature, both internal and external to the surface in producing the contour as it now exists.—The Yorkshire Oolites, Part II., by W. H. Hudleston.

Entomological Society, July 5.—Sir Sidney Smith Saunders, C.M.G., president, in the chair.—Mr. Dunning remarked that the *Ornithoptera* bred by Mr. Sealy from larvæ taken at Cochin, South India, and exhibited by him at a recent meeting had been identified as *O. minos*.—Mr. Bond exhibited two specimens of a *Curculio*, sent from Nova Friburgo, Brazil, which were attached to the same twig and were both attacked by a fungus. Mr. Janson said that they belonged to the genus *Hylopus*, and were well known to be subject to such attacks.—The President exhibited a lock taken from a gate at Twickenham entirely filled with the cells of a species of *Osmia*, which Mr. Smith said was, most probably, *O. bicornis*, of which he had known several instances in locks. He also exhibited an example of the minute *Hylechthrus rubri*, one of the *Stylopidæ*, parasitic upon *Prosopis rubicola*, recently obtained from briars imported from Epirus, and remarked upon a method of expanding the wings of *Stylopidæ*. He also exhibited a series of *Halictus nitidiusculus*, stylopized, and recommended entomologists on the south coast to search in August for stylopized *Halicti*, especially among thistles. Finally, he remarked on the parasites of *Osmia* and *Anthidium*, and enumerated eleven insects attacking the same species of *Osmia* in its different stages—some devouring the egg and pollen-paste, some the larvæ, and others attacking the bee itself.—Mr. Champion exhibited a series of recently captured individuals of *Chrysomela cerealis*, from Snowdon, its only known British locality. Mr. M'Lachlan stated that he had recently seen this species in the Department of Saône-et-Loire, in France, in great numbers, each ear of wheat having several of the beetles upon it, and remarked on the singular nature of its sole habitat in Britain.—The Secretary exhibited nests of a trap-door spider, sent from Uitenhage, near Port Elizabeth, Cape Colony. The nests were not (as is usual) in the earth, but in cavities in the bark of trees; and the "trap-door" appeared to be formed of a portion of the bark, thus rendering it most difficult to detect the nests when in a closed condition.—Mr. Charles V. Riley, State Entomologist of Missouri, exhibited sundry insect pests that do so much damage in the State, including the Army-worm (*Leucania impuncta*), and the Rocky Mountain Locust (*Caloptenus spretus*), and entered at some length into the habits of the latter insect and the vast amount of destitution caused by it; stating that in a short period it devoured almost every living plant, leaving nothing but the leaves of the forest trees, and converting a fruitful country into an absolute desert. From a knowledge of the habits of the insect, and believing in its inability to exist in a moist climate, he had predicted that its ravages would not extend beyond a certain line, and he had seen these predictions fulfilled. Having noticed that hogs and poultry grew excessively fat from devouring locusts, and considering that the use of them as food for man would tend to relieve some of the distress occasioned in the devastated districts; he had caused a number of them to be prepared in various ways, and they were found to be well suited for food, especially in the form of soup.—Mr. Riley also stated that he was very desirous of taking a supply of cocoons of *Microgaster glomeratus* to America to lessen the ravages of the larvæ of the genus *Pieris* on that continent, and would be greatly obliged to any entomologist who could assist him in obtaining them.—The following papers were communicated:—Descriptions of new Heteromerous Coleoptera belonging to the family *Blapsidæ*, by Prof. J. O. Westwood.—Description of a new species of Myriopod, from Mongolia, by Arthur G. Butler.—Descriptions of new *Coleoptera* from Australia, by Charles O. Waterhouse.

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Academy of Sciences, July 12.—M. Frémy in the chair.—M. Chevreul communicated the fourth extract from his third memoir "on the explanation of numerous phenomena which are a consequence of old age."—Are the disasters caused by the hurricane of 1860 near Réunion referable to the laws of Cyclones? by M. Faye.—M. J. Bertrand called the attention of the Academy to a passage in the second edition of P. Secchi's work on the sun, and made some critical remarks thereon.—Note by M. G. A. Hirn relative to the memoir of M. Kretz on elasticity in moving machines.—Theory of perfect numbers, a memoir by M. J. Carvallo.—Magneto-chemical phenomena produced in rarefied gases in Geissler tubes illuminated by means of induced currents, by M. J. Chautard. The author describes the effect of magnets in modifying the spectra of certain elements and compounds. Determinations of the wave-lengths of these modified spectra have been made for chlorine, bromine, iodine; the chloride, bromide and fluoride of silicium, boric fluoride, hydrochloric acid, antimonious chloride, bismuthous chloride, mercuric chloride, and the two chlorides of tin. The light of sulphur and selenium is immediately extinguished on "making" the magnet. Oxygen does not undergo much change. Nitrogen is modified in the red and orange. The hydrogen tube showed the D line on "making" the magnet, the line instantly disappearing on breaking contact. The author explains this phenomenon by supposing that the gas is projected suddenly against the side of the tube on magnetisation and carries away sodium particles.—On the "square mirror," an instrument for tracing right angles on the earth, and for use in the rapid measurement of great distances, by M. Gaumet.—On fused boric acid and its tempering, by M. V. de Luynes. The hardness of this substance (between 4 and 5) is between fluor spar and apatite. The powdered glass combines energetically with water, the temperature of the mixture rising to 100°. The used acid poured on to a metallic surface gives rise to the formation of a vitreous plate, of which the lower surface is more expanded than the upper, producing in consequence a bending of the plate which is sometimes sufficient to rupture it. Poured into oil, the fused acid forms small tailed drops, which break under the same conditions as "Prince Rupert's drops." A plate of the boric acid glass, with parallel faces, acts on polarised light like "toughened" glass, but preserves its property under conditions which destroy the polarising power of glass. The fused acid, placed in water, undergoes hydration by laminæ producing a true exfoliation.—On the laws of the exchanges of ammonia between the seas, the atmosphere, and continents, by M. T. Schlœsing.—Description and analysis of a mass of meteoric ore which fell in Dickson County, Tennessee, by M. Lawrence Smith. Its composition is Fe, 91·15; Ni, 8·01; Co, 0·72; Cu, 0·06. Heated *in vacuo*, two volumes of gas were given off, composed of H, 71·04; Co, 15·03; Co_2, 13·03.—Planet 146 Lucine, discovered at the Observatory of Marseilles by M. Borrelly, June 8, 1875; ephemeris calculated by M. E. Stephan.—On the temporary magnetisation of steel, by M. Bouty.—Theory of storms; conclusions. A note by M. H. Peslin.—Estimation of carbon disulphide in the alkaline sulphocarbonates of commerce, by MM. Delachanal and Mermet.—On the preparation of tungsten and the composition of wolfram, by M. F. Jean.—On some new derivatives of anethol, by M. F. Landolph.—Researches on emetine, by M. A. Glenard.—Differential ophthalmoscopic signs of disturbance and contusion of the brain, by M. Bouchut.—Of the causes of the spontaneous coagulation of the blood on issuing from the organism, by M. F. Glenard.—On the hailstorm which burst over Geneva and the Rhône valley on the night of July 7–8, by M. Colladon.—On clouds of ice observed during an aërostatic elevation on July 4, by M. W. de Fonvielle.

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