THURSDAY, DECEMBER 10, 1874

ON THE CLASSIFICATION OF THE ANIMAL KINGDOM*

LINNÆUS defines the object of classification as follows:—"Methodus, anima scientiæ, indigitat, primo intuitu, quodcunque corpus naturale, ut hoc corpus dicat proprium suum nomen, et hoc nomen quæcumque de nominato corpore beneficio seculi innotuere, ut sic in summa confusione rerum apparenti, summus conspiciatur Naturæ ordo." (*Systema Naturæ*, ed. 12, p. 13.)

With the same general conception of classificatory method as Linnæus, Cuvier saw the importance of an exhaustive analysis of the adult structure of animals, and his classification is an attempt to enunciate the facts of structure thus determined, in a series of propositions, of which the most general constitute the definitions of the largest, and the most special, the definitions of the smallest, groups.

Von Baer showed that our knowledge of animal structure is imperfect unless we know the developmental stages through which that structure has passed; and since the publication of his "Entwickelungs-Geschichte der Thiere," no philosophical naturalist has neglected embryological facts in forming a classification.

Darwin, by laying a novel and solid foundation for the theory of Evolution, introduced a new element into Taxonomy. If a species, like an individual, is the product of a process of development, its mode of evolution must be taken into account in determining its likeness or unlikeness to other species; and thus "phylogeny" becomes not less important than embryogeny to the taxonomist. But while the logical value of phylogeny must be fully admitted, it is to be recollected that, in the present state of science, absolutely nothing is positively known respecting the phylogeny of any of the larger groups of animals. Valuable and important as phylogenic speculations are, as guides to, and suggestions of, investigation, they are pure hypotheses incapable of any objective test; and there is no little danger of introducing confusion into science by mixing up such hypotheses with Taxonomy, which should be a precise and logical arrangement of verifiable facts.

The present essay is an attempt to classify the known facts of animal structure, including the development of that structure, without reference to phylogeny, and, therefore, to form a classification of the animal kingdom, which will hold good however much phylogenic speculations may vary.

Animals are primarily divisible into those in which the body is not differentiated into histogenetic cells (PROTOZOA), and those in which the body becomes differentiated into such cells (METAZOA of Hæckel).

I.—The PROTOZOA are again divisible into two groups: 1. the Monera (Hæckel), in which the body contains no nucleus; and 2. the Endoplastica, in which the body contains one or more nuclei. Among these, the *Infusoria ciliata* and *flagellata* (*Noctiluca*, e.g.), while not forsaking the general type of the single cell, attain a considerable complexity of organisation, presenting a parallel to what happens among the unicellular Fungi and Algæ (e.g., *Mucor*, *Vaucheria*, *Caulerpa*).

II.—The METAZOA are distinguishable, in the first place, into those which develop an alimentary cavity—a process which is accompanied by the differentiation of the body wall into, at fewest, two layers, an epiblast and a hypoblast (*Gastreæ* of Hæckel), and those in which no alimentary cavity is ever formed.

Among the Gastreæ, there are some in which the gastrula, or primitive sac with a double wall open at one end, retains this primitive opening throughout life—as the egestive aperture; numerous ingestive apertures being developed in the lateral walls of the gastrula—whence these may be termed *Polystomata*. This group comprehends the *Spongida* or *Porifera*. All other Gastreæ are *Monostomata*, that is to say, the gastrula develops but one ingestive aperture. The case of compound organisms in which new gastrulæ are produced by gemmation is of course not a real exception to this rule.

In some Monostomata the primitive aperture becomes the permanent mouth of the animal (*Archæostomata*).

This division includes two groups, the members of each of which respectively are very closely allied:—1. The Cœlenterata. 2. The Scolecimorpha. Under the latter head are included the *Turbellaria*, the *Nematoidea*, the *Trematoda*, the *Hirudinea*, the *Oligochæta*, and probably the *Rotifera* and *Gephyrea*.

In all the other Monostomata the primitive opening of the gastrula, whatever its fate, does not become the mouth, but the latter is produced by a secondary perforation of the body wall. In these *Deuterostomata* there is a perivisceral cavity distinct from the alimentary canal, but this perivisceral cavity is produced in different ways.

1. A perivisceral cavity is formed by diverticula of the alimentary canal, which become shut off from the latter (*Enterocœla*).

The researches of Alexander Agassiz and of Metschnikoff have shown that, not only the ambulacral vessels, but the perivisceral cavity of the *Echinodermata* are produced in this manner; a fact which may be interpreted as indicating an affinity with the Cœlenterates (though it must not be forgotten that the dendrocœle *Turbellaria* and many *Trematoda* are truly "cœlenterate"), but does not in the least interfere with the fundamental resemblance of these animals to the worms.

Kowalewsky has shown that the perivisceral cavity of the anomalous *Sagitta* is formed in the same way, and the researches of Metschnikoff appear to indicate that something of the same kind takes place in *Balanoglossus*.

2. A perivisceral cavity is formed by the splitting of the mesoblast (*Schizocœla*).

This appears to be the case in all ordinary *Mollusca*, in all the polychætous *Annelida*, of which the *Mollusca* are little more than oligomerous modifications, and in all the *Arthropoda*.

It remains to be seen whether the *Brachiopoda* and the *Polyzoa* belong to this or the preceding division.

3. A perivisceral cavity is formed neither from diverticula of the alimentary canal nor by the splitting of the mesoblast, but by an outgrowth or invagination of the outer wall of the body (*Epicœla*).

The *Tunicata* are in this case, the atrial cavity in them being formed by invagination of the epiblast.

* Paper read at the Linnæan Society, Dec. 4, 1874, by Prof. Huxley, Sec. R.S.

Amphioxus, which so closely resembles an Ascidian in its development, has a perivisceral cavity which essentially corresponds with the atrium of the Ascidian, though it is formed in a somewhat different manner. One of the most striking peculiarities in the structure of *Amphioxus* is the fact that the body wall (which obviously answers to the somatopleure of one of the higher *Vertebrata*, and incloses a "pleuro-peritoneal" cavity, in the walls of which the generative organs are developed) covers the branchial apertures, so that the latter open into the "pleuro-peritoneal" cavity. This occurs in no other vertebrated animal. Kowalewsky has proved that this very exceptional structure results from the development of the somatopleure as a lamina which grows out from the sides of the body and eventually becomes united with its fellow in the middle ventral line, leaving only the so-called "respiratory pore" open. Stieda has mentioned the existence of the raphé in the position of the line of union in the adult animal. Rathke described two "abdominal canals" in *Amphioxus;* and Johannes Müller, and more recently Stieda, have described and figured these canals. However, Rathke's canals have no existence, and what have been taken for them are simply passages or semi-canals between the proper ventral wall of the abdomen and the incurved edges of two ridges developed at the junction of the ventral with the lateral faces of the body, which extend from behind the abdominal pore where they nearly meet, to the sides of the mouth. Doubtless, the ova which Kowalewsky saw pass out of the mouth, had entered into these semi-canals when they left the body by the abdominal pore, and were conveyed by them to the oral region. The ventral integument, between the ventrolateral laminæ, is folded, as Stieda has indicated, into numerous close-set, longitudinal plaits which have been mistaken for muscular fibres, and the grooves between these plaits are occupied by epidermic cells, so that, in transverse section, the interspaces between the plaits have the appearance of glandular cœca. This plaited organ appears to represent the Wolffian duct of the higher *Vertebrata*, which, in accordance with the generally embryonic character of *Amphioxus*, retains its primitive form of an open groove. The somatopleure of *Amphioxus* therefore resembles that of ordinary *Vertebrata* in giving rise to a Wolffian duct by invagination of its inner surface. But the Wolffian duct does not become converted into a tube, and its dorsal or axial wall unites with its fellow in the raphé of the ventral boundary of the perivisceral cavity.

In all the higher *Vertebrata* of which the development has yet been traced, the "pleuro-peritoneal" or perivisceral cavity arises by an apparent splitting of the mesoblast, which splitting, however, does not extend beyond the hinder portion of the branchial region. But, in many *Vertebrata*, (*e.g.*, *Holocephali*, *Ganoidei*, *Teleostei*, *Amphibia*) a process of the integument grows out from the region of the hyoidean arch, and forms an operculum covering the gill-cleft. In the frog, as is well known, this opercular membrane is very large, and unites with the body wall posteriorly, leaving only a "respiratory pore" on the left side, during the later periods of the tadpole's life. Here is a structure homologous with the splanchnopleure of *Amphioxus;* while, in the thoraco-abdominal region, the splanchnopleure appears to arise by splitting of the mesoblast. Considering what takes place in *Amphioxus*, the question arises whether the "splitting" of the mesoblast in the *Vertebrata* may not have a different meaning from the apparently similar process in the *Arthropoda*, *Annelida*, and *Mollusca;* and whether the pericardium, pleura, and peritoneum are not parts of the epiblast, as the atrial tunic is of the epiblast of the ascidians. Further investigation must determine this point. In the meanwhile, on the assumption that the "pleuro-peritoneal" cavity of the *Vertebrata* is a virtual involution of the epiblast, the peritoneal aperture of fishes becomes truly homologous with the "respiratory pore" of *Amphioxus;* and the Wolffian ducts and their prolongations, with the Müllerian ducts, are, as Gegenbaur has already suggested, of the same nature as the segmental organs of worms.

The division of METAZOA without an alimentary cavity is established provisionally, for the *Cestoidea* and *Acanthocephala*, in which no trace of a digestive cavity has ever been detected. It is quite possible that the ordinary view that these are Gastreæ modified by parasitism is correct. On the other hand, the cases of the Nematoid worms and of the *Trematoda* show that the most complete parasitism does not necessarily involve the abortion of the alimentary cavity, and it must be admitted to be possible that a primitive Gregariniform parasite might become multicellular and might develop reproductive and other organs, without finding any advantage in an alimentary canal. A purely objective classification will recognise both these possibilities and leave the question open.

THE "TIMES" ON THE IMPORTANCE OF SCIENTIFIC RESEARCH

[IN an article which appeared in yesterday's *Times*, occasion is taken of the occurrence of the Transit of Venus to point out the great activity now being displayed by foreign nations in the prosecution of abstract scientific inquiries, and the necessity of retaining England's old pre-eminence in this respect. The article is so important as indicating the growing importance which is being attached to research, that we reproduce a great part of it in our own columns, because the considerations urged by the *Times* lead to a conclusion of no uncertain sound. As England has nobly in the past, when she was almost alone, led in the search after abstract scientific truths, it behoves her now that she is by no means alone and has to compete with rivals who have shown by their Transit expeditions and by many other signs what their opinion is on this matter, to more than redouble her old efforts, if she wishes to retain the position she has won by the accumulated work of centuries.—ED. NATURE.]

THE astronomer's point of view is by no means the only one of general interest connected with the recent Transit. We have, first of all, the remarkable spectacle of trained observers of almost all nationalities—observers sent out by England, the United States, France, Germany, Italy, and Holland — distributed among some seventy stations, some of them the most inhospitable islands of the Southern seas, engaged upon one of the most abstract inquiries which can be imagined. The anxiety of the various European and the American Governments to contribute towards the solution of the problem can perhaps best be shown by indicating the stations occupied this morning by the various parties. The English flag floats over the observatories of three parties in the Sandwich Islands, two parties in Kerguelen's Land, one in Rodriguez, one in New Zealand, two in Egypt, and one in India; nor must we omit to mention Lord Lindsay's station in the Mauritius, though his is a private expedition. This is a goodly list, but it is surpassed in its area of distribution by the American expeditions, which occupy Vladivostok in Siberia, Tien-tsin, a station in Japan, and in the Southern seas Kerguelen's Land, the Crozets, Hobart Town, Bluff Harbour (New Zealand), and Chatham Island. France has seven stations—Campbell and St. Paul's Islands, Noumea, Pekin, Yokohama, and Saigon. Russia does not occupy any southern stations, but she makes up for this by observing at no less than thirty stations within her own territory. The German Government has equipped five southern parties, while Holland is represented at Réunion. Italy has a party in Egypt. She was to have been represented by four parties in all; but little is known of her arrangements.

The number of observed Transits has been so few that it is an easy task to contrast the present arrangements with what was done in former times. Horrox, one of the most gifted of English men of science—whose memory, we rejoice to know, will this year be appropriately, if tardily, perpetuated by a tablet in Westminster Abbey—predicted the Transit of 1639 so shortly before he observed it that there was no time, if, indeed, there had been any desire, to send observers from England. When the next Transits occurred in the following century, in the years 1761 and 1769, the expeditions were few. In the former year we had an English expedition to Sumatra and a French one to Pondicherry, neither of which reached its destination; and there was another French expedition to Tobolsk. Observations were made at many places, the unfortunate Le Gentil, the French Envoy to Pondicherry, making his on board ship. In 1769 came the celebrated voyage of Captain (then Lieutenant) Cook, in the *Endeavour*, to Otaheite, on behalf of England. The King of Denmark sent an observer to Lapland; and the French Academy despatched one to California, in addition to Le Gentil. The latter had waited at Pondicherry since 1761, hoping to make up by good fortune in 1769 for his partial want of success in 1761, but the Fates were against him.

It will be seen from this rapid statement that, so far as the number of the *personnel* is concerned, the present expeditions are beyond all precedent. This remark naturally applies much more strongly to the means of observation. Not only do modern telescopes bear the same relation to those used on former occasions as a Woolwich gun does to a smooth-bore musket, but two new instruments of inquiry have been added to the scientific stock-in-trade. This morning, if the weather has been favourable, more than a score of cameras have obtained permanent records of the black spot travelling over the sun's disc at one part or another, or during the whole time of its passage, and if the spectroscope has not been used to record the planet's contact with the sun long before the eye or photographic plate could detect her presence, and again to mark the exact instant at which she parted company with it, it is not the fault of the instrument. But it is not merely to the *personnel* nor to the instruments employed that we wish to draw chief attention, but rather to the indications afforded that the example which England and France have of old set in promoting such inquiries is being followed by other nations, and with a most remarkable vigour and intensity of purpose. Denmark, which took no part in this morning's observations, has been replaced by the United States, Germany, Holland, and Italy, and the part played by these nations, new to this peaceful strife, is most important. The United States lead all the other nations, in respect both of the amount of money which her Government has contributed, and of the discomfort, not to say dangers, of the stations she has chosen in the Southern seas. Posts of importance which were given up as too hopelessly miserable even for enthusiastic English astronomers will be occupied by Americans. The Germans have closely followed England and the United States in this noble competition, and although the sum contributed by the German Government is small compared with the American subsidy, the German observations made this morning in the South seas will be among the most important obtained by all the expeditions. With regard to Italy, also, there are the same signs of scientific enterprise. The spectroscope, which forms no part of the equipment of the English expeditions, was intended by her men of science to be their chief weapon of attack, and as in no country is there such a skilled body of spectroscopists as in Italy, this determination was probably not arrived at on insufficient grounds.

What, then, is the meaning of all this? It is that as the world grows older each nation as it develops, as the United States, Germany, and Italy have of late largely developed, under modern conditions, feels the necessity for taking a continual and a largely increasing share in the promotion of science even in its most abstract forms. It should be a subject of pride for us to know that in this they are but following the example set by England in former centuries, including the days "when George III. was King." If we consider the revolutions effected by science since Capt. Cook's famous expedition to observe the last Transit, we shall not be astonished that the nations are beginning to vie with each other so eagerly in its development. When Cook sailed in 1768, Watt was thirty-two years of age; in the very year of the Transit he introduced the closed cylinder, and so gave us the steam-engine of to-day in its essential point. In the same year the founders of chemistry were in their early prime. Priestley was thirty-six years of age, Cavendish thirty-eight, Black forty-one, and Lavoisier twenty-six; Dalton was three years old. What has not chemistry done for England since their time? Be it always remembered that all the work of these men was of the most abstract kind, and yet that out of it has grown insensibly a large part of England's commercial greatness. Nor is this all. There is another development of science still which must be mentioned, but which is of so recent a date that in 1769 no one whose name is now associated with one of the greatest triumphs of science was born. We refer to those discoveries that have belted our world with the electric wires which to-day, from the most distant parts of our planet's surface, will bring to Europe the results of this morning's work.

It is a proper subject of national pride that the benefits derived by the world from the invention of the steam-engine and the electric telegraph, and from the various applications of chemistry to the industrial arts, have all, until the last few years, radiated from England. We have here the secret of a large part of England's riches and England's strength. But it is useless to hope that the mere knowledge of the acquired facts of science will furnish that new weapon which nations are now adding to the sword to enforce their superiority. The mental soil which produces new ideas for a nation's use can only be cultivated by the discipline of scientific investigation. Further, it cannot be doubted that, as modern civilisation is still further developed, the new ideas which a nation produces and throws into a concrete form will be among the most valuable of its exports, because each nation will work up the old ideas for itself.

AGRICULTURAL EDUCATION

THE application of the law of selection to the production of farm crops and animals offers a certain and wide field for increasing our agricultural wealth. In every department of the farmer's occupation there is great room for improvement if this scientific principle be borne in mind.

It is well known that science has, in our time, thrown extraordinary light on the action of manures. Yet too few of our farmers are guided in their practice by this light. In every district of the United Kingdom farmers apply manures which are either incapable of drawing out the full productive powers of the soil, or comparatively worthless.

Again, it is notorious that the yield of millions of acres of our wet, cold lands could be largely increased by drainage.

There is no branch of agriculture which has progressed so much in modern times as the manufacture of farm implements and machines. Yet, an enlightened and experienced agriculturist who travels through England cannot fail to see an enormous waste of power, arising from the use of unsuitable implements, as well as from ignorance of the elementary principles of mechanical science.

Numerous additional examples could be cited, but it is not necessary. It is enough to state the broad fact that while the foremost of our farmers are the most enlightened in the world, there is a vast number of occupiers of land in Great Britain and Ireland who do not avail themselves of the aids which science is capable of affording them.

To the farmer, as to everybody else, knowledge is power. The increased annual wealth capable of being produced by the application of this power is very considerable. It has been stated by several persons whose opinions on agricultural questions appear to command respect, that the produce of the soil of England could be doubled by improved modes of farming. After having seen from time to time a good deal of English farming, I consider this estimate quite too high; but all thoughtful and experienced persons will concur in the opinion that by the adoption of means which could be called forth, the produce of the soil of Great Britain would soon be increased to an amount equal to the rental of the entire land of the country; that is to say, *farmers could increase the productive power of the soil to the extent of, say, forty millions sterling a year!* They would reap the first fruits of this harvest. In due time the landlords would come in for their share of it in the shape of increased rents; for, as I have often pointed out, it is a law of agricultural progress that every increase in the productiveness of the land, and every rise in the prices of its products, by increasing the competition for land, tend to raise rents.

How can we increase the productiveness of the land? There are many ways in which progress may be effected; but we must seek the solution of the question mainly in education, using the word in its widest sense.

The wealth of farmers depends on their knowledge, skill, and thrift. Of thrift we shall say nothing in this note. Skill is required by both farmers and labourers. It is a plant of slow growth. The navvy acquires it by plodding application. The skill of the high-class agricultural labourer is acquired in the same way. The skill of the high class-farmer, too, is the result of continuous application to business. The skill acquired by one generation is capable of being imparted to, and of being improved upon, by the next. The skill possessed by both agricultural labourers and farmers in England has been thus transmitted from generation to generation, and improved in its transmission, in accordance with a law of development. It would be unfortunate if any circumstances or set of circumstances should interfere with this development. We cannot now discuss this subject; but it may be remarked that one of the features of the present movement in the agricultural labour market which deserves serious attention is, that skilled hands have left many districts. Several very thoughtful English farmers of my acquaintance already complain of want of skill in the young hands who remain at home. In a recent agricultural tour in England I saw evidence of the same state of things. Unless the movement be arrested, English farming will, in all human probability, undergo a change which may be prejudicial to the agricultural interest. What the tendency of that change would be is foreign to the object of this paper, and accordingly I proceed to make a few remarks on the importance of imparting agricultural knowledge.

It has been already affirmed that general knowledge imparts power to every man. This is true in every state of life. It is true in science; it is equally true in the industrial arts. The proposition is supported by an overwhelming mass of evidence. Royal Commissioners, Special Commissioners, and distinguished independent inquirers are all in unison on the question. All our systems of technical education are based on this one leading idea. The whole programme of the Department of Science and Art is based upon it. In the leading cities and towns the rising generation of the manufacturing classes can acquire scientific knowledge which will be of direct use to them in their several pursuits. In the village school scientific truths are imparted which cannot fail to be of use to the trader and artisan.

How different is the case with the farmer! In his education no systematic effort has been made to instil into his mind those elementary scientifi ctruths on which enlightened agricultural practices are based. The result is, that he grows up in complete ignorance of the rudiments of agricultural science.

How is this state of things to be remedied? In other words, how is a suitable amount of agricultural science to be imparted to farmers?

In answering this question it is important to distinguish between ordinary working farmers who receive their education in Primary schools, and farmers who are able to pay for a higher education, such as is afforded in boarding schools and seminaries and other institutions of the same grade.

As regards the first of these two classes, I would say that I see no reason why an adequate amount of agricultural instruction could not be imparted in the primary schools. All that is required is a suitable text-book or two, and such a system of inspection as will ensure that the book shall be read, and all difficult passages explained by the teachers. This simple system of agricultural education has been tried in Ireland for many years. It has laboured under many difficulties; but as it has succeeded admirably wherever it has been fairly tried, I can have no hesitation in recommending it for adoption elsewhere. To those who desire to introduce it into England I would say, before you start, see that you are upon the right rails, and that you use the proper instruments. In a movement of this kind all sorts of people will come in with all sorts of advice; the busiest and most active of these may be ignorant of the A B C of science and of enlightened agricultural practice. Keep clear of these people. If not, you will either fail altogether, or effect little good, like many others who, from time to time, have embarked in agricultural education.

I look to the diffusion of sound notions of the elements of agricultural science in the way pointed out, as the best means of removing prejudice, and of increasing the agricultural produce of the land in the hands of small farmers.

It is by no means so easy to devise, for the wealthier farmers, a system of agricultural education which will be successful. The words "agricultural education" have led to much confusion of thought; and confusion of thought on any subject works mischief. Some persons use these words in a way which would imply that the farmer should have a special system of education peculiar to himself, from the moment he enters school till he leaves it for good. Of course this is not the case, and it is certain that in the case of large farmers we must look more to the effects of a good general education than of special instruction. The first truths of physical science, of chemistry, and natural history should enter into the curriculum of every middle-class school and college in the country. This knowledge will be useful to the student, no matter what his future calling may be. As regards the farmer, it may be remarked that, without a knowledge of mechanics he cannot be in a position to buy implements and machines to the best advantage, or to understand how to apply horse-power and other forces in the most judicious manner. Look, for example, at the loss of power daily caused by ignorance of the elementary principles involved in common draught. Look at the loss entailed on farmers in the simple matter of common gates for want of knowledge of the means of resisting strains, and of other principles equally elementary. It has been shown that in the production of animals and plants very great mistakes are committed for want of knowledge of physiology. This science should, therefore, be taught in all our middle-class colleges and schools attended by farmers. We must not, of course, neglect mathematics, the study of which is the very best training for the mind. If the large farmer be well instructed in all the sciences named, agriculture will keep pace with other pursuits in which scientific knowledge is required. It is in the universal inculcation of this scientific knowledge that I look mainly for progress in the management of large farms. I do not wish to undervalue, and I cannot in these papers overlook, special agencies for imparting agricultural knowledge to this class. I refer to agricultural colleges and agricultural schools. Viewing the subject theoretically, one of these institutions would seem to be the most perfect place at which the future farmer could spend a year after leaving school or college, and before he enters into practical work. He could attend lectures, and he ought, one would suppose, to be able to see theory reduced to practice.

But after having carefully inquired into the working of these institutions at home and in parts of the Continent, I am bound to say that their theoretical value has not been realised in practice. In point of fact, taking them as a whole, their history has been peculiarly unfortunate. I shall refer to this subject more fully hereafter. At present it is enough to state that with few exceptions agricultural schools and colleges have failed; and success in the exceptional cases has turned upon the peculiar fitness of the individuals on whom the management has devolved, and who by force of character have produced striking results. A general failure in working out a comprehensive system cannot be accounted for by the shortcomings of individuals. The failure of an institution here and there, for a time, can often be traced to the inefficiency of the person or persons at the head of them; I have before my mind numerous examples of the kind; but in accordance with a well-known law, suitable men would arise if the demand existed. And why has this law not prevailed in the case of agricultural schools and colleges? The apparent answer is, that farmers everywhere have not sent their sons to these institutions in sufficient numbers. And why? In answering this question it has been invariably stated that farmers as a class are slow to do what is for their good; to me this off-hand sort of reply has always appeared most unsatisfactory. Farmers, like every other class, find out, after a time, what is for their good. Intelligent farmers, like intelligent men in every walk of life, study their own interests. Owing to their isolation, or want of daily intercourse, they do not move in the path of progress as rapidly as the manufacturing classes who live in cities and towns, and who are brought into daily intercourse with one another. But when we find farmers standing aloof from any system established with the intention of serving them, we may take it for granted that there is something inherent in the system which requires to be adjusted or is inimical to success. What is this something in the history of agricultural colleges and schools? For obvious reasons I cannot fully state my experience on this question; but I can say that the answer will be partly found in the peculiar state of farming as a business. Our scientific knowledge of agriculture, even at the present day, is in a very unsettled state. Theories have risen and fallen in a way which has led rent-paying farmers to regard science with indifference and suspicion. We find evidence of this feeling in our daily intercourse with them. To a large extent they are justified by the vagaries of some of the so-called scientists. I see only one feasible remedy for this, and that is the introduction of the necessary quantity of pure science into the education of the farming classes. This cannot be done in an agricultural college or two. It must be done on a national basis; that is, by establishing science classes in every middle-class college and school throughout the length and breadth of the land. And having done this, a few normal schools of agriculture would soon arise to complete and crown the work. If scientific instruction were placed on a national basis, the normal schools would become filled with the best minds in the country. In the absence of such a system an isolated school or college cannot prevent itself from doing mischief in one direction which has escaped attention; I mean, that if the best men do not enter it, inferior men acquire what I may call an artificial brand which enables them to obtain high positions in connection with agricultural industry—for example, as estate agents and managers—to the exclusion of men of superior natural powers, and to the detriment of the national interests. In other words, the natural law of Selection is subverted.

THOMAS BALDWIN

THE SHEEP

The History, Structure, Economy, and Diseases of the Sheep. By W. C. Spooner, M.R.V.C. Third Edition. (London: Lockwood and Co., 1874.)

THROUGHOUT the whole historic period the sheep has been a source of wealth to man. Mutton has been a staple article of human food, and wool one of the staple materials out of which fabrics have been made for human use. At no period in the history of the United Kingdom has the sheep been so much the object of the farmer's solicitude and care as at the present day. A new edition, purporting to be carefully revised and considerably enlarged, of a work exclusively devoted to the animal, from the pen of Mr. W. C. Spooner, V.S., is, therefore, manifestly entitled to attention. Mr. Spooner has written much. To Blackie's "Cyclopædia of Agriculture" he contributed several valuable papers on veterinary subjects. He has written several other thoughtful essays. He is best known as the editor of an edition of White's "Veterinary Art." The work now before us is the one by which he can best be judged as an author. The title of the volume is pretentious. It would lead the reader to expect an exhaustive treatise; but the most superficial examination corrects this impression.

The volume extends to 322 pages. It is divided into three parts. The first part contains eighty-two pages, and is devoted to the history of the several breeds of sheep. The second part treats of the structure and economy of the sheep, and contains 108 pages; and Part III., occupying the remainder of the text, is devoted to the diseases of the animal. With one or two exceptions, the matter is arranged under these three heads. The exceptions are, however, unpleasant and unaccountable. This arises, to some extent, from treating of the structure and "economy" under one general heading. In this part of the work the author treats of breeding and feeding, which, according to his notions, are manifestly embraced in the term "economy." In the historical section of the book a good deal of information is given on the origin of new breeds, and it is to the repetition of some of this in the chapters on breeding, and the influence of ram sales in the second part of the book, that exception may justly be taken. Tautology, in this busy age, is a great fault. In the present instance it is the less pardonable, because it is not necessary, or even intended, to call back the mind to principles previously expounded.

In the account given of the several breeds no principle of classification appears to have been kept in view. The practical value of the facts is not, of course, lessened by this circumstance; but it must be admitted that the value of a book is greatly enhanced to the public by a proper classification and arrangement of its matter. Judged by this standard, Mr. Spooner's work is singularly defective. In an essay or chapter on breeding, in Part II., we are treated to a disquisition on the merits of the several kinds of sheep which should have been embodied in the description of the several breeds in Part I. In the section devoted to feeding, there are certain theoretical considerations on the size and structure of the chest and abdomen, which should have appeared in the account of the structure of those regions given in an earlier part of the same section.

It is a most ungracious task to write unfavourably of a work of this kind, but the truth is that this new edition affords evidence of great want of care and thought in its preparation. Words and phrases, and even whole sentences, occur throughout the work which illustrate this statement. Take, for example, the following sentence, which occurs in the section on feeding:—"The superiority of particular improved breeds is now generally acknowledged, and may indeed be considered to be established on certain principles, though in arriving at these principles it must be confessed that we are little indebted to science, but rather to the long and attentive observation and correct reasoning of practical men." Overlooking the defective structure of the whole of this sentence, we would observe that the author's view of the nature of science must be peculiar, to say the least of it. If attentive observation and correct reasoning be not science, we should like to know how science ever arose. It would seem as if speculative reasoning were synonymous with science in the mind of our author.

We take another illustration of the culpable want of care bestowed on the preparation of this work from the section devoted to the treatment of scab. Dipping in arsenic is first of all recommended as one of "the most simple and most effectual." Nothing has been said of the dangers attending the use of this substance, or of the consequences which have often followed its use. Mercurial ointment is also recommended. We are told that "tobacco-water is another remedy which has been found effectual, but the high duty it is subject to limits its application." The author ought to have known that tobacco used for this purpose has been for some time exempt from duty on certain conditions. An excellent preparation, the *nicotine* dip, is thus manufactured.

We have had in view in the foregoing remarks the utility of this work to practical men who may seek in its pages facts and principles which would be of direct use and benefit to them in their pursuit of agricultural wealth. Possibly the author intends that it should become a text-book for the use of the 760 persons who, according to the last census, are learning farming professionally in England and Wales. Many of these will, it is to be hoped, in due time, become the agricultural luminaries of their country. It is of national importance that their minds should be thoroughly filled with the great truths of scientific agriculture. They can pick up facts readily enough on the several farms on which they reside; but to books they must look mainly for an exposition of scientific principles. To review this book, or any kindred work, in a way which would be of value to the agricultural student, would require more space than is at our disposal. We shall therefore select one subject well adapted to our purpose, and notice the author's treatment of it. That subject is breeding, which to the agricultural student and to the nation at large possesses the deepest possible interest. The section, or essay, on this subject is introduced under a high-sounding title—"The Principles and Practice of Breeding." We expected a masterly exposition of principles and an array of facts to maintain them. We have been disappointed. Some principles enunciated, which are either wholly or partially true, are illustrated by unhappy examples; and statements are made which are either questionable or contradicted by other statements. In common with many authors and breeders, Mr. Spooner is of opinion that in the offspring the characteristics of the male prevail in the majority of cases (p. 145). The discussion of this subtile topic would occupy much space. We cannot enter upon it now. But if the statement were true in the way Mr. Spooner puts it, the majority of lambs would be of the male gender; but it is not always so. In support of the above proposition we are reminded that "the mule partakes more of the nature of its sire, the ass, than of its dam, the mare." This is quite true; but is it not also true that the jennett is more like its dam, the ass, than its sire, the horse? The statements copied from one work into another on the paramount influence of the male are based partly on erroneous views, and partly on inadequate facts. Given a male and female equal in breeding, in age, and vigour of constitution, they will contribute equally to the characters of the offspring. As a rule the male in every class of live stock is better bred than the female; and as a matter of course the offspring partakes more of his characteristics. Mr. Spooner does not appear to have appreciated the hereditary influence. "Some farmers," he says, "are real advocates for a pure breed and a long pedigree, whilst others despise the pedigree and prefer gaining their ends by means of crossing. Each to a certain extent is right, and each wrong." We ask, how can any person be right to any extent, who despises pedigree? Again, we are told, in the same page, that "a long pedigree may be useless." We give Mr. Spooner credit for more intelligence than to believe he entertains the opinion which those words convey. Indeed, we go so far as to express our belief that, owing to the peculiar style in which he writes, his words do not always convey his real views. We find additional evidence of this in his remarks on breeding in-and-in. Any person conversant with the first principles of breeding knows that breeding in-and-in intensifies the hereditary influence. Two rams, for example, equal in size, age, shape, vigour, and quality, but differing in this—that one is closely bred, while the other is not, will leave their marks on the offspring in very different degrees. The one which is closely bred will, as every breeder of experience and intelligence knows, perpetuate his own points with much greater certainty than the other. According to the language of Mr. Spooner, we should look chiefly to the "resemblance" of the parents. "The stronger resemblance," he says, "there is between the qualities of both parents, if they are good, the more likely is it that the offspring will be perfect." While it is quite true that the nearer the sire and dam approach to each other in shape and quality the better, we are not to recognise this as the embodiment of any fundamental principle of breeding. One of the most difficult things the breeder of improved stock has to effect is to produce uniformity of type or resemblance. The question is, How is it to be done? The answer is this: Skill must be exercised in pairing animals until the desired qualities are produced; and those qualities once obtained, are fixed by close breeding. It is thus that the qualities of shorthorn cattle and Leicester sheep were permanently established. And it is thus, and thus only, that any breeder of our time, or of future time, can succeed in establishing an improved variety of our domestic animals.

In this section of his book, as well as in other parts of it, Mr. Spooner gives a large number of useful and instructive facts on the subject of crossing. We feel very great pleasure in adding that his remarks on this important subject will be worth many times the cost of the work to thousands of sheep-farmers in Great Britain.

CLOWES'S PRACTICAL CHEMISTRY

An Elementary Treatise on Practical Chemistry and Qualitative Inorganic Analysis, specially adapted for use in the Laboratories of Schools and Colleges, and by Beginners. By Frank Clowes, B.Sc. Lond., Science Master at Queenwood College. (London: J. and A. Churchill, 1874.)

If the rate of progress of a science is to be measured by the number of text-books produced annually, Chemistry must assuredly advance with greater strides than any of its sister sciences. Whether this is actually the case we leave to our readers to judge, contenting ourselves here with pointing out the fact that while English Physics is represented by a few manuals, of which a considerable proportion are translations from foreign works, the market is, so to speak, glutted with an ever-increasing stock of chemical text-books.

The volume now before us is the production of a practised teacher of the science, and will doubtless be found of service outside the author's own classes. The work is divided into seven sections and an appendix. In the first section the student is introduced to experiments illustrating the methods of preparation and properties of the common gases, such as oxygen, hydrogen, carbon dioxide, nitric oxide, ammonia, carbon monoxide, chlorine, and hydrochloric acid. After the preparation of these gases the student is made acquainted with the process of distillation as applied to water, and to the preparation of nitric acid. The entire absence of theory from this section is perhaps to be regretted. Although a student may have previously read the reactions that occur in the preparation of the various gases, there is no more favourable opportunity for impressing these upon the mind than at the time of performing the experiment for himself. If beginners were always to ask themselves, What *chemical* change is going to occur in this tube or flask? and then write down the equation, the knowledge gained would not be of that purely mechanical nature which the boring of corks and bending of glass tubes alone tend to engender.

Section II. treats of the preparation and use of the apparatus required for analysis. Bunsen's burner, the spirit lamp, blowpipe, bending and cutting of glass tubing, cork-boring, and other practical minutiæ, are here described, and some valuable hints given on the use of the various pieces of apparatus employed by the student of analysis.

The details of glass-working seem to us somewhat misplaced here. Tubing must be bent, and corks bored and fitted into flasks, tubes, &c., in the course of fitting up the apparatus for the preparation of gases; so that it would be more logical if this section were made to precede Section I. We miss from this section, also, any reference to the excellent blowpipes made on Herapath's principle, now so generally employed in our laboratories. Students who have once used these blowpipes soon abandon the old mouth blowpipe figured in the present work.

The various operations connected with analysis are described and experimentally illustrated in Section III. Here the student is made acquainted with the processes of solution, crystallisation, filtration, evaporation, precipitation, ignition, &c., and the way is thus prepared for the next section, wherein are given the analytical reactions of the more commonly occurring metals. The author adopts the usual analytical classification; this section, indeed, offers but little scope for originality, and we find the same tests and reactions which are to be found in the works of Fresenius and Rose, and the many volumes of their imitators. The modicum of theory relating to the use of symbols and the expression of reactions as equations, which we should have preferred to see in an earlier portion of the book, finds place at the beginning of the present section. We are glad to see equations given for most of the reactions of the metals; too often the words "white pp." or "black pp." go down into the student's note-book without any idea of what chemical change has occurred having entered into his mind. After the reactions of the metals of each group, tables are given showing the characteristic differences between the members of that group and the methods to be pursued in the cases of mixtures. This plan of tabulating the differences between the various metals of a group is a special feature of the present work; in this country the idea seems to have been first introduced into Galloway's "Manual of Qualitative Analysis," and its adoption by Mr. Clowes is to be highly commended. When a student is made to go through a long series of reactions with closely allied metals, he is apt to overlook the points in which they differ unless these are specially pointed out to him. It is as though a zoologist were to give lengthy descriptions of two closely allied species of a genus without any reference to their differential characters. The reactions of the acids, inorganic and organic, follow those of the metals.

Passing on to Section V., we find the ordinary course of analysis pursued in the case of a simple salt containing one base and one acid, the tables being modified to meet the cases of solids and liquids, acid or alkaline.

In the following section, containing the complete course of analytical tables for complex mixtures, we recognise the well-known tables compiled, we believe, by Dr. Hofmann for the Royal College of Chemistry. The phosphate table devised by Mr. Valentin has been introduced with the author's permission. The present work offers, therefore, as good an analytical course as is to be found in any of our text-books, the type in which the tables are printed is decidedly small, but the plan of printing them *across* instead of *along* the page, offers, as the author justly claims, a distinct advantage.

Section VII. is devoted to a description of apparatus and reagents used in the analytical course. The methods given for constructing pieces of apparatus for general use, and the preparation of special reagents such as hydrofluosilicic acid, will be found valuable adjuncts to the book. The appendix contains a list of elements with their symbols and atomic weights, formulæ for the conversion of thermometric scales, and tables of weights and measures.

It will perhaps be better not to inquire into the *raison d'être* of the work an outline of which we have now laid before our readers. It may be asked why the student should not be made acquainted with the method of preparation and properties of nitrogen, nitrous oxide, phosphoretted hydrogen, and cyanogen; these gases surely are of sufficient chemical importance to justify a knowledge of their properties, and their preparation cannot but furnish good exercise for the manipulatory skill of a student. The list of corrigenda is certainly alarming, and we hope the author will have the opportunity of correcting these in a later edition.

The defects we have had occasion to point out in the course of this notice are not, it must be admitted, of a very grave character. We do not scruple to say that the author has performed his task on the whole well, and we should have no hesitation in putting the book into the hands of the chemical student.

The present volume may, in fact, be taken as a fair average specimen of the systems of teaching practical chemistry followed in this country, and as such we shall venture a few remarks upon it in concluding. In the first place, we should like to see a little more *science* introduced into our courses of analysis—something of the nature of a chemical key to the analytical tables is in our opinion a desideratum. At present the student generally follows blindly the instructions given in the tables; he dissolves, precipitates, or filters without any regard to the chemical reactions occurring at the various stages. It is similar to the old system of learning off a problem of Euclid by heart, without entering into the reasoning—change the order of the letters, and confusion is the result. Then, again, we venture to think that a little more of what we may call manufacturing chemistry might be with advantage introduced into our laboratories. After preparing the gases, the student goes on to study the analytical reactions of the metals, where there is very little scope for manipulation. Between these stages, or simultaneously with the latter, the preparation on a large scale of some of the reagents used in analysis, or of some compounds demanding skill and caution, such, for example, as the chlorides of phosphorus, would give a more extended knowledge of practical details, and at the same time furnish the student with a certain amount of technical instruction equally valuable to him as a scientific man or as a manufacturer.

LETTERS TO THE EDITOR

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

The Royal Agricultural Society and the Potato Disease

MY attention has been drawn to a letter in NATURE, vol. xi. p. 67, signed "W. T. Thiselton Dyer," and headed "Royal Agricultural Society and the Potato Disease." It appears that Prof. Dyer has founded the statements and criticisms in that letter upon a paragraph which appeared in the preceding number of NATURE. Had he taken the trouble to read the official reports that have been published by the Society in the agricultural newspapers, the criticisms he might then have made would probably have had some value; and I must express my surprise that a man of scientific pursuits should have omitted to take that most necessary and most elementary course which I may term the verification of fundamental facts. This is the more remarkable as he criticises the Society's want of "methodical scientific method of investigation."

Prof. Dyer asks, "Is it not surprising that the Royal Agricultural Society should think the offer of a 100*l*. prize for an essay in any way an adequate method of dealing with the subject?" Now, what does Prof. Dyer mean by this question? He seems to imply that the Royal Agricultural Society offered such a prize, and that therefore they thought it an adequate method of dealing with the subject. But the Society did not offer such a prize, and have not considered whether such a method would or would not be adequate to deal with the subject.

The truth is, that Lord Cathcart offered such a prize two years ago, and asked the Council of the Society to nominate the judges and otherwise to take charge of the competition. This they did, and for this alone are they responsible.

Prof. Dyer proceeds: "The Society then determined to offer prizes for disease-proof potatoes." To this I must beg leave to reply that the Society did *not* offer prizes for "disease-proof potatoes," but for potatoes which should resist disease for three years in succession in twenty different districts of the United Kingdom. If the somewhat lengthy statement of the terms on which the prize was offered has been colloquially abbreviated into "disease-proof potatoes," that does not justify a scientific man in basing an argument upon it, especially in the columns of a scientific journal.

Prof. Dyer continues: "The utter futility of this proceeding was clearly obvious to anyone in the least acquainted with the subject." Here again I must join issue with the Professor. This prize was offered because certain essayists asserted, and seedsmen advertised, that they possessed varieties of potatoes which would resist disease. To put these statements to the test was in conformity with the Society's ordinary practice, which is to endeavour to make its members acquainted with the actual agricultural value of various articles, whether they be seed-potatoes, manures, implements, or other commodities. As the result has been to show that none of the potatoes experimented upon can resist disease for even one year in our twenty stations, the members of the Society now know what value to attach to the assertions of their proprietors, and the result is therefore not utterly futile.

These experiments have also been utilised to ascertain the influence of soil, climate, and modes of management on the crop itself, and on the potato disease; and the results of this inquiry are now being worked out.

Prof. Dyer goes on to say: "Now, it seems to me that this spasmodic and ill-considered way of dealing with a serious subject contrasts, to an extent that it is impossible quite to regard with satisfaction, with the course that would be adopted in such a matter in other countries. It shows, at any rate, how little the methodical scientific method of investigation is understood by the majority of well-informed English people." I am content to ask Prof. Dyer to point out what is "spasmodic" and what is "ill-considered" in the action of the Society, and how does he justify his assertion about "the methodical scientific method of investigation?"

It must be remembered that the Royal Agricultural Society was not established for the advancement of science, and certainly not for the advancement of botany; but it was established for the promotion of agriculture, especially by the encouragement of the application of the discovered truths of science to the practice of agriculture, as is shown by its motto, "Practice with Science."

The Royal Agricultural Society does, however, enlist the services of scientific men upon its regular staff, and in this and other ways seeks to direct their attention to agricultural problems upon which the light of science is still wanting. As Prof. Dyer has contrasted the Society's "spasmodic and ill-considered way" with "the course that would be adopted in such a matter in other countries," I hope that he will inform me of the course that Agricultural Societies in other countries have adopted in reference to the potato disease and other such matters, without receiving assistance from the Government of the country.

I now come to what Prof. Dyer calls his "second point." He states that the Society, "anxious not to be entirely foiled, offered a sum of money to a well-known investigator of the life-history of fungi, Prof. de Bary, of Strasburg, to induce him to study the potato disease. Considering that De Bary had already written an admirable memoir on the *Peronosporeæ*, there was a certain simplicity in supposing that the gift of a sum of money would elicit some additional information which his zeal as a scientific investigator had failed to do."

So far as I understand the meaning of the phrase "anxious not to be entirely foiled," it implies some previous disappointment. Now, so far is this from having been the fact, that the *first* step taken by the Council of the Society was to direct me to write to Prof. de Bary and urge him to continue his researches into the life-history of *Peronospora infestans*, in view of the vast importance of the subject in its agricultural bearings. Therefore I cannot see how the term "anxious not to be entirely foiled" can be made applicable to it.

The Society at the same time volunteered to place a sum of money at his disposal towards defraying the expenses which he might find it necessary to incur, but I hope that my communication to Prof. de Bary was not conceived in the offensive spirit which Prof. Dyer seems to suggest. The principle involved has been adopted by the British Association as one of the best means of advancing science, and I consider it a very different matter from that "certain simplicity" which Prof. Dyer derides.

This was not only the first, but it was the only step then taken by the Society in reference to the scientific questions bearing upon the potato disease; and its results up to this time are in no respect indicated by the grotesque statements which Prof. Dyer quotes.

H. M. JENKINS,
Secretary of the Royal Agricultural Society of England

Nov. 29

Anabas Scandens

IN a short notice of the contents of the August number of the *Bulletin de la Société d'Acclimatation de Paris*, in NATURE, vol. xi. p. 98, reference is made to M. Cabonnier's announcement of "the arrival from India of several specimens of three varieties of fish *never hitherto brought to Europe*—the *Anabas scandens* or Climbing Perch," &c. With respect to the *Anabas scandens*, I wish to remark that in April 1872 I sent from Calcutta to the Gardens of the Royal Zoological Society of Ireland two specimens of this fish. Both specimens arrived safely and were exhibited in a tank in the Gardens; one died soon after arrival, the other lived for several months, succumbing at length to the cold of the following winter.*

Royal Victoria Hospital, Netley, Dec. 5 G. E. DOBSON

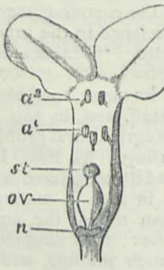
* See Forty-first Annual Report of the Royal Zool. Soc. of Ireland: also P. Z. S. Lond. 1874, p. 319.

FERTILISATION OF FLOWERS BY INSECTS *

VIII.

Alpine Species adapted to Cross-fertilisation by Butterflies, while the most nearly allied species which inhabit the plain or lower mountain region are adapted to Cross-fertilisation by Bees.

IN the last article I attempted to show that in the Alpine region Lepidoptera are far more frequent visitors of flowers than in the plain and lower mountain region, while the frequency of Apidæ, not only absolutely but to a still greater extent relatively, is greatly diminished towards the snow-line. If this be so, whatever may be the cause of the fact, it is hardly to be supposed that the



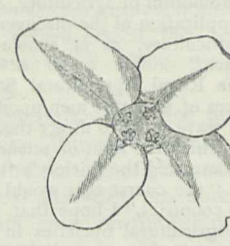
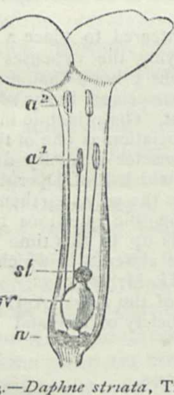


FIG. 41.—*Daphne Mezereum*, L., dissected longitudinally. FIG. 42.—The same flower viewed from above.
(Both figures 3½ times natural size.)

different proportion of visitors of such different structure as butterflies and bees should not have in any way influenced the adaptations of the flowers; and indeed, even during my short stay in the Alps, I succeeded in finding some species of flowers adapted to cross-fertilisation by butterflies, their most nearly allied species which inhabit the plain or lower mountain region being adapted to cross-fertilisation by bees.

1. *Daphne Mezereum* and *striata*.—In both species (Figs. 41-44) the nectar is secreted in an annular swelling (*n*) at the base of the ovary (*ov*), and is contained in the lowest part of the tubular corolla, which includes (1) the ovary (*ov*), terminated by a short-styled, knobbed stigma



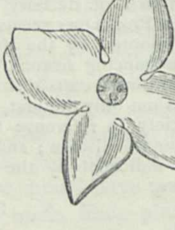
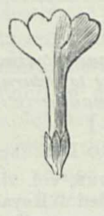
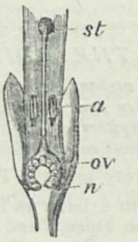


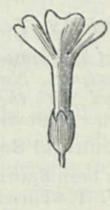
FIG. 43.—*Daphne striata*, Trat., dissected longitudinally. FIG. 44.—The same flower viewed from above.
(Both figures 3½ times natural size.)

(*st*); (2) four lower anthers inserted above the centre of the corolla-tube (a^1); and (3) four higher anthers inserted near its mouth (a^2). In both species, therefore, the proboscis of a visiting insect, when in search of the honey, grazes at first the higher, then the lower anthers, and at last the stigma; but the pollen-grains, being only slightly sticky, scarcely adhere to the proboscis, and, at the most, some few grains will be brought by it to the stigma of the same flower. Only when retreating out of the flower will the proboscis, wetted with honey, be dusted by any considerable number of pollen-grains, which will partly be deposited on the stigma of the next visited flower. Thus cross-fertilisation is secured in case suitable insects visit the flowers, whereas when visits of suitable insects are wanting, pollen may easily fall down in both species from the anthers upon the stigma of the same flower, and effect self-fertilisation.

Agreeing thus far, the flowers of the two species differ remarkably in the length and width of the corolla and in the insects which they attract. The corolla-tube of *Daphne Mezereum* being 6 mm. long and 2 mm. wide, its honey is accessible to a great number of bees, among them to all humble-bees, and to some flies (Eristalis, Rhingia), which will be attracted by the bright red colour, and when seeking for honey and flying from flower to flower will regularly effect cross-fertilisation. The honey is also accessible to butterflies, but in consequence of the width of







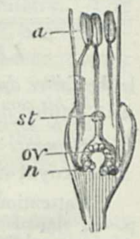
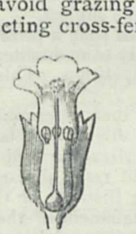


FIG 45. FIG. 46. FIG. 47. FIG 48.

FIG. 45.—*Primula villosa*, Facq. Long-styled flower, natural size. FIG. 46.—Lower part of the same flower, longitudinally dissected: 3½ times natural size. FIG. 47.—Short-styled flower, natural size. FIG. 48.—Lower part of same flower, longitudinally dissected; 3½ times natural size *n*, nectary; *ov*, ovary; *st*, stigma; *a*, anthers.

the corolla-tube the slender proboscis of these insects will often be entered and retracted without touching anthers and stigma. *Daphne striata*, on the contrary, with corolla-tubes of 10-11 mm. long, the entrance of which is only 1 mm. wide, is hardly accessible to any insects except Lepidoptera; and the pale rose or whitish colour of its flowers, crowded together in tens or twenties into umbels, and the entire absence (or nearly so) of scent in the day-time, while they emit a remarkably sweet scent during the evening twilight, prove them to be adapted to Sphingidæ and moths,* which, when visiting the flowers, in consequence of the narrowness of the corolla-tube, cannot avoid grazing the anthers and stigma and regularly effecting cross-fertilisation.



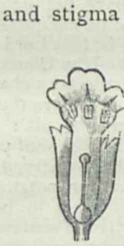


FIG. 49. FIG. 50.

FIG. 49.—*Primula officinalis*, Facq. Long-styled. Natural size. FIG. 50.—The same: Short-styled flower, longitudinally dissected.
(Copied from Hildebrand, "Geschlechtervertheilung," p. 31.)

2. *Primula officinalis* and *villosa* (Figs. 45-50) are connected with one another by a relation analogous to that between *Daphne Mezereum* and *striata*. Both offer the remarkable contrivances for cross-fertilisation which Mr. Darwin has discussed in so masterly a manner in his paper on Primula,† that is to say, both possess two forms of flowers, a long-styled (Figs. 46, 49) and a short-styled (Figs. 48, 50), growing on different stems and existing in nature in about equal number. As is evident from the

* Continued from p. 33.

* I have not yet succeeded in actually observing the fertilisation of either of these two species of Daphne.

† "On the Two Forms or Dimorphic Condition in the Species of Primula and their remarkable Sexual Relations." Proc. Linn. Soc. vi. (1862). Bot. pp. 77-99.

comparison of Fig. 46 with 48 and of 49 with 50, the anthers of the short-styled form are placed at the same height in the corolla-tube as the stigma of the long-styled, and, conversely, the stigma of the short-styled at the same height as the anthers of the long-styled form. Hence the same part of the body (head or proboscis) of any visiting insect which has touched the anthers of the short-styled form touches the stigma of the long-styled form, and conversely, so that by the regular visits of insects, flowers of the long-styled form are fertilised by pollen of short-styled flowers, and *vice versâ*. Thus in *Primula officinalis* and *villosa*, as in all dimorphic species, intercrossing of different plants takes place naturally; and, as Mr. Darwin has proved by experiment, is the only manner of fertilisation that is followed by perfect fertility. But whilst identical in the arrangement of all the parts of the flower and in their remarkable sexual relations, our two species of Primula differ in the wideness of their corolla-tube to such an extent that the wide mouth of the flower of *P. officinalis* is capable of including the whole head of a humble-bee; whereas the narrow corolla-tube of *P. villosa* is not capable of including anything larger than the proboscis of a humble-bee (compare the corolla-tube in Figs. 46 and 48, which, although three-and-a-half times magnified

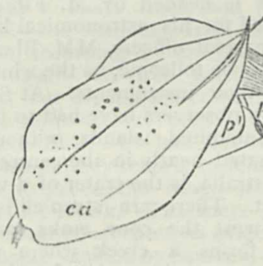


FIG 51.

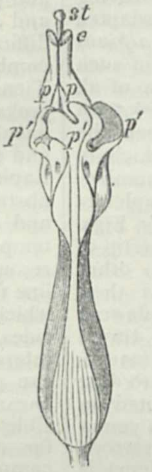


FIG. 52.

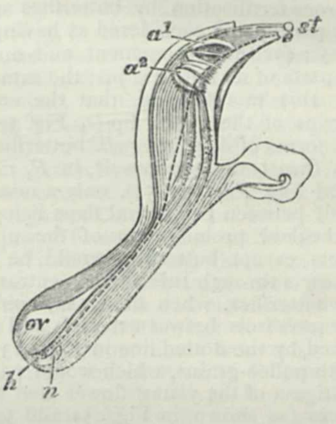


FIG. 53.

appears hardly as wide as the mouth of the flower in Figs. 49 and 50, which is the natural size). In consequence of this narrowness, the flowers of *P. villosa* are not only unavoidably cross-fertilised when visited by butterflies, but they are also far more attractive to butterflies, because their honey, inaccessible to humble-bees, is reserved for them alone; indeed, except some little Coleoptera, I observed only Lepidoptera visit the flowers of this Alpine species of Primula,* whereas the flowers of *Primula officinalis* are adapted by their dimensions to the visits of humble-bees, and are actually visited by them.*

A third example of the same relation between Alpine species and those from the lowlands is presented by *Rhinanthus alpinus* (Figs. 51-56), as compared with *R. crista galli* (Fig. 57). *R. crista galli*, which grows in the plain and lower mountain region, presents two varieties or sub-species: *α*, *major*, and *β*, *minor*, with different forms of flowers; *major* with more conspicuous

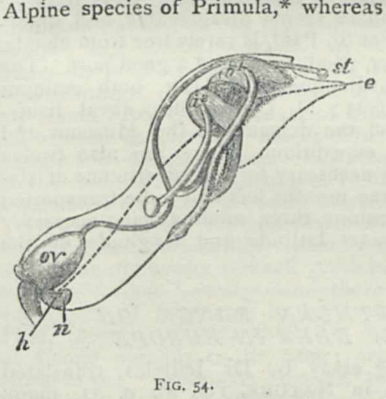


FIG. 54.

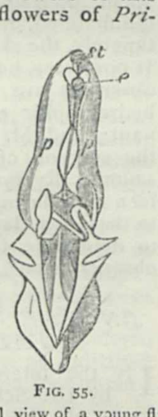


FIG. 55.

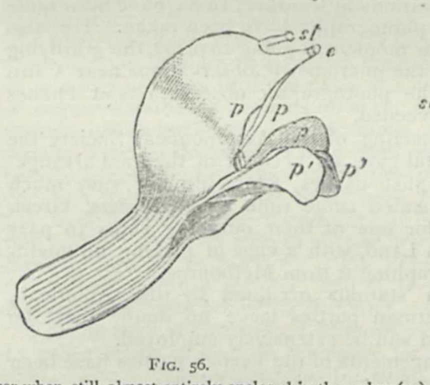


FIG. 56.

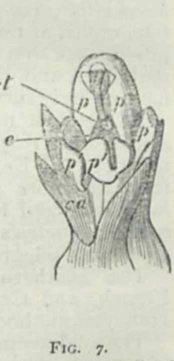


FIG. 7.

FIGS. 51-56.—*Rhinanthus alpinus.*—FIG. 51.—Lateral view of a young flower when still almost entirely enclosed in the calyx (*ca*). FIG. 52.—Corolla of another young flower, somewhat more full-grown, viewed from beneath. FIG. 53.—The same corolla, longitudinally dissected. FIG. 54.—Corolla of an older flower viewed laterally. FIG. 55.—Front view of the same flower. FIG. 56.—Corolla of the same flower, longitudinally dissected, but all four anthers reserved. FIG. 57.—*Rhinanthus crista galli, β* minor.

All figures are $3\frac{1}{2}$ times natural size. In all figures:—*ca*, calyx; *p p*, upper petals, forming together the upper lip; *p' p' p'*, under petals, forming the underlip; *a'*, longer stamens; *a²*, shorter stamens; *n*, nectary; *h*, honey; *ov*, ovary; *st*, stigma. The dotted line on Figs. 53 and 56 signifies the supposed path of the proboscis of butterflies.

ones which never fertilise themseves, *minor* with less conspicuous ones regularly fertilising themselves, in case the visits of insects are wanting (NATURE, vol. viii., pp. 433-435). Both are adapted to cross-fertilisation by humble-bees, which, inserting their proboscis into the comparatively wide entrance of the upper lip (*e*, Fig. 57)

* Visitors of *Primula villosa*.—(A.) Coleoptera: *Anthobium excavatum* Er., frequently, crawling without difficulty into the flowers and out of them. (B.) Lepidoptera: *Pieris callidice* Esp., *Zygæna exulans* Rain, both sucking perseveringly and flying from flower to flower.—Piz Umbrail, July 16, 1874.

* Visitors of *Primula officinalis*.—(A.) Coleoptera: *Meligethes*. (B.) Diptera: *Bombylius discolor* Mgn., sucking. (C.) Hymenoptera, Apidæ: *Anthophora pilipes* F., ♀ ♂, *Bombus muscorum* L. ♀, both frequently sucking; *Andrena Gwynana* K. ♀, *Halictus cylindricus* F. ♀ and *Halictus albipes* F. ♀, collecting pollen of short-styled flowers.—Thuringia, April 16, 1873.

and pressing it between the upper parts of the filaments, cannot fail to pull asunder the anthers, and thus to cause many loose pollen-grains to fall down upon the proboscis, which are deposited on the stigma of the next flower following.* Thus, in both, cross-fertilisation is secured in case humble-bees visit the flowers, whereas butterflies may easily thrust their slender proboscis down to the honey without even touching the anthers, consequently without any benefit to the plant. Suppose, therefore, that *R. crista galli* (*a*) *major* were growing in the Alpine region, and visited frequently by butterflies, but never or only very exceptionally by humble-bees, all or nearly all the individuals would of necessity perish without leaving posterity, unless any modification of the flowers adapted to cross-fertilisation by butterflies appeared. *R. alpinus* may perhaps be considered as having originated in such a way; for the arrangement and mutual situation of all the parts of its flower is just the same as in *R. major*, with only this modification, that the entrance between the margins of the upper lip (*e*, Fig. 57), through which in both forms of *R. crista galli* butterflies as well as humble-bees thrust their proboscis, in *R. alpinus* is completely closed (*pp*, Figs. 54, 55), only a minute opening (*e*, Figs. 51-56) between two lateral flaps being visible at the tip of the beaked prolongation of the upper lip. No other insects except butterflies would be able to insert their proboscis through this narrow entrance into the flower; and butterflies, when doing so, could not fail to thrust their proboscis between the left and right anthers (as explained by the dotted line in Figs. 53 and 56), and to dust it with pollen-grains, which would partly be deposited on the stigma of the young flower next visited; for in young flowers (as shown in Figs. 51 and 53) the style overtops the tip of the beaked prolongation, and the stigma is placed before the minute opening, just in the way of any entering proboscis, whereas in older flowers the stigma is retracted behind the opening by an incurving of the style (as shown in Fig. 56). HERMANN MÜLLER

* H. Müller, "Befruchtung der Blumen durch Insecten," p. 294, *et seq.*

THE TRANSIT OF VENUS

THE long-anticipated Transit of Venus took place yesterday morning; and already has the first instalment of news from distant observers arrived. The Astronomer Royal has been good enough to inform us that Col. Tennant's observations at Roorkee, India, have been quite successful; 100 photographs have been taken. He also telegraphs, at the moment of going to press, the gratifying intelligence that the micrometric observations near Cairo and Suez, and the photographic observations at Thebes have entirely succeeded.

At the last meeting of the Astronomical Society the Astronomer Royal gave an account of the final arrangements of the English parties, which do not vary much from those we stated some time ago. Messrs. Green have arranged for one of their outgoing ships to pass near Kerguelen's Land, with a view of picking up intelligence and telegraphing it from Melbourne.

The southern stations occupied by the American, French, and German parties leave no doubt that the Halleyan method will be extensively employed.

The final arrangements of the French parties have been telegraphed to yesterday's *Times* as follows:—

"France has six stations—three in the Northern Hemisphere, at Pekin, Nagasaki, and Saigon; and three in the Southern Hemisphere, at Noumea, Campbell Island, and St. Paul's Island. Three of these, Nagasaki, Cochin China, and Noumea, present comparatively no difficulties as regards the voyage and installation. The Nagasaki Commission is headed by M. Janssen, member of the Institute and the Board of Longitude, who has taken part in several scientific voyages resulting in important discoveries. He is assisted by M. Tisserand, superintendent of the Toulouse Observatory, and M. Picard, a naval lieutenant, who will employ the photographic apparatus of MM. Fizeau and Cornu, while a professional photographer will use an apparatus invented by M. Janssen. In Cochin China there will be only one observer, M. Héraud, a hydrographic engineer. It was at first decided, as a measure of economy, to dispense with the observations in Cochin China, but it was ultimately resolved to profit by M. Héraud's presence in the colony. He will probably be stationed in Tonquin, of which he is preparing a map. M. André, of the Observatory, and M. Angot, of the College of France, have proceeded to Noumea with an equatorial and photographic lens. The observers at Pekin, St. Paul, and Campbell Islands have had to encounter greater difficulties. It is not very easy to reach Pekin with cumbrous luggage. The Commission has had to reach Tien-tsin by Suez and Shanghai, and thence proceed in junks by the canals. It is headed by M. Fifuriais, a naval lieutenant celebrated for his astronomical labours, and comprises two other naval officers, MM. Blarez and Lapied. Their return may be toilsome, as the winter will obstruct the transport of their instruments. At St. Paul and Campbell Islands the observers have had to found a temporary colony in uninhabited islands, without any resources. St. Paul, situated nearly in the centre of the line from the Cape to Australia, is the crater of a volcano which is becoming extinct. There are steep cliffs on all sides, but towards the west the cone sinks, and the interior of the crater forms a creek where vessels can penetrate. No pure water is to be found. The encampment has been established as near as possible to the sea, the salt water having to be distilled for drinking purposes. The St. Paul Commission is composed of M. Mouchez, captain and member of the Board of Longitude, the author of works on the coast of Brazil and Algeria; M. Turquet, naval lieutenant, long accustomed to astronomical observations, as his coadjutor; M. Cazin, an eminent Professor at the Lyceum of the Rue du Havre, who is entrusted with the photography; and a navy surgeon, M. Rochefort, who will devote himself to the natural history of the island. The Commission is accompanied by twelve naval officers and sailors. Campbell Island, the most distant station, is about 200 leagues south of New Zealand. It is likewise uninhabited, its climate seems disagreeable, and, unfortunately, the sky, as at St. Paul, is rarely free from clouds. It possesses, however, good water and a good port. The observers are MM. Bouquet and Hatt, both eminent hydrographic engineers; M. Courrejolles, naval lieutenant; and M. Filbol, the delegate of the Museum and the surgeon of the expedition. There are also twelve sailors. Everything necessary for the subsistence of sixteen men during three months has had to be transported to these two last stations, three months being necessary to determine the exact latitude and longitude of the observatories."

ON THE NORTHERN RANGE OF THE FALLOW DEER IN EUROPE

IN the interesting essay by Dr. Jeitteles, translated by Dr. Sclater, in NATURE, vol. xi. p. 71, many cases of the reputed discovery of the remains of the Fallow Deer are collected together to prove that the animal is indigenous in Northern Europe, and not imported from the south, as heretofore has been supposed by many able naturalists, such as Blasius, Steenstrup, Rütimeyer, the late Prof. Ed. Lartet, and others. These cases are accepted by Dr. Sclater without criticism, and are deemed by him to place the importation theory, as it may be termed, in the category of "ancient fables." The question, however, seems to me, after many years' study of the fossil and recent Cervidæ of this country and of France, a very difficult one, not to be decided off-hand, and certainly not without a strict analysis of the value of evidence such as that recorded by Dr. Jeitteles, whose method and facts appear to be equally in error.

The identification of fragments of antlers is one of the most difficult tasks which a naturalist can take in hand, and where there are several species of deer associated together in the same deposit, it is sometimes impossible to assign a given fragment to its rightful owner. For example, in the forest beds of Norfolk and Suffolk, and in the Pleiocenes of the Continent, there is a vast number of antlers which are ownerless and which have completely baffled Prof. Gaudry, myself, and others for many years. It is, of course, easy for anyone to classify the flat antler as belonging to one species and the round to another; but the value of the determination depends upon the number of species living at the same time in the same place, possessed respectively of round and flattened antlers. In the Pleistocene and Prehistoric ages, there were four animals which had portions of their antlers flattened—the Reindeer, Irish Elk, True Elk, and Stag—to which, according to Dr. Jeitteles, must be added the Fallow Deer. In this particular case it is not only assumed that the flat antler fragments belong to the last of these animals, but even the uncertain testimony of various authors, who had not critically examined the remains, which they record, in relation to the other species, is taken to prove the range of the Fallow Deer as far north as Denmark. The mere printed reference to the Fallow Deer is accepted as evidence, without, save in two cases, being verified by personal examination. The results of such a method of inquiry seem to me to demand most careful criticism.

The alleged cases of the discovery of Fallow Deer in Central and Northern Europe are as follows. In Switzerland, it is stated to have been identified by Dr. Rütimeyer among the animals which had been used for food by the dwellers in the Lake villages; "although," he writes, "incontrovertible evidence of the spontaneous existence of this deer north of the Alps remains still to be obtained" (quoted by Dr. Jeitteles in NATURE, vol. xi. p. 72.) In a list of the Swiss mammalia which Dr. Rütimeyer was kind enough to prepare for me in 1873, the animal is altogether omitted from the Pleistocene and Prehistoric Fauna. Thus, in the opinion of this high authority, it was not living in Switzerland in those early days. The animal is stated also (on the authority of Jäger in 1850) to have been found abundantly in "the caverns and turbaries as well as in the diluvial freshwater chalk of Wurtemburg." To this I would oppose the opinion of my friend Prof. Oscar Fraas, of Stuttgardt, from whose list of animals (sent to me in 1872) the Fallow Deer is conspicuous by its absence. The Reindeer is abundant in the caves of that region, and to it the flattened fragments of antlers may probably be referred.

To pass over the reputed discovery of the animal "in an old place of sacrifice" near Schlieben, in 1828, in which the discoverer himself remarks that "the subject requires further investigation," there only remain three other sets of fragments to be examined in Germany. First, those at Olmütz, which Dr. Rütimeyer considered to belong possibly to the Stag; secondly, an indistinct figure in the "Ossemens Fossiles," of an antler attached to a skull found at Stuttgardt, which seems to me to belong to the Reindeer; and lastly, a fragment of antler from Buchberg, which, taken along with the find at Olmütz, is the second of the two cases identified by Dr. Jeitteles. It is a museum specimen, which may very probably be liable to the same doubts as those which are entertained by Dr. Rütimeyer regarding the fragments from Olmütz. The teeth and bones quoted from Hamburgh are as likely to belong to the Stag as to the Fallow Deer.

The alleged instances of the discovery of the animal in this country and in France are equally unsatisfactory. The flattened antlers alluded to by Buckland and Owen belong either to the Stag or the Reindeer. Among the many thousands of bones and teeth which I have examined from the ossiferous caves of various ages, from refuse-heaps, and tumuli, I have never seen any fragment which could be attributed to Fallow Deer, except in refuse-heaps not older than the Roman occupation. Nor is it found in Ireland till the Middle Ages. The late lamented Prof. Ed. Lartet, whom I always consulted on difficult questions such as these, believed that the animal was not living in Central and Northern France in the Pleistocene or Prehistoric ages, but that it was imported probably by the Romans.

The only evidence against this view is that afforded by an antler dug up in Paris and brought to Prof. Gervais along with stone celts by some workmen. It seemed to me when I saw it in 1873, in the Jardin des Plantes, not altogether conclusive, because of the absence of proof that all the remains were obtained from the same undisturbed stratum. I should expect to find such antlers in the refuse-heaps of Roman Paris, as in Roman London, and I should not be at all surprised if the remains of widely different ages were mingled together by the workmen, even if they were found in the same excavation. As examples of the necessity of guarding against this source of error, I may quote a recent lower jaw of Kangaroo Rat in the collection of my late friend Mr. Wickham Flower, which was stated to have been dug out of the brick-earth near Sittingbourne, along with the mammoth and other Pleistocene creatures; the bones of an ostrich brought to Prof. Busk, along with mammoth and hippopotamus from the gravels of Acton Green; and lastly, the skeleton of Fallow Deer found in a bog not far from the River Boyne above Leinster Bridge (Co. Kildare), along with a skull of Brown Bear (Scott, *Journ. Geol. Soc.* Dublin, vol. x. p. 151). This last case would have been taken as decisive that the animal lived in Ireland in prehistoric times as a contemporary of the Brown Bear, had not a silver collar round its neck proved that it had belonged to "a member of Lord Rosse's family."

From premises so unsatisfactory as those which have been examined, it seems to me very hazardous to conclude with Drs. Jeitteles and Sclater that the Fallow Deer inhabited Northern and Central Europe in the Pleistocene and Prehistoric ages. The point, to say the very least, is non-proven. On the other hand, the non-discovery of certain relics of the animal by the many able naturalists who have examined vast quantities of fossil remains from those regions, implies, to my mind, the probability that the animal was not then in those parts of Europe. The value of negative evidence depends upon the number of observations, which in this case is enormous. To speak personally, I am in the position of a man waiting for satisfactory proof, holding that up to the present time the common Fallow Deer "has never been found to occur in the fossil state in Northern and Central Europe"—a position which I see no reason to change from the arguments brought forward in NATURE. The animal *ought* to be found fossil in those regions; and it is not for want of looking that it has not yet been found.

For the sake of clearness, I have reserved the reference to other forms of deer, in the essay, for separate discussion. The *Cervus polignacus* of Pomel, from Auvergne, is an obscure form without definition, about which I will not venture to say anything. The *Cervus somonensis* of Cuvier, which I have carefully studied in Paris along with Prof. Gervais, is identical with the form which I have described from Clacton, Essex (*Quart. Geol. Journ.*, 1868, p. 514), under the name of *Cervus brownii*. The latter has been identified by Prof. Busk among the fossil remains from Acton Green. The typical antler of Cuvier's species differs from Plate XVII. Fig. 4 of *C. brownii*, in the possession of a palm of four points, and in being broken and badly restored with plaster at the point where the third tyne, *d*, of my figure joins the beam. Whether this kind of antler belongs to a well-marked variety of Fallow Deer or to a closely-allied species, I will not offer an opinion. It seems, however, safer to follow Professors Lartet, Gaudry, and most of the naturalists since the days of Cuvier, in keeping the fossil separate from the living forms, none of which present, so far as I know, a similar variation of antler. Till such an antler be found it is better to keep the animals apart in classification. And even if they be viewed as belonging to one species, they have only been met with in Pleistocene deposits in this country and in France, and they may reasonably be taken as visitors from the south, such as the contemporary hippopotami. In any case I would submit that they do not afford satisfactory grounds for believing with Dr. Sclater that the present distribution of the Fallow Deer in Northern and Central Europe by the hand of man is "an ancient fable." It is undoubtedly an ancient belief, and it is one which can be proved to some extent to be true by an appeal to the records of history.

To enter into the question of the introduction of Fallow Deer into Northern Europe would far outleap the limits of an article. A reference to Lenz's "Zoologie der Alten," and to Neckam's "Natural History," will show to what an extent the wealthy Romans and mediæval barons were in the habit of importing wild and rare animals for the chase, as well as for the sake of mere curiosity.

W. BOYD DAWKINS

THE ENGLISH ARCTIC EXPEDITION

SINCE our note of last week, the preparations for the Arctic Expedition have been advanced an important stage by the selection of Capt. Nares, of H.M.S. *Challenger*, to command the expedition. The choice is a happy one. Capt. Nares distinguished himself on board the *Resolute* in the Arctic Expedition of 1852-54, serving with M'Clintock, Mecham, and Vesey Hamilton. He led the depot sledge for Mecham's more extended journey. On that occasion he went over 665 miles in sixty-five days, while his efficient assistance enabled Mecham to cover 1,006 miles of ground in ninety-four days. Nares was also foremost in providing amusement for the men during the winter quarters, one of the most essential qualifications for Arctic work. His recent experience in the *Challenger* will have made him thoroughly acquainted with the duties required of the commander of a scientific expedition. Commander A. H. Markham, of H.M.S. *Sultan*, will also take a prominent position in the expedition. Capt. Nares was at Hong Kong when he received the telegram offering the command, and probably by this time is on his way home. The command of the *Challenger* will, it is understood, be entrusted to Capt. Frank T. Thomson, now in command of H.M.S. *Modeste*, in China, and who was the first captain selected for official duties in the Royal Naval College at Greenwich.

We announced, a fortnight ago, that the Admiralty had selected Rear-Admiral Richards, C.B., F.R.S., Rear-Admiral Sir Leopold M'Clintock, F.R.S., and Rear-Admiral Sherard Osborn, C.B., F.R.S., to advise them as to the preparations that should be made. This Committee met for the first time on Tuesday week, and have been sitting periodically since.

We understand that the Foreign Office is about to inquire of the United States Government whether the stores sent to a depot on the west coast of Greenland for the use of the *Polaris* are desired to remain there, or whether they may be made available for our expedition. If the United States consent to transfer these stores, it will be of considerable advantage to our ships.

Active preparations are being made at the Royal Victoria Victualling Yard at Deptford, for provisioning the ships which are to be engaged in the expedition. For this purpose 15,000 lb. of beef are undergoing a process of preservation.

It has been proposed, and no doubt very properly, that no persons not actually belonging to the navy can be allowed to take part in the expedition. This, however, effectually precludes any naturalist — as such — being attached to the staff. But the work to be done will principally consist in making collections to be worked up at home. And there is no reason to doubt that, as in the expedition of the *Erebus* and *Terror*, men will be found officially qualified for attachment to the expedition who will use every opportunity of securing for British science the credit of determining the nature of the fauna and flora of the regions in immediate proximity to the pole.

How great an interest is felt amongst naturalists as to the biological results of the expedition, may easily be imagined on reading the following passage from Markham's "Threshold of the Unknown Region" (pp. 201, 202):—

"The winter quarters were in a harbour called 'Thank God' Bay, in lat. 81° 38′ N., and long. 61° 44′ N., which the *Polaris* reached on Sept. 3. . . . The climate of the winter quarters was found to be much milder than it is several degrees further south. In June the plain surrounding 'Thank God' Bay was free from snow; a creeping herbage covered the ground, on which numerous herds of musk oxen found pasture, and rabbits and lemmings abounded. The wild flowers were brilliant, and large flocks of birds came northward in the summer."

The Kew Herbarium possesses four plants presented to it by Commander Markham, who obtained them from Dr. Bessels, of the *Polaris*. They were collected in 82° N. lat., "the most northern position from which any phanerogamic vegetation has hitherto been procured. The locality appears to have been on the east side of Smith's Sound. The species are *Draba alpina*, L.; *Cerastium alpinum*, L.; *Taraxacum Dens-leonis*, Desf. var.; and *Poa flexuosa*, Wahl." (NATURE, vol. viii. p. 487.)

The importance of obtaining information about the marine forms of life, both animal and vegetable, needs no insisting upon.

NOTES

IT will interest our readers to hear that the Berlin Academy of Sciences has set aside a certain sum of money, which will enable it to call to Berlin eminent men of science, who will have no teaching duties to perform. Prof. Kirchhoff has finally decided to accept the directorship of the Observatory for Solar Physics, now being erected at Potsdam, and will proceed to Berlin to commence his duties in connection with its establishment, in the spring.

IT is with great regret that we have to record the death of one of our most promising young naturalists, Mr. J. Traherne Moggridge, whose occasional contributions to these columns gave evidence of the powers of observation and research for which he was distinguished. His works on "Harvesting Ants and Trap-door Spiders," and "Contributions to the Flora of Mentone"—the latter beautifully illustrated by his own hand—contained important additions to our knowledge of different branches of science; a "Supplement" to the former of these works is just now issued from the press. Mr. Moggridge's kindly and unassuming manners had endeared him to a large circle of friends. A love of natural history was with him hereditary, being the grandson of Dillwyn, the monographer of the Confervæ, and joint author with Turner of the "Botanist's Guide." He died on Nov. 24, at the age of thirty-two, at Mentone, where the state of his health had compelled him to spend the winter for several years past. One of his great wishes was to bring his fellow-sufferers to learn, as he had done, that an invalid may be useful and happy.

MR. J. R. HIND writes as follows to the *Times* of Dec. 7, with regard to a new comet:—"Having been favoured with a telegram from M. Stephan, Director of the Observatory of Marseilles, notifying the discovery of a comet by M. Borrelly about four o'clock this morning, we have been able to observe the comet this evening, its present position allowing of observation both evening and morning. The place telegraphed is—Dec. 6, at 16h. mean time at Marseilles; right ascension, 239° 56′; polar distance, 53° 53′; motion towards the north. An uncertainty as to the comparison star unfortunately prevents me from adding the result of my observations this evening, but the comet will be readily found with a good telescope."

IN the same letter Mr. Hind points out that the zodiacal light has been conspicuous for the last few evenings, and that for several years past this phenomenon has been much more marked in December and January than about the vernal equinox.

SURGEON-MAJOR A. LEITH ADAMS, M.D., F.R.S., has been appointed to the Professorship of Zoology in the Royal College of Science at Dublin. Dr. Leith Adams is the author of several works in which natural history forms an important part; among them may be mentioned "Wanderings of a Naturalist in India, the Western Himalayas, and Cashmere," and "Field and Forest Rambles." His elaborate monograph on the "Fossil Elephants of the Maltese Islands" is also on the point of being published in the "Transactions" of the Zoological Society.

DR. J. W. HICKS has been elected to a Fellowship at Sidney Sussex College, Cambridge. Dr. Hicks was Senior in the Natural Science Tripos, and third among the Senior Optimes in 1870. He for some time held the Lectureship in Botany at St. Thomas's Hospital, and is now Demonstrator of Chemistry in the Cambridge University Laboratory. We may mention that though Sidney College was among the first in the University of Cambridge to offer Scholarships in Natural Science, yet its governing body has been chary of further encouraging the study by the bestowal of Fellowships. Ten years ago, indeed, the Senior in the Natural Science Tripos was rewarded by one; but Mr. Hicks has had to wait while wranglers in the "teens" have been preferred to him. We are glad that the College has made amends at last.

THE course for the Natural Science Moderatorships in Trinity College, Dublin, has just been published. It consists of three parts:—1. Physiological and Comparative Anatomy: books recommended, Carpenter's "Human and Comparative Anatomy" and Rolleston's "Forms of Animal Life." 2. Zoology and Botany: books recommended in Zoology, Huxley's "Anatomy of Vertebrates," Foster's "Introduction to Embryology," Nicholson's "Manual of Zoology," and Gegenbaur's "Comparative Anatomy," by Vogt; in Botany, Henfrey's "Course of Botany," by Masters, "Bentham's British Flora," and "Hofmeister on the Higher Cryptogamia," by Currey. 3. Geology and Physical Geography: books recommended, Dana's "Manual of Geology," Haughton's "Manual of Geology," and Keith Johnston's "Physical Geography." If a suggestion may be allowed, it would appear more in conformity with modern ideas that the subjects of the physiology and structure of plants and animals should be treated of as portions of botany and zoology; and surely the distribution of both plants and animals in space and in time appertains more to biology than to geology. Honours are now given in the natural sciences in the Sophister Classes, and the Professors of Geology, Zoology, and Botany give demonstrations in their respective subjects each term.

IN a note on the pollution of the Regent's Canal, the *Lancet* refers to the attempt which has been made to throw the chief blame on the Zoological Society's Gardens, which pour their surface drainage and the contents of their bathing-tanks into the canal. We have, the *Lancet* states, carefully examined the Society's arrangements, and at once acquit them of any blame in the matter. For, though undoubtedly some of the urinary excretion of the animals is carried off by the surface drainage, still the amount is small, and the evil in that respect is more than counterbalanced by the large volume of water (50,000 gallons) daily poured into the canal. Indeed, if that amount of water were in any way diverted, the condition of the canal would, in dry seasons, become worse than it is at present. We were convinced that none of the solid excreta could find their way to the canal through any channel.

WE hope that the meeting held in London on Monday nigh under the presidency of H.R.H. the Duke of Edinburgh will be the means of securing the remaining 30,000*l.* needed to complete the modest sum wanted wherewith to extend the premises of the University of Edinburgh. The meeting was throughout a satisfactory one, and all the addresses, by H.R.H. the Duke of Edinburgh, the Earl of Derby, Prof. Huxley, Dr. Lyon Playfair, Prof. Allman, and others, were pervaded with a strong feeling as to the necessity for an all-important place in education being given to practical training in science. Indeed, it was distinctly stated by Prof. Huxley that the demand for space was not simply owing to the great increase of students in past years, but to the total and happy revolution which had been effected within the last twenty or thirty years in the mode of teaching all branches of physical science. When he was a medical student, the only branch of scientific study properly taught—namely, by practical instruction—was anatomy. It had now, however, come to be understood that what was true of anatomy was true of all branches of science—that no man could know anything about science unless he worked at it practically with his hands. That was the only knowledge on which he could really depend. Hence had arisen the demand for scientific laboratories, in which the student not only had the means and appliances of investigation, but had his work superintended by practical instructors. That demand had increased tenfold the requirements of any teaching body that would do its work worthily, and without the requisite accommodation the scientific teaching of the University could not possibly yield any sound and fruitful results. Moreover, it had come to be recognised that a man could not be a successful teacher, exercising a moral influence on his students which constituted the essential difference between a professor and a book, unless he was himself an original investigator, promoting and increasing knowledge. We have no doubt that we shall soon be able to announce that the whole 100,000*l.* has been subscribed.

A PAPER on "University Development in Scotland," reprinted from the *Perthshire Constitutional*, has been sent us. It takes Edinburgh University, the largest (it has 1,800 students this year) and best known of the Scottish Universities, as representative of the others, and points out several directions in which there is room for improvement. The writer takes the German University as in some sort a model, and points out the following defects in the Scottish Universities:—(1) The want of sufficiently extensive and suitable buildings; (2) There should be a material increase in the teaching staff; (3) There should be a better endowment of professorships; (4) Graduates should be encouraged to devote themselves to *original research* by the provision of liberally endowed professorships; (5) There should be more liberal superannuation of professors after a shorter period of service. The writer urges on all those who have been educated in Edinburgh, and on all who wish to see it keep its position, to lend a hand in the movement now on foot to raise a sum sufficient to provide the University with the additional buildings which are absolutely necessary to its efficiency.

AT the meeting of the Dundee Town Council last Thursday, a letter from the directors of the Albert Institute of that town was read by Provost Cox, in which it was stated that a scheme for the erection of a college had been prepared, and the co-operation of the Council in the furtherance of the work was requested. It was proposed to establish a college in Dundee in connection with the St. Andrews University, and that at first the college should be opened with six chairs—namely, English Literature and Logic, Chemistry, Natural Philosophy, Engineering, Natural History or Greek and Latin, and Mathematics. To defray the expense of the erection of the college and to pay the salaries, 150,000*l.* would be required at the outside. If the college should succeed, it was proposed to add the following additional chairs—viz., Mental and Moral Philosophy, Political Economy, Ancient or Modern History, Latin and Greek or Natural History, Geography and Astronomy, and Physical Geography and Navigation. To endow these additional chairs a further sum of 75,000*l.* would be required. It was proposed that the management of the college should be carried on by the courts which at present manage the colleges at St. Andrews, the only addition to the University Courts of St. Andrews being that the following gentlemen should be members of that Court:—The Lord-Lieutenant of Forfarshire, the Convener of the County, the Sheriff and Sheriff-Substitute of Forfarshire, and the Provost of Dundee. The Council expressed themselves gratified at the movement, and while stating that they would be willing to give it their hearty co-operation, they resolved to call a special meeting for the consideration of the whole subject, to be held on Tuesday last. We would remind the organisers of the proposed new college of the great value of sound science-teaching to so important a manufacturing and commercial town as Dundee. There is nothing to hinder the wealthy merchants and manufacturers of Dundee starting a college at least equal to the Newcastle College of Science, and they should not rest until they possess an institution as efficient as Owens College, Manchester. This latter institution ought to be taken as a model, where all the so-called "faculies" are complete; a "College of Science," pure and simple, seems to us a blunder.

THE formal inauguration of the recently completed portions of the Edinburgh Museum of Science and Art is, we believe, to take place on Jan. 14 next, by a grand *conversazione* to be given by the Lord Provost in the Museum building.

A FURTHER instalment (the sixth part) of the new Government Map of Switzerland has recently appeared, containing the sheets Meiringen, Laax, Trons, Ilanz, Greina, Vrin, Andeer, Zweisimmen, Blumlisalp, Peccia, Blasca, and Maggia. Altogether 72 sheets are now published out of the 546 which will be necessary for the completion of the map. Those which have been issued are mainly of the central and north-west portions of the country, and regarding them we can only repeat the opinion that we have already expressed respecting the earlier sheets, namely, that they are equal and in some features superior to any maps of the kind that have yet appeared. Great as the cost of this map will be to the nation, we have no doubt that its expense will be repaid many times, in the facilities which it will afford in the construction of roads and railroads, and for many other purposes.

WE take the following from the *Academy*:—Now that the question of the endowment of research is being made so much a subject of discussion, it may interest our readers to learn the following particulars, which we take from the Swedish *Aftonbladet*. About a month since that newspaper drew attention to an appeal for funds made by the botanist Dr. Berggren, who is at present exploring the cryptogamic botany of the mountains of New Zealand. It appears that Dr. Berggren has already made some very valuable explorations, first in Spitzbergen in 1868, then in Greenland in 1870, and now has been sent out to New Zealand with a stipend drawn from a sum of money left by a Herr Lettersted for scientific purposes. Dr. Berggren writes that he has had signal success, especially in discovering species closely analogous to the Arctic forms with which he is familiar, but that his means are at an end. An effort made to induce the Government of Canterbury Province to vote him a sum of money was on the point of succeeding, when an economical frenzy took the Lower Legislative House, and the bill was thrown out. *Aftonbladet* laid these facts before its readers. Almost immediately, the proprietors of another newspaper, *Göteborg's Post*, generously forwarded a large sum towards the prosecution of the work, and private funds came in so rapidly that Dr. Berggren will be able to recommence his valuable explorations directly the next mail reaches New Zealand. This zealous response to the demands of science in so poor a country as Sweden does honour to the intelligence of its people.

A TELEGRAM dated Alexandria, Dec. 8, states that two reconnoitring expeditions, each consisting of eight European and twelve native officers and sixty-three soldiers, have been organised by the Egyptian Government, and have started for the Soudan, with the object of surveying the country between the Nile and the provinces of Darfour and Kordofan. Thence the expeditions will proceed to the Equator, west of the Albert Nyanza. They will repair the wells wherever necessary, and prepare maps, and will also report upon the population, climate, and commerce of the country through which they pass.

A MEETING of the local committee in connection with the recent meeting of the British Association, was held in Belfast on Saturday. The expense incurred has been about 1,800*l.*, leaving a surplus of more than 500*l.*, which the Executive Committee recommend should be divided among various local institutions.

WE would draw attention to a very valuable paper "On the Expediency of Protection for Patents," by Mr. F. J. Bramwell, C.E., F.R.S., published in the *Society of Arts Journal* for Dec. 4.

THE additions to the Zoological Society's Gardens during the past week include two Glaucous Gulls (*Larus glaucus*) from Spitzbergen, presented by Mr. R. E. Beaumont; a Common Raccoon (*Procyon lotor*) from N. America, presented by Mr. T. Trimnell; a Bonnet Monkey (*Macacus radiatus*) from India, presented by Mrs. Phillips; a Solitary Tinamon (*Tinamus solitarius*) from Brazil, received in exchange; three Black-footed Penguins (*Spheniscus demersus*) from S. Africa, purchased; a Capybara (*Hydrochœrus capybara*) born in the Gardens.

THE "CHALLENGER" EXPEDITION*

II.

THE following Table, taken from the chart, gives a good general idea of the distribution of the two formations with respect to depth. It cannot of course be taken as exact; the indications were jotted down from the impression of colour given at the time, and there is no hard and fast line between Globigerina ooze and grey ooze on the one hand, and between red clay and grey ooze on the other. This Table gives an average depth of 1,800 fathoms for our soundings in the Globigerina ooze. This is datum of no value, for we only rarely sounded in shallow water, and we know that this formation covers large areas at depths between 300 and 400 fathoms; but the mean maximum depth at which it occurs is important, and that may be taken from the Table as about 2,250 fathoms. The mean depth at which we find the transition grey ooze is 2,400 fathoms, and the mean depth of the red clay soundings is about 2,700 fathoms. The general concurrence of so many observations would go far to prove, what seems now to stand indeed in the position of an ascertained fact, that wherever the depth increases from about 2,200 to 2,600 fathoms, the modern chalk formation of the Atlantic and of other oceans pass into a clay.

* Continued from p 7.

No. of Station.	Nature of the Bottom. Glob. Ooze.	Grey Ooze.	Red Clay.
From Cape Finisterre to Teneriffe.			
I.	1125	...	...
	1975	...	...
II.	470	...	...
	1800	...	...
III.	1000	...	...
VI.	1525	...	...
From Teneriffe to St. Thomas.			
1	1890	...	...
2	1945	...	...
4	2220	...	...
5	...	...	2740
6	...	...	2950
7	...	...	2750
8	...	...	2800
9	...	...	3150
10	...	...	2720
11	...	...	2575
12	2025	...	...
13	1900	...	...
14	1950	...	...
15	...	...	2325
16	...	...	2435
17	...	...	2385
18	...	...	2675
19	...	...	3000
20	...	...	2975
21	...	...	3025
22	1420	...	...
23	450	...	...
From St. Thomas to Bermudas.			
25	...	3875	...
26	...	2800	...
27	...	2960	...
28	...	...	2850
29	...	...	2700
30	...	...	2600
31	...	2475	...
32	...	2250	...
...	...	1820	...
From Bermudas to Halifax.			
37	...	2650	...
38	...	2600	...
39	...	2850	...
42	...	2425	...
44	...	1700	...
From Halifax to Bermudas.			
50	...	1250	...
51	...	2200	...
52	...	2800	...
53	...	2650	...
54	...	2650	...
55	...	2500	...
From Bermudas to the Azores.			
58	...	1500	...
59	...	2360	...
60	...	2575	...
61	...	2850	...
62	...	2875	...
63	...	2750	...
65	...	2700	...
66	...	2750	...
67	...	2700	...
68	...	2175	...
69	...	2200	...
70	1675	...	...
From Bermudas to the Azores (continued).			
71	1675	...	...
72	1240	...	...
73	1000	...	...
74	1350	...	...
76	900	...	...
From the Azores to Madeira.			
78	1000	...	...
79	2025	...	...
80	2660	...	...
81	2675	...	...
82	2400	...	...
83	1650	...	...
From Madeira to Cape Verde Islands.			
86	2300	...	...
88	2300	...	...
89	2400	...	...
90	2400	...	...
91	2075	...	...
92	1975	...	...
From the Cape Verde Islands to St. Paul Rocks.			
95	2300	...	...
97	2575	...	...
98	1750	...	...
102	...	2450	...
104	...	2500	...
105	...	2275	...
106	1850	...	...
107	1500	...	...
108	1900	...	...
From the St. Paul Rocks to S. Salvador.			
110	2275	...	...
111	2475	...	...
112	2200	...	...
115	2150	...	...
116	2275	...	...
From S. Salvador to Tristan d'Acunha.			
129	...	...	2150
130	...	...	2350
131	2275	...	...
132	2050	...	...
133	1900	...	...
134	2025	...	...
From Tristan d'Acunha to the Cape of Good Hope.			
137	...	...	2550
138	...	...	2650
139	...	2325	...
140	...	1250	...
From the Cape of Good Hope to Kerguelen Island.			
143	1900	...	...
144	1570	...	...
146	1375	...	...
147	1600	...	...
From Kerguelen Island to Melbourne.			
158	1800	...	...
159	2150	...	...
160	...	...	2600

The nature and origin of this vast deposit of clay is a question of the very greatest interest; and although I think there can be no doubt that it is in the main solved, yet some matters of detail are still involved in difficulty. My first impression was that it might be the most minutely divided material, the ultimate sediment produced by the disintegration of the land, by rivers and by the action of the sea on exposed coasts, and held in suspension and distributed by ocean currents, and only making itself manifest in places unoccupied by the Globigerina ooze. Several circumstances seemed, however, to negative this mode of origin. The formation seemed too uniform; whenever we met with it it had the same character, and it only varied in composition in containing less or more carbonate of lime.

Again, we were gradually becoming more and more convinced that all the important elements of the Globigerina ooze lived on the surface; and it seemed evident that so long as the conditions on the surface remained the same, no alteration of contour at the bottom could possibly prevent its accumulation; and the surface conditions in the Mid-Atlantic were very uniform, a moderate current of a very equal temperature passing continuously over elevations and depressions, and everywhere yielding to the tow-net the ooze-forming foraminifera in the same proportion. The Mid-Atlantic swarms with pelagic mollusca, and in moderate depth the shells of these are constantly mixed with the Globigerina ooze, sometimes in number sufficient to make up a considerable portion of its bulk. It is clear that these shells must fall in equal numbers upon the red clay, but scarcely a trace of one of them is ever brought up by the dredge on the red clay area. It might be possible to explain the absence of shell-secreting animals living on the bottom, on the supposition that the nature of the deposit was injurious to them; but then the idea of a current sufficiently strong to sweep them away is negatived by the extreme fineness of the sediment which is being laid down; the absence of surface shells appears to be intelligible only on the supposition that they are in some way removed.

We conclude, therefore, that the "red clay" is not an additional substance introduced from without, and occupying certain depressed regions on account of some law regulating its deposition, but that it is produced by the removal, by some means or other, over these areas of the carbonate of lime, which forms probably about 98 per cent. of the material of the Globigerina ooze. We can trace, indeed, every successive stage in the removal of the carbonate of lime in descending the slope of the ridge or plateau when the Globigerina ooze is forming to the region of the clay. We find, first, that the shells of pteropods and other surface mollusca, which are constantly falling on the bottom, are absent, or if a few remain they are brittle and yellow, and evidently decaying rapidly. These shells of mollusca decompose more easily and disappear sooner than the smaller and apparently more delicate shells of rhizopods. The smaller foraminifera now give way and are found in lessening proportion to the larger; the coccoliths first lose their thin outer border and then disappear, and the clubs of the rhabdoliths get worn out of shape and are last seen under a high power as infinitely minute cylinders scattered over the field. The larger foraminifera are attached, and instead of being vividly white and delicately sculptured, they become brown and worn, and finally they break up, each according to its fashion; the chamber-walls of Globigerina fall into wedge-shaped pieces, which quickly disappear, and a thick rough crust breaks away from the surface of Orbulina, leaving a thin inner sphere, at first beautifully transparent, but soon becoming opaque and crumbling away.

In the meantime the proportion of the amorphous "red clay" to the calcareous elements of all kinds increases until the latter disappear, with the exception of a few scattered shells of the larger foraminifera, which are still found even in the most characteristic samples of the "red clay."

There seems to be no room left for doubt that the red clay is essentially the insoluble residue, the *ash*, as it were, of the calcareous organisms which form the Globigerina ooze after the calcareous matter has been by some means removed. An ordinary mixture of calcareous foraminifera with the shells of pteropods, forming a fair sample of Globigerina ooze from near St. Thomas, was carefully washed and subjected by Mr. Buchanan to the action of weak acid; and he found that there remained after the carbonate of lime had been removed, about one per cent. of a reddish mud consisting of silica, alumina, and the red oxide of iron. This experiment has been frequently repeated with different samples of Globigerina ooze, and always with the result that a small proportion of a red sediment remains which possesses all the characters of the red clay.

In the Globigerina ooze siliceous bodies, including the spicules of sponges, the spicules and tests of radiolarians, and the frustules of diatoms occur in appreciable proportion; and these also diminish in number, and the more delicate of them disappear in the transition from the calcareous ooze to the red clay.

I have already alluded to the large quantity of nodules of the peroxide of manganese which were brought up by the trawl from the red-clay area on the 13th of March. Such nodules seem to occur universally in this formation. No manganese can be detected in the Globigerina ooze; but no sooner has the removal of the carbonate of lime commenced than small black grains make their appearance, usually rounded and mammillated on the surface, miniatures, in fact, of the larger nodules which abound in the clay; and at the same time any large organic body, such as a shark's tooth, that may happen to be in the ooze is more or less completely replaced by manganese; and any inorganic body, such as a pebble or a piece of pumice, is coated with it as a fine black mammillated layer. It is not easy to tell what the proportion of manganese in the red clay may be, but it is very considerable. At station 160, on the 13th of March, the trawl brought up nearly a bushel of nodules from the size of a walnut to that of an orange, but these were probably the result of the sifting of a large quantity of the clay. The manganese is doubtless set free like the iron by the decomposition of the organic bodies and tests. It is known to exist in the ash of some algæ to the amount of four per cent.

The interesting question now arises as to the cause and method of the removal of the carbonate of lime from the cretaceous deposit, and on this matter we are not yet in a position to form any definite conclusion.

One possible explanation is sufficiently obvious. All sea-water contains a certain proportion of free carbonic acid, and Mr. Buchanan believes that he finds it rather in excess in bottom-water from great depths. At all events the quantity present is sufficient to convert into a soluble compound, and thus remove a considerable amount of carbonic lime. If the balance of supply be very delicately adjusted, it is just conceivable that the lime in the shells in its fine state of subdivision having been attacked by the sea-water from the moment of the death of the animal, may be entirely dissolved during its retarded passage through the half mile or so of water of increasing density. The bottom-water in these deep troughs has been lost at the surface, a great deal of it in the form of circumpolar freshwater ice; and though fully charged with carbonic acid, it is possible that it may be comparatively free from carbonate of lime, and that its solvent power may thus be greater.

The red clay, or more probably the circumstances which lead to its deposition, seem on the whole unfavourable to the development of animal life. Where its special characters are most marked, no animals which require much carbonate of lime for the development of their tissues or their habitations appear to exist. Our growing experience is, that although animal life is possible at all depths after a certain depth, say 1,500 fathoms, its abundance diminishes. This would seem to indicate that the extreme conditions of vast depths are not favourable to its development: and one might well imagine that the number of shell-building animals might decrease until the supply of lime was so far reduced as to make it difficult for them to hold their own against the solvent power of the water of the sea—just as in many districts where there is little lime, the shells of land and freshwater molluscs are light and thin, and the animals themselves are stunted and scarce.

It seems, however, that neither the extreme depth at which the red clay is found, nor the conditions under which it is separated and laid down, are sufficient entirely to negative the existence of living animals, even of the higher invertebrate orders. In several of the hauls we brought up holothurids of considerable size, with the calcareous neck-rings very rudimentary, and either no calcareous bodies in the test or a mere trace of such. Nearly every haul gave us delicate branching Bryozoa with the zoœcium almost membranous. One fortunate cast, about 150 miles from Sombrero, brought up from a depth of 2,975 fathoms very well-marked red mud, which did not effervesce with hydrochloric acid. Entangled in the dredge, and imbedded in the mud, were many of the tubes of a tube-building annelid, several of them 3 in. to 4 in. long, and containing the worm, a species of Myriochele, still living. The worm-tubes, like all the tests of foraminifera from the same dredging, were made up of particles of the red clay alone.

It seems evident, from the observations here recorded, tha *clay*, which we have hitherto looked upon as essentially the product of the disintegration of older rocks, may be under certain circumstances an organic formation like chalk; that as a matter of fact, an area on the surface of the globe, which we have shown to be of vast extent, although we are still far from having ascertained its limits, is being covered by such a deposit at the present day.

It is impossible to avoid associating such a formation with the fine, smooth, homogeneous clays and schists, poor in fossils, but showing worm-tubes and tracks, and bunches of doubtful branching things, such as Oldhamia, siliceous sponges, and thin-shelled peculiar shrimps. Such formations more or less metamorphosed are very familiar, especially to the student of palæozoic geology, and they often attain a vast thickness. One is inclined, from this great resemblance between them in composition and in the general character of the included fauna, to suspect that these may be organic formations, like the modern red clay of the Atlantic and Southern Sea, accumulations of the insoluble ashes of shelled creatures.

The dredging in the red clay on the 13th of March was unusually rich. The bag contained examples, those with calcareous shells rather stunted, of most of the characteristic deep-water groups of the Southern Sea, including Umbellularia, Euplectella, Pterocrinus, Brisinga, Ophioglypha, Pourtalesia, and one or two Mollusca. This is, however, very rarely the case. Generally the red clay is barren, or contains only a very small number of forms.

On the 11th of February, lat. 60° 52′ S., long. 80° 20′ E., and March 3, lat. 53° 55′ S., long. 108° 35′ E., the sounding instrument came up filled with a very fine cream-coloured paste, which scarcely effervesced with acid, and dried into a very light impalpable white powder. This, when examined under the microscope, was found to consist almost entirely of the frustules of diatoms, some of them wonderfully perfect in all the details of their ornament, and many of them broken up. The species of diatoms entering into this deposit have not yet been worked up, but they appear to be referable chiefly to the genera Fragilaria, Coscinodiscus, Chætoceros, Asteromphalus, and Dictyocha, with fragments of the separated rods of a singular siliceous organism, with which we were unacquainted, and which made up a large proportion of the finer matter of this deposit. Mixed with the diatoms there were a few small Globigerinæ, some of the tests and spicules of radiolarians, and some sand particles; but these foreign bodies were in too small proportion to affect the formation as consisting practically of diatoms alone. On the 4th of February, in lat. 52° 29′ S., long. 71° 36′ E., a little to the north of the Heard Islands, the tow-net, dragging a few fathoms below the surface, came up nearly filled with a pale yellow gelatinous mass. This was found to consist entirely of diatoms of the same species of that found at the bottom. By far the most abundant was the little bundle of siliceous rods, fastened together loosely at one end, separating from one another at the other end, and the whole bundle loosely twisted into a spindle. The rods are hollow, and contain the characteristic endochrome of the Diatomaceæ. Like the Globigerina ooze, then, which it succeeds to the southward in a band apparently of no great width, the materials of this siliceous deposit are derived entirely from the surface and intermediate depths. It is somewhat singular that diatoms did not appear to be in such large numbers on the surface over the diatom ooze as they were a little further north. This may perhaps be accounted for by our not having struck their belt of depth with the tow-net; or it is possible that when we found it on the 11th of February the bottom deposit was really shifted a little to the south by the warm current, the excessively fine flocculent débris of the diatoms taking a certain time to sink. The belt of diatom ooze is certainly a little further to the southward in long. 80° E. in the path of the reflux of the Agulhas current than in long. 108° E.

All along the edge of the ice-pack—everywhere, in fact, to the south of the two stations, on the 11th of February on our southward voyage, and on the 3rd of March on our return, we brought up fine sand and greyish mud, with small pebbles of quartz and felspar, and small fragments of mica-slate, chlorite-slate, clay-slate, gneiss, and granite. This deposit, I have no doubt, was derived from the surface like the others, but in this case by the melting of icebergs and the precipitation of foreign matter contained in the ice.

We never saw any trace of gravel or sand, or any material necessarily derived from land, on an iceberg. Several showed vertical or irregular fissures filled with discoloured ice or snow; but when looked at closely the discoloration proved usually to be very slight, and the effect at a distance was usually due to the foreign material filling the fissure reflecting light less perfectly than the general surface of the berg. I conceive that the upper surface of one of these great tabular southern icebergs, including by far the greater part of its bulk, and culminating in the portion exposed above the surface of the sea, was formed by the piling up of successive layers of snow during the period, amounting perhaps to several centuries, during which the ice-cap was slowly forcing itself over the low land and out to sea over a long extent of gentle slope, until it reached a depth considerably above 200 fathoms, when the lower specific weight of the ice caused an upward strain which at length overcame the cohesion of the mass, and portions were rent off and floated away. If this be the true history of the formation of these icebergs, the absence of all land débris in the portion exposed above the surface of the sea is readily understood. If any such exist, it must be confined to the lower part of the berg, to that part which has at one time or other moved on the floor of the ice-cap.

The icebergs, when they are first dispersed, float in from 200 to 250 fathoms. When, therefore, they have been drifted to latitudes of 65° or 64° S., the bottom of the berg just reaches the layer at which the temperature of the water is distinctly rising, and it is rapidly melted, and the mud and pebbles with which it is more or less charged are precipitated. That this precipitation takes place all over the area where the icebergs are breaking up constantly, and to a considerable extent, is evident from the fact of the soundings being entirely composed of such deposits; for the diatoms, Globigerinæ, and radiolarians are present on the surface in large numbers; and unless the deposit from the ice were abundant it would soon be covered and masked by a layer of the exuviæ of surface organisms.

SCIENTIFIC SERIALS

Poggendorff's Annalen der Physik und Chemie, No. 6.—The first paper, by G. Lundquist, On the reflection of light from the outside of isotropic bodies, is reprinted from the "Transactions" of the Royal Society of Upsala.—Dr. H. Brougersma contributes a memoir On the Medium in electrical influence, in which, following up the experiments of Riess, he examines Faraday's theory of electrical induction by polarisation of the medium, and describes in detail the apparatus with which he experimented, tabulates his results, and agrees with Riess's induction as to a direct influx of electricity.—The next article comprises a series of communications from the Mineralogical Institute of the University of Strasburg, in which Paul Groth treats of the crystalline form and thermo-electric properties of smaltine or arsenical cobalt. Its chemical formula is very variable, $R = (Co, Ni, Fe)\ As_2$. Eight samples from different localities, which contribute a better knowledge of the hemihedral forms of the species, are discussed. He concludes that some of the forms hitherto regarded as holohedral are hemihedral forms with parallel sides. As with iron pyrites and cobalt-glance, with which it is isomorphous, one part of the crystal is negative towards copper, while the other half is positive.—Dr. Hintze treats of the chemical composition of leadhillite. Prof. Laspeyres two years ago described a mineral from Iglesias, in Sardinia, under the name of maxite, of which the formula was $5PbSO_4 + 9PbCO_3 + 4PbO + 5H_2O$. M. Bertrand, of Paris, soon after published an account of leadhillite from the same neighbourhood. The author proves that the two minerals are identical, and that the formula of leadhillite is not $PbSO_4 + 3PbCO_3$ as hitherto believed, but $2PbSO_4 + 4PbCO_3 + PbO + 2H_2O$. The next paper, by the same author, is crystallographic researches on the combination of aldehyde with the aromatic hydrocarbons. The chemical composition and crystalline forms are given of ditolyltrichloraethan, diphenyltribromaethan, diphenyltrichloraethylen, diphenyldibromaethan, dimonobromphenyltrichloraethan, &c. All these bodies belong to the monoclinic system.—Dr. A. Arzruni gives a short note on twin-growth in willemite. The next paper by the same author is "Optical researches on the turpentinoelhydrates," which he follows by crystallographic and optical researches on compounds of urea. His last paper is on two isomorphous substances derived from benzol.—F. Zollner prints his important paper on the aggregation and position of the sun-spots, and concludes that they are cooled scoriaceous products.—Dr. Karl Braun contributes studies on the earth's magnetism.—Among the reprinted papers are Dr. Andrews' on ozone and Prof. Wright's on the polarisation of the zodiacal light.

Memorie della Societa Spettroscopisti Italiani, September 1874.—This number contains a paper by Mr. J. N. Lockyer, describing certain phenomena seen when examining the spectrum of the electric light through a mass of sodium vapour in a tube. When this is done, the sodium lines are seen to shade gradually off, sometimes on one side, sometimes on both, the boundary of the shading being curved and sometimes limited by a bright line.—There is also another paper by the same author, On experiments on the absorption of a great thickness of sodium and iodine vapour in a tube 5 ft. long. After mentioning that it had been hitherto assumed that a great thickness of gas causes its radiation, and therefore its absorption, to become more continuous, he states that, on generalising his work, it appears that when the density of a vapour is increased, a continuous spectrum is approached in the case of the metallic elements of low specific gravity by the widening of their lines, and in that of the elements of high sp. gr. by the increase of the number of lines. To test this, the absorption of sodium vapour in a 5 ft. tube was observed, and the D line was found to be no thicker than the same line produced by a test-tube full of the vapour, and the line was thicker than the D-line in the solar spectrum, in which spectrum all the short lines are reversed.—Father Secchi communicates a letter of A. T. Arcimis, detailing observations on the spectra of meteorites. The spectra of all seem to be continuous, but wanting in the violet, that colour of the spectrum predominating according to its colour to the naked eye. The sodium line was visible in the trail of some, as also were the lines of magnesium.—G. De Sisa gives a table of the solar spots observed at Palermo from June to September.—A table of the chromosphere, as seen during February and March last at Palermo, is added to this number.—E. Fergola contributes a lengthy paper on the position of the axis of rotation of the earth with respect to its axis of figure.

SOCIETIES AND ACADEMIES

LONDON

Linnean Society, Dec. 3.—Dr. G. J. Allman, F.R.S., president, in the chair.—Mr. Jas. Brogden, Sir Edmund Buckley, Bart., M.P., Messrs. Jas. Cowherd, P. Duffy, C. C. Dupré, A. M. Ross, and J. W. Silver were severally elected Fellows of the Society.—Prof. Huxley read a paper On the classification of the animal kingdom, which will be found in another column. An interesting discussion followed, in which the President, Mr. Busk, Mr. H. G. Seeley, Mr. Stewart, Dr. Murie, and others took part.

Chemical Society, Dec. 3.—Mr. W. H. Perkins, F.R.S., in the chair.—A paper was read by Mr. S. Lupton On the formulæ of the alums; the next was a notice On the colour of cupric chloride, by Mr. W. N. Hartley, who finds that the crystals of the salt when quite dry have a blue colour, and not a green, as they usually appear when slightly moist.—Papers were also read On the oxidation of the essential oils, Part II. by Mr. C. T. Kingzett; On the purification and boiling-point of methyl hexyl carbinol, by Mr. E. Neison; and a note on the boiling-point of methyl hexyl carbinol, by Dr. C. Schorlemmer, F.R.S.

Zoological Society, Dec. 1.—Dr. A. Günther, F.R.S., in the chair.—A letter was read from the Rev. S. J. Whitmee, of Samoa, stating that he had sent home for the Society some birds and a pair of the Samoan Bat, which had lately been described by Mr. Alston as *Pteropus whitmeei*. Particulars were given as to the habits of the latter.—A communication was read from Mr. Henry W. Piers, of Capetown, containing remarks on some specimens of Gymnetrus in the museum at Capetown.—The Secretary announced that Col. R. S. Tickell, late of H.M. Indian Army, had presented to the Society's library a very finely illustrated MS. work, in seven small folio volumes, on the Ornithology of India.—A communication was read from Mr. J. Brazier, of Sydney, N.S.W., giving descriptions of eleven new species of terrestrial and marine shells from North-east Australia.—A paper, by Messrs. P. L. Sclater and O. Salvin, was read on birds collected by Mr. Whitely in Western Peru, being the eighth communication made by the authors on this subject.—A communication was read from Mr. H. Whitely, containing some further notes on Humming Birds collected by him in High Peru.—Mr. A. G. Butler read a paper in which he gave descriptions of three new species of homopterous insects from various parts of the world.—Mr. A. H. Garrod gave some further particulars on the mechanism of the "shew off" in the Bustards, and described the peculiar structure of the *frenum linguæ* recently noticed in a young male of the Great Bustard.

Royal Horticultural Society, Dec. 2.—Scientific Committee.—Andrew Murray, F.L.S., in the chair.—Models were exhibited of the fruit of *Stephanotis floribunda*.—The Chairman made a communication on the Larch disease. It appeared to produce a local destruction and ulceration of the cambium layer; the trees affected by it also suffered from "piping," *i.e.*, premature decay of the heart wood. The disease was now beginning to attack the Spruce and *Pinus excelsa*.—Prof. Thiselton Dyer exhibited part of the stem of a *Calamus* from Sikkim, in which the midrib of a sheathing leaf had produced an adventitious bud on its under side.—Dr. Denny raised a discussion on the possibility of superfœtation in plants.

General Meeting.—W. Lindsay, secretary, in the chair.—Prof. Thiselton Dyer commented on the investigations lately undertaken with respect to the potato disease. Prof. de Bary was disposed to believe that heterœcism occurred in the case of the potato parasite, that is to say, that part of its life was passed upon some other host besides the potato. Mouillefert had recently suggested that this might be clover, and Mr. Jenkins, secretary of the Royal Agricultural Society, supposed that both clover and straw might harbour the unknown stage of *Peronospora infestans*, and that this "would justify the prevailing opinion that farm-yard manure encourages the ravages of the potato disease, especially when applied in spring, because the spores of the fungus would be in the manure which had been used for litter."

Royal Microscopical Society, Dec. 2.—Chas. Brooke, F.R.S., president, in the chair.—A paper by Dr. Hudson, "On the discovery of some new male Rotifers," was read by the secretary, in the absence of the author. It described the male forms of Lascinularia, Floscularia, and Notommata, hitherto believed to be unisexual, and was illustrated by a number of very beautiful diagrams.—A paper by Dr. Schmidt, of New Orleans, upon the development of the small blood-vessels in the human embryo, was taken as read.

Victoria (Philosophical) Institute, Dec. 7.—The proceedings were commenced by the election of sixty-five new members and associates. It was stated that the total number of subscribing members was now 544.—Prof. H. Alleyne Nicholson, M.D., read his paper On the bearing of certain palæontological facts upon the Darwinian theory of the Origin of Species, and on the general doctrine of Evolution. The paper, after discussing the nature of the views usually held as to Evolution, examined in detail the difficulties which Palæontology offers to the acceptance of the Darwinian theory of the Origin of Species, and the arguments employed by Mr. Darwin to lessen or remove these difficulties.

EDINBURGH

Royal Society, Dec. 7.—Sir W. Thomson, president, in the chair.—The President delivered to Prof. Tait the Keith Prize for the biennial period (1871-1873), which had been awarded to him by the Council for a memoir published in the last part of the Transactions of the Society, entitled "First Approximation to a Thermo-Electric Diagram."—The President then delivered an address on "Stability of Steady Motion."

PARIS

Geographical Society, Nov. 18.—President, M. Delesse.—M. Vinot announced that an interesting discovery had been made on the summit of the Puy de Dôme, of the ruins of an ancient monument which seems to date from the first century after the conquest of Gaul by the Romans.—Dr. Hamy, in the name of M. de la Porte, chief of the last expedition to Cambodia, read a note containing interesting details concerning the country which he has explored. With the exception of a few principal points, Cambodia is in great part still unexplored. A new map of the country by M. de la Porte and M. Moura, representing the French protectorate in Cambodia, will shortly be published. M. de la Porte believes that many archæological discoveries of the highest importance are yet to be made in Cambodia, and he expects considerable results from the exploration about to be made by M. Harmand in the regions to the west of the French colony.

Academy of Sciences, Nov. 30.—M. Frémy in the chair.—The following papers were read:—Note on two properties of the ballistic curve, whatever may be the exponent of the power of the velocity to which the resistance of the medium is proportional, by M. H. Résal.—On the carpellary theory according to the Liliaceæ, by M. A. Trécul.—On the distribution of the bands in primary spectra, by M. G. Salet.—On the mechanism of the intra-stomachal solution of the gastric concretions of crabs, by M. S. Chantran.—M. Dumas called the attention of the Academy to the recent appearance of Phylloxera in Pregny, near Geneva, and M. Pasteur made some observations thereon. Letters from M. Schnetzler and M. Max Cornu to M. Dumas on the subject of Phylloxera were also read.—Letter from Mdme. V° Bouchard-Huzard to the President, offering to the Academy documents relating to a great number of its members; documents composing the collection made by J. B. Huzard.—On the heat disengaged by the combination of hydrogen with the metals, by M. J. Moutier. The author has shown that the formula deduced by Clausius from Carnot's theorem for changes of state is applicable to dissociation. The formula is—

$$L = AT(v - v')\frac{dp}{dP}$$

L representing the heat of combination of two bodies at the absolute temperature T under the pressure p, equal to the tension of dissociation at that temperature, v the specific volume of the dissociated elements, and v' the specific volume of the compound under the same conditions of temperature and pressure. A is the thermal equivalent of work. From this formula the value of L can be found when we have tables of the tensions of dissociation of the compound at different temperatures.—The recent experiments of MM. Troost and Hautefeuille have made known these tensions for combinations of hydrogen with palladium, potassium, and sodium, at different temperatures.—Orbit, period of revolution, and mass of the double star 70 *p* Ophiucus, by M. C. Flammarion.—Observations of the zodiacal light at Toulouse, the 16th, 21st, and 23rd of September; 9th, 10th, and 11th Oct.; 10th and 12th of November, 1874, by M. Gruly.—Laws of double internal reflection in birefringent uni-axial crystals, by M. Abria.—Researches on the decomposion of certain salts by water, by M. A. Ditte. In this third note the author has examined the double sulphate of potassium and calcium.—On the additive product of propylene and hypochlorous acid, by M. L. Henry.—Employment of gas-retort carbon in the distillation of sulphuric acid, by M. F. M. Raoult.—Influence of boiling distilled water on Fehling's solution, by MM. E. Boivin and D. Loiseau.—Iron in the organism, by M. P. Picard.—On experimental septicemy, by M. V. Feltz.—On the birth and evolution of *bacteria* in organic tissues sheltered from the air, by M. A. Servel.—Note on a stony concretion, by Dr. T. L. Phipson.—On some passages in "Stan. Bell," from which it may be concluded that *Amaranthus blitum* is cultivated in Circassia for the nitre which it contains; extract from a letter from M. Brosset.—Note on the lowering and natural elevation of lakes, by M. Dausse.—The compound flute during the reindeer period, by M. Ed. Piette.

BOOKS AND PAMPHLETS RECEIVED

BRITISH.—The Straits of Malacca, Indo-China, and China: J. Thompson, F.R.G.S. (Sampson Low).—Travels in South America: Paul Marcoy (Blackie and Son).—Supplement to Harvesting Ants and Trapdoor Spiders: J. Traherne Moggridge, F.L.S., F.Z.S., and Rev. O. Pickard-Cambridge (L. Reeve and Co.)—English Men of Science; their Nature and Culture: Francis Galton, F.R.S. (Macmillan and Co.)—Selections from Berkeley: Alex. Campbell Fraser, LL.D. (Clarendon Press).—Elements of Animal Physiology: John Angell (Wm. Collins.)—Elements of Magnetism and Electricity: John Angell (Wm. Collins).—Principles of Metal Mining: J. H. Collins, F.G.S. (Wm. Collins).—Evolution and the Origin of Life: H. Charlton Bastian, M.A., M.D., F.R.S. (Macmillan and Co.)—The Forces which carry on the Circulation of the Blood: Andrew Buchanan, M.D. (J. and A. Churchill).

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