THURSDAY, JUNE 8, 1871

THE GENERAL OCEANIC CIRCULATION

AMONG the results of the *Porcupine* Expeditions of 1869 and 1870, there are perhaps none more important than those relating to the Temperature of the Deep Sea. For it is only to such accurate determinations of ocean temperatures as have now been made for the first time, not only at the surface and the bottom, but also at intermediate depths, that a really scientific theory can be framed of that great Oceanic Circulation, which, while it eludes all ordinary means of direct observation, seems to produce a far more important effect, both on terrestrial climate and on the distribution of the marine fauna, than that of the entire aggregate of the surface-currents which are more patent to sight. The latter usually have winds for their prime motors, and their direction is mainly determined by the configuration of the land; so that their course and action will change with any superficial alteration which either opens out a new passage or blocks up an old one. The former, on the other hand, depending solely on difference of temperature, will (to use Sir J. Herschel's apposite language) have its movements, direction, and channels of concentration mainly determined by the configuration of the sea-bottom; and vast elevations and subsidences may take place in this, without producing any change that is discernible at the surface.

The history of the doctrine of the general oceanic circulation has been recently given in the Anniversary Address of the President of the Geological Society, with a completeness which (so far as we are aware) had never been previously paralleled. But this doctrine has hitherto rested on the very insecure foundation of observations which were alike inadequate and inaccurate; and it has consequently been discredited, both by physicists and by physical geographers. It is now impossible to assign a precise value to the older observations upon deep-sea temperatures. For it was shown by the careful experiments which were made by Mr. Casella two years ago, under the direction of the late Prof. W. A. Miller, Dr. Carpenter, and Captain Davis of the Admiralty, that the pressure of sea-water at great depths on the bulb of the thermometer—a pressure amounting to about a ton per square inch for every 800 fathoms—exerts so great an influence on even the very best instruments of the ordinary construction, as to cause a rise of eight or ten degrees under an amount equivalent to that which would be exerted at from 2,000 to 2,500 fathoms' depth;* and the error of many thermometers under the same pressure was two or three times that amount. There is reason to believe that some of the thermometers formerly employed, especially in the French scientific expeditions, were protected against that influence; but no such protection appears to have been applied to the thermometers supplied to Sir James Ross's Antarctic Expedition; and the observations by which he supposed himself to have established the existence of a uniform deep-sea temperature of about 39°, now seem to have been altogether fallacious. So again, Captain Spratt's observations in the Mediterranean, though made with great care, were seriously vitiated by this source of error.

It appears from Mr. Prestwich's exhaustive summary, that as long ago as 1812 Humboldt had maintained that such a low temperature exists at great depths in tropical seas, as can only be accounted for by the hypothesis of under currents from the Poles to the Equator. And this view was adopted by D'Aubuisson, Lenz, and Pouillet; the latter of whom considered it certain "that there is generally an upper current carrying the warm tropical waters towards the Polar seas, and an under current carrying the cold waters of the Arctic regions from the Poles to the Equator." Our Arctic navigators had met with temperatures in the Polar seas as low as 29° at 1,000 fathoms; and these observations have been more recently confirmed by those of M. Charles Martins and others in the neighbourhood of Spitzbergen. Several instances are recorded, on the other hand, in which temperatures of from 38° to 35° were observed at great depths nearly under the Equator; and this alike in the Atlantic, Pacific, and Indian Oceans.

The Temperature-soundings taken in the *Lightning* and *Porcupine* Expeditions, with trustworthy instruments, have shown:—(1) That in the channel of from 600 to 700 fathoms' depth which lies between the North of Scotland, the Orkney and Shetland Islands, and the Faroes, there is an upper stratum of which the temperature is considerably higher than the normal of the latitude; whilst there is stratum occupying the lower half of this channel, of which the temperature ranges as low as from 32° to 29°·5; and a "stratum of intermixture" lying between these two, in which the temperature rapidly falls—as much as 15° in 100 fathoms. (2.) That off the coast of Portugal, beneath the surface-stratum, which (like that of the Mediterranean) is super-heated during the summer by direct solar radiation, there is a nearly uniform temperature down to about 800 fathoms; but that there is a "stratum of intermixture" about 200 fathoms thick, in which the thermometer sinks 9°; and that below 1,000 fathoms the temperature ranges from 39° down to about 36°·5. (3) That in the Mediterranean the temperature beneath the super-heated surface-stratum is uniform to any depth; being at 1,500 or 1,700 fathoms whatever it is at 100 fathoms, namely from 56° to 54°, according to the locality. To these may be added (4) the observations recently made by Commander Chimmo, with the like trustworthy thermometers, which, in lat. 3° 18½′ S., and long. 95° 39′ E., gave 35°·2 as the bottom temperature at 1,806 fathoms and 33° 6 at 2,306 fathoms. These seem to be the lowest temperatures yet observed in any part of the deep ocean basins outside the Polar area.

It is clear, therefore, that very strong evidence now exists, that instead of a uniform deep-sea temperature of 39°, which, on the authority of Sir James Ross, by whom the doctrine was first promulgated, and of Sir J. Herschel, by whom it was accepted and fathered, had come to be generally accepted in this country at the time when the recent deep-sea explorations commenced, not only is the temperature of the deeper parts of the Arctic basin below the freezing-point of fresh water, but the temperature of the deepest parts of the great oceanic basins, even under the Equator,

* Mr. Prestwich cites Dr. Carpenter as estimating the error from pressure "at 2° or 3° or even more." The error is said by Dr. Carpenter to have been from 2° to 3° on the depths of from 500 to 700 fathoms first explored; but would have been from 8° to 10° at the depths subsequently reached.

is not far above that point. And it seems impossible to account for the latter of these facts in any other mode, than by assuming that Polar water is continually finding its way from the depths of the Polar basins along the floor of the great oceanic areas, so as to reach or even to cross the Equator. And as no such deep efflux could continue to take place without a corresponding in-draught to replace it, a general circulation must be assumed to take place between the Polar and Equatorial areas, as was long since predicated by Pouillet.

Such a vertical circulation, it was affirmed by Prof. Buff, would be necessarily caused by the opposition of temperature between the Equatorial and the Polar seas; and this view was adopted by Dr. Carpenter, in his *Porcupine* Report of 1869, as harmonising with the temperature-phenomena which had been determined in the expedition of that year. It has been since contested, however, not only by Mr. Croll and Dr. Petermann, but also by Dr. Carpenter's colleague, Prof. Wyville Thomson, all of whom agree in regarding the amelioration of the temperature of the Arctic Sea as entirely due to an extension of the Gulf Stream, the underflow of Polar water being merely its complement. And the authority of Sir John Herschel was invoked against the idea that any general oceanic circulation could be maintained by difference of temperature alone; though his statements, when carefully examined, only go to prove that no such difference could produce *sensible currents.*

Such was the state of the question when the *Porcupine* Expedition of last year concluded its work; and the results obtained, whilst confirmatory of previous observations, suggested to Dr. Carpenter a definite Physical Theory, which now comes before us with the express approval of the great philosopher who had been said to be opposed to it.

Having ascertained, as our readers have learned from his report, the existence of an outward under-current in the Strait of Gibraltar, which carries back into the Atlantic the water of the Mediterranean that has undergone concentration by the excess of evaporation in its basin, Dr. Carpenter applied himself to the consideration of the forces by which the superficial in-current and the deep out-current are sustained; and came to the conclusion that, as had been previously urged by Captain Maury, a *vera causa* for both is to be found in excess of evaporation, which at the same time lowers the level and increases the density of the Mediterranean column as compared with a corresponding column of Atlantic water. This conclusion, when scientifically worked out, was found to be applicable, *mutatis mutandis,* to the converse case of the Baltic Sound; in which, as was long ago experimentally shown (with a result that has recently been confirmed by Dr. Forchhammer), a deep current of salt water flows inwards from the North Sea, whilst a strong current of brackish water sets outwards from the Baltic, the amount of fresh water that drains into which is greatly in excess of the evaporation from its surface.

Comparing, then, the Polar and Equatorial areas, it is shown by Dr. Carpenter that there will not only be a continual tendency in the former to a lowering of level and increase of density, which will place it in the same relation to the latter as the Mediterranean bears to the Atlantic; but that the influence of Polar cold will be to produce a *continual descent* of the water within its area; thus constituting the *primum mobile* of the General Oceanic Circulation, of which no adequate account had previously been given. This conclusion, as our readers will have seen, has been most explicitly accepted by Sir John Herschel.

Our limits do not admit of our following Dr. Carpenter through his discussion of the relative shares of the Gulf Stream and of the General Oceanic Circulation in that amelioration of the temperature of the Polar area, of which the industry of Dr. Petermann has collected a vast body of indisputable evidence; and for this discussion we would refer such of our readers as are specially interested in the question to the last part of the "Proceedings of the Royal Geographical Society." But as Dr. Carpenter has now shown a capacity to deal not merely with Physiological but with Physical questions, in a manner which has obtained the approval of some of the ablest physicists of our time, we hope that he will not again be accused (as he was by some of those who opposed his views on their first promulgation) of venturing beyond his depth when he began to reason on these subjects, and of advancing doctrines which his own observations refuted. The exclusive doctrine of the thermal action of the Gulf Stream advocated by Mr. Croll, rests, as Dr. Carpenter has shown, upon so insecure a basis, that a very large body of careful observations must be collected before any reliable data can be obtained as to the heat it actually carries forth from the Gulf of Mexico. And how much of this heat is dissipated by evaporation, as well as by radiation, before one-half of the Stream reaches the banks of Newfoundland (the other half having turned round the Azores to re-enter the Equatorial current), is a question which there are as yet no adequate data for determining. On the other hand, in his conclusion that a great body of Ocean water slowly moving northwards, so as to carry with it a considerable excess of temperature even to the depth of 500 or 600 fathoms, must exert a much greater heating power than the thinned-out edge of the Gulf Stream, Dr. Carpenter seems to us to have both scientific probability and common sense on his side.

SCIENCE IN ITALY

Atti dell' Accademia Pontificia de' Nuovi Lincei.

Reale Istituto Lombardo di Scienze e Lettere. Rendiconti.

Annali di Chimica Applicata alla Medicina. Compilati dal Dottor Giovanni Polli.

ITALY has become a nation. It is no longer enslaved by the barbarous despotism, of a single city, nor divided into mutual throat-cutting republics, nor diplomatically parcelled into heir-looms for royal families. It has at last become the country of its own people. The moral and intellectual laws of Natural Selection are now freely operating, and they will soon show what manner of people these Italians really are.

There are many ways of gauging the civilisation of a community. The consumption of soap has been suggested, and has the advantage, being numerically definite. Thus, let s represent the quantity of soap used, p the population, and x the state of civilisation, we obtain the following equation—

$$x = \frac{s}{p}$$

and thus moral philosophy is brought within the reach of the mathematician. But there is another test which is, I think, even safer than soap, that is, the current literature of the nation, and more especially its periodical literature. The readers of *Reynolds's Weekly Newspaper* and the *Sporting Life* diverge so widely from the subscribers to NATURE, that their differences almost come within the reach of ethnological specification, and I believe that the direction of the growth of Young Italy may best be determined by watching the progress of its periodical and general literature.

It is a very interesting and promising fact that during the last two years the proportion of purely scientific works to those of light literature has been greater in Italy than in either England, France, or Germany. This refers only to original Italian works, and does not include translations. The periodicals named at the head of this article are good examples of the progress of the highest kind of intellectual culture in Italy. The first is published at Rome, the second and third at Milan. "The Transactions of the Pontifical Academy of the New Lynxes" does not belong to Young Italy, as the fasciculi before me are for the twenty-second year of the Academy, and the new Lynceans claim Pontifical patronage, and announce it in their name, which of course is derived from the old classical society of the Lynx-eyed Philosophers of the middle ages; a title which, in spite of its fanciful character, presented one of the earliest formal recognitions of the paramount importance of laborious observation, as opposed to the speculative and disputatious spirit of contemporary philosophy.*

The papers of Father Secchi and Prof. Respighi, on their spectroscopic and telescopic observations on the sun and stars, occupy a considerable portion of these Transactions. Father Secchi's observations are tolerably well known to English readers, but I doubt whether such is the case with Respighi's spectroscopic researches on "Stellar scintillation," the results of which were stated in papers read at the Lyncean meetings of May 10, 1868, and February 14, 1869. The second paper supplemented the first and embraces 720 observations, extending from October 4 to February 12. The primary results obtained by Prof. Respighi were that in the spectrum of a star near the horizon, dark lines and bright bands travel along the spectrum, most frequently from the red to the violet, but sometimes in the contrary direction, and occasionally oscillate from one colour to the other. The nearer to the horizon, the more distinct and definite are these moving lines and bands, and the more slow and regular their movements. The bright moving bands are more rare and less regular than the dark lines, and are only seen when the star is very near the horizon. Further observations brought out the law that in the normal condition of the atmosphere their motion is from the red to the violet in the spectrum of all stars on the west, and from the violet to the red when the star is in the east; while near the meridian, whether on the north or south horizon, the motion is generally an oscillation from one colour to the other; and sometimes the lines appear stationary, or traverse only a portion of the spectrum. In abnormal states of the atmosphere the moving lines are weaker and more irregular in form and motion; this is especially the case during strong winds, which sometimes reduce the movements on the spectrum to mere variations of brilliancy, even in stars very near to the horizon.

Prof. Respighi observes that these appearances are not due to an oscillation of the characteristic spectrum of the star, and that there is no superposition of its colours due to any sensible movement of the image of the star in the normal states of the atmosphere, though he does not deny that there may be such sensible oscillation and superposition, under conditions of abnormal atmospheric disturbance. He has observed that when the moving lines are regular in form and motion, there is usually a continuance of fine weather, and that the phenomena of scintillation are most marked and decided on those nights when there is much humidity in the atmosphere. He believes that by careful study of these phenomena the spectroscope may become an important meteorological instrument.

It would occupy too much space to follow Prof. Respighi through his theoretical reflections on these phenomena, which he attributes to irregularities in the temperature, and distribution of aqueous vapour, &c., in the earth's atmosphere, and the effects of its rotatory movement with the earth, which carries it across the direction of the radiation of the light from the stars.

Besides the above-named, there are some very interesting papers on electro-static induction, and electrical induction or influence in rarefied gases, by Prof. Volpicelli.

The four first numbers of the present year of the Reports of the Royal Institution of Lombardy are remarkably rich in interesting papers, extending over a wide range of subjects. Buccellati on Military Punishment, Lambrosi on the Italian Races, and Ciavarini on the Laws of Human Progress, are the chief essays in the Department of the Moral and Political Sciences. In the Department of the "Mathematical and Natural Sciences" the subjects of the papers are more varied, including, Rovida on the Pulse of the Veins, Barbieri on the Utility of Statistics of Hernia in Italy, Experimental Researches on the Origin of Fibrin, and a new Theory of the Cause of the Coagulation of the Blood, by Mantegazza, and Serpieri on the Probable Relation between the Luminous Cones (*pennacchi*) of the Solar Corona, and the Positions of the Planets.

The author of this paper supposes that the corona is an electrical phenomenon identical with that of our terrestrial aurora borealis, that the sun and all the planets mutually act and react upon each other inductively; that the cones of rays which stretch out from the corona are electrical streamers pointing towards one of the planets; that the curved lines and rays which have been observed

* The original *Academia Lincea* was founded in Rome by Federigo Cesi, the Marchese di Monticelli, in 1603. Cesi was the first president, and Baptista Porta the Neapolitan vice-president. Galileo became a member in 1611. It preceded our Royal Society and the French Academy by about half a century, and combined the functions of these societies with a scheme of philosophical brotherhood and affiliated lodges, somewhat resembling the masonic organisation. Its members were required to be "philosophers eager for real knowledge, who will give themselves to the study of nature, and especially to mathematics." They were to waste no time in "recitations and declamatory assemblies," and to "pass over in silence all political controversies and quarrels of every kind, and wordy disputes, especially gratuitous ones" They are commended to "Let the first fruits of wisdom be love; and so let the Lynceans love each other as if united by the strictest ties, nor suffer any interruption of this sincere bond of love and faith, emanating from the source of virtue and philosophy."

are other streamers, pointing obliquely to planets or comets; that the zodiacal light is the general stream of electrical influence emanating from the sun and embracing all his planetary children; and that the sun-spots and the hydrogen prominences are due to electrical outbursts. We have had similar hypotheses put forth in England, but not so well argued as by Prof. Serpieri. Like the rest, he fails, however, to supply us with any explanation of the source of such tremendous electric energy. We may have the cylinder, the prime conductors, the insulators, the Leyden jars, and all the apparatus of a fine electrical machine; but we shall get no sparks unless somebody turns the handle. We obtain no electrical force without an expenditure of equivalent mechanical power. In the battery we must oxidise an equivalent of zinc for each equivalent of electricity produced. We know something about the laws of electrical excitation; and those who assume the existence of such huge electrical forces without indicating their origin in accordance with these known laws, only carry the problem of the source of solar energy one stage further back without advancing a single step towards its solution. Among the other papers are Lannetti on Etruscan Crania, and some on Pathology and pure Mathematics.

The Annals of Chemistry, compiled by Dr. Polli, is a carefully collected and valuable record of the progress of Chemistry, in which the subjects are classified under the heads of Pharmacy, Hygiene, Dietetics, Physiology, Toxicology, Pathology, Therapeutics, and Miscellaneous. It is published monthly in octavo fasciculi of sixty-four pages, each containing abstracts of papers from native and foreign journals. It sells at rather less than one shilling. As our *Philosophical Magazine*, with eighty pages of the same size, scarcely pays expenses at *2s. 6d.*, we may infer that the *Annali di Chimica*, of Milan, has a better circulation than its old-established scientific contemporary of "London, Edinburgh, and Dublin."

W. Mattieu Williams

SEELEY ON THE ORNITHOSAURIA

Index to the Fossil Remains of Ornithosauria, Aves, and Reptilia from the Secondary Strata, arranged in the Woodwardian Museum, Cambridge. By Harry Govier Seeley. 8vo. pp. 144. (1869. Cambridge: Deighton.)

The Ornithosauria, an Elementary Study of the Bones of Pterodactyles. By Harry Govier Seeley. With 12 plates. 8vo. pp. 136. (1870. Cambridge: Deighton.)

THANKS to the activity of the "Coprolite" workings in the Upper Greensand around Cambridge, the Woodwardian Museum possesses particularly rich series of interesting reptilian remains, especially those belonging to the *Ornithosauria* or Pterodactyles (Flying Lizards) of the Secondary rocks; to which the second work with its twelve plates is entirely devoted, as is also a large part of the Catalogue first published.

The "Index to the Fossil Remains" is introduced to the attention of the student and anatomist by a prefatory notice from the Rev. Adam Sedgwick, Woodwardian Professor, who, although in his eighty-fifth year, evinces still considerable remains of his wonted fire, when taking up his pen to write of the treasures contained in the Museum of his Alma Mater. The cost of preparing these works has been borne by Prof. Sedgwick, but the printing of both books has been defrayed out of the funds of the Syndics of the University Press.

1. The first book is intended to serve as a guide to the student in the examination of the remains of the extinct birds and reptiles preserved in the Woodwardian Museum, each case, shelf, and bone being numbered so as to correspond with the catalogue in which it is described. The list of specimens from the Cambridge coprolite bed occupies about half the book.

Many new forms are here announced by the author for the first time, as *Enaliornis* (a new bird) several new *Ichthyosauri*, a new Crocodile, 3 species of *Stereosaurus*, 2 new Chelonians; so that we have altogether 70 species from the Cambridge Greensand. There are also Chalk (8 sp.), Gault (2), Wealden (12), Purbeck (7), Potton beds (18), Portland (1), Kimmeridgian (10), Coral rag (3), Oxford clay (8), Oolites (4), Lias (20), foreign reptiles (24), making a total of 187 species.

2. In the second work, that on the Ornithosauria, the author enumerates the materials at his disposal, namely, 500 bones in one collection, and 400 in another, probably representing not fewer than 150 individuals, which well displays the richness of the area.

The bones from the coprolite diggings are much broken, but they retain sufficient character to be readily determined by the comparative anatomist.

Probably, no group of animals have caused more contention between Naturalists than the Ornithosaurians. They have been regarded as bats (Sömmering), as intermediate between birds and reptiles (Goldfuss), amphibians (Wagner), and so on. Herman von Meyer, who has paid more attention to them than any other anatomist, concludes them to be reptiles, though with strong avian affinities. Prof. Owen maintains that they are Saurians.

Mr. Seeley combats these views, and contends that the Pterodactyles were more nearly allied to birds than reptiles, and he refers them all to a new genus, *Ornithocheirus.*

He contends against the cold-blooded view taken of them by Prof. Owen, and asserts that they were warm-blooded, chiefly founding his opinion on the form of the brain. There is a very strong objection to be made against the retention of the terms "cold-blooded," and "warm-blooded," for it seems to us that the heat developed by the animal's body is in direct proportion to the work to be performed. Thus, in aërial locomotion, the efforts of the pectoral muscles to sustain the body in the air, necessitate also a correspondingly more rapid action of the heart and lungs, producing, therefore, more rapid circulation, and an increased bodily temperature. We are therefore inclined to agree with Mr. Seeley on the grounds that, in proportion to the rapidity and the sustained action of the great motor muscles of the body (whether of legs or wing) so will be the rapidity of the action of the heart and lungs, and consequently the acceleration of the temperature of the whole body.

The bones from the Cambridgeshire Greensand are very often so fragmentary that their determination requires the most exact anatomical skill, and we think the plates would have been more useful if in a few instances (perhaps in all) the missing parts and processes had been indicated in outline, so as to help to the better understanding thereof by the student.

H. Woodward

OUR BOOK SHELF

Handbuch der Systematischen Anatomie des Menschen. Von Dr. J. Henle, 1 Band, 1 Abtheilung, Knochenlehre, 3 Auflage, pp. 310. (Braunschweig, 1871. London: Williams & Norgate.)

IT is unnecessary to commend the work of Prof. Henle, which is on the whole the most full and exact yet published. It shares the richness and accuracy of its illustrations with the last edition (the fourth) of Cruveilhier's great work, and shares with it the serious disadvantage of being incomplete. Indeed, while in the latter the part relating to "Angéiologie" which includes the description of the heart, blood-vessels and absorbents, was published in 1867, preceding the completion of the second volume on visceral anatomy in the following year, the third volume of the German work, with the whole of the nervous system, has not yet appeared. In this respect the only English work on descriptive anatomy which can rival Henle's has a great advantage; each edition of what was originally Dr. Quain's Anatomy has been published complete, and on this ground, as well as that of conciseness, the last edition of this work may, with the help of Prof. Sharpey's masterly introduction on general anatomy, take rank with those of France and Germany.

The department of osteology is not that which Prof. Henle has done best. In minute accuracy of detail it is decidedly inferior to Mr. Ward's treatise, which at least equals the best efforts of the French School of Anatomy. And there is a want of attention to broad views of morphology almost as conspicuous as in M. Cruveilhier's work. Thus the comparison between the upper and lower extremities (pp. 226—229) is very insufficient, giving no account of the important and opposing views which have been maintained on this subject, and admitting the demonstrably false position that the radius answers to the fibula, and the ulna with the olecranon to the tibia with the patella. The difficult subject of the homologies of the cranial and facial bones is also entirely omitted, an omission rendered necessary by the absence of any account of their fœtal development. The rigid specialisation of human osteology so as to exclude all reference to embryology and comparative anatomy on the one hand, and on the other to the mechanism of the skeleton, makes what ought to be the most interesting part of anatomy the most arid and forbidding. In the last edition of "Quain's Anatomy" we have within a shorter compass a good account of the antecedent development, as well as the mere ossification of the several bones, with illustrative diagrams, and a sufficient account of its homologies to awaken interest in this attractive study. On the other hand, there is nowhere to be found so complete an account of Abnormalities as in Prof. Henle's work, a subject of which the importance is only beginning to be recognised in England. The references to observations in this branch of the subject are very full, and include many only lately published. On this, as on other points, the author has added many fresh facts in the present edition. On the whole, however, it differs but little from the first issue in 1855, and the number of woodcuts remains the same. Among the more important additions may be mentioned one on the differences in the skull of the two sexes (p. 216). No mention is made of the little tympano-hyal bone described by Prof. Flower, and even the ordinary variations of the styloid process, which throw so much light on its homology, are scarcely alluded to.

In conclusion, every anatomist will acknowledge the industry and care with which even small advances in knowledge are added in this edition, but will also hope that nothing may delay the appearance of the volume which is to complete the whole treatise, and no doubt complete it worthily of its distinguished author, and of what he has already published.

H. P.

LETTERS TO THE EDITOR

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

Science Lectures for the People

OF the justice of your remarks on "Science Lectures for the People" there can be no doubt whatever. The lectures in question are perfect models of what lectures should be, and while reading them I pictured to myself the rich feast that had been prepared for the people who were fortunate enough to hear them —especially for those who had some previous acquaintance with the subjects of which they treat. They are couched in simple language, so that those who run may read. They are strictly to the point, well calculated to excite further inquiry, and in every way adapted for the purpose for which they were intended. It may be, however, doubted, whether lectures on scientific subjects before the general public, however delivered, do that amount of good which they certainly ought to do. A lecture to be thoroughly and lastingly effective presupposes a certain acquaintance with the subject already. To listen even to the most brilliant and never so simply worded address on Spectrum Analysis or Coral Reefs, has a very transient effect, I take it, upon those who have rarely or never heard of such things. However praiseworthy, therefore, every effort to scatter scientific knowledge among our population may be—and it certainly deserves every commendation—my decided opinion, arrived at after large experience with the people in towns and country, especially the latter—is that it will fail, unless we begin with the young. People in masses may be compared with fuel laid in the grate. If you ignite it from the top, a considerable time will elapse before it reaches the whole mass; but if the fire be applied from below, the course is more rapid, and the fuel sooner feels the effect. So with science teaching, or any teaching, we must begin in our schools. Every school, from the primary to the highest, must be opened to its influence. Teachers, I am sure, would welcome the innovation, for it would dispel many a weary hour both for teacher and taught. The everlasting monotony of reading, writing, arithmetic, and scripture, would be enlivened by simple explanations of the human body, plants, &c., and thus children would be taught to take an interest in all matters connected with their future welfare even from their infancy. The same remarks, slightly modified, would apply to many of our middle class and upper schools; for scientific matters, in far too many cases, have still to find a place even here—parents being themselves quite as much, in many instances far more, to blame than the regulations of the school.

It is precisely owing to this want of early training, and consequently to an utter ignorance of the subject, that the lectures on divinity, science, &c., in our universities are of such little real value, and of such little interest to the students. They attend them, it is true, not from any genuine love, but simply because they must attend some for certificates or otherwise. No fault whatever attaches to the lectures themselves; on the contrary, they are of the greatest possible value, and had the students themselves been trained properly and gradatim when at school, the attendance would be vastly increased, a genuine love for the lectures would be engendered, and incalculable results would be the consequence. Or take another instance—our farmers' clubs. With laudable zeal these have been formed all over the kingdom. Lectures on scientific subjects connected with agriculture are delivered from time to time. All very admirable no doubt in its way. The attendance generally is good, but from the vacant stare, the nodding head, and subsequent remarks, nothing can be clearer than that nine-tenths of the lecturer's address on the abstruse niceties of chemical analysis, &c., have been utterly thrown away. What subjects can be more valuable to a farmer than a knowledge of the constituents of the air, the origin of soils, the inner life of plants, the wonderful dependence of animals and plants upon each other, the means of judging artificial manures, &c.; and yet, except among the upper favoured few, utter ignorance of these matters almost universally prevails. It is not from indifference to the subject, far from it, but, as in the former case, from a want of early training in this particular line of thought. The farmer acts just as his father acted before him. He is of all people the most backward in leaving the old routine, and considers such subjects as geology and botany altogether beside the purpose, and a waste of time for his children to learn, though he will praise them in the same breath.

There is nothing more trying for a master's patience—and I speak from experience—than this persistent and short-sighted adherence to what has gone before, just as if the world (the agricultural world particularly) had to jog on to the end of time in the self-same fashion.

Whatever united action, therefore, may be taken by our leaders in science for bringing about a more healthy feeling on this subject, for scattering science and a love for it in every household, depend upon it the readiest and surest way will be to urge on Government to introduce, nay, force, the subject freely and universally into all schools, so that it may grow up with the rising generation, and become a part of their very existence. The task is Herculean, no doubt. An enormous amount of prejudice will have to be overcome, but

> Sedit, qui timuit ne non succederet; esto:
> Quid? qui pervenit fecitne viriliter?

Lectures on science will thus be not merely listened to as now, but understood and appreciated. Superstition, the child of Ignorance, will be dispelled, and a nation of reasoning and thinking men and women inaugurated as the glorious and inevitable consequence. THOMAS FAWCETT

Blencowe School

Preponderance of West Winds

I HOPE you will publish this reply to Mr. Laughton's letter in NATURE of May 4, on the Prevalence of West Winds.

He maintains from statistical evidence that west winds occupy a greater portion of the earth's surface than east winds; that their force is greater; and that in the upper regions of the atmosphere the preponderance of west winds is still more decided than at the earth's surface; so that on the whole the atmosphere moves round the earth from west to east.

It is in my opinion certain that this is on the whole proved. I do not question Mr. Laughton's facts but his inferences from them. He thinks this rotation points to some force acting from without—some cosmical cause of a nature quite unlike the sun's heat. I maintain, on the contrary, that all the phenomena of the great atmospheric currents, of which the trade-winds are a part, are to be accounted for by the heat of the sun as the motive power, combined with the rotation of the earth as a modifying influence.

In discussing the question of whether the phenomena point to such a cause as that suggested by Mr. Laughton, the motion of the upper strata of the atmosphere is quite unimportant. It is only the currents at the surface of the earth that can in however infinitesimal a degree increase or diminish the velocity of the earth's rotation; and if the circulation of the atmosphere is due to the sun's heat as its motive power, it cannot have the slightest effect on the earth's rotation; while if it is due to any mechanical force acting from without, as Mr. Laughton thinks—if the Cartesian theory is true, and the circulation of our atmosphere is part of a cosmical vortex—the earth's rotation must be accelerated by its friction. This follows from the simplest dynamical principles. It is true that the acceleration which could be produced in such a way would at the greatest be far too small for us to detect; but it is quite possible for us to ascertain whether or not the currents of air that sweep over the surface of the earth are by their united action capable of affecting its rotation; or, to state the problem more definitely, whether or not the effect of west winds in accelerating the rotation is balanced by the effect of east winds in retarding it. I maintain that such evidence as we have tends to the conclusion that the effects of the two are so balanced.

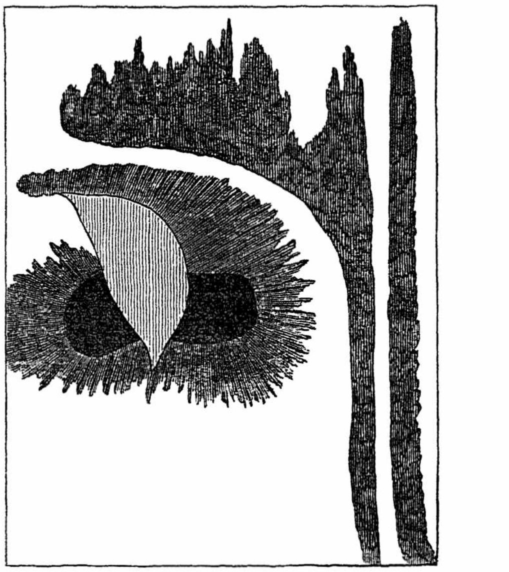
The separate effect of any wind covering a given area on the earth's rotation = the east and west component of its force × the radius of the parallel of latitude. The latter factor gives leverage. An east wind near the equator has more effect in retarding the rotation of the earth than a west wind of equal extent and force at a higher latitude has in accelerating it, just as a weight at the end of the long arm of a lever outweighs an equal weight at the end of the short arm. Now, the east winds, under the name of trade-winds, are chiefly to be found in the lower latitudes, and for the reason just given they are able to balance the west winds, which are certainly more forcible, and according to Mr. Laughton, occupy a greater area, but being at higher latitudes act at a disadvantage. If it can be shown—and the facts certainly point to it—that the total mechanical effect of the winds is not such as to produce any effect on the earth's rotation, this goes very far to prove that they have no motive power except the sun's heat.

But how is the motion of the upper strata of the atmosphere from west to east to be accounted for? The answer to this will involve the entire theory of the great currents of atmospheric circulation. There is always a current of air towards a heated place along the earth's surface, like the draft towards a fire, and a compensating current of air away from it in the upper regions of the atmosphere. The equatorial latitudes being the hottest, there are currents to them from the higher latitudes, which bring with them the smaller velocity due to the rotation of the higher latitudes, and thus move less rapidly than the earth in those lower latitudes to which they flow. Moving with a less velocity than the earth is the same as moving from the east, and thus are the trade-winds constituted; they are from north-east in the northern hemisphere and from south-east in the southern. This is generally understood and believed; what follows is less generally understood, though I claim no originality for it.

The air rises up over the equatorial regions like a column of smoke over a fire, and flows off towards the poles. Coming from the latitudes where the velocity of the earth's rotation is greatest, it carries that greater velocity with it, and spends the energy of its motion in the form of the west winds of the higher latitudes. The reason, then, that the upper strata of the atmosphere (in all latitudes except on the equator) have a motion round the earth from west to east, is simply that they are at the same time moving from latitudes where the velocity of the earth's rotation is greater to latitudes where it is less. JOSEPH JOHN MURPHY

Remarkable Sun-spots

THE accompanying sketch shows in a rough way the umbræ and a small portion of the penumbra of a sun spot that I observed on the 6th and 7th of this month, and which was made remarkable by the presence of a reddish-brown object like a cloud, that seemed to hang over the nucleus of the principal umbra, apparently dividing it in two. Could this object be seen without the intervention of the dark glass, it would doubtless show a bright red instead of a reddish-brown colour; and from its fog-like aspect, though it was well defined in outline and acuminated at both ends, the impression was inevitable that it hung at a certain altitude above the spot. However, it evi-



dently had no motion distinct from the latter, as on the 7th it occupied the same position as on the day before, but it was much reduced in size. On the 8th it was seen no longer, and the nucleus was now in one, seeming to show pretty clearly that its previous apparent division in two was really caused by the intervention of the brown cloud suspended over it, and that the phenomenon did not consist of two distinct neuclei with the brown object lying between them. I am not aware that anything like this was observed before. J. BIRMINGHAM

Millbrook, Tuam, May 18

ANNUAL VISITATION OF THE ROYAL OBSERVATORY

ON Saturday last the Board of Visitors of the Royal Observatory made their annual visitation to our National Observatory to examine into the work done, and to receive the Report of the Astronomer Royal. We have not space for the report in full, but this is not to be regretted, for it contains a quantity of minute detail about trivial matters which the ordinary run of mankind would not think worth the printing.

There are, however, several points of great scientific interest in the Report, the new Water Telescope and the instruments for use in the approaching observations of the Transit of Venus having been the lions at Greenwich.

The correction for level-error in the transit instrument having become inconveniently large, owing apparently to a gradual subsidence of the eastern support since the erection of the instrument, about a ton weight of stone was placed on the western pier. Not the slightest change, however, could be traced as due to this; the level-error maintaining its usual value. This plan having failed, the stones were removed, and a sheet of very thin paper, $\frac{1}{270}$ inch in thickness, was placed under the eastern Y, which was raised from its bed for the purpose. The collimators having been observed just before this operation, no difficulty was experienced in adjusting the instrument so as to have very nearly the same error of Azimuth as before. The mean annual value of the level-error appears to be now sensibly zero. This will give some idea of the delicate arrangements necessary for this ponderous instrument.

The usual course of Astronomical observations now carried out for so many years has been adhered to. The list of fundamental stars used for determination of clock-error has been increased to 210. Besides these, Nautical Almanac, circumpolar, and moon-culminating stars have been observed; also refraction stars, stars with large proper-motion, and stars which are required for any special investigation. A few of Bradley's stars which had been inadvertently omitted have been observed in the past year. The Sun, Moon, and large planets have been observed as usual. As the siege and war operations in Paris seriously interfered with the observations of small planets made at the Paris Observatory, observations of them were continued at Greenwich throughout each entire lunation during the investment of the city.

The observations of γ Draconis, the star which passes very near the Zenith of Greenwich, with the Water Telescope, made in the spring of the present year, are completely reduced, with the exception of a small correction for the positions of the micrometer-wires, to be determined shortly. As the astronomical latitude of the place of observation is not known (it is not many yards from the transit circle), the bearing of these observations on the question of aberration cannot be certainly pronounced until the autumn observations shall have been made; but, supposing the geodetic latitude to be accordant with the astronomical latitude, the result for aberration appears to be sensibly the same as with ordinary telescopes.

With regard to the Magnetic instruments, the Astronomer Royal states that a plan was arranged last year for photographic impression of hour-lines upon the photographic sheets carrying the records of the three Magnetometers and of the Earth-current Galvanometers: an arrangement already for some time carried out in the new instruments by Dr. Balfour Stewart. The beam of light, constantly directed through a cylindrical lens to fall upon the sheet, emanates from one of the existing lamps, or (in one instrument), from a flame specially mounted for it; it is, however, obstructed by a shade till $2\frac{1}{2}$ minutes before each hour, and acts till $2\frac{1}{2}$ minutes after each hour. The connections of the shades were so arranged that all could be opened and closed by a single wire.

The following numerical results of the magnetic elements for 1870 may be interesting:—

Mean westerly declination .	19° 54′ nearly.
Mean horizontal force . . .	3·865 (in English units). 1·782 (in Metrical units).
Mean dip	67° 51′ 9″ (by 9-inch needles). 67 52 25 (by 6-inch needles). 67 53 41 (by 3-inch needles).

The observations of dip at different hours appear to show a diminution from 9h. A.M. to 3h. P.M.

A small Appendix of great interest is attached to the report. Those who have given attention to the history of Terrestrial Magnetism are aware that Halley's Magnetic Chart is very frequently cited; but the Astronomer Royal could not learn that any person, at least in modern times, had ever seen it. Inquiries were made of nearly all the principal scientific bodies in Europe, and in several of the best continental libraries in vain. At last, by the assistance of Mr. Winter Jones, Principal Librarian of the British Museum, a copy was discovered in the library of the Museum. 600 copies have been taken in a reduced size, for insertion, as an Appendix, in the Magnetical and Meteorological volume for 1869.

On the subject of Chronometers it is remarked, "The performance of chronometers, as depending on their mechanical construction, is very admirable; I have remarked but one point on which I could desire change, namely, that the balance should be struck more lightly, at a greater distance from its axis; the late Mr. Charles Frodsham, at my suggestion, had made experiments on this point, which promised to be successful. The principal errors of even moderately good chronometers are, however, produced by defective compensation, which the most skilful makers cannot perfectly manage. I have long been of opinion that the final adjustment for compensation ought to be made by some more delicate operation than that which suffices for approximate compensation; but the able chronometer-makers whom I have consulted have not yet devised a satisfactory plan."

With reference to Time Signals, we read that a proposal has been made to have a time-ball dropped at Queenstown, and that the report of the Westminster Clock shows that 55 per cent. of its errors are under 1^s, and 94 per cent. under 3^s.

In December two attempts were made to determine the longitude of Gibraltar, at the request of Professor Newcomb, but without success, the cable connecting Falmouth and Gibraltar being out of order.

During the year the time of the Astronomer Royal has been partly occupied in preparations for the Transit of Venus, 1874. Measures have been taken for equipping each of five stations with a Transit, an Altazimuth, and an Equatoreal. Some other instruments mounted in temporary observatories were inspected by the visitors. Of Transits there are five new, all mounted on stone piers. Of clocks to accompany them, there are two from the Royal Observatory, three new. Of Altazimuths, one from the Royal Observatory, four new. Of Equatoreals, 6 inches in aperture, and carried by clock-work, there are five, purchased or new. Of clocks of an inferior class, to accompany the two last classes of instruments, one can be supplied, nine must be procured. Fifteen portable observatories must be prepared, of which specimens were exhibited to the visitors. The Royal Observatory can supply three 4-inch detached telescopes, and two more will be desirable.

The report goes on to say:—"My preparations have respect only to eye-observation of contact of limbs. With all the liabilities and defects to which it is subject, this method possesses the inestimable advantage of placing no reliance on instrumental scales. I hope that the error of observation may not exceed four seconds of time, corresponding to about 0″·13 of arc. I shall be very glad to see, in a detailed form, a plan for making the proper measures by heliometric or photographic apparatus; and should take great interest in combining these with the eye-observations, if my selected stations can be made available. But my present impression is one of doubt on the certainty of equality of parts in the scale employed. An error depending on this cause could not be diminished by any repetition of observations. As, in the event of any national enterprise being promoted in the direction of photographic record, it is probable that the Astronomer Royal may ministerially take an important part, I venture to submit to the Board of Visitors that suggestions on the value and plan of such observations fall entirely within their competence."

All the American observers of the Solar Eclipse, as well as M. Janssen, have visited the Observatory during the past year.

The current reductions of observations, it is remarked, are in a healthy state. Regular reductions give, "in general, great facility for the most advanced inferences; the star-catalogues, and solar, lunar, and planetary errors, lend themselves immediately to investigations of a physical character; the magnetic reductions distinctly, though tacitly, exhibit some of those results (for instance, annual inequalities) which in various observatories have been the subject of special memoirs.

"But from time to time it becomes desirable to unite some of those annual or nearly annual results in groups, so as to exhibit the results justly derivable from masses of observations extending over long periods of years. These operations require new organisations; and, what is worse, they require additional grants of money. I have usually refrained from asking for these, without the distinct approval of the Visitors. I would now submit for their judgment the following subjects:—

"The vigorous prosecution of the Meteorological Reductions (exhibiting the results deducible from the photographic registers) already begun.

"The combination of the results of Magnetic Observations on disturbed days, from the year 1864.

"The discussion of Magnetic Storms, from the year 1858.

"Perhaps, also, the discussion of observations in groups depending on Lunar Declination, or other phases."

The report concludes as follows:—"There is another consideration which very often presents itself to my mind: the waste of labour in the repetition of observations at different observatories. The actual Greenwich system was established when there was little to compete with. Other observatories have since arisen, equipped with and principally using the same classes of instruments, and devoting themselves in great measure to the same subjects of observation (except the unrelenting pursuit of the moon, and perhaps the fundamental elements of the ecliptic). Ought this Observatory to retire from the competition? I think not; believing that there is greater security here than anywhere else for the unbroken continuity of system which gives the principal value to series of observations. Still, I remark that much labour is wasted, and that, on one side or another, that consideration ought not to be put out of sight in planning the courses of different observatories."

This is a very broad hint for some English as well as Foreign Observatories, and it will be well for the cause of Science if the directors of those observatories will take it.

THE SCIENTIFIC VALUE OF CHEESE-FACTORIES

THE American system of cheese-factories was established nearly twenty years ago, and in its present condition of maturity it retains all the essential features which were characteristic of its infancy.* The test of twenty years' experience in a country where apparent improvements are eagerly submitted to a fair trial is amply sufficient to prove the success of the system. Recently the question of its adaptability to English dairy districts has acquired considerable prominence in agricultural circles, and is now passing from the stage of discussion to that of experiment. The two great merits which are claimed for it are, economy in the labour of production, and superiority of quality in the produce. It is evident that if a dozen farmers convey their milk to one building (a factory) to be made into cheese or butter, fewer hands are required to perform the work than if the process were carried on at a dozen different places by as many sets of people. The factory can be furnished with better labour-saving machinery than the farm-dairy, and the former establishment requires no more supervision than the latter. The process of cheese-making, also, occupies practically the same length of time, whether the quantity of milk under treatment be large or small, so that two or three persons whose energies are concentrated at one place will produce as great an economic result as a dozen or more who are necessarily employed at as many different points, each one going through the same routine independently of the other.

The superiority in the quality of the manufactured article may be more difficult of explanation, for the best farm-dairies produce as good cheese as any factory. The reason why the establishment of factories has improved the *average* make of cheese is because fewer first-rate cheese-makers are required under the factory system. But when Mr. Jesse Williams established the first factory twenty years ago, the great bulk of American cheese was extremely poor, and for many years after it was almost unsaleable in the English market. At the present day, on the contrary, it can compete on even terms with all but the very choicest English makes, notwithstanding that it has to undergo the ordeal of a long sea-voyage. The factory-system, therefore, has not only improved the *average* quality of American cheese, but it has very considerably raised the standard of the choicest brands.

Students of nature are perfectly well aware that the most sure and rapid progress is made by means of association and co-operation. The same phenomena are observed from different points of view by workers in the same field; a comparison of their notes leads to the grouping of kindred facts; the apparent exceptions are seen to be the product of attendant variations in the methods or circumstances of observation; and by a process of induction an explanatory theory is arrived at, to be confirmed or rejected by future investigations. In this manner the cheese-factory system has gone far towards the establishment in America of a science of cheese-making. Each factory has been the theatre of exact observations, which have been duly recorded. The results of comparisons of these records have been embodied in papers read before the American Dairymen's Association; and the conclusions of the authors have been frequently put to the crucial test of experiment.

The American Dairymen's Association is only a child of the Factory-system. It is organised on a plan similar to that of the British Association for the Advancement of Science, and like that institution, holds an Annual "Convention," at which papers are read and lectures are delivered. These contributions to the literature of dairying, and the discussions thereon, are published in an annual "Report," which also contains detailed reports from numerous cheese and butter factories, giving the dates of commencing and finishing work, the number of cows supplying the factory, the quantity of milk received, the quantity of cheese made, the percentage of cheese to milk at different periods of the year, and as compared with

* For detailed descriptions of this system, *vide* Journal Royal Agricultural Society, 2nd Series, vol. vi. p. 173, and vol. vii. p. 1.

previous years, as well as other data, including peculiarities in modes of manufacture, which may be useful for comparison with the methods pursued and the results obtained at other factories. There can be no doubt that these efforts must sooner or later result in the formation of a dairy science, and in the establishment of sound theories of dairy management.

But the functions of the American Dairymen's Association are not confined to observation and experiment at home. Already the inquiries of its officers have enabled its members to improve their cheese-making practice by adopting some features of our Cheddar system; and in the last volume of the Report of the Association is an able paper by Prof. Caldwell,* showing some features common to the numerous cheese-making processes followed in Holland, Switzerland, France, and Italy. One of the most interesting points brought out is the intimate connection that exists between the ripening of cheese and the development and growth of *Micrococcus* and other forms of mould. As a matter of commerce it is important to the farmer to ripen his cheese as soon as possible. This is done in various ways, all having for their object the introduction of large numbers of germs of the appropriate fungus. The ripening of Stracchino cheese is thus induced by the introduction of layers of old curd; that of Roquefort by an admixture of mouldy bread, containing germs of *Penicillium*, and that of Brie by packing the thin cheeses between layers of musty hay. Another observation of interest is, that the presence of free ammonia in the curing-room hastens the ripening of the cheese, a fact which may have some bearing on the well-known property of American cheese (which is always packed in boxes) to ripen more rapidly than English makes.

These evidences of a process of scientific investigation induce us, therefore, to regard the factories, or associated dairies, as they are termed, as possessing a scientific value, both as educational establishments and as laboratories. But, it may be asked, why is this not true also of the farm-dairy? Our answer is, that while the manager of a factory makes cheese-making his sole business, his success in which depends entirely on his skill and knowledge, the English dairy-farmer has little or nothing to do with cheese-making, but occupies himself with the management of his farm. With the production of the milk his supervision ceases, and the manufacturing process is either carried on by his wife, who has household cares to occupy her time and thoughts, or by a dairymaid, who has no interest in the matter, and who knows that her services are at a premium.

Thus, with the exception of the additions to our knowledge of the *rationale* of cheese-making, for which we are chiefly indebted to Dr. Voelcker's chemical researches,† the manufacture of dairy products in England can hardly be said to have advanced during the last half century, while it has made enormous strides in America during the last ten years. Let us hope that the establishment of cheese-factories in England, commenced last year at the risk of some liberal-minded Derbyshire landlords,‡ may also be the dawn of an English era of progress in this most important agricultural industry.

* Sixth Annual Report, Syracuse, N.Y., 1871, p. 25.
† Vide Journ. Royal Agric. Soc., vol. xxii. p. 29, and vol. xxiii. p. 170.
‡ Ibid, 2nd series, vol. xii. p. 42.

HYDRAULIC BUFFER FOR CHECKING THE RECOIL OF HEAVY GUNS

THE ingenious instrument, the name of which stands at the head of this paper, deserves some notice, not only on account of its utility for its purpose, but as an interesting method of meeting and overcoming those violent efforts of nature to which she is provoked by explosion. In the recoil of a heavy gun, we have an example of the greatest force which man attempts to control. The inventions of Captain Moncrieff, which no long ago formed the subject of an article, seek to utilise this force; other gun carriages lead it to expend itself as harmlessly as possible.

The Hydraulic Buffer accomplishes this latter object in a manner very ingenious, and affording some interesting illustrations of Nature's laws; it also possesses several advantages over other methods which have been and are still used. For it the public service is indebted to Colonel Clerk, R.A., F.R.S., Superintendent of the Royal Carriage Department in Woolwich Arsenal. Before the introduction of the Hydraulic Buffer into the English service, and in those cases where it is not yet applied, the method employed to overcome the recoil was the friction of iron plates. To the bottom of the gun-carriage several plates are fixed, which pass between long plates placed along the middle of the slide or platform on which the carriage runs; and the friction of their surfaces in contact overcomes the force of the recoil, and brings the gun and carriage to a standstill. The amount of the friction can be regulated by the compression given to these plates, and requires to be altered for the various charges used. The compression must be taken off to allow the gun to be run forward to the firing position, and must be again set up to meet the recoil.

The Hydraulic Buffer, on the other hand, is always ready for use, and never needs any adjustment. This is one of its advantages, and one which is of special importance in the heat and excitement of action. It consists of a cylinder (A B in figure) placed in the platform, and lying along its length. In the cylinder is a piston pierced with four holes, and the extremity of the piston-rod is attached to the carriage. When the gun and carriage are run out for firing, the piston is moved to the lower end of the cylinder (A), which is filled with water, except a small air-space exceeding slightly the cubic content of the piston-rod, so as to allow for the displacement of the water when the piston is driven to the other end of the cylinder. When the gun is fired, and with its carriage begins to recoil, the piston is driven back into the cylinder. The first effect of this is to compress the air in the cylinder very violently, then the water begins to run through the four holes in the piston, this motion soon attains a very great velocity, and in imparting this to the water, the force of the recoil is soon exhausted. It is spent in transferring the water with very great rapidity through these orifices from one side of the piston to the other.

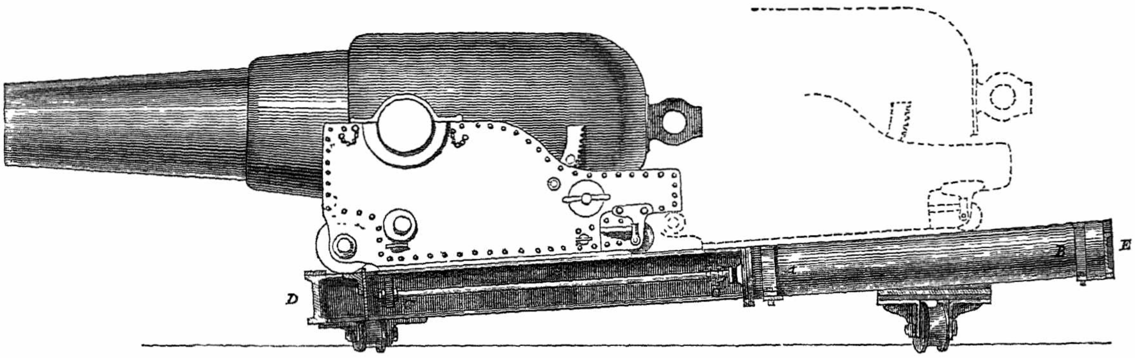
This rapidity depends on the ratio of the area of the piston to the area of the four holes in it. A very small diminution in the area of these orifices would cause the recoil to be checked very much sooner; a correspondingly slight increase would allow the piston to strike with violence against the end of the cylinder. It was found in an experiment with a 20-pounder gun, that when the holes were 0·562 of an inch in diameter, the recoil extended the whole length of the cylinder, 2ft. 9in., and struck violently the end of it; when a piston was used with holes 0·437 in. in diameter, the recoil was only 1ft. 11in., and ended quietly, the same charge being used. In another experiment with a 12-pounder gun in a boat carriage the holes in the piston were five-eighths of an inch in diameter, the recoil was 2ft. 2in.; when the diameter of the holes was increased by one-sixteenth of an inch the recoil was 3ft. 2in.* The proper ratio of the area of the holes to the area of the piston is evidently that which will allow the recoil to expend its force in nearly, but not quite, the whole length of the cylinder. When once this ratio is fixed, it is very remarkable that the amount of the charge, or the slope at which the platform is placed, whether up or down or

* The reason of this is evident from a little consideration: first, every addition to the area of the holes diminishes the area of the piston, which acts on the water; secondly the difference of the work done by the recoil is proportional to the difference of the *squares of the velocities* given to the water in passing through the orifices in the two cases.

horizontal, makes comparatively little difference in the length of the recoil. With a 12-ton (300 pounder) gun a service charge of 30 lbs. of powder gave a recoil of 4 ft. 5 in.; with a battering charge of 43 lbs. the recoil increased only to 5 ft. 1 in.. If the charge is heavy, or if the slope favours the recoil, the carriage will not go much further back than if these conditions are reversed. But it will do so more rapidly. The space travelled over is not much greater with the violent recoil, but it is done in a shorter time. It is also worthy of notice that quick burning powder, such as the rifled large grain, does not give so long a recoil as the slow burning ones, such as the pebble and pellet powders, although it acts much more violently on the gun; the reason is that the recoil is more rapid. Few machines give so striking an illustration of how important an element is time in work to be done, and how much force is to be increased if anything is done more rapidly. The strength of one man is quite sufficient to push in or pull forward the piston of the Hydraulic Buffer, because he does it quietly, "takes his time to do it." The force of a 25-ton gun, recoiling from the discharge of 70 lbs. of powder, and a 600 lb. shot exhausted itself in doing the same, because it does it so quickly.

In fact, the ease with which the hydraulic buffer permits slow motion is one of its disadvantages, and prevents its application to sea service carriages, as it would not keep the carriages from moving as the ship rolled. A modification to obviate this difficulty has been proposed. It consists of a solid piston (without holes), and the back and front ends of the cylinder are connected by a pipe through which the water is driven by the recoil. The motion of the water can be stopped altogether by the stopcock till the gun is fired, and the area of the orifice through which the water is to pass can also be regulated by it.

The resistance of the water, and consequently the pressure on the cylinder from the recoil, is not uniform. It becomes greatest at the moment when the air receives its maximum compression, before the water attains its highest velocity in passing through the holes in the piston. At this point the force of the recoil is felt as a severe strain upon the cylinder and the platform which holds it. This destructive action of the recoil of heavy guns not only upon platforms, pivots, and racers, but also upon the foundations on which they rest, is one of the great difficulties with which modern military engineering has to grapple. To remedy this disadvantage by causing the recoil to meet with a gradually increasing resistance,



A B cylinder; C end of piston-rod attached to carriage; C′ end of piston-rod after recoil; D E slide or platform. The dotted lines show the position of the carriage and gun after recoil.

so that its force may be felt as a continuous pressure, and not at any point as a shock or blow, the following very ingenious arrangement was proposed by Mr. H. Butter, Chief Constructor in the Royal Carriage Department. It consists in placing along the length of the cylinder and through the holes in the piston four tapering rods, the largest extremities of them being at the rear end of the cylinder, and being of such a size as there to fill completely the piston holes. These orifices and also the whole cylinder must be larger than where the rods are not employed. The effect in this case is that, as the area for the water to flow through the piston is continually diminishing as the holes get further along the rods, the force of the recoil has to impart a continually increasing velocity to the water, and is at no point felt as a shock or blow. The resistance, slight at first, gradually increases throughout the recoil, and so exhausts its force not at any one point, but throughout the whole of its course.

It has been suggested, and it is a consummation most devoutly to be wished, that the Hydraulic Buffer might be applied to railway trains so as to take away the destructive effects of a collision. A train of carriages separated by Hydraulic Buffers would, if suddenly stopped at a high speed, simply close up, the piston being driven in, and the force of the collision would exhaust itself in the motion given to the water in the cylinders. Some practical difficulties stand in the use of this application of the invention; principally, that the length of the piston rods would inconveniently increase the length of the train. But there are none which might not be overcome by a little ingenuity; and the great importance of the object to be gained makes the neglect of any promising means to attain it highly culpable. However, slowness in taking up new ideas (especially if they do not immediately add to dividends), is not altogether a peculiarity of Government departments.

A very interesting pamphlet on this subject has been published by Colonel Clerk, in which Mr. Butter shows the work done in the Hydraulic Buffer, by comparing it with the moment of a similar weight of water falling through such a height as to give it the same velocity as that with which it passes through the holes in the piston. By this ingenious comparison he ascertained that a locomotive engine, weighing 50 tons, and moving at the rate of 30 miles an hour, would be brought to rest in the space of six feet by two Hydraulic Buffers of 12in. diameter. "There are," Colonel Clerk remarks, "two important problems to be worked out by the railway authorities:—(1) to have no railway collisions; (2) if they must sometimes occur, to render them as harmless as possible;" and it is with the second that he deals. The plan which has been so successful in meeting the violence of exploding gunpowder, should, at least, have a trial in a case of far greater importance—security to life in railway collisions. To refuse this, on account of a few difficulties or inconveniences, seems a sin against Nature herself.

NOTES

It will be welcome news to astronomers throughout the world to hear that the Board of Visitors of the Royal Observatory have determined to ask the Government to grant the sum of 5,000*l*. to enable *photographic* observations to be made of the approaching Transit of Venus. It is a matter of wonder that now, when the labours of De la Rue and Rutherford have brought this most perfect means of astronomical record to a pitch of perfection which it is scarcely needful to surpass, it is still ignored in official observatories. In the matter of the Transit of Venus, it will more than double the chances of success, and Mr. Rutherford has shown that in other inquiries it enables an only moderately skilled person to do in a month what a Bessel would require years to compass by the old method. There is no doubt that the appeal to Government will be successful. Would that we had a Physical Observatory and a Board of Visitors to look after other phenomena which we are now neglecting, the observation of which is even of more importance in the present state of science than that of any number of Transits of Venus!

At the conclusion of a recent lecture at the Royal Institution Dr. Carpenter "expressed the earnest hope that the liberal assistance of Her Majesty's Government, which has already enabled British Naturalists to *obtain the lead* in this inquiry, would be so continued as *to enable them to keep it for the future*. In particular he called attention to the suggestion lately thrown out by M. Alex. Agassiz that an arrangement might be made by our own Admiralty with the naval authorities of the United States, by which a thorough survey, Physical and Biological, of the North Atlantic should be made between the two countries, so that British and American explorers, prosecuting in a spirit of generous rivalry labours most important to the science of the future, might meet and shake hands on the mid-ocean." We fear that if we do not bestir ourselves the credit which has been won by British scientific enterprise will pass elsewhere. The United States Government is not only preparing the Deep-sea Exploring Expedition, of which we gave an account in our last issue, but is also fitting out a similar expedition to the North Pacific. The German Government is about to send a like expedition to explore the depths of the Atlantic to the west of Portugal, where the *Porcupine* Expedition of last year met with its greatest biological successes; and the Swedish Government has already despatched two ships expressly fitted for deep-sea exploration, to Baffin's Bay; the Natural History part of the work being under the charge of Mr. Lindape, who acted as assistant-naturalist in the last *Porcupine* Expedition. What are our Scientific men as a body, what is our Government doing? We grieve to say that up to the present time we have heard of no general appeal to the Government for the required help. And thus, having shown other nations the way to the treasures of knowledge which lie hid in the recesses of the ocean, we are falling from the van into the rear, and leaving our rivals to gather everything up. Is this creditable to the Power which claims to be mistress of the seas? Is it fair to the eminent men who have freely given their best services to the nation, and obtained for it a glorious scientific victory? If their success is regarded by other countries as so distinguished that they are vieing with each other for a participation in it, surely we ought at least to *hold our own*.

A paragraph has appeared in several papers to the effect that the lime light is to be displayed on the great clock tower at Westminster during the sitting of Parliament. We are glad to announce that the light in question will not be the lime light, but a much more brilliant one – the magneto-electric. Such a light has now for some time past shone from the Capitol at Washington, and was under the consideration of Lord John Manners some few years ago. Mr. Ayrton, we learn, has expressed great interest in the matter, an estimate has been called for, and as there is already steam power available, we may hope that, under Dr. Tyndall's direction, the new light will soon brightly shine.

The Educational Lectures delivered at the London Institution during the past session by Prof. Huxley, Dr. Odling, and Mr. R. A. Proctor, were followed by examinations, and on Wednesday last the prizes and certificates obtained by the students were distributed by Mr. Thomas Baring, M.P., F.R.S., the president of the Institution. In Chemistry, the first prize was awarded to Frederick Garrett, and the second prize to A. J. Richardson. In Biology, Miss Dora Harris gained the first prize, while A. Percy Lloyd and Miss F. L. Tolmé obtained second prizes. In Astronomy, the first prize was gained by A. J. Wallis, and second prizes fell to Miss Annie Piper and Edward Garrett.

W. T. Thistleton Dyer, Esq., commenced last Monday a course of six lectures on the Natural History of a Flowering Plant, at the Royal College of Science for Ireland, St. Stephen's Green. The lectures will be continued on the following Monday and Thursday evenings.

The Society of Arts has this year conferred its Albert Gold Medal upon Mr. Cole, C.B. It seems agreed on all hands that without Mr. Cole we should have had neither the South Kensington Museum nor any of those Science and Art classes which are now either in full work or are springing up throughout the country, and are doing an incalculable amount of good. If this be so, then certainly Mr. Cole has done more for the spreading of Science and Art in this country than any other man of his time; and our scientific and artistic bodies should join with the Society of Arts in acknowledging his services.

The Royal Commission on Scientific Instruction and the Advancement of Science recommenced their sittings on Tuesday last, and will meet again to-morrow.

Prof. Humphry, of Cambridge, will hold classes for instruction in Practical Anatomy on Tuesdays, Thursdays, and Saturdays at half-past twelve during the Long Vacation, commencing July 4. There will also be classes for instruction in Practical Histology on Wednesdays and Fridays at half-past twelve, commencing July 5. This, together with a course of instruction in the Physiological Laboratory, under the direction of Dr. Michael Foster, will constitute a course of Practical Physiology. Gentlemen who have entered to the Anatomical Lectures will be at liberty to attend these classes without additional fee.

There will be an election to a Science Fellowship at Corpus Christi College at the beginning of Michaelmas Term. Candidates must have passed all the examinations required by the University for the degree of B.A., and must not be in possession of any benefice or property which would disqualify for retaining a Fellowship. This examination will commence on Monday, October 9, and will be specially in chemistry. Candidates are requested to communicate with the president, either personally or by letter, at their convenience, before the end of Act Term.

The Sheepshanks Astronomical Exhibition at Trinity College, Cambridge, has been awarded to Horace Lamb, Scholar of the College. The Exhibition is open to all members of the University, the only conditions being that the person elected shall become a member of Trinity College.

At a recent Court of Governors of St. Bartholomew's Hospital, Mr. Paget, F.R.S., was appointed consulting surgeon to the hospital. At a Court held last Thursday, Mr. Callender was elected surgeon. There is now, therefore, a vacancy for the office of assistant-surgeon to the hospital.

We greatly regret to hear of the alarming illness of Mr. Grote, the Vice-Chancellor of the University of London. His long and useful life has been devoted to the cause of higher education in this country, and since the foundation of the University he has been one of its staunchest and most unwearied friends.

WE observe that Miss Esther Greatbatch, who has just passed the second (special) examination for women at the University of London in French and in Harmony and Counterpoint, also took the second prize at the examination which followed Prof. Guthrie's Lectures on Physics at the London Institute, in February, 1870, and out of seventy-four candidates, the first prize for the examination in Physical Geography, which followed Prof. Huxley's lectures on that subject in 1869. In 1868 Miss Greatbatch passed as a Junior with first class honours, and gained a prize for Mathematics at the Cambridge Local Examination. In December, 1870, she passed as a Senior, with first class honours, gaining the Mill-Taylor Scholarship and a prize for Political Economy. Miss Greatbatch did not take up the Mill-Taylor Scholarship, which can only be held at Cambridge. She is a pupil of the North London Collegiate School for Girls, where she has received the whole of her education. The lady to whom we alluded last week is not the first who has gained a special distinction of proficiency in Natural Philosophy and Chemistry at the examinations of the University of London, that honour having been conferred on Miss Orme in 1870.

PROF. HUXLEY'S "Elementary Lessons in Physiology" are about to be translated into Hindostanee.

THE Paris correspondent of the *Daily News* states that the chateau of the Marquis Laplace at Arcueil Cachan, which escaped the Prussians, has been plundered by a band of housebreakers from the Mouffetard district. The manuscripts of the celebrated astronomer were thrown into the Bièvre, from which the original of "The Mechanism of the Heavens," in the author's handwriting, has subsequently been fished out. The library, which was rich in rare books, souvenirs, and works of art, has been looted and devastated.

THE medal given by the Royal Geographical Society to Dr. Keith Johnston is in acknowledgment of the services of the devotion of more than forty years of an unusually active life to purely geographical pursuits. He has done more for popularising geography than almost any other living author. The publication of his "Physical Atlas" in 1847 gave an unexampled impetus to the study of Physical Geography in Britain, and his publications since then, of great utility and importance, have been very numerous.

WE learn from the *Journal of Botany* that the well-known cryptogamist Fries accompanies the Swedish Arctic expedition as botanist, and MM. Lindahl and Nauckhoff as zoologist and geologist. The expedition intends to visit Baffin's Bay, and to return in October.

A NEW botanical magazine has just appeared at Lund in Sweden, "Botaniska Notiser," edited by Otto Nordstedt. It will be specially devoted to Scandinavian botany, and to a review of all botanical papers published in Sweden, Norway, Denmark, and Finland.

THE yearly part, just issued, of the Natural History Transactions of Northumberland and Durham contains, as usual, many valuable contributions to scientific literature. The first paper is a Revision of the Catalogue of Coleoptera of Northumberland and Durham, by Mr. T. J. Bold, including 1,520 species, about one half the number hitherto found in Great Britain. Dr. W. C. M'Intosh contributes a short Report on the Collection of Annelids dredged off Northumberland and Durham, and Mr. George Hodge a Catalogue of the Echinodermata of the same counties, forty-three in number, accompanied by interesting remarks on each species, and illustrated by four plates. From Messrs. W. Kirby and J. Duff we have some elaborate Notes on the Geology of part of South Durham, the lower coal measures in the neighbourhood of the village of Etherley, embellished by diagrams showing the position of the coal-seams. Then follow five papers on remarkable fossils of the carboniferous series by Mr. Albany Hancock, in conjunction with Messrs. T. Atthey and R. Howse; viz., On the Labyrinthodont Amphibian, *Loxomma Allmanni*, being its first occurrence in the neighbourhood; On a new generic form of the same order, to which the name *Batrachiderpeton lineatum* is given; On another new form from the magnesian limestone, *Lepidotosaurus Duffii*; A description of a specimen from the marl-slate of the oldest known reptile, *Proterosaurus Speneri*, and of a new species, *P. Huxleyi*; and A description of four specimens from the same formation of *Dorypterus Hoffmanni*; these papers are illustrated with six well-executed plates. The last paper is on *Saccamina Carteri*, a new foraminifer from the carboniferous limestone of Northumberland (with one plate), by Mr. H. B. Brady; and the volume closes with an admirable address from the president of the Tyneside Naturalists' Field Club, Mr. G. S. Brady, in which he gives a sketch of the work of the society during the past year, and of the general additions to natural history literature during the same period, especially in the departments of "Spontaneous Generation" and the "Origin of Species." The president for the present year is Mr. G. C. Atkinson.

THE last number of the "Bücher-verzeichniss," published by Friedländer and Son, of Berlin, is a valuable and copious catalogue of astronomical literature in English, French, German, Latin, and the other European languages.

A THIRD edition of Prof. Brünnow's "Lehrbuch der Sphärischen Astronomie" has just been published in Berlin.

WE are favoured by Mr. Login with a photograph representing the produce of one grain of wheat grown on the Egyptian system in India, which gave off 160 shoots, and has produced 105 ears of corn; another, $4\frac{1}{2}$ ft. high, which produced 45 ears from $4\frac{1}{2}$ in. to 5 in. in length; and another $3\frac{1}{2}$ ft. high, with about 50 ears. These are represented as about average results from this system, and are contrasted with a single plant grown on the native broad-cast system, assisted by irrigation, producing seven ears from each grain, and another without irrigation, producing from five to fifteen ears, and also represented as average results. We congratulate the Indian authorities upon having a man of Mr. Login's wide grasp in their service. This is by no means the first time we have referred to his labours.

WITH reference to the alleged disappearance of Aurora Island, one of the New Hebrides group, to which we alluded some weeks since on the authority of a paper read before the Academy of Natural Sciences of Philadelphia, a correspondent of the *Shipping and Mercantile Gazette* affirms that the whole story is a fable. The original statement rested on a notice by Captain Plock, of the French ship *Adolphe*, bound from Iquique to London, that he passed over the position of the Iles de l'Aurore, as marked on his French chart of the South Atlantic, and saw nothing of them, from which he concluded that they had disappeared. It appears, however, that the Iles de l'Aurore (Aurora Islands) never existed. They were formerly placed between lat. 52° 38′ and 53° 15′ S., and between long. 47° 43′ and 47° 57′ W. of Greenwich. The first reporters of the islands probably saw icebergs in the given locality, and mistook their character. Aurora Island, in the New Hebrides group, has been confounded with the Aurora Island in the Paumotu, Tuamotu, or Low Archipelago. Aurora, Makatea, or Metia Island, lat. 15° 50′ S., long. 148° 13′ W., one of the Low Archipelago, has not been visited for some time, but its elevation would lead to the inference that it could not disappear suddenly; it is fertile and inhabited. This is the island visited by Wilkes, and on which the unique specimens of mollusca were found. It is upwards of 2,500 miles eastward of the New Hebrides.

AMERICAN NOTES *

THE official report of the geological explorations prosecuted during the past summer by Prof. F. V. Hayden, under the authority of the Department of the Interior, has just been published by the Government in a well-printed volume of over five hundred pages, containing a full account of the geology and natural history of the region traversed. It embraces an article by Prof. Hayden upon the physical character and local geology of the different sections of his route, which extended from Cheyenne, by way of Fort Fetterman, South Pass, Fort Bridger, the Uinta Mountains, to Green River, and back again, *viâ* Bridger's Pass, to Cheyenne. This is followed by an account of the Geology of the Missouri Valley from Omaha to Salt Lake Valley, with observations on the mines, ores, coals, and salts. An appendix contains an article by Prof. Cyrus Thomas upon the agricultural possibilities of the country, with a list of the orthopterous insects, including a number of new species, followed by a number of special reports—as one by Prof. Meek, on the invertebrate fossils; on the Tertiary coals of the West, by Prof. Hodge; on the ancient lakes of Western America, by Prof. Newberry; on the vertebrate fossils of the Tertiary formation, by Prof. Leidy; on the fossil plants of the Cretaceous and Tertiary formations of Kansas and Nebraska, by Mr. Lesquereux; on the fossil reptiles and fishes of the Cretaceous rocks of Kansas, the fossil fishes of the Green River group, and the recent reptiles and fishes, by Prof. Cope; and on the industrial resources of Western Kansas and Eastern Colorado, by Mr. Elliott. Lists of the mammals, molluscs, and birds, of the coleoptera, hemiptera, and plants, are also included, together with an account of the general meteorology of the expedition. A large number of new species of different kinds are described, and the whole work forms a very important addition to our information relative to the geology, geography, and natural history of the West.

The second and third annual reports of the Peabody Academy of Science of Salem (for 1869 and 1870) have just been published, giving a gratifying account of the activity of that young and energetic society, which, although only in the third year of its existence, already ranks among the best establishments of the kind in the country, and which, in the number of excellent working naturalists associated with it, is rapidly making its mark. The donations to the museum of the academy during 1870 alone amounted to 195, received from 148 different persons. The identification of the specimens presented has been accomplished by the officers of the academy, aided by specialists in other parts of the country. The reports embrace references to several exploring expeditions instituted in the interests of the academy in different parts of the United States, as well as in Central America. The second number of the first volume of the Memoirs of the academy has also just appeared, and closely resembles typographically, as well as in size and other features, the well-known Memoirs of the Boston Society of Natural History, and of the Museum of Comparative Zoology. This part is occupied entirely by a paper upon the embryology of certain neuropterous and other insects, by Dr. A. S. Packard, jun., the Secretary of the Council.—Attention is called by the Panama papers to the extraordinary meteorological conditions that have lately prevailed throughout Central and South America, especially in the falling of large quantities of rain where previously such an occurrence was almost unknown. This unusual amount of precipitation is understood to have first occurred on the Isthmus of Panama, and to have resulted in disastrous floods at Aspinwall and elsewhere, of which an account has already been given. The climatic change seems to have travelled southwardly from that region, and to have involved successively a large portion of the chain of the Andes in its operations. The latest advices from Peru show that in localities hitherto perfectly rainless torrents have fallen to such an extent as to produce very great disasters. These have occurred at Payta, San José, Lambayeque, &c. The villages on the western slope of the Andes in Chili and Peru are not prepared for such an occurrence (of which many of the inhabitants had never had any practical experience), the sites and material of the buildings being alike unsuited to resist storms. The town of Lambayeque, containing seven or eight thousand inhabitants, is reported to have been entirely destroyed by the rain. The most southerly point reached by the rain at last dates seems to be the valley of Canete, which was inundated to the great damage of the sugar and other plantations. Much land has been totally ruined by the washing out of its soil, leaving behind a mere collection of gravel and stones. Vessels passing along the western coast at a distance of hundred miles and more experienced heavy rains where previously nothing but fog had been met with. The electric phenomenon visible around Mount Tacora, to which we recently referred, seems to have been a part of this same system of atmospheric disturbance, and connected with it was a widely extended arrangement of the telegraph lines in Chili, an event of extreme rarity.

* Communicated by the Editor of *Harper's Weekly*.

SCIENCE IN VICTORIA

ONE or two interesting subjects were discussed at a recent meeting of the Royal Society of Victoria, and we are favoured by a correspondent with the following particulars:—Notes on the working of the great Melbourne telescope, which some time ago was inconsiderately pronounced to be a failure, which were read by Mr. Farie MacGeorge, who has had charge of the instrument since Mr. Le Sueur left. It was stated that the speculum polished by Mr. Le Sueur had worked very satisfactorily, and some fresh discoveries with regard to Sirius and the star *d* were thus described by Mr. MacGeorge:—"On 9th Dec. 1870—indifferent evening—I noted all the faint stars near Sirius for future identification. On the 18th Jan. 1871, for the first time, I chanced upon Lassell's observations of Sirius in the 'Memoirs of the Royal Astronomical Society,' 1867. Mr. Martin there mentions having suddenly found a very faint star in the neighbourhood of Sirius which had, until then, escaped keen observers like Struve, Lassell, and himself, in the exquisite 4ft. equatorial at Malta. On comparing the position of this faint star—now called Lassell's Companion—with the faint stars noted by me on 9th December, it evidently corresponded with one noted on that date, so that with our great equatorial my eye, unbiassed by previous knowledge, detected at the first inspection on an indifferent evening an object which had long escaped these careful and experienced observers in the great Malta equatorial, an instrument of acknowledged excellence and equal aperture to our own. Several still fainter stars have since been seen near Sirius, two of them between Lassell's Companion, the star *d*, and Sirius. So far as I have yet seen, any want of definition is evidently due to atmospheric defects, not instrumental ones, the power of definition being at all times in direct ratio with the goodness of the evening." Prof. Wilson made a suggestion to the society respecting an expedition to Cape York, in a steamer, to witness the Total Eclipse of the Sun on the 12th December next, the eclipse being visible along a portion of the northern coast of Australia. The proposal was favourably entertained, and an understanding arrived at that it should receive fuller consideration at the next meeting. The annual meeting of the Acclimatisation Society of Victoria was held on the 10th March, Dr. Black, the President, occupying the chair. In their customary report to the subscribers, the council, while regretting the smallness of their numbers, stated that under the management of the new secretary Mr. A. C. Le Sœur, the society bade fair to again become extensively useful. It was mentioned that four ostriches which had been received from South Africa had been taken charge of by Mr. Samuel Wilson, of Longerenong, and had now increased to sixteen, and there was every reason to suppose that their numbers would be considerably augmented in the course of this season. So far the experiment had been a marked success. Ostrich farming was a profitable occupation at the Cape colony, and it was hoped it wou d ultimately become so here. The climate of the Wimmera district, it was remarked, appeared to be well adapted to their habits; as a proof of which, the young Australian birds were now taller than the parent stock. It was stated, amongst other subjects dealt with in the report, that the society had done and was doing all in its power to encourage sericulture in the colony, and to this end had, in conjunction with Dr. Von Mueller, sent white mulberry cuttings and plants to all parts of Victoria. Some months ago a box of silkworm eggs was sent by the Governor of India to his Excellency the Governor, who kindly handed them to the society for d's.ribution, and lately a supply of very superior Japanese eggs, such as were seldom sold to foreigners, had been forwarded by Dr. Bennett, the hon. secretary of the Acclimatisation Society of New South Wales. The Silk Supply Association of London, it was mentioned, in one of their reports recently published, recognised no less than 36,000 square miles of country in Victoria as well suited to the growth of silk; and when the numerous young plantations came into bearing a great stimulus would be given to this industry, which in all probability would, before many years, add materially to the wealth of the colony.

MR. BENTHAM'S ANNIVERSARY ADDRESS TO THE LINNEAN SOCIETY

(*Continued from page* 94)

PRESERVED specimens have the great advantage over living ones, that they can be collected in infinitely greater numbers, maintained in juxtaposition, and compared, however distant the times and places at which they had been found. They are often the only materials from which we can obtain a knowledge of the races they represent; although still consisting of individuals only, they can, by their numbers, give better ideas of species and other abstract groups than the almost isolated living ones; and their careful preservation supplies the means of verifying or correcting descriptions or delineations which have excited suspicion. Their great drawback is their incompleteness, and the impossibility of deriving from them all the data required for the knowledge of a race or even of an individual. It is owing to the frequency with which characters supplied by preserved specimens, although of the most limited and unimportant a nature, have been treated as sufficient to establish affinities and other general conclusions which have proved fallacious, that the outcry I have alluded to has been raised against museums and herbaria by those very theorists whose speculations would fall to the ground if all the data supplied by preserved specimens were removed from their foundation.

In respect of these deficiencies, as well as in the means of supplying them, there is a great difference between zoological and botanical museums. Generally speaking, zoological specimens show external forms only; botanical specimens give the means of ascertaining internal structure;* and as a rule the characters most prominently or most frequently brought under the observer's notice acquire in his eyes an undue importance. Hence it is that external form was for so long almost exclusively relied upon for the classification of animals, whilst the minutiæ of internal structure were at a comparatively early period taken account of by botanists, while palæontologists are still led to give absolute weight to the most uncertain of all characters—outline and external markings of deciduous organs. External form is, however, really of far greater importance in animals than in plants; the number, form, size, and proportions of limbs, the shape and colour of excrescences, horns, beaks, feathers, hair, &c., in animals may be reckoned almost absolute in species when compared with the same characters in the roots, branches, and foliage, and, to a certain extent, even in the flowers of plants. In plants, local circumstances, food, meteorological conditions, act readily in modifying the individual, and producing more or less permanent races of the lowest degree (varieties); whilst animals in these respects are comparatively little affected, except through those slow or occult processes by which the higher races, species, or genera in all organisms are altered in successive ages or geological periods. Even relative position of external parts, so constant in animals, is less so in plants. Animals being thus definite in outline, and a very large proportion of them manageable as to size, their preserved specimens, carcases, or skins can be brought together under the observer's eye in considerable numbers, exhibiting at once characters sufficient for the fixation of species; whilst, with a few rare exceptions, a whole plant in its natural shape can never be preserved in a botanical museum. And, although good botanical specimens have a general facies, often sufficient to establish the species if the genus is known, yet the most experienced botanists have often erred in their determinations where they have been satisfied with external comparison without internal examination.

Identification of species is, however, but a small portion of the business of systematic biology, and for higher purposes the classification of species, and the study of their affinities, the pre-eminence of ordinary zoological over botanical specimens soon fails, those characters distinguished by Prof. Flower as adaptive are proportionately more prominent, and the essential ones derived from internal structure are absent; and not only do the former thus acquire undue importance in the student's eyes, but arguments in support of a favourite theory have not unfrequently been founded on distortions really the result of bad preparation, although supposed to be established on the authority of actual specimens, and therefore very difficult to refute. Mounted skins of vertebrata, showy insects in their perfect stage, shells of malacozoa, corals, and sponges, necessarily form the chief portion of a museum for public exhibition; but science and instruction require a great deal more; museum collections really useful to them should exhibit the animal as far as possible in all its parts and in all the phases of its life. This necessity has been felt in modern times, and has resulted in the establishment of Museums of Comparative Anatomy, amongst which that of our own College of Surgeons has certainly now taken the lead. But I have nowhere seen, except on a very small scale, the two museums satisfactorily combined. The idea, however, is not a new one; several zoologists have expressed their opinions on the desirableness of such an arrangement, which it is to be hoped will be duly considered in the formation of the new National Zoological Museums about to be erected at South Kensington, for the double purpose of exhibition and science. The requirements of the gazing public are sure to be well provided for, and there is every reason to believe that the exertions of scientific zoologists will not have proved useless, that we shall in the portion devoted to science and instruction see the skins of vertebrata preserved without the artist's distortions, accompanied, as far as practicable, by corresponding skeletons and anatomical preparations, as well as by the nests and eggs of the oviparous classes; insects with their eggs, larvæ, and pupæ; shells with the animals which produce them, &c., always with the addition, as far as possible, of the collector's memoranda as to station, habits, &c., in the same manner as herbarium specimens are now frequently most carefully completed by detached fruits, seeds, young plants in germination, gums, and other products.

Here, however, will arise another source of false data to be carefully guarded against—the mismatching of specimens, which in botany has probably produced more false genera and species than the misplacing of garden labels. The most careful collectors have in good faith transmitted flowers and fruits belonging to different plants as those of one species—the fruits perhaps picked up from under a tree from which they were believed to have fallen, or two trees in the same forest with similar leaves, the one in flower the other in fruit, supposed to be identical, but in fact not even congeners, and the mismatching at the various stages of drying, sorting, distributing, and finally laying in the specimens, have been lamentably frequent. Collectors' memoranda, if not immediately attached to the specimens or identified by attached numbers, have often led the naturalist astray, for collectors are but too apt, instead of noting down any particulars at the time of gathering, to trust to their memory when finally packing up their specimens. And so long as reasoning by analogy was never allowed to prevail over a hasty glance at a specimen and the memoranda attached to it, false genera and species arising from these errors were considered indisputable. *Magallana* of Cavanilles was, till recently, allowed materially to invalidate the character of Tropœoleæ, overlooking the strong internal evidence that it was founded upon the fruit of one natural order carefully attached to a poor flowering specimen of another.

Zoological museums and botanical herbaria differ very widely in the resources at their disposal for formation, maintenance, and extension of their collections. Zoological museums are by far the most expensive, but on the other hand as exhibitions they can draw largely on the general public, whilst herbaria must rely mainly upon science alone, which is always poor; both, however, may claim national assistance on the plea of instruction as well as of pure science, and for practical or economic purposes the herbarium is even more necessary than the museum. The planning the new museums so as best to answer these several purposes for which they are required, has, we understand, engaged the attention of the Royal Commission on Scientific Instruction and the Advancement of Science, and our most eminent zoologists have been consulted; any further observations on my part would therefore be superfluous. If our Government fail in their arrangements for the promotion of science, it will not be for want of having its requirements laid before them.

I am unable to say what progress has been made of late years in zoological museums, my notes on Continental ones were chiefly taken between the years 1830 and 1847, and would therefore be now out of date. It would, however, be most useful if some competent authority would undertake a tour of inspection of the more important ones, as in the great variety of their internal arrangements many a useful practical hint might be obtained, and we much want a general sketch of the principal zoological and botanical collections accessible to science, showing in what branch each one is specially rich, and where the more important

* By *internal structure* is here meant the morphology of internal organs or parts, usually included in the comparative anatomy of animals, not the microscopical structure of tissues, which is more especially designated as vegetable anatomy.

typical series are now respectively deposited. In herbaria a few changes have recently taken place which it may be useful to record. Paris, I mean of course the brilliant Paris of a twelvemonth back, had lost considerably. Of the many important private herbaria I had been familiar with in earlier days, two only, those of Jussieu and of A. de St. Hilaire, had been secured for the national collection, Webb's had gone to Florence, J. Gay's, which would have been of special value at the Jardin, was allowed to be purchased by Hooker and presented by him to Kew. The celebrated herbarium of Delessert is removed to Geneva, whilst his botanical library, one of the richest in existence, is locked up within the walls of the Institut. These are but partially replaced by M. Cosson's herbarium, which has much increased of late years, and to which he added last spring the late Schultz Bipontinus's collection rich in Compositæ. The national herbarium of the Jardin des Plantes is still one of the richest, but no longer *the* richest of all. The limited funds at the disposal of the Administration have allowed of their making but few acquisitions; their staff is so small and so limited in the hours of attendance, that the increase of the last twenty years remains for the most part unarranged, and their library is most scanty. Science has been out of favour with their governments of display. It would be out of place for me here to dwell upon the painful feelings excited in my mind by the dreadful ordeal through which a country I have been so intimately associated with for more than half a century is now passing, feelings rendered so acute by the remembrance of the uniform kindness I have received from private friends as well as from men of science, from Antoine Laurent de Jussieu and his colleagues to the eminent professors of the Jardin, who have now passed through the siege; but I may be allowed to express an anxious hope that when the crisis is passed, and the elasticity of French resources will have restored the wonted prosperity, the new Government may at length perceive that, even politically speaking, the demands of science require as much attention as popular clamour.

The Delesserian herbarium has been well received at Geneva, where it has been adequately deposited in a building in the Botanic Garden, very near to the Natural History Museum now erecting. At Paris it had been for some time comparatively useless, owing to the attempt to class it according to Sprengel's Linnæus, but now an active amateur committee, Messrs. J. Mueller, Reuter, Rapin, and others, under the presidency of Dr. Fauconnet, have already made great progress in distributing the specimens under their natural orders; and Geneva, already containing the important typical collection of De Candolle, and Boissier's stores rich especially in Mediteranean and Oriental plants, has become one of the great centres where real botanical work can be satisfactorily carried on; and as she has had the good sense to level her fortifications, she may accumulate national treasures with more confidence in the future. Munich has lost much of the prospect she had; the Bavarian Government failed to come to terms with the family of the late von Martius, his botanical library has been dispersed, and his herbarium removed to Brussels, where it is to form the nucleus of a national Belgian collection. At Vienna the Imperial herbarium is now admirably housed in the Botanical Garden, and is in good order, with the advantage of a rich botanical library in the same rooms. At Berlin, where the Royal Herbarium, like the Zoological Museum, has always been kept in excellent order, want of space is greatly complained of since it has been transported to the buildings of the University. At Florence, as we learn from the *Giornale Botanico Italiano*, the difficulties with regard to the funds left by Mr. Webb for the maintenance of his herbarium have been overcome, and it is to be hoped that the liberal intentions of the testator who made this splendid bequest for the benefit of science will no longer remain so shamefully unfulfilled. To the above six may be added Leyden, Petersburgh, Stockholm, Upsala, and Copenhagen, as towns possessing national herbaria sufficiently important for the pursuit of systematic botany; but when I visited them, now many years since, they were all, more or less, in arrear in arrangement. I know not how far they may have since improved. In the United States of America, the herbarium of Asa Gray, recently secured to the Harvard University, now occupies a first rank. That of Melbourne in Australia, founded by Ferdinand Mueller, has, through his indefatigable exertions, attained very large proportions; and that of the Botanical Garden of Calcutta, under the successive administration of Dr. Thomson and the late Dr. T. Anderson, had recovered in a great measure its proper position, which, I trust, it will henceforth maintain. Our own great national herbarium and library at Kew is now far ahead of all others in extent, value, and practical utility; originally created, maintained, and extended by the two Hookers, father and son, their unremitting and disinterested exertions have succeeded in obtaining for it that Government support without which no such establishment can be really efficient, whilst their liberal and judicious management has secured for it the countenance and approbation of the numerous scientific foreigners who have visited or corresponded with it. Of the valuable botanical materials accumulated in the British Museum during the last century I say nothing now, for the Natural History portion of that establishment is in a state of transition, and my own views as regards Botany have been elsewhere expressed. I have only to add that we have also herbaria of considerable extent at the Universities of Oxford, Cambridge, and Edinburgh, and at Trinity College, Dublin, and to express a hope that the necessity of maintaining and extending them will be duly felt by these great educational bodies, if they desire to secure for their professorial chairs botanists of eminence.

3. Pictorial representations or drawings have the advantage over museum specimens, that they can be in many respects more complete, they can represent objects and portions of objects which it has been impossible to preserve, they can give colour and other characters lost in the course of desiccation, they preserve anatomical and microscopical details in a form in which the observer can have recourse to them again and again without repeating his dissections, and although, like a museum specimen, each drawing represents usually an individual, not a species, yet that individual can by exact copies be multiplied to any extent for the simultaneous use of any number of naturalists, whilst specimens of the same species in different museums are corresponding only, not identical, and imperfect comparison and determination of specimens supposed to be authentic (*i.e.*, exactly corresponding to the one originally described) have led into numerous errors. Drawings, moreover, of diagrams and other devices can represent more or less perfectly the abstract ideas of genera and species, they can exhibit the generic or specific character more or less divested of specific or individual peculiarities.

Drawings on the other hand are, much more than specimens, liable to imperfections and falsifications arising from defective observation of the model and want of skill in the artist, and errors thus once established are much more difficult of correction than even those conveyed by writing. A pictorial representation conveys an idea much more rapidly, and impresses it much more strongly on the mind, than any detailed accompanying description by which it may be modified or corrected, and is but too frequently the only evidence looked into by the more theoretical naturalist. This is especially the case with microscopical and anatomical details of the smaller animals and plants, the representations of which, if very elaborate and difficult to verify, usually inspire absolute confidence. Drawings are also costly, often beyond the means of unaided science, who here again, as in the case of gardens and museums, is obliged to have recourse to the paying public; the public in return require to have their tastes gratified, artistic effect is necessarily considered, thus increasing the cost and removing the pictures still further from the reach of the working biologist. It appears to me, however, that collections of drawings systematically arranged have not generally met with that attention which they require from directors of museums, and that their multiplication in an effective and cheap form ought to be a great object on the part of Governments, Scientific Associations, and others who contribute pecuniarily to the advancement of science.

To be effective, the first requisites in a zoological or botanical drawing are accuracy and completeness; it is a faithful representation not a picture that is wanted. Many a splendid portrait of an animal or plant, especially if grouped with others in one picture, has been rendered almost useless to science by a graceful attitude or an elegant curve which the artist has sought to give to a limb or to a branch, and those analytical details which are of paramount importance to the biologist are neglected, because they spoil the general effect. We next require from an illustration, as from a description, that it should be representative, or to a certain degree abstract, and this requires that the artist, if not himself the naturalist, should work under the naturalist's eye, so as to understand what he delineates. Great care should be taken, in the selection for the model of an individual in a normal state, as to health, size, &c., and in the selection and arrangement of the anatomical details, so as to represent the race rather than the individual, all of which requires a thorough acquaintance with the questions to be attended to. It is true that the artist working independently and copying mechanically may serve as a check on the naturalist, who in minute microscopic examinations may be apt to see too much in conformity to preconceived theories; but that is not often the case, the most satisfactory analytical drawings I have always found to be those made by the naturalist's own hand, and I have long felt how much my own inability to draw has detracted from the value of botanical papers I have published. And thirdly, when we consider that the great advantage of an illustration over a description is, that the one gives us at a glance the information which we can only obtain from the other by study, we require that each drawing or plate should be as comprehensive as is consistent with clearness and precision. Outline drawings or portraits without structural details often omit the essential characters we are in search of; where details are unaccompanied by a general outline, we miss a great means of fixing their bearing on our minds. Structural details may also equally err in being too numerous or too few, or too large or on too small a scale. If the plate is crowded with details of little importance, or which may be readily taken from the general outline, they draw off the attention from those which it is essential should be at once fixed on the mind, and if enlarged beyond what is necessary for clearness, they require so much the more effort to comprehend them, unless indeed they be destined to be hung up on the walls of a lecture-room. I believe it to be the case with some drawings of the muscles of vertebrata, or of the internal structure of insects, as I know it to be with those of ovules and other minute parts of flowers of the late Dr. Griffith and others, that with their very high scientific value, their practical utility is much interfered with by the large scale on which they are drawn. A great deal depends also on the arrangement in the plate, always keeping in mind that the object is not to please the eye, but to convey at one view as much as possible of comparative information without producing confusion.

Biological illustrations in general have much improved in our time. It is true that some of the representations of animals and plants dating from the middle of last century will enter into competition with any modern ones as to the general outlines and facies, but analytical details were almost universally neglected, and colouring when attempted was gaudy and unfaithful. At present I believe we excel in this country in the general artistic effect, as unfortunately also for the naturalist in the costliness, of our best zoological and botanical plates; the French are remarkable for the selection, arrangement, and execution of the scientific details, and as a model I may refer to some of the publications of the Paris Museum, such as the Malpighiaceæ of Adrien de Jussieu, and also for the excellent woodcuts illustrating their general and popular works; the Germans and some Northern states for the admirable neatness of microscopic and other minutiæ executed at a comparatively small cost, owing partially at least to the use of engravings on lithographic stone.

4. Written Descriptions are what we must chiefly rely upon to convey to the general or to the practical naturalist the results of our studies of animals and plants; but descriptions are of two kinds—individual descriptions and descriptions of species, genera, or other races. The former are like preserved specimens or delineations, materials for study, like them they require in their preparation little more than artistical skill guided by a general knowledge of the subject; but abstract descriptions, whether specific or relating to races of a higher degree, require that study of the mutual relations of individuals and races and their consequent classification which constitute the science of systematic biology, and this distinction should be constantly kept in view for the just appreciation of all descriptive works. Any tyro can with care write a long description of a specimen unimpeachable as to accuracy, but it requires a thorough knowledge of the subject and a keen appreciation of the bearings of the points noticed to prepare a good description of a species. For the latter to be serviceable it must be accurate, it must be full without redundancy, it must be concise without sacrificing clearness, it must be abstractive not individual, and lastly, the most difficult qualification of all and that which constitutes the main point of the science, the abstraction must be judicious and true to Nature.

The paramount importance of accuracy is too evident to need dwelling upon. We are all liable to errors of observation. Imperfect vision or instruments, optical deceptions, accidentally abnormal conditions of the specimen examined, hasty appreciation of what we see from preconceived theories, are so many of the causes which have occasionally led into error the most eminent of naturalists, and require to be specially guarded against by repeated observation of different specimens and constant testing at every step by reasonings from analogy. Errors once established on apparently good authority are exceedingly difficult to correct, and have been the source of many a false theory. Where loose examination and hasty conclusion have been frequently detected, we can at once renounce all confidence in an author's descriptions—in his genera and species—unless confirmed from other sources, but an accidental oversight on the part of a naturalist of established reputation is the most difficult to remedy, notwithstanding the eagerness with which some beginners devote themselves to hunting them out. No botanist was, I believe, ever more careful in verifying his observations over and over again, and in submitting them to the tests supplied by the extraordinary methodising powers of his mind, than Robert Brown, no one has ever committed fewer of what we call blunders, or established his systematic theories on safer ground, yet even he has been detected in a few minor oversights, eagerly seized upon by a set of modern speculative botanists, lovers of paradoxes, as justifying them in devoting their time and energies to the disputal of several of his most important discoveries and conclusions.

The value of a description as to fulness and conciseness is practical only, but in that point of view important. A description, however accurate, is absolutely useless if the essential points are omitted, and very nearly so if those essential points are drowned in a sea of useless details; the difficulty is to ascertain what are the essential points; and hence one of the causes of the superiority of monographs and floras over isolated descriptions, such as those of Zoologies and Botanies of exploring expeditions, which I insisted on in my address of 1862; in the former the author must equally examine and classify all the allied races, and thus ascertain the essential points; in the latter case he is too easily led to trust to what he believes to be essential. My own long experience in the using, as well as in the making, of botanical descriptions, has proved to me how difficult it is to prepare a really good one, how impossible it is to do it satisfactorily from a first observation of a single specimen. However carefully you may have noted every point that occurs to you, you will find that, after having comparatively examined other specimens and allied forms, you will have many an error to correct, many a blank to fill up, and much to eliminate. I have more than once had to verify the same species in two authors, the one giving you a character in a few lines which satisfies you at once, the other obliging you to labour through two or three quarto pages of minute details, from which some of the essential points are omitted.

But the great problem to be solved at every stage in systematic or descriptive biology, and that which gives it so high a scientific importance, is the due detection and appreciation of affinities and mutual relations, and in this respect the science has made immense progress within my own recollection, and especially during the last few years the gradual supplanting of artificial by natural classifications has been too often commented upon to need repetition. It is now, I believe, universally admitted that a species consists of individuals connected together by certain resemblances or affinities the result of a common descent. It is also acknowledged that for scientific purposes these species should be arranged in groups according to resemblances or affinities more remote than in the case of species, although here commences the great difference of opinion as to the meaning of these remote affinities, whether they also are the result of a common descent, or of that supposed imitation of a type which I have above alluded to. For those, however, who have once connected affinity with consanguinity, it is difficult to recede from so ready an explanation of those mysterious resemblances and differences, the study of which must be the ruling principle to guide us in our classifications. All this has now been fully explained by more able pens than mine; my only object in repeating it is to point out clearly the need of treating all systematic groups from the order down to the genus, species, or variety, as races of a similar nature, collections of individuals more nearly related to each other than to the individuals comprising any other race of the same grade, and of abolishing the use of the expression *type* of a genus, or other group, in any other than a purely historical sense, as a question of nomenclature.* If a genus has to be

* For the purposes of instruction some one species is often named as a type of a genus, that is to say, as fairly representing the most prevalent

divided, our laws of nomenclature require the original name to be retained for that section which includes the species which the founder of the genus had more specially observed in framing his character, and therefore, and for that reason only, it becomes necessary to inquire which was or which were the so-called typical species—the biologist's or as it were the artist's, not Nature's type.

I need not repeat what I said in 1862 of the comparative value of monographs and faunas or floras over miscellaneous descriptions, observing only that the immense progress made in the accumulation of known species henceforth diminishes still more the relative importance to science of the addition of new forms when compared to the due collocation and correct appreciation of those already known. Much has been done of late years in the latter respect, but yet some branches of biology, and perhaps entomology more than any other, are very much in arrear as to supplying us with available data for investigating the history of species and their genealogy; their origin, progress, migration, mutual relations, their struggle, decay, and final extinction. It is to be feared that in insects as in plants, but too large a proportion of the innumerable genera and sub-genera have been founded rather on the sortings of a collector than on the investigation of affinities; and, indeed, that must in a great measure be the case so long as a large proportion are only known from their outward form at one period only of their varied phases of existence.

The days of a Systema Naturæ, or single work containing a synopsis of the genera and species of organised beings, are long since passed away. Even a Species Plantarum, now that their number at the lowest estimate exceeds 100,000, has become almost hopeless. The last attempt, De Candolle's Prodromus, has been nearly forty years in progress, the first portion has become quite out of date, and all we can hope for is that it may be shortly completed for one of the three great classes of plants. Animals might have been more manageable were it not for the insects. Mammalia estimated at between 2,000 and 3,000 living species, birds at about 10,000, reptiles and amphibia under 2,000, fishes at about 10,000, crustacea and arachnida rather above 10,000, malacozoa about 20,000, vermes, actinozoa, and amorphozoa under 6,000, would each by themselves not impose too heavy a tax on the naturalist experienced in that special branch who should undertake a scientific classification and diagnosis of all known species. In one important branch, indeed, the fishes, this work has been most satisfactorily carried out in Dr. Günther's admirable Genera and Species of all known fishes published under the misleading title of "Catalogue of the Fishes in the British Museum," and recently completed by the issue of the seventh volume. The sound philosophical views expressed in his preface to that volume (which, by some strange inversion, bears a signature not his own) can be appreciated by us all, and zoologists are all agreed as to the care with which they have been worked out in the text. Insects are, however, the great stumbling-block of zoologists. The number of described species is estimated by Gerstaecker at above 160,000, viz.: Coleoptera, 90,000; Hymenoptera, 25,000; Diptera, 24,000; Lepidoptera, 22,000 to 24,000. Mr. Bates thinks that, for the Coleoptera at least, this estimate is too high by one-third, but even with that deduction the number would exceed that of plants, and it is probable that the number of as yet undiscovered species in proportion to that of the described ones is far greater in the case of insects than of plants. We can therefore no longer hope for a Genera and Species of insects, the work of a single hand, or indeed guided by a single mind. The great division of labour, however, now prevalent among entomologists may procure it for us in detail, with one drawback only, that the smaller the portion of the great natural class of Arthropoda to which the entomologist confines his attention, the less he will be able to appreciate the significance of distinctive characters, and the more prone he will be to multiply small genera—that is to enhance beyond their due value the races of the lowest grades—to the great inconvenience of the general naturalist who has to make use of the results of his labour.

A Genera Plantarum is still within the capabilities of a single botanist, although he must, of course, trust much to the observations of others, and it therefore cannot be so satisfactory as if he had examined every species himself. The last complete one was Endlicher's, the result of several years' assiduous labour, but now thirty years old. Dr. Hooker and myself commenced a new one, of which the first part was published in 1862, and which might have been brought nearly to a close by this time had we not both of us had so many other works on hand to deter us, although the researches necessary for these other works have proved of great assistance to the Genera. As it is, the part now nearly ready for press carries the work down to the end of Compositæ, or about half through the Phænogamous plants. In regard to works of a still more general description, the exposition of the families or orders of plants, we have nothing of importance since Lindley's "Vegetable Kingdom," dated 1845, but republished with some additions and corrections in 1853, and Le Maout and Decaisne's "Traité Générale," mentioned in my address of 1868, and of which Mrs. Hooker is now preparing an English translation, under the supervision of Dr. Hooker. Dr. Baillon has also commenced a "Histoire des Plantes," containing a considerable number of useful original observations, and illustrated by excellent woodcuts, but as a general work, one portion is of too popular a character, and in some cases too diffuse to be of much use to science, and the generic character too technical for a popular work without any contrasted synopsis, and its great bulk in proportion to the information conveyed will always be a drawback. I cannot believe that the author can have been a party to the unblushing announcement of the French publisher, that it is to be completed in about eight volumes. If carried out on the plan of the first one, it must extend to four or five times that number. In Zoology, Bronn's most valuable "Klassen und Ordnungen der Thierreichs," continued after his death by Keferstein and others, which I mentioned in my address of 1866, has advanced but slowly. The Amorphozoa, Actinozoa, and Malacozoa, forming the first two volumes, were then completed, and Gerstaecker has since been proceeding with the Arthropoda, commencing with the Crustacea for the third volume, of which only the general matter and the Cirripedia and Copepoda are as yet published, and three or four parts of a sixth volume for birds have been issued by Selenka, treating the anatomical and other matters in great detail. Another general work of merit, although on a smaller scale, has been proceeding as slowly. Of Carus and Gerstaecker's "Handbuch der Zoologie," the second volume, containing the Arthropoda, Malacozoa, and lower animals, had been already published in 1861, and to this was added in 1868 the first half of the Vertebrata for the first volume, with a promise that the remainder should appear in the autumn, but which promise has not yet been fulfilled. Among the other recently published systematic zoological handbooks of which I have memoranda as published in various Continental states, the most important are said to be Harting's, published at Kiel, in the Netherlands, of which up to 1870 only three volumes had appeared, containing the Crustacea, Vermes, Malacozoa, and lower animals; A. E. Holmgren's "Swedish Handbook;" Zoology, of which Mammalia were published in 1865, and Birds in 1868 to 1871; and Claus's "Grundzüge," and Troschel's "Handbook" (7th edition) for University Teaching in Germany.

In a comparative sketch of the more partial monographs, faunas, and floras, I had wished to direct my attention more especially to the means afforded us of comparing the plants and animals of different countries; and with this view one of the questions I addressed to foreign zoologists was—"What works or papers are there in which the animals (of any of the principal classes) of your country are compared with those of other countries?" The answers to this query have not been generally satisfactory. Where the zoology has been well investigated, we have popular handbooks, elaborate memoirs, and works of high scientific value, or splendidly illustrated. But short synoptical faunas, so useful to the general naturalist and corresponding to the floras we now possess of so many different countries, are very few; the statement of the general geographical range of each species, so prominent a feature in many modern floras, is still less thought of, and indications of allied or representative races in distant countries are equally rare. We have indeed several excellent essays on the geographical distribution of animals; I had occasion to allude to several of them in my address of 1869, but they are in general chiefly devoted to discussion, with statements of such facts only as bear upon the author's conclusions, not records of facts which may be useful to the geographical or general biologist. These must be collected from a great variety of separate works and papers, of which I have received long lists from Denmark, Sweden, Germany, Switzerland, Italy, France, and the United

character; but to prevent any confusion with *the* imaginary type, it would surely be better to call it an "example," as, indeed, is often done. In geographical biology the word "type" is used again in another sense, which, however, does not lead to any misunderstanding.

States. As yet I only have had time to refer to a few which appeared to bear more immediately on the objects I had in view, but I hope on some future occasion to return to the subject. In the meantime I must content myself with glancing rapidly over the different countries, taking them in the order adopted in my former addreses, and endeavouring to show the progress making in supplying our deficiencies. Towards these deficiencies I would particularly call the attention of entomologists and terrestrial malacologists, for insects and land shells are of all others the animals whose life and local stations are the most closely dependent on vegetation. In the following notes I am further precluded from entering into details as to the zoological works or memoirs mentioned, by the consideration that they would be superseded by the analysis given in the annual reviews inserted in *Wiegmann's Archiv*, and more especially in our own admirably conducted *Zoological Record*, which so strongly claims the support of everyone interested in the promotion of Zoological Science.

(*To be continued.*)

ZOOLOGY

Note on Transversely Striated Muscular Fibre among the Gasteropoda.*

IN studying the radula of a species of *Acmæa* (probably *A. Borneensis* Rye), obtained by Prof. A. S. Bickmore at Amboyna, I noticed, on placing the structure under a power of 100 diameters, that certain of the muscular fibres which adhered to it, when torn from the buccal mass, had a different appearance from the others. On increasing the power to some 800 diameters, it was at once evident that the different aspect of these fasciculi was caused by fine, but clearly defined, transverse striation. Suspecting that it was an optical delusion, caused by a very regular arrangement of the nuclei of the fibres, I subjected the muscle to various tests and to still higher magnifying powers. I also introduced under the same glass some of the voluntary dorsal muscles of a small crustacean for comparison. The structure of the ultimate fibres in both appeared to be similar. These seemed to be composed of a homogeneous tube or cylindrical band of translucent matter, with nuclei interspersed at irregular intervals. In neither was there any appearance of separation into transverse discs, as is seen in the striated muscles of vertebrates. That the striated appearance was not due to contraction and folding of the muscle, was evident upon taking a side view of one of the fibres, when the striæ on each side, as well as the intervening elevations, were seen to correspond exactly to each other. The only perceptible differences between the muscles of the crustacean and the striated muscles of the mollusk, appeared to be that the latter were much more finely striate; the striæ being six to eight times as numerous as in the former in the same space. No difference between the striated and nonstriated muscles of the *Acmæa* could be observed, except in the fact of the striation. In both the nuclei were irregularly distributed. The appearance of the striated fibre reminded one of a string of rhombic beads, which bore no relation to the position of the true nuclei. The striated fibres appeared, after a careful dissection of the parts in a number of specimens, to be the retractors of the radula; they were longer and in narrower bands than the nonstriated fibres, and comparatively much fewer in number. The striation was most evident toward the middle of the fibres, and became evanescent toward their extremities.

Lebert and Robin (Müller's Arch. f. Anat. and Phys., 1846, p. 126) state that the primitive muscular fasciculi of invertebrates often have the nuclei and intervening clear spaces "arranged in such regular order that they might, at the first glance, be mistaken for transversely striated muscular fibres. The latter, however, are actually found in one acephalous mollusk, *Pecten* (and probably in *Lima* also), and some annelids," and are constantly present in the voluntary muscles of *Crustacea* and *Insecta*. In the further researches of M. Lebert (Annales Sci. Nat., t. xiii. 1850, p. 161), he observes that there is nothing extraordinary in the discovery of transversely striated muscular fibre in *Polyzoa* (*Eschara*) by Milne-Edwards, and in *Actinia* by Erdl, since "the further we have pursued the study of the comparative histology of muscular fibre, the more convinced we have become that transversely striated muscular fibre is to be found in a large number of animals of very inferior organisation, without regard to their more or less advanced position in the animal kingdom."

Striated muscular fibre has lately been shown to exist in the "tail" or appendix of *Appendicularia* by Moss (Trans. Lin. Soc., vol. xxvii. p. 300). It was already known to exist in *Salpa*, (Eschricht, ov. Salperne), in the articulated brachiopoda (Hancock, Tr. Roy. Soc., 1857, p. 805), and in *Pecten* (Lebert, Annales Sci. Nat. 1850, 3rd ser. t. xiii. p. 166; and Wagner, Lehrb. d. vergleich. Anat., t. ii. p. 470, 1847), as well as in *Eschara* (Milne-Edwards, Annales Sci. Nat., series ii. t. iv. p. 3). I believe, however, that this is the first instance in which it has been shown to exist in the class *Gasteropoda*; and this, as well as the rarity of such cases among the lower invertebrates, is a sufficient apology for bringing forward such an isolated fact. Other duties have not yet permitted me to determine whether this phenomenon is constant throughout the genus, or whether it does or does not occur among allied genera. W. H. DALL

* Communicated by the author, from the "American Journal of Science and Arts," vol. i., Feb. 1871.

SCIENTIFIC SERIALS

IN the first paper in the *American Naturalist* for May, Prof. C. F. Hartt opens out quite a new field for investigation in the rock-inscriptions of Brazil, and illustrates it with nine plates of very great interest. The inscriptions occur on the rocks in various districts, and are many of them very rude, representing human and other figures, the sun, moon, and stars, and others very difficult to decipher. Prof. Hartt mentions as a curious circumstance that the hands and feet are always represented by radiating lines, usually only three digits being drawn for each hand and foot; the number rarely reaches four, and never five. This, he thinks may be explained by the fact that many tribes of Brazil are unable to count beyond three or four. The antiquity of these rock paintings and sculptures is undoubted, being mentioned by many ancient writers, as well as by Humboldt and others in more recent times. There can be no doubt that they ante-date the civilisation of the Amazons, and there is a strong probability that some of them, at least, were drawn before the European discovery of America. A short paper, by Dr. F. R. Hoy, on Dr. Koch's *Missourium tetracaulodon*, made by Prof. Owen into a Mastodon, points out several particulars in which Dr. Koch's account of the discovery of the fossil is not to be relied on, especially the inference of the great antiquity of man deduced from it. Mr. J. H. Emerton gives an account of the so called "Flying Spiders," which are merely blown about by the wind. Among the "Miscellany" is an interesting note by Mr. A. Garrett, on the Distribution of Animals in the South Seas, especially in the Viti Islands. The number is altogether one of unusual interest.

Archiv für Anthropologie, 1870, Heft 3. An essay on "Theories of Sexual Generation," by Prof. His, of Basel, is rather historical than speculative, tracing the two principal lines of opinion represented in early science by Hippocrates and Aristotle, as to the respective functions of the two parents, and the mode of transmission of their bodily characteristics to the offspring. Among modern writers Prof. His dwells especially on Harvey's views. A paper by Dr. Welcker, "On the compressed feet of Chinese ladies," contains careful drawings, showing the shoe, the foot, and the abnormal position of the bones. As complete an account is given as the subject needs from an anatomical point of view. Dr. Jensen, occupied in studying the proportions of the brain in the insane, arranges for this purpose, a "stereoscopic-geometrical drawing apparatus," by the aid of which to produce geometrical drawings on which measurements can be made. Dr. Schaaffhausen's dissertation on "Cannibalism and Human Sacrifice," is a valuable, though somewhat undigested contribution to the subject. Among the motives assigned for cannibalism, the principal are hunger, revenge, superstition, such as induces savages to devour a brave warrior to obtain his courage, and lastly, the gluttonous longing for a kind of flesh which is described as appetising. Human sacrifice may sometimes be a relic of early cannibalism, an offering to deities who devour human flesh, or it may be an act of propitiation. There is evidence of the ancient or modern existence of cannibalism in most countries of the world, Great Britain being distinctly included. Even in modern times it occasionally breaks out in the civilised world, but on the whole its frequency among savages, and its general disappearance under improved social conditions, enable the writer, who argues in favour of a steady progression in the civilisation, to put it fairly into his argument.

SOCIETIES AND ACADEMIES

London

Geological Society, May 24.—Prof. John Morris, Vice-President, in the chair. Messrs. Mosley, Colvin, Noble, F.R.A.S., and Davey, were elected Fellows of the Society. The following communications were read:—(1) "On the principal Features of the Stratigraphical Distribution of the British Fossil Lamellibranchiata." By Mr. J. Logan Lobley, F.G.S. In this paper the author showed, by means of diagrammatic tables, what appears to be the present state of our knowledge of the general stratigraphical distribution of the fossil Lamellibranchiata in Britain. As a class, the Lamellibranchs are sparingly represented in the Lower, and more numerously in the Upper Silurian group, and fall off again in the Devonian; they greatly increase in number in the Carboniferous, become scanty in the Permian and Trias, and attain their maximum development in the Jurassic rocks. They are also largely represented in the Cretaceous and Tertiary series. The stratigraphical distribution of the two great subordinate groups, the Siphonida and the Asiphonida, corresponds generally with that of the class; the Siphonida predominate over the Asiphonida in Tertiary formations, whilst the reverse is the case from the Cretaceous series downwards. Nearly all the families of Lamellibranchs are represented in the Jurassic and Carboniferous rocks, and in the former very largely. The author remarked especially on the great development of the Aviculidæ in Carboniferous times. Mr. Etheridge, after noticing the importance of the paper, remarked that possibly the great difference observed in the proportions of Lamellibranchiata in different formations might to some extent be due to our want of knowledge. Of late years, in the Caradoc and Lower Silurian series, the number of species had been nearly doubled, principally through the persevering industry of one single observer, Lieut. Edgell. The same was to some extent the case in the Carboniferous rocks, owing to the collections of Mr. Carrington. Much was also being done for the Oolitic series, in connection with which the names of Mr. C. Moore, Mr. Sharp, and Dr. Bowerbank ought to be mentioned. Mr. Griffiths and the Rev. Mr. Wiltshire were doing the same work for the Gault. What the late Mr. S. P. Woodward had done as to the distribution of the different species of molluscs through time, Mr. Lobley was doing on a larger and more extended scale. Prof. Ramsay was glad to find that Mr. Lobley was, to some extent, doing the same for the Lamellibranchiata as Mr. Davidson had done for the Brachiopoda. He did not know how the case might be with the Silurian and Devonian formations, but in the Carboniferous strata the Lamellibranchiata were obtaining a preponderance over the Brachiopoda. He accounted for their comparative absence in formations of other ages, especially between the Upper Silurian and Rhætic beds, by the best known areas of those periods having been mainly continental, or containing principally freshwater or inland sea remains, so that the true marine fauna was absent. In Carboniferous times possibly the true relative proportions of the two forms had been preserved in the deposits. Mr. Judd was doubtful as to the safety of placing too great reliance upon figures. He questioned whether some of the conclusions as to the great increase of Lamellibranchiates between the Carboniferous and Jurassic periods could be substantiated. Much depended on the amount of the rocks present in different countries, and the study bestowed on each. The conditions also for the preservation of the fossils might be more favourable at one time than another. Mr. Carruthers considered the tables as of the greatest value, as indicating the present state of our knowledge. He called attention to the difference of conditions under which deposits had accumulated, which must have to some extent affected the proportion of Lamellibranchiates preserved in the different formations. Mr. Charlesworth remarked on the occurrence of *Trigonia* in the Australian seas, and on there being varieties of form among specimens of existing species so great that if they were found fossil they might be regarded as of several species. Mr. Hughes considered that the data were too incomplete to justify the generalisations of some of the previous speakers. It had been pointed out that whenever the tables showed a very large number of Lamellibranchs from any formation, that formation had been carefully worked out by local observers; and therefore he would like to know in each case the proportion the Lamellibranchiata bore to the total number of fossils found. It had been shown also that a larger proportion of Brachiopoda had been found in the older rocks, and of Lamellibranchiata in the newer. But in the older rocks whole genera of Lamellibranchs are confined to horizons and localities which are not cut off by stratigraphical breaks, such as would allow us to think it at all probable that they can be characterised by peculiar genera. He thought the scarceness and irregular occurrence of Lamellibranchs in the older rocks could be best explained on the supposition that those portions of the older deposits which were least favourable to Lamellibranchs happened to be those now chiefly exposed to our search, and that those few portions are only in part worked out. Mr. Jenkins observed that in thick deposits there was a far greater likelihood of numerous forms being present than in thin, for thickness meant time, and time meant variation. Prof. Morris dissented from this view, as in thin littoral deposits an enormous number of shells might be present, while in beds formed of deep sea they might be almost entirely absent.—2. "Geological Observations on British Guiana," by Mr. James G. Sawkins, F.G.S. In this paper the author gave a general account of his explorations of the Geology of British Guiana when engaged in making the geological survey of that colony. He described the rocks met with during excursions in the Pomeroon district, along the course of the Cuyuni and Mazuruni rivers, on the Demerara river, on the Essequibo and its tributaries, on the Rupununi river, and among the southern mountains. The rocks exposed consist of granites and metamorphic rocks, overlain by a sandstone, which forms high mountains in the middle part of the colony, and is regarded by the author as probably identical, or nearly identical, with the sandstone stretching through Venezuela and Brazil, and observed by Mr. Darwin in Patagonia. Prof. Ramsay remarked upon the barrenness, from a geological point of view, of the district investigated by Mr. Sawkins, and especially called attention to the absence of fossils in the stratified rocks. He referred briefly to Mr. Sawkins's labours in Trinidad and Jamaica, and to his discovery of metamorphosed Miocene rocks in the latter colony exactly analogous to the metamorphic Eocene rocks of the Alps. He was glad to see that the author had brought forward examples of cross-bedding in metamorphic rocks, and considered that the results adduced were favourable to those views of the metamorphic origin of granite which he had himself so long upheld. Mr. D. Forbes, on the contrary, considered that the facts brought forward by Mr. Sawkins were confirmatory of the eruptive nature of the granites observed. He added that cross-bedding was common in igneous rocks and even in lavas. Mr. Tate remarked that in the country to the north of the district described in the paper metamorphic rocks abound. He considered that the series of metamorphosed Jurassic rocks extends across the whole north of South America, and perhaps into California. Similar sandstones to those described occur in the basin of the Orinoco, and contain fossils which show them to be of Miocene age. Mr. Tate did not consider these sandstones as the equivalent of the Patagonian sandstones, as from the shells contained in the latter they would appear to be Pliocene or Pleistocene. Mr. Sawkins, in reply to a question from Mr. Tate, stated that the only gold found in the country had probably been carried down from the well-known gold district of Upata. He also entered into a few additional details connected with the chief points in his paper, dwelling especially upon the physical features of the country, in illustration of which several landscape drawings were exhibited.

Royal Institution of Great Britain, June 5.—Sir Frederick Pollock, Bart., M.A., vice-president, in the chair. Silas Kemball Cook, Miss Elinor Martin, Dr. Charles Bland Radcliffe, and Mrs. Radcliffe were elected members of the Royal Institution. The special thanks of the members were returned for the following donation to "The Fund for the Promotion of Experimental Researches":—Sir Henry Holland, Bart. (thirteenth annual donation), 40*l*.

Anthropological Institute, May 29.—Prof. Busk, F.R.S., vice-president, in the chair. George Latimer of Puerto Rico was elected a member. Mr. F. G. H. Price read a paper "On the Quissama Tribe of Angola," inhabiting that portion of Angola situated on the south bank of the Quanza river. The country had lately been visited by Mr. Charles Hamilton, well known for his travels among the Kaffirs. The Quissama bear the reputation of being cannibals, but cannibalism, although undoubtedly practised by them to some extent, does not largely prevail. The men are well formed, and average about five feet eight inches in height, they are copper-coloured, have long, coarse, and in some instances, frizzled, hair; their heads are mostly well developed, and the Roman nose is not unfrequently met with, Their weapons are spears, bows and arrows, and occasionally guns, the latter being rude copies from the Portuguese article. Mr. Hamilton was well received by the chief, who told him that he was the first white man that had seen the tribe at home. The men and women of the Quissama are addicted to hunting; they are virtuous, practice monogamy, marry young, and are very prolific. The men largely preponderate in numbers over the women, the result, it is supposed, of infanticide, but of that practice Mr. Hamilton had seen no evidence. The Quissama believe in the existence of a Supreme Being.—A paper was read by Lieut. George C. Musters, R.N., on the races of Patagonia inhabiting the country between the Cordillera and the Atlantic, which the author had traversed during the years 1869 and 1870. The Patagonians consist of three races distinctly differing in language and physique, and partially differing in religion and manners, Tehuelches or Patagonians, Pampas, and Manzaneros, the latter being an offshoot of the Araucanians of Chile. The Tehuelches and Pampas are nomadic tribes subsisting almost entirely by the chase. The proverbial stature of the Patagonians was so far confirmed by the observation that the Tehuelches give an average height of five feet ten inches, with a corresponding breadth of shoulders and muscular development; the Manzaneros come next in order of height and strength, the Pampas being the smallest of the three races. The Manzaneros are remarkable for their fair complexions, whilst the Tehuelches are, literally speaking, Red Indians. Lieut. Musters had visited all the various tribes of those races, from the Rio Negro to the Straits of Magellan, for political purposes, and he estimated the population, which he described as diminishing, as follows:—Tehuelches 1,400 to 1,500, Pampas 600, and the remainder Manzaneros, amounting in all to about 3,000.—Dr. Eatwell contributed a communication on Chinese burials.—Mr. Josiah Harris announced the arrival from the coast of Peru of various pieces of rag, of wooden images, pottery, and other articles of great interest; and the chairman stated that the specimens would be exhibited and described at the next meeting of the Institute.—Mr. George Harcourt exhibited a flint implement found near a stream flowing from Virginia Water, and a bronze Celt discovered in the root of a tree in the parish of Thorpe, Surrey.

Paris

Academy of Sciences, May 1.—M. Chasles contributed a rather long but very important paper on Conic Sections. The illustrious mathematician gives the theorems rather than the mode of demonstrating them. It is a reminiscence of the old academy in the golden age of the seventeenth century. The theorems are very numerous.—M. Trécul read a rather long account of the analysis of the juices which can be extracted from aloes.—M. Decaisne read a memoir, which is printed at full length, on the Temperature of Children when they are taken ill.—M. Delaunay presented the second number of his monthly meteorological report for the month of April. It is to be noticed that April expired on a Sunday, and that M. Delaunay spared not a single hour, as his *résumé* was ready on the following day. The observatory had suffered scarcely any injury up to the end of the second siege. No delegate of the Commune had presented himself either to take possession of it or to blow it up.

May 8.—It was only at this late date that M. Longuet's death was officially made known to the Academy. M. Delaunay, who presided over the proceedings, gave expression to a few becoming sentences of regret at the loss the Academy had experienced. M. Longuet was a physiologist of much ingenuity and ability.—M. Duchartre, member of the Botanical Section, read a rather long paper on our knowledge of Liliaceæ.—M. Sedillat, the learned Arabic scholar, read a paper on the etymology of French words having an Arabic origin. Their number is immense, and M. Littré, in his great "Etymological Dictionary," supposes it to be even much larger. The intercourse with Arabs was very active even in mediæval times, as is proved by the history of the University of Paris, which so long defended Averrhoes. M. Sedillat gives many instances chosen from an immense number of others.—M. Stanislas Meunier sent a very interesting paper on meteorites. The experiments were made by him according to the precepts given by M. Daubrée, to whom M. Stanislas Meunier is assistant. M. Daubrée is now a refugee at Versailles. The museum where these experiments were executed is said to be safe, contrary to previous assertions. M. Stanislas Meunier explained by what process serpentine mountains can be changed into tadjerite. Tadjerite is found in some meteorites which belong to the museum collection. Specimens are also to be found in the British Museum, Yale College, U.S., &c. M. Boilot, the scientific editor of the *Moniteur*, read a paper which was written to show astronomers that they must study carefully the different kinds of combustion on the surface of the earth, natural or artificial, to gain some quasi-experimental knowledge of the celestial phenomena of the origin and variations of star light. The doctrine was illustrated by some interesting observations.—M. Quesneville, editor of the *Moniteur Scientifique*, presented a set of his papers.—M. Tremeschini presented three drawings representing one large solar spot seen on the 6th, 7th, and 8th of May at noon. These drawings are inserted in the *Comptes Rendus*. M. Tremeschini lives at Belleville, the spot where the rebellion fought its last desperate struggle. It is to be hoped that he escaped safe, though up to this moment nothing has been heard from him.

BOOKS RECEIVED

English.—A Memoir of the Indian Survey: C. R. Markham (India Office).—Light Science for Leisure Hours: R A. Proctor (Longmans).—At Last, 2 vols.: Rev. Canon Kingsley (Macmillan and Co.).—The Modes of Origin of Lowest Organisms: Dr. H. C. Bastian (Macmillan and Co.).

Foreign.—(Through Williams and Norgate)—Lehrbuch der Mechanik: Dr. Wernicke.—Le Soleil: Padre Secchi

DIARY

THURSDAY, June 8.

Society of Antiquaries, at 8.30.—On the important Excavations in Rome during the present season: J. H Parker, F.S.A.

Mathematical Society, at 8.—On Plücker's Models of Certain Quartic Surfaces: Prof. Cayley.—On the Motion of a Plane under certain Conditions: Mr. S. Roberts.

Royal Institution, at 3.—Sound: Prof. Tyndall.

FRIDAY, June 9.

Astronomical Society, at 8.

Quekett Microscopical Club, at 8.

Royal Institution, at 9.—On Dust and Smoke: Prof. Tyndall.

SATURDAY, June 10.

Royal Institution, at 3.—On the Instruments Used in Modern Astronomy: J. N. Lockyer, F.R.S.

MONDAY, June 12.

Royal Geographical Society, at 8.30.

TUESDAY, June 13.

Photographic Society, at 8.

THURSDAY, June 15.

Royal Society, at 8.30.

Society of Antiquaries, at 8.30.

Chemical Society, at 8.—An Experimental Inquiry as to the Action of Electricity upon Oxygen: Sir B. C. Brodie, Bart.

Linnean Society, at 8—On British Spiders: Rev. O. P. Cambridge.—On a Luminous Coleopterous Larva: Dr. Burmeister.

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Errata.—Vol. iv., p. 95, 2nd column, line 30, for "R. T. Friswell" read "R. J. Friswell"; line 37, for "Fl_2" read "Tl_2"; for "FlO_2" read "TlO_2."