THURSDAY, JULY 13, 1876

THE UNIVERSITY OF MANCHESTER

I.

WE have already alluded to a recent movement for procuring a University Charter for the Owens College, Manchester. While this took its origin in the teaching staff of the college, it has now, we believe, spread beyond these limits, and is at present engaging the earnest attention of the governing body of that institution. A pamphlet, drawn up by the members of the senate, and embodying their views, has likewise been sent to some of the most eminent men of the country, and replies have been received on the whole decidedly favourable to the object.

Under these circumstances we may be pardoned an attempt to discuss, however imperfectly, the present state of the higher education of this country, and to point out in what direction, and according to what principles, an improvement of the system may, in our opinion, most properly be brought about.

We shall therefore begin by a definition. Let it be understood that when we use the word University, we mean an institution in which, as far as training is concerned, the higher education of the whole man is contemplated. Now this means more than mere intellectual training—far more than mere intellectual instruction—for it means such a training as will turn out a man of high cultivation in all his powers—one able to take a leading part in the progress of his race. Such a cultivation has a four-fold aspect, moral, intellectual, social, physical. It may perhaps be giving undue prominence to this latter element, to insist upon the neighbourhood of a considerable river as a *sine quâ non* in founding a University, but this is only an extreme expression of the views entertained, we doubt not, by the authorities of Oxford and Cambridge, that a University should contemplate the physical training of its undergraduates, as well as what we call training in its higher forms. If these be the true functions of a University, it is almost superfluous to say that such an institution, in common with everything possessing vitality, must be constantly reforming itself, so as to adapt its training to the ever-varying and ever-advancing requirements of the age; and it is most certainly the part of a wise Government to consider how far the present institutions of our country meet its educational wants, and if they do not, to consider whether they cannot with propriety do something to supply these legitimate requirements.

Now this at once leads us to ask in the first place, What are the most distinguishing characteristics of the present age, or rather, perhaps, in order to limit our inquiry, of the British citizen of the age? what are, in fine, the essential conditions which the statesman must not ignore, but by which he must consent to be guided in all his attempts to legislate on the question?

In the first place, he cannot ignore what may be termed the religious difficulty. Perhaps, roughly speaking, about half the inhabitants of the country may be regarded as attached more or less to the Church of England, while the other half differ more or less widely from the tenets of that Church. Here it is evident that this difference of opinion does not imply any want of interest in religion, but the very reverse. What it does indicate is the line that must be pursued in all future legislation on the subject. The statesman must deal with men as they are, and in consequence of this difference he cannot afford, and indeed he will not attempt, to place the higher education of the country in the hands of one religious body, however powerful, whether this be the Church of England on the one hand or the positivists on the other. Such a policy may have been possible, perhaps even desirable, a couple of centuries ago, but it is neither possible nor desirable now.

In the next place, the statesman cannot ignore the fact that certain branches of knowledge and their applications have developed of late years in a very wonderful manner, so as almost to fix a new epoch in the progress of our race. The present is eminently the scientific age of the world.

Again this wonderful progress of scientific knowledge has added greatly to the wealth of the nation, especially in its larger centres of industry, and there is in consequence a very persistent and most praiseworthy cry for increased facilities for higher cultivation. Nor is this cry limited to scientific culture alone, in which case it would be less praiseworthy; but it embraces general cultivation, having, however, especial reference to these recently-developed branches of knowledge which have made our great cities what they are, and in which progress is necessary to a continuance of their well-being.

Now these inevitable conditions are not merely destined to regulate all future steps that may be taken for the spread of higher education, but they have already modified the position of the present institutions of our country, and besides this they are even now determining the action of Government in a variety of ways. The increased endowment of research, the loan collection of scientific instruments, and other developments which these will inevitably bring about, are indications that our present rulers are very much alive to the true welfare of the country. We are, however, here engaged rather with the future of the higher education, and we shall now show in what manner the principles we have dwelt upon have already modified our existing Universities.

To make this clear, let us begin by a brief description of the chief Universities of England and Scotland, and for this purpose we may confine ourselves to the two great English Universities, the four Scotch Universities, and the University of London.

The two great English Universities have come down to us from a time when the people of England practically thought alike on religious matters. Until recently these institutions bore all the marks of this ancient unity, inasmuch as they only gave their degrees and Fellowships to members of the Church of England. But it is well known that by recent enactments, not only degrees, but Fellowships may be held by those who are not members of the national Church. Nevertheless, while open to all, these Universities yet retain an especial relation to the Church of England, and we believe there is no widespread wish to see the connection violently altered.

In many respects these Universities are institutions of great excellence, while in some respects they are altogether unique. In principle they embrace a very complete system of culture, in practice, however, it is found that their system is more especially adapted to the wealthier classes of the community. Judging of a tree by its fruits, we must not forget what a brilliant galaxy of statesmen, divines, philanthropists, and men of the highest general culture, have owed their training to these great Universities. It is when we come to strictly scientific professions, such as medicine and chemistry, that the deficiencies of these institutions begin to appear; neither Oxford nor Cambridge has turned out an appreciable number either of distinguished physicians or distinguished chemists. Those who are desirous to become proficient in these branches of knowledge almost invariably go elsewhere. The same may perhaps be said of the science of engineering.

It has been proved a great misfortune to the country that these two Universities have unwarrantably neglected the scientific training of their graduates. Nor is it untrue to say that in the past generation they have produced statesmen of unquestionable eminence, but yet profoundly ignorant of the scientific requirements of their country. It is only now, after a somewhat prolonged agitation, that the minds of the rulers of this country are becoming awake to the paramount value of science in the development of our resources.

Let us now briefly consider the four Universities of Scotland. These institutions educate a far larger proportion of the people of Scotland than Oxford and Cambridge do of the English people. They are the training-schools rather of the middle than of the upper classes of the community. They excel in those branches in which Oxford and Cambridge are deficient, and they are deficient in those respects in which Oxford and Cambridge excel. Good medical men and men of good acquirements in various branches of science are produced by these Universities, but the accomplished scholar or mathematician is not produced—at least to any great extent. Nor, so far as we are aware, is any attention given to the physical training of the undergraduates. The Scotch Universities are not now connected with the Established Church of Scotland, except in the fact that there is a theological faculty attached to each of them, and that the Church of Scotland looks to that faculty alone for the theological training of its ministers. They are in the habit, however, of giving theological degrees with praiseworthy impartiality to eminent divines in all the somewhat numerous divisions of the Presbyterian Church, and occasionally to English Nonconformists.

The University of London is different from all these, inasmuch as it is entirely unconnected with any religious denomination. It had its origin, if we mistake not, in the wish to give degrees to those who, from adverse circumstances, had been unable to receive a University education, but who were yet possessed of the requisite information implied in a degree.

At the present moment a large number take advantage of this institution, and we believe that nearly 700 candidates presented themselves at the recent matriculation examination. Of these, however, the great majority are not unattached students, but are probably connected with some metropolitan or provincial college that has not the power of granting degrees. Thus the University of London is at present the degree-giving body for the alumni of a considerable number of colleges scattered throughout the country, and in virtue of this position it has a very great influence in regulating the studies at those institutions.

We have thus briefly described the present position of the higher education of this country, and it remains to consider in what respect the present system is deficient and how this deficiency may be remedied, consistently, of course, with those conditions which we have stated, and which no legislation can possibly ignore. This, however, must be reserved for a future occasion.

GALILEO AND THE ROMAN COURT

Galileo Galilei und die Römische Curie. Von Karl von Gebler. (Stuttgart, 1876. London: Trübner and Co.)

THIS work supplies a continuous and detailed narrative of the circumstances under which Galileo incurred the hostility of the dominant party at Rome at the opening of the seventeenth century, and was by their influence denounced to, and ultimately tried and condemned by, the supreme tribunal of the Inquisition. An Appendix contains the text of the principal documents referred to in the body of the work. The whole forms a volume of rather more than 400 pages.

Such an undertaking, though it may, at first sight, appear a mere piece of surplusage to those who know how extensive is the already existing Galileo literature, is yet abundantly justified by recent events. Within the last ten years original documents published in France and Italy, and German critical researches based upon them, have completely overthrown the view hitherto held by the most competent writers on this subject, and compelled the adoption of a diametrically opposite conclusion. All previous narratives of the trial of Galileo are thus necessarily superseded, and its history must be entirely re-written. Without attempting to explain the nature of the evidence which has brought about this change of view, a task much beyond my present limits, I propose to state wherein the change itself consists, and to what extent the opinions hitherto held concerning the conduct of the prisoner and of the Court are affected by it.

The essence of the charge against Galileo was, as we learn from the sentence finally pronounced, that after having been formally prohibited by the Inquisition from defending the Copernican theory, he had, in his Dialogues on the two rival systems of the universe, openly contravened this order, and so committed a clear act of contumacy, or, as we should call it, contempt of Court. On the question whether the accused had actually defended Copernicanism in his Dialogues, modern writers were able to form an independent judgment by the study of his incriminated work; but the statement about the injunction personally laid upon him by the Inquisition rested solely on the assertion of the Court itself, unsupported by one tittle of corroborative evidence. It is therefore a remarkable circumstance, and no bad illustration of how much may be done by strong asseveration, that the best historians, including some by no means antecedently inclined to repose a child-like confidence in the veracity of the Holy Office, one and all accepted its statement on this decisive point as representing an undoubted historical fact. As Galileo's advocacy of Copernicanism was indisputable, the gratuitous admission of the second premiss of the Court necessarily also involved its conclusion, viz., that it had a right to punish the philosopher for his transgression of its command. Such accordingly was the practically unanimous verdict of historians.

Up to 1867 no portions of the proceedings in the case, except the sentence and form of recantation, had been made public in a trustworthy shape; but in that year M. de l'Epinois was permitted by the Roman authorities to publish *in extenso* the greater part of the original trial-record preserved in the archives of the Inquisition. A mass of fresh evidence thus became generally accessible, and was further increased by the publication in 1870, by Prof. Gherardi, of a second set of original documents bearing on the trial. It now became possible to check the statements of the tribunal by reference to the documents which it employed, and to the defence and depositions of the accused. This was done by Dr. Emil Wohlwill, of Hamburg, who, in a pamphlet published in 1870, showed that such a comparison led straight to the conclusion that the personal injunction asserted and relied on by the Inquisition had never been actually delivered to Galileo. Wohlwill supports this position by a mass of corroborative testimony extracted, with singular acuteness and ability, from Galileo's works and letters, and thus renders his case perfectly irresistible. These new results, striking and interesting as they obviously are, have attracted but little notice on the Continent, and an account of them given by me in a Friday evening lecture at the Royal Institution[1] constitutes, I believe, the only public attention they have received in this country.

As the charge advanced against Galileo was, after all, only formal and technical, his exoneration from it will hardly be considered as affecting in any considerable degree the estimate hitherto formed of his conduct in the matter, except indeed by those persons who consider unhesitating obedience to the will of a Roman Congregation as the duty of every right-thinking man. Unfortunately too, the nature of his answers under examination must influence opinion more considerably in an unfavourable direction. Not only did Galileo deny on oath having ever held the Copernican doctrine; he actually offered to write another Dialogue in refutation of the arguments in favour of the condemned tenet to be found in his former work, and protested his belief in the old Ptolemaic hypothesis as "most true and indubitable." Much allowance ought unquestionably to be made for an infirm and terror-stricken old man, but, even so, there remains an amount of really gratuitous insincerity on which it is painful to dwell, though it would be disingenuous to pass it over in silence.

As to the course pursued by the condemning tribunal, there can be little or no doubt that it deliberately lent itself to perhaps the most nefarious practice of which a judicial body can be guilty, namely, the admission of evidence known both to be false and to have been fabricated for the express purpose of securing a conviction which could not be compassed by fair means. The theological antagonists of the Holy Office have, no doubt, over and over again charged it with atrocities of this and of every other description, but I know of no instance save the present in which it has been convicted of such an enormity out of the mouth of its own records.

[1] On May 8, 1874.

Thus much of introduction appeared indispensable in order to define the point of view from which the volume in hand is written. Herr von Gebler regards the conclusions of Wohlwill as so firmly established, that his duty as an historian is no longer to discuss or defend them, but to weave them, together with the previously known facts of the case into a succinct narrative arranged in the order of time. Even to summarise the contents of his volume would be to attempt a fresh Life of Galileo. All that can be done here is to draw attention to a few of the salient incidents as they are presented in Von Gebler's pages.

It would seem that it was the Jesuits who, from beginning to end, were responsible for the persecution of the philosopher; and, most unfortunately for him, he quitted the service of the only State in Italy which could have enabled him to defy their machinations at the very time when its protection began to be urgently needed. Oppressed by the amount of lecturing and teaching incumbent upon him as Professor at Padua, and anxious, as it would seem, to illustrate in his own person the benefits to be derived from the "endowment of original research," Galileo applied for, and after some negotiation obtained, the post of first Mathematician about the person of the Grand Duke of Tuscany, which he hoped would secure him uninterrupted leisure for the prosecution of investigation and discovery. Von Gebler comments as follows on this calamitous step:—

"In spite of all the great advantages which this new post brought him, Galileo made a thoroughly bad exchange when he quitted the free territory of the Venetian republic in order to commit himself to the doubtful protection of a sovereign who, though personally very well disposed towards him, was young, vacillating, and, moreover, completely under the control of Rome. It was essentially the first step in the course which led Galileo towards his doom. Complete freedom of teaching existed actually in the Venetian Republic; nominally only in Tuscany. In Venice politics and science appeared guaranteed against Jesuit intrigues, for when Paul V. had thought fit to lay the uncompliant Republic under an Interdict (April 13, 1606), the Fathers of the Society of Jesus had to submit to immediate and permanent expulsion from its territory. In Tuscany, on the other hand, where the Order was thoroughly at home, its mighty influence lay heavy on all that touched its interests, and especially therefore on politics and science. Had Galileo never forsaken the fresh healthy air of the Free State, in order to breathe a close Rome-infected Court atmosphere, he would, there is every reason to believe, have escaped the subsequent persecutions of Rome, inasmuch as that same republic which, but shortly before, had not allowed itself to be intimidated by the papal excommunication pronounced against its Doge, its Senate, and its entire Government, would assuredly not have delivered up one of its University professors to the vengeance of the Roman Inquisition."

The period of private controversy during which the question at issue between the old and the new astronomy was forced, against the wish of Galileo, from a scientific to a theological mode of discussion, is very fully described by our author, who gives many amusing instances of the ludicrous manner in which the Aristotelian philosophers attempted by *à priori* logical considerations to disprove the reality of the celestial appearances revealed by the telescope, and "as by magical enchantments to conjure them out of the heavens." So far as the *truth* of the Copernican theory was concerned, these individual skirmishes were put an end to by the peremptory decree of the Index Congregation (March 5, 1616), which reduced the revolutionary theory, for all Roman Catholic astronomers, to the level of a mere hypothesis, convenient indeed for the representation of phenomena, but not corresponding to actual external facts. This, the undoubted scope of the decree, which has escaped most previous writers, is carefully stated by von Gebler. The point is one of much interest, since the repressive attitude then taken up was not finally abandoned until as late as 1820. Two hundred years of astronomical research were needed to break down the unyielding Papal *non possumus*.

The appearance in 1632 of Galileo's Dialogue on the Ptolemaic and Copernican systems was the signal for the final catastrophe. Its high significance is well brought out in the following extract:—

"The book contains far more than the title promises, for the writer has, in connection with his discussion of the two great systems of the universe, introduced a record of almost every important result obtained by him during nearly fifty years of scientific research and discovery. The author shows himself determined to adopt a style which should appear not exclusively calculated for scholars, but, on the contrary, intelligible and even highly attractive for every really educated man. The essential object of the book was to spread abroad as widely as possible a clear recognition of the constitution of nature in its absolute and final form. That this object was so successfully achieved is attributable not merely to Galileo's philosophic, but, in the first instance at least, perhaps even more to his literary eminence. The external form of the work was in itself most happily chosen. There is not a trace of the dryness of a systematic treatise in which proof succeeds proof with a wearisome monotony, hardly relieved by a single pause. On the contrary, the facile lively form of dialogue so tolerant of digression, gave the author full opportunity to develop his impetuous eloquence, his singular power of reasoning, his biting satire —in short, his special and brilliant style."

Next let us observe the effect of the work on the enemies of its author:—

"Galileo, as one of the most momentously effective of pioneers, was in a high degree obnoxious to the Jesuits, and members of the order had repeatedly been signally worsted in scientific conflicts with the great philosopher, a circumstance by no means fitted to dispose the Fathers of the Society more favourably towards him. As soon as they recognised that in his latest work he had employed an immense array of facts and an overwhelming force of argument for the destruction of the fundamental principles of the old school, in order to build up with an inexorable logic the modern edifice upon its ruins, the Jesuits set all their levers to work to secure the suspension of the revolutionary book, and later, to bring about the ruin of its dangerous author. A prosecution before the Inquisition was their most convenient, indeed probably their only possible weapon."

The notion, still entertained by some writers, that nothing really serious was meant by the trial, but only the settlement of a point of ecclesiastical etiquette, is totally dispelled by the evidence stated in von Gebler's narrative. We see Galileo completely panic-stricken on first receiving the summons of the terrible tribunal, endeavouring in every possible way to keep out of its grip, and only finally complying when the Court had actually issued its writ to have him brought up to Rome *in irons*. We see the Grand Duke of Tuscany writing autograph letters to the Cardinals who were members of the Holy Office, begging for a favourable consideration of his servant's case. We see the Pope himself in a fit of ungovernable fury against Galileo;—fury so intense that the Florentine Ambassador, who had provoked it by defending the philosopher, precipitately dropped the subject, "lest he too should be charged with heresy by the Holy Office." During the slow progress of his case in Rome, Galileo was unquestionably treated with quite exceptional favour, in being allowed to reside in the house of the Ambassador except during the days of his actual examination, and even then lodged in comfortable rooms in the apartments of the Commissary Fiscal, instead of in the ordinary prison. Of what took place during the examination we are not completely informed. That the prisoner was threatened with the torture is certain; whether it was actually inflicted is still a moot point. Von Gebler very confidently maintains that it was not, and his reasoning at least proves that, if employed at all, it must have been but slightly.

The closing portion of the narrative presents a dismal picture of years lingered out amid severe physical suffering under the stony-hearted supervision, constant petty interference, and reiterated threats of the Holy Office. And when at last the old man dies, blind and helpless, but surrounded with a glory destined to outlive that of popes and cardinals, the Inquisition is seen nervously bustling about to prevent any memorial being erected to the great astronomer, "lest the good be scandalised," or if that could not be achieved, at least to secure that neither in the inscription nor in the oration pronounced at the grave, "words should occur injurious to the reputation of this tribunal."

"The feeble Duke of Tuscany did not venture to disregard in the smallest degree these unamiable Papal wishes. Even the last directions of Galileo, that he should be laid in the tomb of his ancestors in the church of Santa Croce at Florence, were not respected. The insignificant side chapel of that church, called the *capella del noviziato*, received the mortal remains of the great departed. His body was there buried quietly and without public ceremonial in accordance with the will of Urban VIII. No memorial, no inscription marked his last resting-place. But, do what Rome would to wipe out the memory of the famous philosopher, she failed in her attempt to bury in the same grave with his lifeless corpse, the immortal name of Galileo Galilei."

Herr von Gebler has performed his task with meritorious zeal and conscientious labour. He is scrupulously accurate in his use of authorities, and shows a fixed determination—no small merit in a biographer of Galileo—not to exchange the standing-ground of history for the quicksands of ecclesiastical controversy. His narrative is clear and readable, though not free from a tendency to diffuseness and verbal redundancy which are more sharply criticised in England than in Germany. On one point only does he appear to me open to any serious censure, viz., in the amount of recognition which he has assigned to the principal pioneer in the department of history on which he writes, I mean, of course, Dr. Wohlwill. Without wishing to imply that von Gebler has intentionally minimized the credit he has given to Wohlwill, I certainly think that a person acquainted with the latter's pamphlet only by the former's references, would form an inadequate conception of the extent to which its few and unassuming pages have supplied both materials and suggestions since incorporated and turned to account in the present work. SEDLEY TAYLOR

MARGARY'S JOURNALS AND LETTERS

The Journey of Augustus Raymond Margary from Shanghae to Bhamô, and back to Manwyne. From his Journals and Letters. With a brief Biographical Preface, and concluding Chapter, by Sir Rutherford Alcock, K.C.B. Portrait and Map. (London: Macmillan and Co., 1876.)

THE publication of these journals and letters can only serve to confirm and deepen the general regret felt at the untimely fate of Mr. Margary. After looking at the manly, genial, and determined face which Jeens has so faithfully reproduced, and reading the hurried but able and invariably interesting notes which have been preserved of the now famous journey, one burns with vexation that through some possibly preventible misunderstanding or ignorant blunder, so promising and noble a youth should have been sacrificed, just when he had shown of how great things he was capable. We need not here enter into details with which, doubtless, all our readers are familiar through the daily press, and to which we have already referred in connection with Dr. Anderson's recent work (vol. xiii., p. 422), to which the present publication is the fitting complement.

The Indian Government had determined to make another attempt—Sladen's in 1868 was a failure—to open up a trade route between Burmah and China. A party was to leave Bhamô in January, 1875, cross the frontier, and make its way to Shanghae. It was thought advisable that some one should traverse the route in an opposite direction, so as to meet this party on the frontier; Mr. Margary, who had been for some years in our Consular Chinese Service as interpreter, was selected for the critical but honourable duty, and in accordance with instructions set out from Shanghae in August, 1874. The energetic youth—he was twenty-eight years of age—eager to be of use in the world, and naturally eager for distinction, rejoiced to have such a splendid opportunity, dangerous though he knew the task to be, and with speed and secrecy made his preparations, and set out furnished with a pass from the Chinese Government. He had a journey before him of not far short of 2,000 miles, right through the heart of the Chinese Empire, a large portion of the distance over ground not previously traversed by any European. About one half of the distance was in steamer and by boat up the Yang-tse-Kiang, and its tributary, the Yuan. At Chen-Yuan-Fu, in the Kwei Chou province, he was furnished with carriers and baggage animals, and thus safely made his way to his destination, Bhamô, in Burmah, a short distance on the other side of the Chinese frontier. Probably no one ever made a journey of such length through any part of China and met with fewer obstructions. It was not the pass he was provided with that alone did it, for in one or two instances the officials of towns could annoy him in spite of it. It was his humanity, his toleration, his geniality and sense of humour and disposition to see the best side of everything and everybody; it was these qualities combined with his perfect acquaintance with the language and knowledge of and respect for Chinese customs, along with a determination to make his mission a success, that carried him safely and happily through circumstances in which ninety-nine others would have come to grief.

During a great part of his journey, Mr. Margary was almost prostrated by illnesses of various kinds; yet those are mistaken who think that the book before us contains merely a few meagre scraps thrown together to make up a volume. In spite of illnesses and of the fact that as in duty bound he made all haste to get to the end of his journey, Mr. Margary contrived, by observation and intercourse, to obtain a substantial amount of really valuable information about the country and the people through which he passed. He had of course no time for minute exploration, though a fair acquaintance with geology and botany qualified him for profitable work of this kind; but his journals and letters contain many important notes on the physical geography and resources of the extensive tract through which his journey lay. He kept eyes and ears open, and his notes show that in this part of China there is plenty of scope for mining and commercial enterprise, and a fruitful field awaiting the scientific explorer. Many important observations will also be found in these remains concerning the people of the various districts and their ethnological relations. Especially do the notes of his intercourse with officials, and non-officials as well, serve to shed a light on Chinese character that we are sure will be new to many. Mr. Margary set himself from the first to understand the Chinese, a task of the greatest difficulty, and came to the conclusion that the common notions on this curious people are far from correct.

The brief biographical sketch and a few early letters enable one to trace the growth and training of the unfortunate youth from his school-days. He was evidently made of excellent stuff to begin with, and took the best possible advantage of his educational opportunities. When only about twenty he was appointed as interpreter to China. Here he speedily acquired a mastery of the language, and did duty at various places before his last settlement at Shanghae. While on the island of Formosa he supplemented his defective scientific education by, as we have said, the acquisition of a knowledge of botany and zoology. On several occasions, moreover, before his final feat, he showed his readiness of resource, bravery, determination, and skill in dealing with men. And yet, through some yet unexplained blunder, this splendid young fellow, so well adapted for long service to his country and to science, was obscurely and brutally murdered in a petty Chinese village. The mission under Col. Browne had proceeded on its way some little distance beyond the Burman frontier, when Margary volunteered to go forward with one or two attendants to remove some seemingly small obstruction at Manwyne. No more was seen of him alive by his party; his murder at Manwyne was evidently part of a scheme to attack and murder the whole party, who of course returned frustrated in their object.

It is not for us to enter into any discussion as to who are the real authors of the treacherous affair; so far as data permit, Sir Rutherford Alcock discusses the whole question, as well as shows the value of Margary and of his journey, in an Appendix. Whoever was to blame, Margary himself was blameless: it is difficult to regard his death as anything but an unrelieved loss: we trust her Majesty's Consular Service contains many like him.

OUR BOOK SHELF

Through Bosnia and the Herzegóvina on Foot during the Insurrection, August and September, 1875. By Arthur J. Evans, B.A., F.S.A. With a Map and 58 Illustrations. (London: Longmans and Co., 1876.)

THIS is an opportune publication, and we recommend it to our readers as one that will give them a good and lively idea of the countries referred to and their various peoples—of much interest at present in connection with the Servian rising. Mr. Evans entered Bosnia at Brod on the Save, went leisurely south, with various divergences, through the country, reaching the sea near the mouth of the Narenta and coasting along to Ragusa. Mr. Evans mixed freely with all classes of the people wherever he went, is well acquainted with Bosnian, and indeed with general European history, is a discriminating ethnologist, and has a good knowledge of botany. He studied the features and habits of the people closely as he sojourned among them, and gives many notes that might be found of value to those who take interest both in Aryan and Turanian ethnology. The people are evidently capable of good things if they had the chance and were free from oppression; but Mr. Evans's observation confirms all that has been said as to the impossibility of the Turk ever treating a Christian subject with justice or even humanity, unless compelled. The book contains a map and many attractive illustrations, is interestingly written, and will give English readers a fair idea of a country that is almost as little known to the generality as the heart of Africa.

LETTERS TO THE EDITOR

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

Firths, Dales, and Lakes, Valleys and Cañons

IN NATURE, vol. xiii. p. 481, you honoured me by printing a notice of some writings on glacial subjects, and since then many pamphlets have been sent to me. I would gladly show that I have studied them. Though I do not believe in a "glacial period," I have convinced myself that local glacial climates, like the existing climate of Greenland and the "Arctic current" have prevailed in different regions at different times, and that marks of these "local glacial periods" include "valleys" of certain forms, with "firths" and "lake basins." Glaciation occupied the attention of the Geological Society at their last meeting, when Prof. Ramsay read an abstract of a paper, in which a foreign writer compared Greenland and Norway. So far as I understand that writer's views as to glacial action in general, I agree with him. Many writers hold opposite opinions as to "the usual evidence of powerful ice erosion," and "the alleged power of a glacier to excavate a depression in the earth's surface" (Judd), as to "abrasion," and "the inability of glaciers to excavate except under peculiarly favourable circumstances" (Bonney). Truth is learned by observation and by perseverance. A drop hollows a stone, not by force, but by frequent falling, and that truth has become proverbial. A stream of water by flowing, and by rolling stones, makes a watercourse, and that truth is proved by every shower and in every gutter. By perseverance flowing water makes a deep watercourse. According to the latest official report of Dr. Hayden (June 4, 1876), streams which began to flow about the sources of the Mississippi, when the Rocky Mountains were raised, have gone on flowing ever since in the same channels, and some have worn cañons "from half a mile to a mile deep," not by force, but by frequent flowing. A glacier also flows. It is acknowledged that it wears and grooves rock, but still it is denied that a wide deep stream of flowing ice can make a wide deep furrow. It is said that ice "abrades," but does not "erode," that it cannot "excavate," unless under favourable circumstances. It is maintained that flowing ice cannot hollow out a basin, though flowing water does it on a small scale wherever it flows. Much is done by perseverance. As a drop hollows a stone, and water a watercourse, so ice makes an ice-channel slowly; and much repetition by glacialists may in time convince sceptics of that truth. Icebergs are the ends of glaciers pushed out into the sea, and there launched. Some of them are 3,000 feet thick. They prove their size by grounding in soundings off Newfoundland, and Labrador, and Greenland, and by their rate of flotation when they float with 300 feet above water, as "flat-topped islands of ice" in southern seas. A "glacier" cannot easily be measured on shore, but these vagrant fragments roughly measure parent glaciers. A pressure of 3,000, or of 1,000, or of 500 feet of ice upon sand or stone moving in an ice-channel is great abrading force. At the base of every ice-fall, or ice-rapid, the plunging ice-river must tend to "excavate," because falls and rapids of water excavate pools of various size proportioned to their power. The area of Greenland nearly equals that of India, and that area, so far as it is known, is covered with thick ice which is slowly moving seawards. The coasts are furrowed by deep hollows, of which most contain flowing glaciers, of which many enter the sea, and launch "islands of ice." Some "bergs" now float to the lowest latitude reached by northern drift-stones on shore in Europe and in America. I say nothing here about marine glaciation. The Greenland glaciers are flowing from an area where water generally falls frozen; they flow as rivers now flow from India, and all of them are slowly wearing their channels at some rate, and working up stream like Niagara Falls. There is no measure for the time during which these powerful ice-rivers of Greenland have been slowly hollowing stone by frequent flowing, unless it be the work of erosion done. It is denied that the work was done by the glaciers. Yet no rivers flow where ice fills the dales, and these Greenland dales have been "eroded," and bear "the usual evidence of powerful ice erosion," according to photography and descriptions. According to the clearest marks the whole Scandinavian peninsula, and the whole of Finland have at some time been covered by ice on the scale of Greenland ice. Sermitualik glacier, photographed by Mr. Bradford before 1870, is near Cape Desolation in Greenland, opposite to Shetland, Bergen, Christiania, St. Petersburg, &c. It is from three and a half to four miles wide where it enters the sea, and there it is about 800 feet thick. It extends inland as far as the eye can reach, and probably comes from the watershed of Greenland. Taking the ice to weigh only 55 lbs. per foot cube, the pressure above the sea-level on the ice channel is about 44,000 lbs. on the foot square. Between ice and rock are large stones, grit, and mud; and the rock is rounded where it is visible at the edge of the glacier, near the sea-level. The slopes between the lakes of Finland, and the gulf near Viborg, at the side of the Saiamen canal, and elsewhere, are polished, striated, and rounded. I took rubbings in September, 1865, and recognised the work of ice on the scale of Greenland ice. In Norway the old marks are plain on the sides of firths and dales, and some lead back to glaciers, which still flow from large areas upon the watershed, which still are covered by considerable sheets of ice. In Greenland this engine is seen at work; in Scandinavia the work of the engine is better seen. That work is, first a rounded worn plateau about the watershed called the "fjeld;" second, a series of slopes much glaciated; and third, below these slopes, long grooves hollowed out of the solid, called "dales." In these dales rivers now flow to lakes and to firths. Of these rivers some have worn deep watercourses, and cañons proportioned to their size and age. At the bottom of the dales are hollows which are called lakes, and firths when they hold fresh or salt water; in the rivers are smaller pools, which become ponds in dry weather. This northern country opposite to Greenland has been "carved" in this fashion by ice on the large scale, and afterwards by water-streams, and by the frequent falling of rain drops. It has also risen from the sea. The ice-cover has been taken off Scandinavia and Finland, and there it is possible to test theories about the work which an ice-cover is now doing on the present chief gathering grounds of snow throughout the world. But that Scandinavian work is the same kind of work which is found with small glacial marks elsewhere. Hollows have rounded sections ◡, or when deep they are like U. Hills between hollows commonly are hog-backs ⌒, and generally the land is rounded, except where peaks rise, and cliffs have broken. But this kind of rounded sculpture exists only in some regions of the world, and it marks the site of local glacial periods, as I believe. Elsewhere the section of valleys is angular like V, or in cañon countries like Y. These angular grooves are known to be the work of streams, because every stream of water carves on the same plan. Rounded hills and dales are at first sight evidence of powerful ice erosion, but some kinds of rock weather in bosses. If it be admitted that a drop wears a stone, that a stream makes a deep cañon in a long time, and that a glacier "abrades" or makes any mark at all, it seems to follow that an ice-engine as large as India or Scandinavia has in fact done the large work which it might be expected to do by perseverance in working, as it is known to work, wherever snow now gathers in large masses. Given the hardly perceptible wearing of water and time, a cañon a mile deep and many hundreds of miles long has resulted from the flowing of a stream. Given glacial "abrasion" and time enough, than valleys of rounded section, and firths and lake-basins of a particular kind probably resulted from the flowing of ice.

There are plenty of hollows in the earth's surface which are not the result of erosion but of other causes with which I am not now concerned. Where a stream flows from source to mouth on a gradual slope, there has been no great disturbance of level since the stream began to work. Where ice fills the dales there are no cañons. Where ice has filled dales and has left fresh marks, cañons are short and small. In mountain regions where ice-marks are rare or absent, cañons are of great depth and length, apparently because their streams have flowed in the same channels ever since the mountains were raised. But where cañons are marked features, these lakes, firths, and dales of rounded section are very rare, or do not exist. It seems therefore that hollows which have, in fact, been carved out of the earth's surface may be known for water-work, or for ice-work by their shape, and that firths, dales, and lakes may mark the sites of local glacial periods; and cañons the sites of climates that have not been glacial since the streams began to flow. Perseverance may accomplish great results insensibly like ice in dales, water in water-courses, and drops on stone.

Let me counsel those who wish to study the works of ice on a large scale to abandon the retiring glaciers of Switzerland and study Nature in Norway. This is the best season for travelling there. J. C.

June 23

The Loan Scientific Collection at South Kensington

As a science teacher, privileged to attend the special demonstrations upon the extraordinary assemblage of apparatus now filling the galleries of the exhibition buildings, a list of some of which appeared in last week's NATURE, would you allow me to call attention to the provision of the department by which the general public may be admitted, if room, at a nominal charge.

Within the past few days my note-book shows that the original instruments of Sir Isaac Newton, Faraday, Fizeau, Wheatstone, Watt, Savery, Black, Cavendish, Guerické, and others employed in their classic researches, have been shown and explained (and used, so far as experimentalists would presume to touch such now almost venerated relics).

The spacious and well-appointed lecture-theatre has not been always crowded; but I have the impression that if the above regulation were widely understood there would be such a gathering, not of the merely curious, who would attend as at an entertainment in natural magic, but of those deeply interested in the topics discussed, as would prove too large for the accommodation at present provided; and, whilst scientific enrichment of the public would be more largely secured, a compliment would at the same time be paid to the directors for their great efforts to promote the success of this important undertaking.

The School of Science, July 6 WILLIAM GEE

Evolution of Oxygen by "Vallisneria Spiralis"

HAVE any of your readers noticed the rapid evolution of oxygen by a blade of *Vallisneria spiralis?* If a blade is cut or broken and held under water, the bubbles of gas are rapidly noticed issuing from the broken end, and by a simple arrangement of placing the broken blade or several blades into a test tube filled with water the water is displaced and the gas collected. After forty-eight hours the pores of the broken end of the blade close up and a fresh fracture is necessary to restore the evolution of gas, which also ceases at night only to recommence when the sunlight reappears. I have collected about a cubic inch of gas in eight hours from one blade of the plant. A confirmation of my experiment would please me.

Stroud, July 3 WALTER J. STANTON

Stamens of Kalmia

IF the beautiful spring trap formed by the stamens of the Kalmia, by which insect fertilisation is secured, has not yet been noticed, I may perhaps be allowed to call attention to it.

Cahirmoyle, Ardagh, Co. Limerick C. G. O'BRIEN

Optical Phenomenon

FOR more than half an hour after sunset this evening there was a broad band of light rising vertically through a clear sky immediately above where the sun had set. It moved as the sun moved northward below the horizon, retaining its vertical position. It must have been formed at a very great height in the atmosphere, for it outlasted all the other sunset tints, which were very beautiful. It would be interesting to know whether this was seen from many places far apart. JOSEPH JOHN MURPHY

Old Forge, Dunmurry, Co. Antrim, June 27

The Cuckoo

WITH regard to the letter of Mr. Adair, in last week's NATURE, p. 210, on the cuckoo, I have only to observe that if it does not sing in Somersetshire after Midsummer it does *here*, in Middlesex; I heard it, to my astonishment, early in the morning of the 6th inst., in the woods and hills to the north. I never recollect its note so late, not after the 3rd.

Harrow, July 10 HENRY ST. JOHN JOYNER

OUR ASTRONOMICAL COLUMN

SHORT'S OBSERVATION OF A SUPPOSED SATELLITE OF VENUS.—This observation which, as it appears in the *Philosophical Transactions*, vol. xli. (NATURE, vol. xiv., p. 194), is mystified by a typographical error, is also found in "Histoire de l'Academie des Sciences, 1741," p. 125, where the micrometrically-measured distance of the suspicious object from Venus is given in what seems to be a more correct form, and as it was used by Lambert in his calculations. After referring to the observations of the elder Cassini in 1672 and 1686, the writer—probably Cassini II., author of "Elemens d'Astronomie"—states that Mr. Short had again seen the satellite, real or apparent, in the preceding year (1740), under similar circumstances, and with the same phase as Cassini had described; he had been informed of this in January, 1741, by M. Coste, "auteur de la Traduction du livre de l'Entendement Humain de Locke, et de plusieurs autres ouvrages;" and having communicated the observation to the Academy of Sciences, had been charged by that body to inquire more particularly concerning it, and report the result. But as Short had not seen the satellite again up to June, 1741, nothing further was ascertained than had been notified in the letter addressed to M. Coste, which was from "Mr. Turner, written from London, June 8."

Short's observation was "made in London, November 3, 1740, in the morning, with a reflecting telescope of 16½ English inches, and which magnified the diameter of the object from fifty to sixty times. He perceived at first what appeared to be a small star very near to Venus, upon which, having applied to his telescope a stronger eyepiece and a micrometer, he found the distance of the small star from Venus, 10 minutes 20 seconds. Venus then appeared very distinctly, and the sky being very clear, he took eyepieces three or four times more powerful, and saw, with an agreeable surprise, that the small star showed a phase, and the same phase as Venus; its diameter was rather less than a third of that of Venus, its light not so vivid but well defined; the great circle which passed through the centres of Venus and of the satellite, which it would be difficult to designate otherwise, made an angle of about 18 to 20 degrees with the equator, the satellite being a little towards the north, and preceding Venus in right ascension. Mr. Short examined it at different times and with different telescopes during the space of an hour, until the light of day or of the twilight obliterated it entirely."

It will be seen that Short's observation, divested of the typographical error in the *Phil. Trans.*, by which it was confused, is intelligible enough, and it may not be without interest if we examine the circumstances under which it must have been made.

Taking the place of Venus with sufficient precision for the purpose in view from the tables of Le Verrier, we have the following figures:—It may be premised that the date given in NATURE last week from the *Phil. Trans.* is the morning of October 23, but it is to be remembered that the Gregorian style had not then been introduced in this country; in the present mode of reckoning, it becomes the morning of November 3, as stated in the "Histoire de l'Academie."

G.M.T.	Venus, App. R.A.	App. N.P.D.	Dist. of Venus from the Earth.
1740, Nov. 2, at $18^h\ 30^m$	175° 21′ 11″	87° 12′ 21″	0·7007.

Hourly motion in R.A. + 2′ 28″; in N.P.D + 0′ 49″.

The apparent diameter of Venus (Le Verrier) was 23″·7, and her heliocentric longitude being 86° 11′, and her geocentric longitude 174° 38′; the breadth of the illuminated portion of her disc was 0·514; elongation, W. 46½°.

Short says the daylight put a stop to his observations "about a quarter of an hour after eight," which we may assume to imply apparent time, and as the correction from apparent to mean time was then $16^m{\cdot}1$ subtractive, his observation may be supposed to have terminated at 8 A.M., and as he had viewed the object during the space of an hour, we find Venus must have been at an altitude of 36° when he first perceived it, and further, it should be noted, the sun rose at $7^h\ 0^m$, so that Short's observations must have been made entirely in daylight, with the planet particularly well situated.

The suspected satellite was 18°–20° north-preceding Venus, which implies a mean angle of position of 289°, and as the distance was 10′ 20″, we have for the difference of right ascension, $39^s{\cdot}1$, and for the difference of N.P.D., 3′ 22″. Supposing these differences to apply to $7^h\ 30^m$ A.M., the position of the object would be R.A. $11^h\ 40^m\ 50^s{\cdot}6$, N.P.D. 87° 9′ 23″; whence, bringing forward to the epoch of the *Durchmusterung*, its R.A. is $11^h\ 46^m\ 46^s$, N.P.D. 87° 47′·5 for 1855·0.

Unless we had been able to correct the misprint in the *Phil. Trans.* by the French account of the observation, it might, perhaps, have been inferred that the distance was intended to be 1° 2′ or 1° 12′, and in this case the 3.4 magnitude star *β* Virginis would have fallen very nearly upon Short's position; at 7 A.M. this star preceded Venus 1° 5′, and was N. 26′.

It will be found that our examination of Short's observation does not tend to explain it. Though Lalande thought when conversing with him on the subject in 1763, that he doubted his having observed a satellite of Venus, he appears to have been sufficiently impressed with his observation to have had the appearance engraved, and to have "carried it with him as a seal."

The observation of Andreas Mayer at Greifswald, mentioned in NATURE last week in the notice of Schorr's "Der Venusmond," was communicated to Lambert after the appearance of his memoir "Essai d'une théorie du satellite de Vénus," in the Berlin Memoirs, 1773, of which an abstract is found in the *Astronomisches Jahrbuch*, 1777. It is printed at p. 186 of the *Jahrbuch* for 1778, where also appear the two letters from Abraham Scheuten to Lambert, referring to his observations of what he believed to be a satellite of Venus, *after* the planet had left the sun's disc in the transit of 1761, June 6, which at noon at Crefeld was near the centre of the disc and at 3 P.M., near the limb. Lambert follows with a particular examination of Scheuten's observation in connection with the observations of Montaigne at Limoges in May preceding.

γ ARGUS.—Gilliss, in the notes to the 1850 "Catalogue of Double Stars observed at Santiago," remarks of this object: "The cluster deserves special attention for its evident changes since Herschel's observations." From a comparison of the observations it is not obvious to what changes reference is here made. Perhaps some reader of NATURE who can favourably command this star's position will describe the actual configuration, &c., of the principal star and *vicinæ*.

Mr. S. M. Drach writes with reference to views of binary stars from Venus and Mars: "Has it ever been noticed by cosmographists that an observer at these planets must see our moon at a maximum elongation-angle from our earth, ranging from Venus from $5\frac{1}{11}$ to $31\frac{1}{4}$ minutes of degree, and from Mars from $3\frac{1}{2}$ to $16\frac{5}{8}$ minutes of degree, whence follows that our *present century's* certitude of Binary Stellar Systems is a PRIMITIVE feature of naked-eye astronomy to the Venus or Mars observers. This elongation diminishes to zero in about seven days of either planet, since their rotation periods nearly equal the earth's."

THE NORWEGIAN-ATLANTIC EXPEDITION

THIS Expedition left Bergen June 1 for the Sognefiord, where the first week was spent in preparatory work—sounding, dredging, and trawling in 600 fathoms. The temperature at the bottom was found exactly the same as in former years, 43°·7 F. The fauna was a mixture of Atlantic and Arctic. There were found several specimens of *Brisinga coronata* (Sars), *Munida tenuimana*, one large *Actinia* and a sponge, *Tisiphonia agariciformis*, and, among other mollusca, *Aximus eumyarius* (Sars), *Kelliella abyssicola* (Sars), *Malletia obtusa*, and *Taranis Mörchi*. The second week was spent at Hüso, a small island at the mouth of the Sognefiord, where magnetical base-observations were made on shore and on board, ship swung for deviation, &c.

June 20 the Expedition left this place, and steered along the deep channel surrounding Southern Norway from the Skagerrack up to Cape Stadt. The first soundings and dredgings showed a very flat bottom at a depth of about 200 fathoms, and with a fauna mainly Atlantic. About 150 miles N.W. of Cape Stadt the temperature began to fall, the depth remaining unchanged. At the next sounding the depth increased and the bottom temperature was still falling, until at last the Miller-Casella thermometer showed 32° at 300 fathoms, and 30° at the bottom in 400 fathoms. This is exactly like what the *Porcupine* found in the *Lightning* Channel. Off Stadt the fauna was Arctic and Glacial. Among the specimens brought up was a gigantic *Umbellularia*, 5 feet high, a *Nymphon*, 10 inches between the ends of the feet, a new large *Archaster*, and many other characteristic forms. No less than eight forms of Hydroids were also found at this depth, three different species of Arctic *Fusus*, and several specimens of *Yoldia intermedia*, &c.

The Expedition ran into Christiansund June 23, and was to leave that port in a few days for the Faroes and Iceland.

THE KINEMATICS OF MACHINERY[1]

II.

AFTER the discussion of lower pairs of elements, higher pairs are considered, such, for instance, as that of the duangle and triangle, the motions of which with respect to each other are thoroughly described. One of the most useful sections of the book, and which we strongly recommend to the attention of engineers and machinists, is that on the General Determination of Profiles of Elements for a given Motion (p. 146). To the practical mechanic who has read the discussion on the different pairs of elements, it must appear that there are some motions taking place in machines in the required manner that are not constrained completely by the resistance of the parts of the machine, such, for example, as the motion of the bed-plate of a planing machine in the V guides, and it is obvious that this motion would not be constrained to take place in the required manner if the machine were turned upside down. The constraint only in certain positions of the pair of elements is called *force closure*, and the pair is called an incomplete pair of elements, the determination of the motion in the required

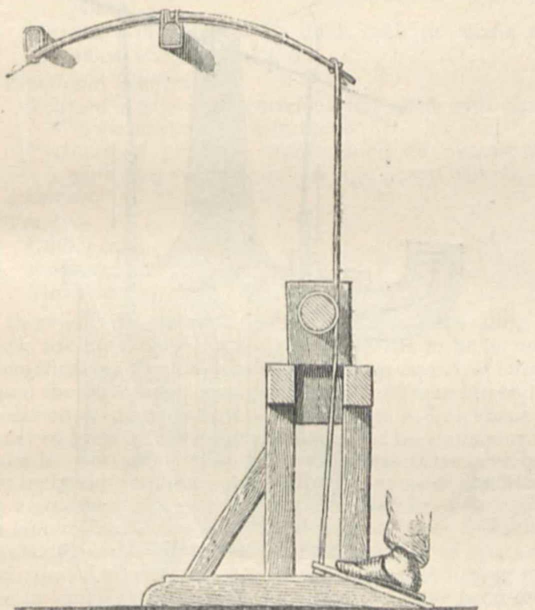

FIG. 5.

manner being effected only with the assistance of the weight of one element, which must be greater than any disturbing force tending to cause motion in the direction opposite to that in which its weight acts. As examples of force-closed pairs are mentioned the plummer block of a water-wheel, which, owing to the weight of the wheel, constrains the motion without the complete closure of the pair by the addition of the cap, also railway wheels with the metals on which they roll.

We pass now to the History of Machine Development. "At the commencement of a study of machine development it is first of all necessary to know distinctly what it is that makes a machine complete or incomplete. It is only possible to judge of the completeness of a machine from the excellence of the work produced by it, if we are able to estimate separately what part of the result is due to the skill of the workman. Certain Indian fabrics, for instance, are of extraordinary excellence and delicacy, although they have been made in most defective looms; throughout the whole manufacture of these it is the weaver's dexterity that plays the most important part. In no machines can we absolutely do away with human action, if it be for no further purpose than to start and stop the process. It appears, therefore, that the most complete machine is the one fulfilling best its own work, and having for this share the greatest proportion of the whole task." The great use of tracing the history of the development of machines is, that the more clear the path along which real advance has come to pass can be laid down, the more clearly we are enabled to see the direction that must be taken by succeeding advances. Probably the earliest machine known is the fire-drill, used in very early days of the development of the human race for producing fire by its rapid rotation between the hands, being at the same time held in firm contact with another flat piece of wood. The improvements on this appear to have been pointing the fire-drill at the other end, enabling the vertical pressure to be supplied by an assistant by means of a flat piece pressed on the top of the drill,

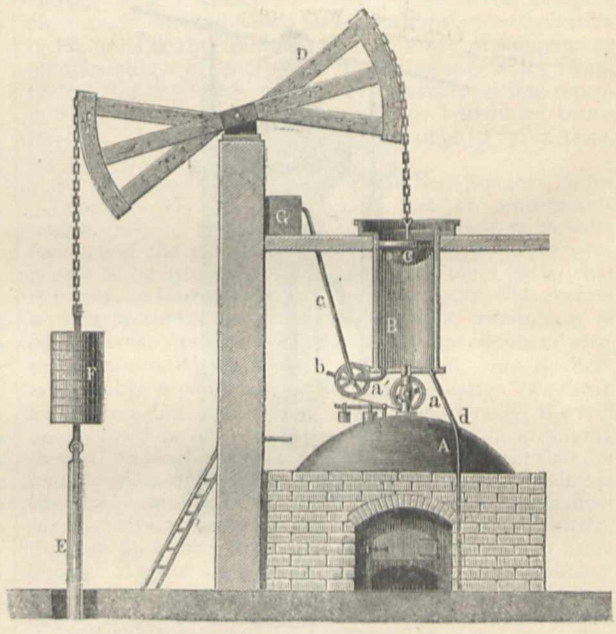

FIG. 6.

and communicating the rotation to the drill by means of a cord wrapped once or twice round it. The applications of this tool seem to have been numerous, as with it hard woods, bone, horn, and even hard stones, appear to have been drilled, no doubt with the assistance of a supply of sand and water. From the fire-drill, probably after a very long interval, sprang the potter's wheel, and the earliest forms of turning-lathe turned in a similar manner; the principle is preserved to the present day in the bow-drill used for light metal-work. The origin of the screw and nut is lost in obscurity, but this pair of elements was certainly known to the Greeks and Romans; Prof. Reuleaux's suggestion of its origin, tracing it to the fire-drill, is very ingenious, even if it is not the right one; that with long-continued use of the drill, the cord may have worn spiral groves on the spindle, forming a screw-thread while the cord itself formed the nut. "The forms of the word screw in the Germanic languages greatly strengthen my suggestion. We cannot take into account the fact that in English and the Romance languages the characteristic portion of the screw is called 'thread' (*filo*, *filet*),

[1] "The Kinematics of Machinery: Outlines of a Theory of Machines." By F. Reuleaux, Director of and Professor in the Königlichen Gewerbe-Akademie in Berlin, Member of the Königl. technischen Deputation für Gewerbe. Translated and edited by Alex. B. W. Kennedy, C.E., Professor of Civil and Mechanical Engineering in University College, London. (London: Macmillan and Co., 1876.) Continued from p. 214.

for this name may have been subsequently given to it." Again, "The bow of the archer is a machinal organ in which energy is stored; the sensible force of the muscles is made latent in it, and it is this latent energy stored in the elastic bow which actually propels the arrow. In the ballista and catapult this principle receives still more extended application, for in them kinematic means are employed to store the energy of many men, so as to employ it concentrated with correspondingly increased effect. Later on the same principle extends itself to primary forces, and it is to-day more used than ever, from the tiny watch-work or the spring of a gun-lock, through innumerable mechanisms, up to the Armstrong accumulator or the air-vessels of the Mont Cénis borers." But it is from the kinematic point of view that the progress of the development of the machine is most accurately measured. What is the fundamental characteristic of the improvement that has been effected in the various stages of advance in the development of a machine? Prof. Reuleaux answers: "The line of progress is indicated in the manner of using force-closure or more particularly in the substitution of pair closure and the closure of the

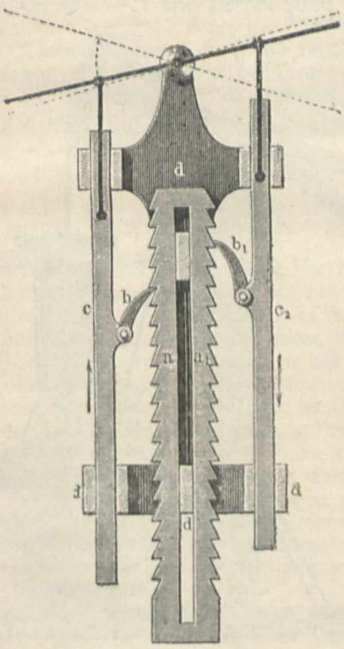

FIG. 7.

kinematic chains obtained by it for force-closure." In the fire-drill, which is an early form of turning-pair, we have not only force-closure by the action of the hands in the longitudinal direction, previous to the introduction of the bearing-piece on the top, but also force-closure in the transverse direction by the hands. The invention of the string for turning the drill, itself a great advance, introduces another kinetic pair of elements, but still the string is constrained to keep in contact with the stick by the force-closure of the tension produced by the hands. In the earliest form of lathe with double headstocks, the force-closure of the double element is changed to pair-closure, marking a great advance in the development of the machine, and the string is worked in a more definite manner by one end being fastened to a bow or spring-beam, whilst the other is worked by the foot (Fig. 5).

"Thus simplicity or fewness of parts does not itself constitute excellence as a machine, but increased exactness in the motions obtained, with diminished demands on the intelligence of any source of energy."

In more recent machinery, such as Newcomen's engine (Fig. 6), we see the connection of the beam D and the pump-rod E, affected by the force-closure of the weight F acting on the chain, the connection of the piston C, and the beam D, affected by force-closure also, by the same weight, whilst the valve-gear was worked by hand.

By the invention of his nearly perfect parallel motion, Watt introduced kinematic pair and chain-closure into the steam-engine, as well as by the introduction of automatic valve-gear. Space will not permit us to give an account of the systems of kinematic notation proposed by Prof. Reuleaux, but it certainly is one of the most important chapters in the book, and will well repay a careful study, although some little time and trouble is evidently required to get the meaning of the various symbols impressed on the memory. When this has been done we have no doubt that it will amply compensate the learner for his pains, by the much more ready comprehension he will obtain of complex mechanisms. We can only say, in the words of our author, "The reader need not fear that any continual alteration of his accustomed ideas will be demanded from him in making himself familiar with the system of contractions. For a scientific symbolic

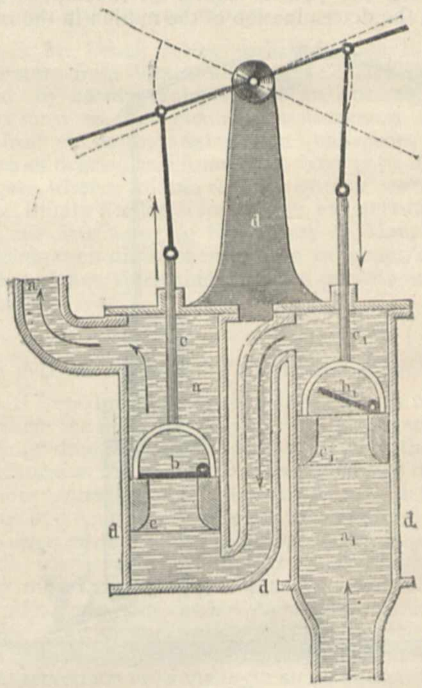

FIG 8.

notation is in essence nothing else than a systematised method of contraction—it is not a hieroglyphic system mysterious to the uninitiated." Under the head of analysis of chamber-crank chains, the various disc-engines, rotatory engines and blowers, of which such a large and varied assortment has been from time to time invented, are described and figured, and our author states at the end of the long list so formed that the whole of the forms that have appeared are probably not exhausted, and that "a comparison of the machines described shows, indeed, that there are many easily constructed inversions of existing mechanisms which have not yet been proposed, and many analogies to existing forms which have not been tried; so we may look forward still to the production of whole series of chamber-crank trains by the never-resting empirics. In Chapter xi. we come to the machine considered as a combination of constructive elements and the complete enumeration of them, and their systematic classification deserves particular attention. As an example of this classification we may give the double-acting ratchet train (Fig. 7) and the double-acting pump (Fig. 8); these are classed together, and a closer examination of the function and elements of each will immediately show the correctness of so doing. The two bars *c* and *c* in the ratchet train correspond with the two pump rods and buckets. The pump barrels *d d* correspond with the guide frames *d d* of the ratchet train, the valves *b* and *b* correspond with the pawls *b* and *b*, while the water in the two barrels is the exact equivalent of the ratchet *a a*. As the bar *c* descends the pawl *b* would pass over a certain number of teeth of the ratchet equal to the number in the length of stroke of *c*, if the bar *c* was disconnected with the lever but as it is, during the descent of *c*, through a certain distance the ratchet is lifted an equal distance by the other pawl *b*; thus we see that each pawl passes over twice as many teeth of the ratchet as correspond to the length of its stroke. This has an exact parallel in the double-acting pump, for there also each bucket in its down stroke moves through a length of water equal to double the length of its stroke. The following is the outline of Prof. Reuleaux' Classification of Constructive Elements :—

- Rigid Elements—
  - Joints (for forming links) such as rivets, keys, keyed joints.
  - Elements in pairs or in links, such as shafts and axles, levers, cranks, &c.
- Flectional Elements—
  - Tension organs by themselves and used with chain-closure, such as belts, cords.
  - Partners of pressure organs such as pistons and plungers, steam cylinders and pump barrels.
  - Springs.
- Trains—
  - Click-gear.
  - Brakes.
  - Movable couplings and clutches.

In conclusion we must say that the cuts illustrating the book, are much superior to those generally to be found in theoretical books on machinery, but they do not, of course, equal the elaborate working drawings to be found in certain books on machine design. In Fig. 169, p. 218, the rope appears to have somewhat lost its way. The translator has done his work most admirably, and great must have been the ingenuity required to manufacture some of the names here presented for the first time to the English reader. In fact we could hardly imagine a book more difficult to translate, on account of the great number of specially-constructed words in it, nor do we remember having read one in which the duties of the translator have been more successfully carried out. The book appears at a particularly suitable time, now that the beautiful and extensive collection of kinematic models by Prof. Reuleaux, designed by him and constructed especially to illustrate his treatment of the theory of mechanism, is to be seen at the Loan Collection of Scientific Instruments at South Kensington.

PERIGENESIS v. PANGENESIS—HAECKEL'S NEW THEORY OF HEREDITY

UNDER the title "Perigenesis der Plastidule oder die Wellenzeugung der Lebenstheilchen," Prof. Haeckel has published quite recently a pamphlet containing an attempt to furnish a mechanical explanation of the elementary phenomena of reproduction which shall be more satisfactory than Mr. Darwin's ingenious and well-known theory of Pangenesis. I shall endeavour to show that Prof. Haeckel's theory is essentially that with which both English and German students of Mr. Herbert Spencer's works have long been familiar; and that it does not furnish a clearer explanation than does Mr. Darwin's Pangenesis, of the special facts of heredity which Mr. Darwin had in view.

Haeckel commences with a very concise statement of what is at present known as to the visible composition of "plastids," those corpuscles of life-stuff called "cells" by Schleiden and Schwann, "elementary organisms" by Brücke, "life-units" by Darwin. Most plastids possess a differentiated central kernel or nucleus, which again possesses one or more nucleoli. The substance of which the body of such a nucleated plastid or *true* cell is mainly composed is generally known by von Mohl's term, "protoplasma." Haeckel proposes to distinguish the substance of the nucleus by the name "coccoplasma." In the simplest form of plastid, the "cytod," which is devoid of nucleus, and is exhibited by those lowly organisms known as Monera, by the young Gregarina (Ed. van Beneden), by the hyphæ of some Fungi, and by the ripe egg of all organisms (if we may judge from the results of the most recent researches), coccoplasm and protoplasm are not differentiated, but exist as one substance, which Haeckel, following Ed. van Beneden, distinguishes as "plasson." Whether these distinctions have a real value or not, is of no moment for the question in hand. It is a widely-accepted doctrine—in fact, the fundamental generalisation on which Biology as a science rests—that the excessively complex chemical compound which forms the substance of plastids or life-units is the ultimate seat of those phenomena or manifestations of energy which distinguish living from lifeless things—to wit, growth by intus-susception, reproduction, adaptation, and continuity or hereditary transmission. Leaving Prof. Haeckel's pamphlet for a time, let us go back thirteen years.

As long ago as July, 1863, Mr. Herbert Spencer, in his "Principles of Biology," pointed out at considerable length (vol. i., p. 181) that the assumption of definite forms, and the power of repair exhibited by organisms, is only to be brought into relation with other facts (that is to say, so far explained) by the assumption that *certain units* composing the living substance or protoplasm of cells possess "polarity" similar to, but not identical with, that of the units which build up crystals. Mr. Spencer is careful to explain that by the term "polarity" we mean simply to avoid a circuitous expression, namely, the still unexplained power which these units have of arranging themselves into a special form. He then points out that the units in question cannot be the molecules of the proximate chemical compounds which we obtain from protoplasm—such as albumen, or fibrin, or gelatin, or even protein. Further he shows that they cannot be the *cells* or morphological units, since such organisms as the Rhizopods are not built up of cells, and since, moreover, "the formation of a cell is to some extent a manifestation of the peculiar power" under consideration. "If then," he continues, "this organic polarity can be possessed neither by the chemical units, nor the morphological units, we must conceive it as possessed by certain intermediate units, which we may term *physiological*. There seems no alternative but to suppose that the chemical units combine into units immensely more complex than themselves, complex as they are; and that in each organism, the physiological units produced by this further compounding of highly compound atoms, have a more or less distinctive character. We must conclude that in each case, some slight difference of composition in these units, leading to some slight difference in their mutual play of forces, produces a difference in the form which the aggregate of them assumes."

Further on Mr. Spencer applies the hypothesis of physiological units to the explanation of the phenomena of heredity, introducing the subject by the following admirable remarks, which appear to me to assign in the most judicious manner, their true value to such hypotheses and to be as strictly applicable to later speculations as to his own. "A positive explanation of heredity is not to be expected in the present state of biology. We can look for nothing beyond a simplification of the problem, and a reduction of it to the same category with certain other problems which also admit of hypothetical solution only. If an hypothesis which certain other wide-spread phenomena have already thrust upon us, can be shown to render the phenomena of heredity more intelligible than they at present seem, we shall have reason to entertain it. The applicability of any method of interpretation to two different but allied classes of facts is evidence of its truth. The power which organisms display of reproducing lost parts, we saw to be inexplicable except on the assumption that the units of which any organism is built have an innate tendency to arrange themselves into the shape of that organism. We inferred that these units must be the possessors of special polarities, resulting from their special structures; and that by the mutual play of their polarities they are compelled to take the form of the species to which they belong. And the instance of the *Begonia phyllomaniaca* left us no escape from the admission that the ability thus to arrange themselves is latent in the units in every undifferentiated cell. . . . The assumption to which we seem driven by the *ensemble* of the evidence, is that sperm-cells and germ-cells are essentially nothing more than vehicles, in which are contained small groups of the physiological units in a fit state for obeying their proclivity towards the structural arrangement of the species they belong to. . . . If the likeness of offspring to parents is thus determined, it becomes manifest, *a priori*, that besides the transmission of generic and specific peculiarities, there will be a transmission of those individual peculiarities which, arising without assignable causes, are classed as 'spontaneous'. . . .

"That changes of structure caused by changes of action must also be transmitted, however obscurely, from one generation to another, appears to be a deduction from first principles—or if not a specific deduction, still, a general implication. . . . Bringing the question to its ultimate and simplest form, we may say that as on the one hand physiological units will, because of their special polarities, build themselves into an organism of a special structure, so on the other hand, if the structure of this organism is modified by modified function, it will impress some corresponding modification on the structures and polarities of its units. The units and the aggregate must act and re-act on each other. The forces exercised by each unit on the aggregate, and by the aggregate on each unit, must ever tend towards a balance. If nothing prevents, the units will mould the aggregate into a form in equilibrium with their pre-existing polarities. If contrariwise, the aggregate is made by incident actions to take a new form, its forces must tend to re-mould the units into harmony with this new form; and to say that the physiological units are in any degree so re-moulded as to bring their polar forces towards equilibrium with the forces of the modified aggregate, is to say that when separated in the shape of reproductive centres, these units will tend to build themselves up into an aggregate modified in the same direction." (P. 256.)

Thus, then, Mr. Herbert Spencer definitely assumes an order of molecules or units of protoplasm—lower in degree than the visible cell-units or plastids—to the "polar forces" of which and their modification by external agencies and interaction, he ascribes the ultimate responsibility in reproduction, heredity, and adaptation.

I am unable to say whether Mr. Darwin was acquainted with or had considered Mr. Herbert Spencer's hypothesis of physiological units, when in 1868 he published his own provisional hypothesis of Pangenesis. But an examination of the bearings of the two hypotheses shows that the former does not render the latter superfluous, nor is the one inconsistent with the other. Mr. Darwin wished to picture to himself and to enable others to picture to themselves a process which would account for (that is, hold together and explain) not merely the simpler facts of hereditary transmission, but those very curious though abundant cases in which a character is transmitted in a latent form and at last reappears after many generations, such cases being known as "atavism" or "reversion;" and again those cases of latent transmission in which characteristics special to the male are transmitted to the male offspring through the female parent without being manifest in her; and yet again the appearance at a particular period of life of characters inherited and remaining latent in the young organism. According to the hypothesis of pangenesis, "every unit or cell of the body throws off gemmules or undeveloped atoms, which are transmitted to the offspring of both sexes and are multiplied by self-division. They may remain undeveloped during the early years of life or during successive generations; their development into units or cells, like those from which they were derived, depending on their affinity for, and union with, other units or cells previously developed in the due order of growth."

In an essay ("Comparative Longevity," Macmillan, 1870, p. 32) published six years ago, I briefly suggested the possibility of combining Mr. Herbert Spencer's and Mr. Darwin's hypotheses thus: "The persistence of the same material gemmule and the vast increase in the number of gemmules, and consequently of material bulk,[1] make a *material* theory difficult. Modified force-centres, becoming further modified in each generation, such as Mr. Spencer's physiological units, might be made to fit in with Mr. Darwin's hypothesis in other respects." In fact in place of the theory of emission from the constituent cells of an organism of material gemmules which circulate through the system and affect every living cell, and accumulate in sperm-cells and germ-cells, we may substitute the theory of emission of force, the two theories standing to one another in the same relation as the emission and undulatory theories of light.

It may, however, be very fairly questioned whether our conceptions of the vibrations of complex molecules, or in other words their force-affections, are sufficiently advanced to render it desirable to substitute the vaguer though possibly truer undulatory theory of heredity for the more manageable molecular theory (Pangenesis). How are we to conceive of the propagation of such states of force-affection or vibration (as they are vaguely termed) through the organism from unit to unit? In what manner, again, are we to express the dormancy of the pangenetic gemmules in terms of molecular vibration? It is true that molecular physics furnishes us with some analogies in the matter of the propagation of particular states of force-affection from molecule to molecule, as, for example, in the various modes of decomposition exhibited by gun-cotton, in contact actions and the like; but it will require a very extended analysis of both the phenomena of heredity and of molecular phenomena similar to those just cited, to enable us to supersede the admittedly provisional hypothesis of Pangenesis by a hypothesis of vibrations. And it is necessary here to remark that in the fundamental conception of Pangenesis, namely, the detachment from the living cells of the organism of gemmules which then circulate in the organism, there is nothing contrary to analogy, but rather in accordance with it. It is quite certain that in some infective diseases the contagion is spread by specific material particles. This seems to be established, although it is far from settled as to whether these particles are parasitic organisms or portions of the diseased organism itself. Mr. Darwin's pangenetic gemmules may, even if not accumulated and transmitted from generation to generation, be called upon to explain the solidarity of the constituent cells of one organism; they may be assumed as agents of

[1] On this subject see Mr. Sorby's recent Presidential Address to the Royal Microscopical Society, in "Quarterly Journal of Microscopical Science," April, 1876.

a peculiar kind of infection,[1] by means of which the molecular condition or force affection of one cell is communicated to others at a distance in the same organism. It is difficult without some such hypothesis of an active material exchange of living molecules between the various cells of the body, to conceive of the way in which "change is propagated throughout the parental system," or a modified part is to "impress some corresponding modification on the structures and polarities" of distant units, such, for example, as those contained in the mammalian ovum.

In the human ovary no egg-cells are produced after the age of two and a half years. Each of the many hundred eggs there contained reposes quietly in its follicle, whilst the growth and development of other organs is proceeding. Then a renewed period of activity for the ovary commences, but the majority of the originally-formed egg-cells retain their vitality and form-individuality for more than forty years. How, we may ask, during that time are they subjected to the influence of new polar forces acquired by the other units of the body? We know that they are so impressed, or have such influences propagated to them. Is it by "action at a distance," or by the contact action of circulating infective gemmules?

Such being the state of speculation, in England at any rate, with regard to the mechanical explanation of heredity, we return to Prof. Haeckel's recently enunciated theory of the Perigenesis of plastidules.

It is clear, to begin with, that Prof. Haeckel has either never studied or has forgotten Mr. Herbert Spencer's writings. His attempt to substitute something better for Mr. Darwin's provisional hypothesis of Pangenesis, as he tells us, has its origin, to a great extent, in the admirable popular lecture of Prof. Ewald Hering of Prague, "Über das Gedächtniss als eine allgemeine Function der organisirten Materie" [On Memory as a General Function of Organised Matter], published in 1870, and to some extent, including terminology, is based on an essay by Elsberg, of New York, published in the *Proceedings* of the American Association, Hartford, 1874. With the latter of these publications I am only acquainted through Prof. Haeckel's citations, but with the former at first hand. Prof. Hering gives a brief outline in the lecture in question, of the fundamental doctrine of physiological psychology, which had been previously worked out to its consequences on an extensive scale, by Mr. Herbert Spencer. Prof. Hering has the merit of introducing some striking phraseology into his treatment of the subject, which serves to emphasise the leading idea. He points out that since all transmission of "qualities" from cell to cell in the growth and repair of one and the same organ, or from parent to offspring, is a transmission of vibrations or affections of material particles, whether these qualities manifest themselves as form, or as a facility for entering upon a given series of vibrations, we may speak of all such phenomena as "memory," whether it be the conscious memory exhibited by the nerve-cells of the brain or the unconscious memory we call habit, or the inherited memory we call instinct; or whether again it be the reproduction of parental form and minute structure. All equally may be called "the memory of living matter." From the earliest existence of protoplasm to the present day, the memory of living matter is continuous. Though individuals die, the universal memory of living matter is still carried on.

Prof. Hering, in short, helps us to a comprehensive conception of the nature of heredity and adaptation by giving us the term "memory," conscious or unconscious, for the continuity of Mr. Herbert Spencer's polar forces or polarities of physiological units.

[1] It is a striking exemplification of the unity of biological science that we should have to look to the pathologist for the next step in this region of speculation, and that fermentations, phosphorescence, fevers, and heredity, should be simultaneously studied from a common point of view with psychology.

Elsberg appears (though this is only an inference on my part) to be acquainted with Mr. Herbert Spencer's hypothesis of physiological units. Adopting Haeckel's useful term "plastid" for a corpuscle of protoplasm (cell or cytod), he designates the physiological units "plastidules," a name which Haeckel has accepted, and which may very possibly be found permanently useful. But Elsberg does not appear to have helped on the discussion of the subject to a great extent, since he proceeds no further than is implied in adopting Mr. Darwin's theory of Pangenesis, whilst substituting the "plastidules" for Mr. Darwin's "gemmules." It appears to me that Elsberg, in his combination of the Spencerian and Darwinian hypotheses, has omitted the sound element in the latter, and retained the more questionable. He should have conjoined Mr. Herbert Spencer's conception of "plastidules" possessing special polarities or force affections which they are capable of propagating as *changes* of state (*i.e.*, force-waves) to associated plastidules, and so to offspring with Mr. Darwin's conception of a universal and continuous emission of such changes from all the cells of an organism, and the frequent occurrence of a persistently latent condition of those changes—a condition which Hering's happy use of the term "memory" enables us to illustrate by the analogous (or we should rather say identical) "latent" or "dormant condition" of mental impressions.

This is, in fact, the position which Prof. Haeckel takes up—though independently of what Mr. Spencer has written on the subject, excepting so far as the influence of the latter is to be traced in Elsberg's essay. For Haeckel, living matter, protoplasm, or plasson consists of definite molecules—the plastidules—which cannot be divided into smaller plastidules, but can only be split into lower chemical compounds. What Mr. Spencer calls polarities or polar forces Haeckel speaks of as "undulatory movements"—a symbol which has the advantages and disadvantages of analogy, but which, like "polarity," is *only* a symbol, and covers our incapability of conceiving more definitely the character of the phenomenon it designates. The undulatory movement of the plastidules is the key to the mechanical explanation of all the essential phenomena of life. The plastidules are liable to have their undulations affected by every external force, and once modified the movement does not return to its pristine condition. By assimilation they continually increase to a certain point in size, and then divide, and thus perpetuate in the undulatory movement of successive generations the impressions or resultants due to the action of external agencies on individual plastidules. This is Memory. All plastidules possess memory —and Memory, which we see in its ultimate analysis is identical with reproduction, is the distinguishing feature of the plastidule; is that which it alone of all molecules possesses in addition to the ordinary properties of the physicist's molecule; is in fact that which distinguishes it as vital. To the sensitiveness of the movement of plastidules is due Variability—to their unconscious Memory the power of Hereditary Transmission. As we know them today, they may "have learnt little and forgotten nothing" in one organism, "have learnt much and forgotten much" in another, but in all, their Memory, if sometimes fragmentary, yet reaches back to the dawn of life on the earth.

E. Ray Lankester

Addendum.—It will interest many readers to know that Prof. Haeckel takes an opportunity in this pamphlet of referring to Bathybius. He does not allude to the report from the *Challenger*, to the effect that Bathybius is a gelatinous precipitate of sulphate of lime, but speaks of it as of old. He draws attention to the recent observations of an excellent naturalist, Dr. Bessels, who, I find, in the *Jenaische Zeitschrift*, 1875, vol. ix. p. 277, writes as follows:—"During the last American expedition to the North Pole, I found, at a depth of ninety-two fathoms in

Smith's Sound, large masses of free, undifferentiated, homogeneous protoplasm which contained no trace of the well-known coccoliths. On account of its truly Spartan simplicity, I called this organism, *which I was able to observe in the living state*, 'Protobathybius.' It will be figured and described in the Report of the expedition. I will merely state here that these masses consisted of pure protoplasm, with only accidental admixture of calcareous particles, such as formed the sea-bottom. They formed exceedingly viscid, net-like structures, which exhibited beautiful amœboid movements, took in carmine-particles as well as other foreign bodies, and showed active granule-streaming."

This is certainly a very deliberate and definite statement on the part of Dr. Bessels, who is a well-known and accomplished observer. It will be interesting to see how these observations can be reconciled with the view taken by Sir C. Wyville Thomson and Mr. Murray.

DINNER TO THE "CHALLENGER" STAFF

ON Friday last, Sir C. Wyville Thomson and other members of the *Challenger* staff were entertained at dinner in the Douglas Hotel, Edinburgh, by a large and distinguished company. Besides the civilian chief himself, the other members of the staff present were Mr. J. Y. Buchanan, Mr. J. Murray, Lieut. Balfour, Dr. Crosbie, and Paymaster Richards. The Lord Provost occupied the chair, the croupiers, as the vice-chairmen are called in Scotland, being Professors Huxley and Turner. The speeches were unusually happy and spirited, but we have space to give only a few quotations from that of Prof. Huxley in proposing the health of the scientific staff of the *Challenger*, and their director, Sir C. W. Thomson. After referring to previous Government expeditions for ocean exploration, Prof. Huxley pointed out that the peculiarity of the *Challenger* Expedition was that in her case the cruise became secondary and the scientific object primary; that she was, in fact, fitted up and instructed with the view of obtaining certain scientific data which were requisite for the further progress of natural knowledge. In her case the duty of geographical exploration was reduced to *nil*, and the duty of scientific investigation had become paramount.

After showing the great importance of a knowledge of the nature of the sea-bottom, Prof. Huxley went on—

"Thirty years ago it would have been absolute madness for anyone—I was going to say—to have hoped to obtain any knowledge of the nature of the sea-bottom or of the things which lived there at depths of 5,000, 6,000, 15,000, or 20,000 feet. But then here comes one of those admirable examples of the way in which the theoretical life of this world and the practical life interlock with one another, and interact with one another. Theoretical science, abstract investigation, carried on without reference to any practical aim whatever, that sort of abstract investigation which recent Acts of Parliament have endeavoured to throw a slur upon in this country, though I am happy to say that that has been removed in the House in which it originated—that kind of abstract investigation without immediate practical result, gave us the electric telegraph. When the electric telegraph was got, practical men desired to use it as a means of connecting remotely removed countries. For that purpose it was necessary to lay submarine telegraphs. For that purpose it was necessary to improve our means of sounding; and so out of the electric telegraph came those means of sounding at great depths of the sea, which have enabled us, for the first time, to bring up from the bottom, from a depth of two or three, or it may be four miles of sea-water, the actual things which are to be found at that enormous depth. That took place twenty years ago. In 1858, my friend Commander Dayman was engaged in the survey of the Atlantic for the purposes of the cable; and the Americans, who joined in the like service, had invented means by which specimens could be brought up from that depth. So that, if I may so say, ten years ago it was in the air to apply those new methods supplied by practical life to scientific purposes, to apply the methods of sounding, the methods of dredging, and the methods of ascertaining temperature which had been devised for the purposes of the telegraph engineer, to further investigation of the contents and nature of the sea. But it is all very well for ideas to be in the air. It needs clear brains to get them out of the air, and in this case there were two very clear brains at work on the subject—one of them the brain of our distinguished guest of to-night, Sir C. Wyville Thomson—and the other the brain of my friend Dr. Carpenter, who is well known to the scientific world."

Prof. Huxley then referred briefly to the history of recent deep-sea exploration and to the influences brought to bear on the Admiralty to send out the *Challenger*. He spoke of the object of the expedition and of the important results which have been achieved. "It was a very considerable task," he said, "it was a task which would have been absolutely chimerical thirty years ago, but it was a task which had been rendered possible, and which has been actually performed in the most satisfactory manner. The *Challenger* has brought home, I am informed, the records of such operations performed at between 300 and 400 stations—that is to say, at 300 or 400 points along that 70,000 miles, we know exactly the depth of the sea, the gradations of temperature, the distribution of superficial life, and the nature of what constitutes the sea-bottom; and such a foundation as that for all future thought upon the physical geography of the sea up to this moment not only had not existed, but had not even been dreamed of. I won't detain you by speaking of the great results of the expedition, for one very good reason, that I don't know them. They are in the breast of my friend at the opposite end of the table. But he has been good enough to favour us at the Royal Society from time to time with reports of what he has been about, and some of the discoveries which have been made by the *Challenger* are undoubtedly such as to make us all form new ideas of the operation of natural causes in the sea. Take, for example, the very remarkable fact that at great depths the temperature of the sea always sinks down pretty much to that of freezing fresh water. That is a very strange fact in itself, a fact which certainly could not have been anticipated *à priori*. Take, again, the marvellous discovery that over large areas of the sea the bottom is covered with a kind of chalk, a substance made up entirely of the shells of minute creatures—a sort of geological shoddy made of the cast-off clothes of those animals. The fact had been known for a long time, and we were greatly puzzled to know how those things got to be there. But the researches of the *Challenger* have proved beyond question, as far as I can see, that the remains in question are the shells of organisms which live at the surface and not at the bottom, and that this deposit, which is of the same nature as the ancient chalk, differing in some minor respects but essentially the same, is absolutely formed by a rain of skeletons. These creatures all live within 100 fathoms of the surface, and being subject to the fate of all living things, they sooner or later die, and when they die their skeletons are rained down in one continual shower, falling through a mile or couple of miles of sea-water. How long they take about it imagination fails one in supposing, but at last they get to the bottom, and there, piled up, they form a great stratum of a substance which, if upheaved, would be exactly like chalk. Here we have a possible mode of construction of the rocks which compose the earth of which we had previously no conception. But this is by no means the most wonderful thing. When they got to depths of 3,000 and 4,000 fathoms, and to 4,400 fathoms, or about five miles, which was the greatest depth at which the *Challenger* fished anything from the bottom—and I think a very creditable depth too—they found that, while the surface of the water might be full of these calcareous organisms, the bottom was not. There they found that red clay so pathetically alluded to by my friend on the right [Commander Stewart, who replied for the Navy] as the material to which when glory called him he might be reduced. This red clay is a great puzzle—a great mystery—how it comes there, what it arises from, whether it is, as the director has suggested, the ash of foraminiferæ; whether it is decomposed pumice-stone vomited out by volcanoes, and scattered over the surface, or whether, lastly, it has something to do with that meteoric dust which is being continually rained upon us from the spaces of the universe—which of these causes may be at the bottom of the phenomenon it is very hard to say; it is one of those points on which we shall have information by-and-by. I will not detain you further with speaking of the matters of interest which have come out of this cruise of the *Challenger*; I will only in conclusion remind you that work of this kind could by no possibility be done without the zealous aid of an intelligent executive. That is the first condition, but our thanks have already been rendered to the executive officers of the *Challenger*. In the second place, it could only have been done by the aid of such a scientific staff, composed of picked men as was sent out in the *Challenger*, such men as Buchanan, Murray, and Moseley, and Wild, and Suhm; and I can hardly mention the name of the last gentleman without, in passing, lamenting that he alone of all the staff who left our shores,—he who certainly was the last person we should have imagined we should not see again—that a man of his accomplishments and promise and geniality and lovability should be the only one not to be welcomed back by the friends who loved him, and by the country which would have been glad to adopt him. But, again, a work such as has been done by the *Challenger* could only have been effectively carried out under the direction, not only of a man who intellectually knew what he was about, but whose moral qualities were such as to get the people with whom he was associated to work with him."

Prof. Huxley concluded by referring to the harmony which throughout prevailed among the staff of the *Challenger*.

"When men are shut up together in a limited society, whether it be a cathedral town or a ship, they begin to hate one another unless the bishop is a very wise person. In this case I do not doubt that the bishop was a very wise person, and I do not believe that the whole course of the *Challenger* afforded occasion for any such triangular duels as one hears of in the novels of Captain Marryat."

Sir C. Wyville Thomson made a suitable reply to the toast, giving a brief account of the various operations of the *Challenger*, and referring to the great amount of work yet to be done ere all the results could be given to the world.

PHOTOGRAPHIC PROCESSES [1]

It is not my intention to enter into the history of any of the processes to which I propose to call your attention to-night, as I somewhat dread to enter upon such controversial ground. Probably the demonstration of the production of photographic prints by various methods will be of greater interest than any history.

Astronomy was the religion of the world's infancy, and it can hardly be a matter of surprise that untutored yet inquiring minds, unaided by any distinct revelation, should have attributed to the glorious orb, the centre of our solar system, the possession of divine attributes, and as they gazed upon the wondrous effects of his magical painting, that they should have offered to him their adoration and worship, and carefully noted any phenomena due to him. Thus probably the first photographic action noticed would be at a very early period of human existence, when the exposure of the epidermis to his rays caused what is known to us as tan, whilst the parts of the body covered would remain of their pristine whiteness. A photographic action which would be remarked at a later date would be the fading of colours in the sunlight. Ribbons, silks, curtains, and similar fabrics of a coloured nature undergo a change in tint when exposed to it.

I have here a specimen of a pink trimming used by the fair sex, and the lady who presented me with it informed me that it was "a most abominable take in," as the colour "goes" after two days' wear. Her ideas on the subject and my own somewhat differed, for to me it presented a capital opportunity of using the material as a means for obtaining a photographic print in a moderate time. I have here two results of the exposure of this stuff to the sunlight. One was exposed beneath a negative of an anatomical subject, and we have the image represented as white upon a pink ground. The other subject is a map. An ordinary map was superposed over a square piece of the stuff, and placed in sunlight whilst in contact. We have in this case the lines of the map represented as pink on a white ground, from which the colour had faded.

The general opinion is, I believe, that the colour is given off somewhat similarly to the scent from a rose. Were this entirely the case, the light would not act as it does, but beneath the negative or map, the colour would bleach uniformly. The bleaching seems to be a really chemical change in the dye due to the impact of light. There are many other bodies besides dyes which change in light, and some of them are of the most unlikely nature. I had intended to show you to-night the change that takes place in glass by exposure to light for long periods. My friend, Mr. Dallmeyer, has in his possession specimens of brown and flint glass, which have markedly changed colour in those halves of the prisms purposely exposed to solar influences. In some cases there is a "yellowing" of the body, and in others a decided "purpling."

It is, however, only those bodies which change rapidly in the light that are utilised in photography. The most common amongst these are various compounds of silver, for they are peculiarly sensitive to the action of light. Nearly every silver compound is more or less changed by it, and when I say changed I mean altered in chemical composition. When we reflect what light is we can better understand its action. Light, as experiment, confirmed by mathematical investigation, tells us, is caused by a series of waves issuing from the luminous source, not, indeed, trembling in our tangible atmosphere, but in a subtler and infinitely less dense medium, which pervades all space, and which exists even in the interior of the densest solids and liquids. These waves of ether, as this medium is called, batter against and try to insinuate themselves amongst the molecules of any body exposed to their action, a good many millions of millions of them impinging every second against it. Surely it is not surprising to think, small though the lengths of these waves be, that this persistent battering should in some instances be able to drive away from each of the molecules some one of the atoms of which they are composed.

Take as a type that salt of silver which was, perhaps, the first known to change in the presence of light-silver chloride. For our purpose we may represent each of its molecules as made up of two atoms of silver locked up with two atoms of chlorine. Let us consider the action of the light on only one molecule. The waves strike against it energetically and persistently; the swing that the molecule can take up is not in accord with the swing of the ether. It is shaken and battered till it finally gives up one atom of chlorine; the vibration of the remaining two atoms of silver and one of chlorine are of a different period, and are not sufficiently in discord to cause a further elimination of an atom. The molecule which contains the two atoms of silver and one of chlorine is called a sub-chloride of silver or argentous chloride, and is of a grey violet colour. If, then, I place silver chloride (held in position by a piece of paper) beneath a body, part of which is opaque and part transparent, and expose it to sunlight, I shall find that where the opaque parts cover it, there the white chloride will remain unchanged, whilst on the portions beneath the transparent parts, the dark silver sub-chloride will have been formed. Of course were the paper, after removal of the body, to be further exposed to light, the image obtained would disappear, as a blackening over the whole surface would ensue. In this state, then, the print is not permanent. Fortunately for photography, a ready solvent of silver chloride was

[1] Lecture by Capt. Abney, R.E., F.R.S., at the Loan Collection, South Kensington.

found by Sir John Herschel in sodium-hyposulphite. On applying this salt to the image, it was removed, and also one atom of silver and one of chlorine from the sub-chloride molecule, leaving the atom of metallic silver behind. The chemical change that takes place on the silver chloride can be very distinctly shown by exposing it perfectly pure beneath water. The presence of the sub-chloride is shown by the colour, and that of the chlorine can be exhibited by the usual chemical tests.

In making an ordinary silver print on paper, we have, however, something more present than silver chloride; we have an organic salt known as the albuminate of silver, that is, a combination between albumen and silver. I have in this test-tube a little dilute albumen—the solid constituent of the white of an egg. Into it I drop a little silver nitrate: a flocculent precipitate is at once apparent. The silver from the nitrate has combined with the albumen, and on burning a piece of magnesium wire before it the outer surface shows a darkening; evidently, then, the albuminate of silver is decomposed by light. For silver printing purposes, paper is coated on one surface with a solution of albumen and sodium chloride, and the production of the silver chloride and albuminate is effected by floating that surface on a solution of silver nitrate. When dry, the paper which is now sensitive to light is ready for exposure beneath a negative. Here we have two prints produced on paper so prepared. If now I take one of them and dissolve away the insoluble salts in sodium hyposulphite, you see that the colour is of a disagreeable foxy-red tint. To show you how this want of a pleasing tone may be overcome, the other print is immersed in a weak solution of gold, and by a well-known chemical action the metallic gold is deposited on the darkened portions of the picture. Now when gold is precipitated, it has not the well-known yellow colour, but is of a bluish purple; thus the deposited gold mixes its peculiar tint with that of the silver, and after immersion in the hyposulphite we obtain a print whose beauty cannot be surpassed.

I daresay that many of you may have been charmed with the production of magic photographs, as they were called. Some few years ago the sale of such was enormous, but now the curiosity of the public seems to be satiated. The magic, as you may be aware, consisted in being able to produce on a white piece of paper a photograph of some unknown object. These mysterious pieces of paper were generally supplied in packets, containing with them a piece of blotting-paper. The directions stated that the blotting-paper was to be damped, and whilst moist, to be applied to the surface of one of the accompanying pieces of blank paper, and then a photograph would shoot out. I will endeavour to show you one method of their production. Here I have an ordinary photographic print which has not been treated with gold, but merely immersed in sodium hyposulphite and then washed. I immerse it in a solution of mercurous chloride which I have in this dish, and immediately a bleaching action is set up. The action continues, and the paper is apparently blank. What has happened? Simply a white compound of silver and mercury has been formed, which is indistinguishable from the paper. If I wash the paper and dry it, it is in the state of the paper supplied in the packets. I have one here washed and dried, and I immerse it in the sodium hyposulphite. The image immediately reappears, a combination has taken place between the constituents of the hyposulphide, the mercury, and the silver.

Need I say that the blotting-paper supplied is impregnated with the same sodium salt? In damping it the molecules of the latter are so separated and mobile, that they are free to combine with the white image. By similar treatment the picture may be made to again disappear and once more reappear.

Besides silver there are various other metals which will give a photographic image. This paper, which has a slightly yellow tint, has been brushed over with ferric chloride, more commonly known as perchloride of iron, in which we have the maximum number of colours of chlorine combined with metallic iron. Allowing ordinary white light to act upon it, the waves cause a disturbance between the iron and the chlorine atoms, and one of the latter is shaken off, leaving ordinary ferrous chloride, or muriate of iron behind. A piece of paper, similarly prepared, has been exposed beneath a negative, and the reduction of the ferric chloride to the ferrous state can be demonstrated by floating it on a solution of potassium ferricyanide. The combination between the lowest type of the iron salt and this salt results in the formation of a deep blue precipitate known as Turnbull's blue. You see, after applying it, we have the lines of this map, of which this is the negative, of an intense blue. Instead of demonstrating the change of the iron salt by this means, I may float it on a weak solution of silver nitrate. The ferrous salt of iron will reduce the silver, whilst the ferric salts are wholly inoperative to produce the same effect. Here we have such a print.

The principal investigator of the action of light on iron compounds was Sir John Herschel, and he employed a variety of different combinations. Perhaps one of the most interesting exhibits in the Photographic Section is that old list of Fellows of the Royal Society on which were pasted, by the hand of that distinguished philosopher, the actual solar spectrum prints made during his researches on these and other metallic salts.

Uranium salts are also capable of being reduced to less complex forms by the action of light. I will not enter into a detailed description of the decomposition, but will simply exhibit the method of producing a print with the salt. The paper has been coated with uranic nitrate and exposed to light, beneath the same negative before shown to you. The image is made visible by a solution of potassium ferricyanide, as in the case of the iron salt.

In the cases of photographs are shown some interesting specimens of iron and uranium prints, made by Nièpce de St. Victor. I believe they were presented to Sir Charles Wheatstone by that ardent experimentalist. The subdued brown tones of the latter were probably obtained by the admixture of a little iron with the uranium.

Within the last couple of years the salts of iron have been put to practical photographic printing purposes by Mr. W. Willis, jun., of Birmingham, and a valuable process has resulted from his labours. The sensitive salt employed is an organic salt of iron known as ferric oxalate, and Mr. Willis made the discovery that amongst other metals platinum could be reduced to the metallic state from a double chloride of potassium and platinum, by ferrous oxalate in the presence of a potassic oxalate. A piece of paper is floated on a weak solution of silver nitrate and dried; and over the surface is brushed a mixture of the platinum salt and the ferric oxalate. After exposure to light (which produces the ferrous salts) beneath a negative, the paper is floated on a solution of neutral potassium oxalate, when the image at once appears formed of platinum black, a substance at once durable and incapable of being acted upon by atmospheric influence. Such an exposed paper I have here, and floating it on oxalate solution, you see the image is immediately developed. The unreduced iron salt can be eliminated by soaking the print in the oxalate solution, and a rinse and hyposulphite removes all traces of silver nitrate. After a few changes of water, the print may be dried, and is permanent. I should explain that the paper is first coated with silver nitrate in order to cause the platinum to adhere firmly to the surface of the paper. When omitted, the fine black powder formed is apt to precipitate in the bath.

Before dwelling upon that metallic compound which in photography is next in importance to silver, I must call your attention to the first vanadium print ever produced. Prof. Roscoe, who has already delighted an audience in this room with an admirable lecture on Dalton's apparatus and what he did with it, has made a classical investigation of the compounds of this metal, and amongst other interesting facts, has noticed that the vanadium salts are reduced by light in a somewhat similar manner to the uranium salts.

We now have to consider the printing processes which are due to the action of light on the dichromates of the alkalis in the presence of organic matter. For our purpose to-night we may take as a type potassium dichromate, a salt which readily parts with its oxygen to those compounds that have an avidity for it, more especially to certain carbon compounds under the influence of the ether waves.

To show that this salt is thus easily reducible by light in the presence of organic matter, I have here a piece of paper which has been brushed over with it, and exposed beneath a print. For a moment I float it on a weak solution of silver nitrate. The brilliant crimson colour of the part not exposed to light tells us that silver dichromate has been formed, but where the solar rays have acted, the colour remains unchanged. A slight modification of this process now exhibited to you is known as the chromatype, the offspring of Mr. Robert Hunt, so well known in the scientific world for his researches on light. Whilst experimenting with the chromatype process, Mr. W. Willis, the father of the gentleman I have already mentioned, discovered what is known as the aniline process. It is based on the fact that an acid in the presence of potassium dichromate strikes a blackish green or red colour when brought in contact with aniline. You will see the *modus operandi* when I say that paper is floated with potassium dichromate and a trace of phosphoric acid. Aniline is dissolved in spirits of wine, and the mixed vapours allowed to come in contact with the sensitive paper that has been exposed beneath a positive print, such as a map or plan. The impact of the light has so changed the potassium salt, that the aniline vapour causes but little coloration, whilst where the paper has been protected from it, the dark colour indicates that the dichromate is unchanged. The formation of this black colour is familiar to the manufacturers of aniline colours, being, I believe, similar in composition to the residue left after the formation of aniline purple by Mr. Perkins's method.

It should be noted that for copying engineers' tracings and drawings this process is extremely valuable, as there is no occasion to take a negative on glass before obtaining a print. All that is requisite is that the original should be fairly penetrable by light. A piece of paper prepared as indicated, a sheet of glass to place over the plan, and a box in which to place the exposed print to the aniline vapour are the only necessary plant for the reproduction of a design.

(*To be continued.*)

NOTES

THE following are the officers of the forty-sixth annual meeting of the British Association which will commence at Glasgow on Wednesday, September 6, 1876:—President-designate—Prof. Thomas Andrews, M.D., LL.D., F.R.S., Hon. F.R.S.E., in the place of Sir Robert Christison, Bart., M.D., D.C.L., F.R.S.E., who has resigned the Presidency in consequence of ill health. Vice-Presidents elect—His Grace the Duke of Argyll, K.T., F.R.S., &c., the Lord Provost of Glasgow, Sir William Stirling Maxwell, Bart., M.A., M.P., Prof. Sir William Thomson, D.C.L., F.R.S., &c., Prof. Allen Thomson, M.D., LL.D., F.R.S., &c., Prof. A. C. Ramsay, LL.D., F.R.S., &c. General Secretaries—Capt. Douglas Galton, C.B., D.C.L., F.R.S., &c., Dr. Michael Foster, F.R.S. Assistant General Secretary—George Griffith, M.A., F.C.S. General Treasurer—Prof. A. W. Williamson, Ph.D., F.R.S. Local Secretaries—Dr. W. G. Blackie, F.R.G.S., James Grahame, J. D. Marwick. Local Treasurers—Dr. Fergus, A. S. M'Clelland. The Sections are the following:—Section A: Mathematical and Physical Science. President—Prof. Sir W. Thomson, D.C.L., F.R.S. Section B: Chemical Science. President—W. H. Perkin, F.R.S. Section C: Geology. President—Prof. J. Young, M.D. Section D: Biology. President—A. Russell Wallace, F.L.S. Department of Anthropology, A. Russell Wallace, F.L.S. (President), will preside. Department of Zoology and Botany, Prof. A. Newton, F.R.S. (Vice-President), will preside. Department of Anatomy and Physiology, Dr. J. G. M'Kendrick (Vide-President), will preside. Section E: Geography. President—Capt. Evans, C.B., F.R.S., Hydrographer to the Admiralty. Section F: Economic Science and Statistics. President—Sir George Campbell, K.C.S.I., M.P., D.C.L. Section G: Mechanical Science. President—C. W. Merrifield, F.R.S. The First General Meeting will be held on Wednesday, Sept. 6, at 8 p.m. precisely, when Sir John Hawkshaw, C.E., F.R.S., will resign the chair, and Prof. Andrews, F.R.S., President Designate, will assume the Presidency, and deliver an Address. On Thursday evening, Sept. 7, at 8 p.m., there will be a *soiree*; on Friday evening, Sept. 8, at 8.30 p.m., a Discourse; on Monday evening, Sept. 11, at 8.30 p.m., a Discourse by Prof. Sir C. Wyville Thomson, F.R.S.; on Tuesday evening, Sept. 12, at 8 p.m., a *soirée;* on Wednesday, Sept. 13, the Concluding General Meeting will be held at 2.30 p.m. The Local Committee, as our readers will have seen from a previous report, have made unusual exertions to render the Glasgow meeting a success. A variety of interesting collections will be exhibited, and the excursions which have been already arranged for will doubtless form one of the most attractive, and not the least instructive, feature of the meeting.

IT is with sincere regret that we notice the announcement in *L'Explorateur* of the death of the eminent and well-known geographer, Dr. August Heinrich Petermann, at the early age of fifty-four years. He was born April 18, 1822, at Bleicherode, in Prussian Saxony. In 1839 he became a pupil of the special Academy founded at Potsdam by the geographer Berghaus, whose secretary and librarian he was for six years, as well as *collaborateur*, for he took an active part in the preparation of the great Physical Atlas of his master; the English edition, which appeared at Edinburgh in 1847, even bore his name. In 1845 he left Germany for Edinburgh, after two years' stay in which city he went to London, where he became a Fellow of the Royal Geographical Society. He wrote many valuable articles on the Progress of Geography, in the *Athenæum* and the "Encyclopædia Britannica," published the "Atlas of Physical Geography" in conjunction with the Rev. Thomas Milner, and a *Tableau* of Central Africa according to the most recent explorations. It was greatly due to his influence that the English Government entrusted to the German travellers Barth, Overweg, and Vogel, missions fruitful in results both to science and commerce. Petermann also, as our readers know, paid great attention to questions connected with the Arctic regions, though his opinions on certain points connected with Arctic geography are not likely to be confirmed. Still he did excellent service in this department by advocating the equipment of expeditions private and governmental, and by recording speedily and accurately the results from time to time obtained. In 1854, Petermann accepted the chair of geography in the University of Gotha, and in 1855 received from the University of Göttingen the degree of Ph.D. It was at this time that he undertook the direction of the great geographical establishment of Justus Perthes, of Gotha, and commenced to edit the well-known *Mittheilungen*, the monthly geographical review, whose scientific value has been long recognised. Petermann had a comprehensive idea of what is included under geographical science, and it will be difficult to supply his place either as editor of the *Mittheilungen*, or in the department of scientific geography.

MR. CROSS on Monday received a very numerous deputation from the British Medical Association, who laid before him their views with regard to the Vivisection Bill now before Parliament. These opinions were conveyed by Mr. Ernest Hart, Mr. John Simon, Dr. Wilks, senior physician of Guy's Hospital, and Sir W. Jenner, who raised his voice against a measure which would place men of science under police supervision, and would lay a ban upon them for inflicting cruelties on the lower animals when ten thousand times greater cruelties were inflicted by those who were going to pass this Bill. Such conduct would make those who passed it objects of scorn to all the scientific men in Europe. The Home Secretary, in reply, pointed out that the Bill was framed practically in accordance with the views of the Royal Commission, and that whether the Bill passed now depended entirely upon the line of conduct pursued by the medical profession.

WE are compelled by a pressure on our space to postpone the continuation of Dr. Richardson's articles till next week.

THE Kew museums have recently acquired some interesting additions to their already unique and valuable collections by the presentation, by his Royal Highness the Prince of Wales, of the botanical specimens collected during his recent visit to India. These specimens consist of a number of seeds and fruits of economic or medicinal value, as well as of condiments, drugs, gums, &c., from Southern India, and a series of named woods from Kanara. Though most of the seeds, fruits, and gums are already contained in the Kew collection, so rich is it in Indian and Colonial products, some are nevertheless absolutely new, and many of them are fresher than those which have been contained in the Museum for some years.

M. RAFFRAY, we learn from *L'Explorateur*, entrusted with a scientific mission by the French Minister of Public Instruction, proposes to explore the Sunda Islands and New Guinea, especially in relation to their natural history. He takes with him as assistant, M. Maurice Maindrow, of the Entomological Laboratory of the Paris Museum. The explorers will embark at Toulon on the 20th inst. for Singapore, in a government vessel. From Singapore, M. Raffray will proceed by Batavia to Ternate and the island of Waigiou, where the two explorers intend to sojourn till the spring of next year. Proceeding then to Dorey, they will endeavour to land on the coast of the Aropin country, on the south of Geelvincks Bay, a region which has not been visited by the Italian explorers, Beccari and D'Albertis. M. Raffray expects his expedition to last for two or three years, according to the state of his health.

SIGNOR D'ALBERTIS and party have left Somerset on their way to New Guinea; they have a steam launch with them.

MR. ERNEST GILES, the Australian explorer, was last heard of at Mount Murchison on April 10, when all was well. Mr. Giles expected to reach Beltana, South Australia, about September.

IN reference to our article on the Tasmanians last week, we learn that that people are not quite extinct, though nearly so. It appears by a letter from M. Castelnau, French Consul at Sydney, to the Geographical Society of Paris, read at its last sitting, that the only four Tasmanians living were presented at the last levée held by the Governor of Tasmania. The *Times* of last Thursday intimated the death of another last Tasmanian; but evidently we have not yet seen the end of them.

WE are glad to see that the subscription for the proposed memorial to the late Mr. Daniel Hanbury is progressing; there is already a considerable list of subscribers, but there is room for many more. The memorial, as we have already intimated, is to be a gold medal, to be awarded for high excellence in the prosecution or promotion of original research in the natural history and chemistry of drugs. Subscriptions should be sent to the hon. secretaries to the fund, 17, Bloomsbury Square, W.C.

A MEETING has been held to promote a memorial to the late Dr. Parkes, F.R.S. It is hoped that a sufficient sum of money may be collected to establish a museum and laboratory of hygiene similar to those now existing at Netley.

THE Council of the Royal School of Mines have awarded the Royal Scholarships for first-year students to T. E. Holgate and F. G. Mills; the Royal Scholarship for second-year students to A. N. Pearson; the De la Beche Medal and Prize for Mining to H. Louis; the Murchison Medal and Prize for Geology, and the Edward Forbes Medal and Prize for Natural History and Palæontology, to W. Hewitt. The following have obtained the Associateship of the school during the past session (1875–76):—W. Hewitt, C. V. Boys, J. de Goncer, F. E. Lott, H. Louis, E. F. Pittman, E. B. Pressland, J. H. Barry, A. J. Campbell, P. de Ferrari, M. H. Gray, H. Gunn, W. Howard, A. B. Kitchener, W. F. Ward.

CAPT. MOUCHEZ sent to Amsterdam and St. Paul Island, some time since, a trading-vessel, in order to collect specimens of natural history to complete the collections made during the Transit of Venus expedition. The ship was wrecked on Amsterdam Island, and the crew were drowned, the captain only being saved. He remained for two months on the island, and was rescued by a Norwegian whaler. But during his forced stay in that solitude, Capt. Herman did not lose sight of the objects of his mission, and devoted to it all the time he was not obliged to devote to obtain food and shelter. All the objects collected under such peculiar circumstances have been sent to France by the Messageries Nationales, and are expected to arrive by their next steamer.

MR. FLOYD (not Lloyd), the President of the Board of Trustees for the Lick Donation, has come to an arrangement with M. Leverrier for the better execution of the contemplated instruments for the Paris and San Francisco Observatories. The masses of glass required are to be made in Paris, at Feil's glass-works, and the object-glasses very likely by an English optician. The French refractor is to have a double set of object-glasses, the necessary money having been given to M. Leverrier by M. Bishofsheim, one of the richest Parisian bankers, the donor of the Bishofshelm transit instrument now constructing at the Paris Observatory.

THE following are the numbers of visitors to the Loan Collection of Scientific Apparatus during the week ending July 8:—Monday, 3,211; Tuesday, 2,544; Wednesday, 607; Thursday, 609; Friday, 614; Saturday, 4,354; total, 11,939.

DURING the present week twelve demonstrations of apparatus were given at the Loan Collection on Monday, eleven on Tuesday, six on Wednesday, seven to-day; five will be given to-morrow, and seven on Saturday.

AN examination will begin onTuesday, October 10, at Merton College, Oxford, for the purpose of electing to one Physical Science Postmastership, of the annual value of 80*l.*, tenable for five years from election. The subjects of examination will be Chemistry and Physics. There will be a practical examination in Chemistry. Further information may be obtained from the tutor in Physical Science.

MR. THOMAS STEVENSON writes with reference to Mr. Kinahan's letter on sand-drift in NATURE, vol. xiv., p. 191, that from a passage in his book on "The Design and Construction of Harbours," second edition, p. 243, it will be learned that the pine planted by Lord Palmerston was the *Pinus maritima major*. In his report to Lord Palmerston in 1839, Mr. R. Stevenson recommended that this pine should be procured from France. A kind of bent grass was planted on the side next the sea, so as to act as a protection to the pines during their first growth. The result of the experiment was highly successful.

A REPORT has gone the round of the papers that the Government have recently made an offer to the Council of the Zoological Society of a strip of ground on the north bank of the Regent's Canal, on condition that the Gardens should be opened free to the public on one day in each week, and that this offer has been declined. This report is quite unfounded, the strip of land referred to having been granted to the Society in 1869. Upon it is built an aviary and the lodge in connection with the Primrose Hill gate. That a still further extension of the Gardens would be to the public gain, all visitors will no doubt testify.

HERR CARL HAGENBECK, the well-known dealer in living animals at Hamburg, has just received a large collection from Upper Nubia, amongst which are four elephants, five giraffes, and several other large mammalia. They are under the care of four Hamran Arabs, whose sword-hunting feats have been so well described by Sir Samuel Baker in his work on the Nile and its tributaries. Dressed in their native costumes and mounted on four fleet dromedaries, these Arabs cause quite a sensation among the inhabitants of Hamburg, and are of themselves, independent of the animals, well worthy of a visit from all passing in that direction.

THE living gorilla, which we referred to a fortnight ago as being at Liverpool, after travelling from Hull to Hamburg, was forwarded to Berlin, in the Aquarium of which city we believe it is to be deposited.

MR. W. S. WARD, of the United States Executive, is now on a visit to England to make himself acquainted with the principles and construction of the most important public aquaria in this country with reference to the establishment of similar institutions on an extensive scale in New York, and other leading American cities.

PROF. H. G. SEELEY has been appointed to the Professorship of Geography in King's College, London.

THE Dutch Society of Sciences, Haarlem, has awarded the Boerhaave Medal to Prof. W. Hofmeister, Professor of Botany in the University of Lübingen.

WE are doing a good deal, says the *Gardeners' Chronicle*, to bring scientific literature within the reach of the people, but our French neighbours are certainly ahead of us in this respect. This conviction is forced upon us by the recent purchase of a Manual of Botany of sixty-two pages for the sum of 10 centimes—a penny in English money! This closely printed little work, by one M. Anciaux, forms one of a series of similar *brochures* which is issued by M. Ad. Rion under the title of "Les Bons Livres." It contains chapters on vegetable anatomy and physiology, on botanical geography, classification, and taxonomy, and is certainly a marvel of cheapness.

M. CEZANNE, the young and promising member of the French Chamber of Deputies for Hautes-Alpes has died of consumption. M. Cezanne, the author of a valuable work on the physical phenomena presented by waterfalls on mountains, was the founder and president of the French Alpine Club. His loss will be so much more heavily felt that the French Minister of Public Instructio n is at present making great efforts to popularise the new institution. An official circular, published almost on the very day when M. Cezanne died, recommends the heads of the several government schools in France to organise tourists' expeditions during hot days for exploring the Alps and Pyrenees. Railway companies are to issue special tickets at exceedingly moderate rates.

THE Prefect of the Seine Department has created a fund of 11,000 francs for sending to Dieppe, the seaport nearest to Paris, a number of pupils of the municipal free schools. Fifty will be selected from each school, and are to be chosen according to their merits. These tourist-laureates are to be boarded in the Dieppe College, visit surrounding places, and receive instruction in the natural curiosities or historical facts connected with the localities.

WE observe from the *Bulletin Mensuel* of the Observatory of Montsouris for May that the Administration of Paris on April 11 last decided that meteorological observations be made with special refeience to health in different parts of the city, and voted an annual grant of 12,000 francs to the Observatory, to which the inquiry has been entrusted. It has been resolved that the work shall embrace, in addition to the meteorological observations usually made, atmospheric electricity, and variations in the composition of the air (see ante, p. 156). In the meantime observations and experiments are being conducted at Montsouris with the view of arriving at simple practical methods of observing with scientific precision the different variable elements contained in the air, before extending the observations to the different quarters of the city. This number of the *Bulletin* details some very interesting results of elaborate observations made on the ozone, carbonic acid, and organic matters of the air of Paris, illustrated with figures of some of the more interesting organisms.

THE interesting address by the senior vice-president, Mr. J. Thackray Bunce, at the last annual meeting of the members of the Birmingham Midland Institute, has been printed in a separate form. Mr. Bunce contrasts the condition of Birmingham with regard to education twenty-three years ago, when the Institute was founded, with its condition now. The contrast is very great indeed, and the Institute has no doubt done much to dispel the darkness in the midst of which it started. Mr. Bunce sketches the progress of the Institute, which is now in a most flourishing condition, and rightly urges the members to renewed efforts to make it increasingly useful.

THE following additions have been made to the Royal Aquarium, Westminster, during the past week:—Picked Dogfish (*Acanthias vulgaris*); Bass (*Labrax lupus*); Streaked Gurnards (*Trigla lineata*); Sapphirine Gurnards (*Trigla hirundo*); Turbot (*Rhombus maximus*); Greater Pipefish (*Syngnathus acus*); Cornish Suckers (*Lepidogaster cornubiensis*); White Bream (*Abramis blicca*); Pope or Ruff (*Acerina vulgaris*); Zoophytes (*Alcyonium digitatum*).

THE additions to the Zoological Society's Gardens during the past week include a Great-headed Maleo (*Megacephalon maleo*), from Celebes; a Bornean Fireback Pheasant (*Euplocamus nobilis*); two Common Crowned Pigeons (*Goura coronata*), from New Guinea; two Black-backed Geese (*Sarcidiornis melanota*), from India (?); a Saddle-billed Stork (*Xenorhynchus senegalensis*), from West Africa, purchased.

SOCIETIES AND ACADEMIES

LONDON

Anthropological Institute, June 13.—Col. A. Lane Fox, F.R.S., president, in the chair.—Prof. Busk, F.R.S., described a collection of crania of natives of the New Hebrides, some of which had been sent to the president by Mrs. Goodenough, and others to the Royal College of Surgeons, by Dr. Corrie, R.N. Seven were from the Island of Mallicollo and three from that of Vanikoro. With respect to the former, he remarked that they were of special interest as being the first, so far as he was aware, that had ever been brought to Europe from that locality, and also from their extraordinary form, due to the artificial depression of the forehead, a mode of deformation not hitherto recorded among the Melanesian race of New Guinea and the South Sea. The peculiar form of the head among the Mallicollese was noticed by Captain Cook and the two Forsters on the occasion of the discovery of the Island in 1774. The skulls from Vanikoro, on the other hand, represented the normal form of the cranium in people of the same race.—A paper by Mr. Ranken on the South Sea Islanders, was read by Mr. Brabrook. The author proposed that the name Mahori should be adopted to distinguish the light races of the Pacific from the Papuans or blacks. He adduced evidence to show that the latter first occupied a considerable number of the islands, and that the lighter race arrived subsequently from the west and formed a settlement in Samoa, whence it is now well established, that they spread in all directions, and, in some instances, mingled with the Papuans. He mentioned several points in which the Mahoris differ essentially from the Malays, who, however, appear to be a cognate race.—A short account of a visit paid to New Guinea, by M. d'Albertis, was communicated by Mr. Franks.—Mr. Distant described some photographs of natives of the Nicobar Islands.

Geologists' Association, June 2.—Mr. Wm. Carruthers, F.R.S., in the chair.—Notes on the geology of Lewisham, by Mr. H. J. Johnston Travis, F.G.S. The author, after briefly alluding to that portion of the Upper Chalk which is exhibited in the excavations, proceeded to describe the Thanet Sands, and to compare this section with the neighbouring one at Charlton, where, in the Thanet Sands, casts of *Cyprina* and the vertebra of fish have recently been discovered. Referring to the well-known green-coated flints about which there has been so much controversy, he mentioned a circumstance which may be noted at the fault near St. John's Station, Lewisham. The Chalk and Thanet Sands are there faulted against each other at an angle of 40°, but the actual line of contact is now occupied by a band of flint. This shows that the chalk has been dissolved away by acidulous waters, following the fissure down to this band of flint, which has resisted further action. Portions of the same flint, where yet imbedded in the chalk, retain the usual white surface, whilst those portions projecting into the sands are green-coated. The author then instituted a close comparison between the Woolwich and Reading beds of the Lewisham and Charlton sections respectively.

Victoria (Philosophical) Institute, July 3.—A paper on the unseen universe, was read by the Rev. Dr. Irons.

BERLIN

German Chemical Society, June 12.—A. W. Hofmann, president, in the chair.—F. Sonnenschein spoke on two active principles of gelsonia sempervirens; one called gelsinic acid by Wormsley proved to be æsculine; the other, a strong but amorphous base, of which no compound seems to crystallise excepting perhaps the platinum-salt, acts like strychnine and digitaline and gives a red colour with sulphate of sesquioxide of cerium.—A. Müller reported on the ground water of Gennevilliers, the irrigation-ground of Paris, his analyses yielding less favourable results than those published in the reports of the Paris Commission. The President remarked upon the difficulty of drawing conclusions from isolated analyses, a continuation of systematical researches being absolutely necessary for the purpose.—C. J. Austen described a new dibromo-dinitro-benzol fusing at 99°. With ammonia it yields monobromo-dinitraniline. With aniline a corresponding compound originates, which yields a nitro-product capable of uniting with alkalies.—Emil Fischer and Otto Fischer have made new researches on the di-azo compounds of rosaniline, of leukaniline and of hydrocyano-rosaniline. The di-azoleukaniline yielded, with sodium, a hydrocarbon, $C_{20}H_{18}$ (corresponding to leukaniline, $C_{20}H_{15}[NH_2]_3$) fusing at 58°, distilling above 300°, and yielding, with chromic acid, a ketone, $C_{20}H_{16}O$.—Emil Fischer has combined phenyl-hydrazine, $C_6H_5N_2H_3$, with CS_2, forming $(C_6H_5N_2H_3)_2CS_2$. This body dissolves in potash, and from the solution sulphuric acid precipitates an acid, phenyl-sulpho-carbazinic acid, $C_6H_5N_2H_2.CS.SH$, while one molecule of phenyl-hydrazine is split off. This acid is easily decomposed by heat, yielding hard and colourless prisms $(C_6H_5N_2H_2)_2CS$, diphenyl-sulphocarbazid; alkali changes it into a black colouring matter, isomeric with the above and soluble in alkali with a red colour. Phenyl-hydrazine and bromide of ethyl yield a new crystalline substance,

$$C_6H_5N_2H_2(C_2H_5)\ (C_2H_5Br),$$

bromide of phenyl-diethyl-hydrazonium. With oil of bitter almonds phenyl-hydrazine forms crystals of the composition $C_6H_5.N_2H.CH.C_6H_5$. Isocyanate of ethyl and phenyl-hydrazine form a urea of the composition $C_6H_5N_2H_2 - CO - NHC_2H_5$. With acetic anhydride and with oxalic ether, phenylhydrazine yields products in which one atom of hydrogen is replaced by acid radicals. At last the higher homologue, toluyl-hydrazine, has been prepared, $C_7H_7N_2H_3$ in the manner formerly described for preparing phenylhydrazine.—H. Vohl claims priority for a test for sulphur in organic compounds lately described by Weith.—B. W. Gerland described several sulphates of tetroxyde of vanadium as well as metavanadic acid.—H. Grünzweig and R. Hofmann defended the existence of crystallised ultramarine against some doubts lately expressed by Büchner.—H. Landolt published elaborate researches on the specific deviation of the plane of polarisation of solutions, from which he concludes that indifferent solvents affect the values observed very considerably, so that concentrated solutions only can furnish results of any approach to exactness.—E. A. Grete described a volumetric method of determining sulphuret of carbon, xanthogenic acid, alkalies, and copper, depending on the formation of insoluble xanthogenate of copper.—V. Meyer and F. Spitzer have transformed the product of the action of PCl_5 on camphor; $C_{10}H_{15}Cl$ into crystallised ethyl-terpene, $C_{10}H_{15}—C_2H_5$.

PARIS

Academy of Sciences, June 26.—Vice-Admiral Paris in the chair.—The following papers were read:—Geometric points and envelope curves satisfying the conditions of constant product of two variable segments; generalisation of some theorems expressed in radii vectors, by M. Chasles.—Note on the development of cos. mx and sin. mx, according to powers of sin. x, by M. Yvon Villarceau.—On the maximum of possible repulsive force of the solar rays, by M. Hirn. Taking (from experiment) 0·293833 cal. to represent the heating per square metre on the earth's surface, the two pressures 0·0004157 gr. and 0·0008314 gr. are necessarily the greatest possible for a perfectly absorbing and a perfectly reflecting surface; on any hypothesis attributing phenomena of light and heat to movements of ponderable matter. If, then, a radiometric or other experiment give, for solar repulsion, a value superior to those now specified, we must conclude against a direct impulsion by light, and the idea of mass, density, &c., in light. Now Mr. Crookes has estimated the apparent repulsion at 1 gr. per sq. metre, or more than a thousand times superior to the above maximum for reflecting bodies.—New experimental considerations on Mr. Crookes's radiometer, by M. Ledieu. This refers chiefly to experiments by M. Bertin, who has a paper on the subject in the June number of *Annales de Chimie et de Physique*.—Properties common to canals, rivers, and water-pipes with uniform *régime* (first part), by M. Boileau.—M. de Saporta was elected correspondent for the Section of Botany, in room of the late M. Thuret; MM. Godron and Duval Jouve were the other candidates.—Report on a memoir of M. Felix Lucas, entitled "Calorific Vibrations of Homogeneous Bodies." The chief object proposed is to deduce from thermodynamics the principles of conductivity of heat in homogeneous bodies, enunciated by Fourier, considering heat as the result of molecular vibrations.—Exposition of a new method for resolution of numerical equations of all degrees (third part), by M. Lalanne.—On a differential radiometer, by M. de Fonvielle.—Process for the manufacture of soda from wrack by endosmotic steeping in lye, by M. Herland.—On the catastrophe of Grand Sable (district of Salazie), Isle of Réunion, by M. Vinson. The renewal of subterranean commotions in May points to volcanic action as the cause of the catastrophe.—Elements and ephemerides of planet 153, Atala, by M. Bossert.—On linear differential equations of the second order, by M. Fuchs.—On the contact of surfaces of an implex with an algebraic surface, by M. Fouret.—On some experiments made with Crookes's balance, by M. Salet.—On some derivatives of normal pyrotartaric acid, by M. Reboul.—Volumetric determination of formic acid, by MM. Portes and Ruyssen.—On the arragonite observed on the surface of a meteorite, by Mr. J. Lawrence Smith. It was in the form of white incrustation, on meteoric masses found in the desert of Mexico. The matter seems to have been incrusted on the iron after fall of the latter. The mass lay in a valley between high mountains of calcareous formation, and would often be washed and covered with water during heavy rains.—On the combinations of carbons found in meteorites, by Mr. J. Lawrence Smith.—On the employment of chloride of calcium in the watering of streets, promenades, and public gardens, by M. Houzeau. At Rouen, this waste product of the manufactories of pyroligneous acid has been utilised in the way referred to, and with the best results. It impregnates the soil with hygrometric matter which makes durable for a week the moisture imparted. It is healthy, always containing a good deal of chloride of iron and tarry matters; and compared with water, it realises an economy of about thirty per cent. Further, it improves streets and roads by covering them with a sort of patina or hard superficial crust, resisting both desiccation and disaggregation.—Study on the formation and growth of some galls, by M. Prillieux.—Experimental researches on the action of aniline, introduced into the blood, and into the stomach, by MM. Feltz and Ritter. This inquiry was suggested by an analysis of wines sold at Nancy, which showed that fuchsine is largely employed to heighten the colour of wine, and to mark the addition of water. Its injurious action is shown on man and on dogs.—Researches on *Cypressus pyramidalis*, by M. Hartsen.—Process of registration and reproduction of colours, of forms, and of movements, by M. Cros.

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