THURSDAY, JULY 24, 1873

THE ENDOWMENT OF RESEARCH

III.

IT is probable that though the main proposition here advocated, that original workers in the Sciences deserve, on public grounds, a recognised position and pecuniary support, will not meet with much opposition from any quarter, the means by which this desirable end is chiefly proposed to be attained will not be acquiesced in with equal readiness. Englishmen have been so long accustomed to regard their Universities as merely high schools of liberal education, and the independent growth of modern Science in this country has been so rapid and vigorous, that to many worthy persons it will seem nothing better than a Utopian dream to attempt to re-establish the genuine pursuit of scientific knowledge as an end in itself at our ancient seats of learning. Those, however, who know something about the system of a German University, and are acquainted with the former history of Oxford and Cambridge, will not consider the attempt to be of such a hopeless character. The present time also affords an admirable opportunity of urging upon public attention a fundamental reform in the direction above indicated. The Universities have of late years been losing many of the peculiarities which they once so warmly cherished, and at the same time their revenues have been increasing to an enormous extent. The same Government which passed a Bill to pronounce them national and not ecclesiastical establishments, has also issued a Royal Commission to inquire into the extent and distribution of their endowments. Now that the nation has established its claim to remodel the Universities solely with a view to the public interest, and is taking stock, as it were, of the property which has fallen under its disposal, the very occasion has come when scientific men should formulate their demands on behalf of those public interests which the practical politician is likely to neglect. It must, moreover, be borne in mind that the impulse in this direction must come from without, for although it will not be difficult to prove that no less benefit would accrue to the Universities themselves than to the cause of Science from the scheme herein advocated, yet the most advanced academical reformers do not seem to have got beyond the notion of extending and perfecting the professorial functions.

We propose then to show at some length that the Endowment of Research should naturally take a leading place in the reconstruction of the University system which appears to be close at hand, and to indicate in what manner such endowment may most readily be carried into effect. For this purpose it will not be necessary to reveal the many minor abuses which the reforms of twenty years ago failed to remove, but it will be necessary to adopt the more difficult task of sketching out the true conception of what a University should be, and of considering the comparative claims to endowment of teaching and of study.

Without any attempt to prejudge the matter, or to awake the dormant controversy as to the original meaning of the word, it may be safely laid down that a University is an institution composed of the most competent teachers and the most promising students, on which the State, in consideration of its diligently promoting the higher education, confers a lofty position and important privileges. That such an institution should enjoy large endowments is evidently not of the essence of its nature, for the Universities of old were uniformly most famous when they were least rich : it is, however, absolutely necessary for the healthy activity of its functions that it should not be so encumbered with wealth as to be disposed to lavish sinecures upon its favourite members. It is evident, also, that it will forfeit its trust as the home of Culture and of Science, and will degenerate into a lyceum for the adult sons of the well-to-do classes, unless it continually maintains itself on a level with the ever-advancing boundaries of human knowledge, and that just so far as it lags behind it will exercise a mischievous influence on the simple public, who continue to rely upon its treacherous authority. Further, it is of great importance that the original institution, on which alone the rank was bestowed, and which alone deserves the high privileges, should not be absorbed by the growth of a number of parasitic institutions, whose interests and aims may be not identical with or even analogous to its own. But above all other symptoms of decay that a University can show, is to be placed its rejection of the highest branches of knowledge which the progressive activity of human thought is ever comprehending within the domain of Science. To this danger the most ancient and the most wealthy Universities are naturally the most exposed. Their antiquity leads them to regard the erudition which they have inherited through many centuries as synonymous with real knowledge, and their wealth is used (where it is not misused) to afford encouragement only to those kinds of learning which their traditions have sanctified. In brief, a false University would be an institution which is content merely to satisfy the demand for teaching which custom approves, and which neglects as a hindrance to its tuitional duties the higher knowledge which it was originally founded to promote.

To recall such a University to the true conception of its duties no mere mechanical changes with reference to its internal organisation will be sufficient. It has lost the spirit of disinterested study which first gave it life, and the atmosphere of intellectual activity under which alone it can flourish. It requires that new vigour should be poured into it, and a new order of workers established within its limits. It requires to be relieved of the burden of part of its wealth, in order that it may receive back again greater advantages than it can give. By endowing research in all those departments of knowledge to which the scientific method has been already extended, and by reserving the power of similar endowment for those other departments of knowledge which will, no doubt, before long be similarly reduced to order and law, Oxford and Cambridge may yet regain the proud position which was once theirs, as " bodies of learned men devoting their lives to the cultivation of Science, and the direction of academical teaching."

To point out more particularly the source from which the endowments of research should be drawn, it will be necessary to revive the original distinction between the Universities and the Colleges of which they may be said to be now composed. To raise the University proper at the expense of the individual Colleges, has long been a favourite project with academical reformers, yet no one yet appears to propose any more radical scheme than an augmentation in the number of University Professors, and a diminution in the influence of College tutors. Against any such scheme, however carefully elaborated, there arise the old objections that an improvement in the mechanism of teaching is not the main reform of which the Universities stand in need, and that the endowment of more teachers will not remedy the crying evil which has so lamentably hindered the advance of purely scientific investigation in this country. The circumstance that the Universities are comparatively poor, while many of the Colleges are very rich, and an awakening conviction that the Colleges exist for the Universities, and not the Universities for the Colleges, would seem to have suggested the above proposal: whereas the smallest historical knowledge of the objects with which the Colleges were originally founded, would reveal the curious circumstance that the first benefactors had a truer conception of the manner in which knowledge ought to be endowed, than have the modern recipients of their benefits. Nothing can be more certain, though nothing is more frequently denied by those whose duty it is to be better informed, than that the majority of the great Colleges were not founded to be boarding schools for teachers and students, subordinate to the University curriculum, but to be homes at the central seats of learning, where life-long students might be supported while acquiring all the knowledge of the age, and augmenting the store of learning which they had there inherited. According to the old Oxford tradition, she could boast in the fifteenth century before there was ever a wealthy College that she had thousands of students living in hundreds of private halls. Many of the early Colleges did not include at all in their arrangements those whom we should now call Undergraduates, some of those which did do so allowed for a teaching staff independent of the body of Fellows, and it is within modern memory that many Colleges have had more Fellows than Undergraduates on their books. All these facts, and there are many similar ones, go to prove decisively that, in the language of Mr. Mark Pattison, "the Colleges were in their origin endowments not for the elements of a general liberal education, but for the prolonged study of special and professional faculties by men of riper age: and that so far from it being the intention of a Fellowship to support its holder as a teacher, it was rather its purpose to relieve him from the drudgery of teaching for a maintenance, and to set him free to give his whole time to the studies and exercises of his faculty." The wish of the Founders, that is to say, when harmonised with the wants of the present age, and interpreted into the language of modern science, was to afford the means of living and the instruments of work to those who pledge their lives to the unremunerative task of scientific investigation, and original research.

Surely then, if the influential and wealthy members of our Universities have at heart the real interest of their Institutions, or retain any veneration for the express intentions of their benefactors, they should not be the last to join in the patriotic object of raising the scientific reputation of this country, and increasing in manifold unseen ways the elements of our national greatness. C.

ALEXANDER VON HUMBOLDT

Life of Alexander von Humboldt, compiled by F. Löwenberg, Robert Ave-Lallemant, and Alfred Dove. Edited by Professor Karl Bruhns. Translated by J. and C. Lassell. 2 vols. (London: Longmans, 1873.)

WE cordially welcome this admirable translation of the only biography of A. v. Humboldt that has yet appeared possessing any authentic or scientific value. Humboldt's own definitely expressed aversion to biographical notices, whether in regard to himself or his friends, the fact of his having outlived nearly all his blood-relations and the greater number of the contemporaries of his earlier working years, together with other causes, combined, for a time, to retard the appearance of a trustworthy life of this remarkable man.

The want of such a work was, however, strongly felt, and at the Congress of Astronomers convened at Vienna on Sept. 14, 1869, in honour of the centenary of A. v. Humboldt's birth, Dr. Karl Bruhns, Director of the Observatory at Leipzig, laid before the meeting the prospectus of a Scientific Biography of their great countryman, for which he demanded their active co-operation. The result of this appeal and of his own editorial labours, was the appearance last year, in Germany, of the work of which the present excellent translation gives us two volumes. The third volume of the original, which consists of critical *résumés* by various writers of the state of different branches of the physical and natural sciences, with notices of Humboldt's contributions to each, has been omitted by the translators, on the ground that the facts were treated of with sufficient minuteness in the general biography. On less good grounds, as it appears to us, they have also omitted from the last section of the second volume, the comprehensive catalogue of his published writings, of which upwards of 600 are enumerated in this list.

Humboldt's life, like the work devoted to its exposition, resolves itself into two distinct parts or periods. The first of these is characterised by intense and incessant activity in the acquisition of knowledge, the second by the quiet mature elaboration of the results of earlier study and observation ending in a thirty years' term of comparative stagnation under the depressing influences of honorary court servitude.

Alexander v. Humboldt was born at Berlin, in 1769, and together with his elder brother Wilhelm, was prepared under excellent private tutors for his university career at Frankfort, A. O., where he matriculated in 1787. He had already then shown that craving for the accumulation of facts which he retained to his latest years, and from his boyhood had been distinguished for his love of observing and collecting natural history objects, and his inaptitude for acquiring the exact classical scholarship for which his brother evinced such marked ability. Botany was Alexander's first love, and the earliest of his voluminous literary productions was a treatise in French which appeared anonymously at Berlin, in 1789, in the *Gazette Literaire*, entitled, "Sur le Bohon-Upas, par un jeune Gentilhomme de Berlin." This composition was, however, rapidly followed by papers on the flora and geology of the Rhine lands, and other districts which he visited in the course of the few short intervals of cessation from study which mark his university career, and by numerous essays on mathematical, physical, medical, physiological, and even *classical* subjects; for by dint of hard work he had, during his attendance on Heyne's Greek lectures at Göttingen, so thoroughly mastered his earlier deficiencies that he won from that learned professor the distinction of being commended as "a better philologer than any who had left the class for many years." The University of Göttingen to which the brothers had migrated in 1789, and which had already begun to attract students from all parts, as the best school of pure and practical science, afforded the advantages that Frankfort had failed to give them; and here, under Lichtenberg, Gmelin, Osiander and Blumenbach, Alexander laid the solid foundations of those varied acquisitions in the departments of physical and natural science, which justly entitle him to rank as the greatest pioneer in the cause of modern research. Others may have very far surpassed him in one or more domains of inquiry, but no one man in his time has done more than A. v. Humboldt in accumulating materials, testing evidence, repeating experiments and carrying on observations in almost every section of knowledge by which the labours of subsequent inquirers have been lightened. To his latest years, Humboldt did justice to the benefit which he had derived from Göttingen, which he had entered with "the *unusual* advantages," as we are told by his former tutor, the mathematician, Fischer, "of having received an excellent education, and of possessing a proficiency in mathematics which might have secured him distinction had he been able to devote his attention exclusively, or even partially, to that science." Political economy had, however, already become the principal object of his studies, in consequence of his having made choice of the public bureaucratic service of the State as his future career. In 1790 his experiences of foreign travel were begun during a visit to England, made in company with George Forster, the friend whose adventurous voyages and various books of travel had given Humboldt from his earliest boyhood the keenest desire to visit tropical lands, and see with his own eyes the exotic floras and faunas which he described in such glowing colours. The journal which records the experiences of this tour gives evidence of the astonishing range of information possessed at this time by Humboldt, who, true to his destined vocation, set himself steadily to work to observe everything bearing upon the politico-economical aspects of English life, although his scientific tastes are perpetually cropping out in remarks upon the geological features of the country. To this first experience of English life and to the influence exerted on his future pursuits by intercourse with George Forster and his friends, Humboldt long looked back with grateful pleasure. Soon after his return to Germany he went to Hamburg for the sake of attending lectures on currency, book-keeping, and other practical branches of commercial knowledge at the Academy of Commerce, which, under the management of its chief professors, the jurists Busch and Ebeling, was attracting the attendance of young men preparing for a political career.

From Hamburg A. von Humboldt passed to the Freiberg School of Mines, where, under Werner, he prepared himself for the special duties of the post of Assessor and Superintendent of Mines to which he had for some time aspired, and which for a time after its attainment seemed to him the realisation of all his wishes. No *employé* had ever been more zealous, and all his reports were expansive geognostic treatises on the districts he was called upon to survey. The charm of novelty soon, however, wore off, and then the complete stagnation, the systematised red-tapeism, and the absolute dearth of intellectual or rational interests belonging to Prussian Public Service in those times, proved as unbearable to Alexander as they had already become to his elder brother, and both ceased their official connection with the State at the first moment they could do so. Society in Berlin was equally distasteful to them on account of the prejudice and etiquette by which it was regulated, and after a prolonged and happy sojourn at Jena and Weimar, the then active centres of the true intellectual, æsthetical, and literary life of Germany, Alexander proceeded, on the death of his mother in 1796, to carry out his long-cherished dream of visiting far distant tropical regions. To prepare himself thoroughly for this purpose had been for years the object of his studies, and few men were ever better fitted than himself for the end he had in view. To his other qualifications for becoming an efficient scientific traveller, he added the possession of an almost unparalleled range of knowledge, including an intimate acquaintance with the character, history, and resources of his own country, unbounded love of nature, unflinching perseverance, nearly inexhaustible capacity for work, wide sympathies with his fellow-men, a ready gift of pleasing and being pleased, and an ardent, almost ideal enthusiasm, which found expression in his own favourite motto, "Der Mensch muss das Grosse und Gute wollen" (Man must strive after the Great and the Good).

After oft repeated disappointments and many shattered plans, A. v. Humboldt, in spite of the numerous obstacles arising from the disturbed political condition of Europe at the time, achieved his long-cherished project of visiting the New World, and in the summer of 1799 he landed in South America. In the following year he and his companion and friend, Bonpland, plunged into the steaming forests of the Orinoco, and bidding farewell to civilisation, threw themselves into the work before them. An enormous mass of specimens collected from every kingdom of nature preceded A. v. H.'s return to Europe in 1804, and gave the scientific world at home a faint foreshadowing of the gigantic dimensions of the labours accomplished by that indefatigable explorer. Paris was at that time the only spot where a work such as he meditated could be produced, and accordingly thither he repaired, and after securing the co-operation of Cuvier, Latreille, and many of the other leaders of science, proceeded to elaborate his materials. The result of these combined labours was the appearance, in 1807, of the magnificent work known as "Voyage aux Régions equinoxiales du Nouveau Continent fait dans les années 1799 à 1804, par A. de Humboldt et A. Boupland." The cost of bringing out this colossal *résumé* of his American observations involved Humboldt in pecuniary embarrassments, from which he can scarcely be said ever to have freed himself, and which had moreover the disastrous results of forcing him to accept help at a subsequent period from the King of Prussia; and thus incur an obligation which he found could only be redeemed by devoting himself to the perpetual restraints of a court-life. The times were inauspicious to great literary or scientific undertakings, and hence we cannot wonder that the "Voyages aux Rég. Equinox." should have proved pecuniarily a failure. At that period of political inquietude and financial depression in every part of the Continent, 290*l.* was a very large sum to pay for any work, although, perhaps, not in this case commensurate with the outlay, when we bear in mind that the printing and paper alone had cost 840,000 francs, and that it contained more than 1,400 beautifully coloured illustrations, and consisted of twenty folio and ten quarto volumes, which were, moreover, divided into five distinct parts, complete in themselves, and to be purchased separately. Humboldt had started on his travels with property realising about 500*l.* a year, but the cost of his expedition and of publishing, added to the war requisitions by which the value of his private property had been materially injured, left him for a time on the brink of absolute poverty. These temporary anxieties had, however, little effect on his mental energies; and after the completion of his American voyage, he continued for twenty years to reside at Paris, where his life was passed in one incessant whirl of intellectual labour, scientific discussions and social intercourse. Thus at one time he would spend months together working with Guy Lussac in the laboratory of the Ecole Polytechnique, at another keeping watch day and night at the Observatory, while he was always preparing fresh papers to read before the Institute and other scientific associations, and carrying one or more works contemporaneously through the press. Besides these labours he had early entered upon the study of the Oriental languages with the view of undertaking a scientific expedition into Asia for the purpose of collecting materials for a comparison between the eastern and the western continents. This scheme after many abortive attempts was finally carried out in 1829, when by the munificent aid of the Prussian King and the truly imperial liberality of the Emperor Nicholas, Humboldt found himself able to penetrate at the head of a carefully equipped scientific staff into the Steppes and the remotest parts of Asiatic Russia. The cost of his journey from Berlin to St. Petersburg and back was defrayed by the Prussian Government, whilst a sum of 20,000 roubles was placed at his disposal for his personal expenses by the Emperor, on his arrival in Russia. The results of this great expedition are of very inferior value to those yielded by the American voyages of earlier years.

This comparative failure may be in part referred to the short time—only nine months—devoted to the purpose, during which the veteran traveller passed over nearly 12,000 miles of the Russian territory. The journey was moreover a princely procession rather than a scientific expedition. Wherever he went crowds of local dignitaries, soldiers and police officers surrounded him. Governors of provinces, commandants of fortresses, superintendents of mines welcomed him with speeches and reports whenever he appeared within the limits of their jurisdiction. Generals supplied him with minutes of the strength of the various brigades under their command, while officers and men in dress uniforms saluted him in military fashion as he passed their posts. At Miask these military marks of respect culminated in the presentation, by the directors of the mines, of a grand cavalry sabre, in honour of his sixtieth birthday. The learned bodies were equally on the alert to show him respect. At Kasan, after incessant feasting and speechifying, the Professors escorted him to his lodgings at 1 A.M. in gala costume, and reappeared in the same attire at 4.30 A.M. to speed his departure to the next station. After enduring a host of similarly oppressive social distinctions, which included at Jekatharinenburg the obligation of leading off a ball in a stately quadrille, and on the Steppes at Orenburg the necessity of presiding over a Kirghis festival at which the men ran races and the Tartar Sultanas warbled sweet songs in his praise, Humboldt had to encounter at Moscow one of the most absurd ordeals to which the fame of his greatness exposed him. On his arrival he was invited to attend a special meeting of the Physical Society, and duly made his appearance at the University, holding in his hand the paper he had prepared to read to the learned members "On the deviation of the Magnet in the Ural." The court, passages, stairs, and halls were crowded with great people, gorgeous with stars and orders, amongst whom stood conspicuous the Professors, wearing long swords girded to their sides, and three-cornered hats tucked under their arms. Speeches of welcome in German, French, and Latin from the Governor-General, the chief clergy, and the deans of the various faculties had to be heard and replied to, and instead of engaging in scientific discussion on magnetic aberration, Humboldt had to listen to a Russian poem in which he was hailed as Prometheus, and to examine a plait of Peter the Great's hair, which was solemnly presented for inspection by the Rector of the University. The "Asie Centrale" and a few very fragmentary works were the immediate results of this most oppressively-honoured expedition, from which, satiated with ceremonials and respect, Humboldt had, in the winter of the same year, 1829, returned to Berlin, which thenceforth to the end of his long life in 1859 became his home.

To fully understand the sacrifices to expediency and to the obligations of gratitude made by Humboldt in accepting the position of what may best be termed an honorary *attache* to his own Court and Sovereign, one requires to read with attention the pictures drawn in these volumes of society in the Prussian capital during the earlier half of this century. But it would scarcely, perhaps, be possible in the present changed position of Prussia to realise the deadness and stagnation that then hovered over every phase of social life. Humboldt, who from the year 1809, when he accompanied the Prince of Prussia to Paris in the capacity of friendly and official adviser, had repeatedly been entrusted with diplomatic and other honourable missions by the Sovereign, entertained a warm regard for the different members of the Royal family, while his relations to the late King Frederick William IV. were those of a long-tried, affectionate friendship. These feelings undoubtedly softened the hardships of the courtly bondage in which he spent his last thirty years, but though they may have gilded the bitter pill, they scarcely made it palatable; and Humboldt's voluminous correspondence at Berlin bears ample testimony to the struggle which was going on within himself to keep in check his contempt for Courts, his natural proclivity to sarcasm, and his impatience of routine constraints. With the view of trying to leaven the dead mass around him, and to awaken some interests apart from everyday life, he gave popular lectures to the upper classes, which ultimately resolved themselves into that very attractive—if slightly prolix—*résumé* of his knowledge, observations, and speculations, which we know under the title of "The Cosmos." And while he laboured assiduously to exercise his influence for the endowment of scientific institutions of all kinds, and the encouragement of learning and learned men, not only in Germany, but in every country where his reputation made his recommendations authoritative, he set his scientific brethren a striking example of patient, persevering industry in trying to keep pace with the rapid progress of inquiry, and of humble readiness in renouncing old opinions whenever he found that they had been superseded by more correct views.

To the English reader interested in tracing the progress of scientific and social development in Germany and other parts of the Continent during the close of the last and the first half of the present century, the "Life of A. von Humboldt, by Bruhns and Lassell," cannot fail to prove at once instructive and suggestive.

STIRLING'S "PHILOSOPHY OF LAW"

Lectures on the Philosophy of Law. Together with Whewell and Hegel, and Hegel and Mr. W. R. Smith, a Vindication in a Physico-Mathematical regard. By James Hutchinson Stirling, F.R.C.S. and LL.D. Edin. (London: Longmans, 1873.)

THIS volume contains certain lectures on the Philosophy of Law, delivered to the Juridical Society of Edinburgh in November 1871, together with a discussion of Hegel's opinions concerning gravitation and the differential calculus. Of the lectures we may say, that if the members of the Juridical Society understood them, they must be much more clever than we profess to be. The first lecture is an introduction to philosophy in general, that is, the philosophy of Hegel. It expounds the doctrine of the *notion*, and discloses in the briefest possible space the "secret of Hegel." Mr. Stirling has already written a work of two substantial octavo volumes, entitled "The Secret of Hegel." A friend of the author being found reading it, and being asked what he thought of the "Secret," answered, "Why, I think the author has kept it." If then the secret cannot be disclosed in two volumes, how did Mr. Stirling hope to make it plain in a lecture occupying only fifteen printed pages? In reading this lecture we did not enjoy for a single moment the feeling of solid ground. We had an impression that we understood what logic was until we met with the following passage:—

"Hegel's system, as is now pretty well known, is contained in three great spheres—the Science of Logic, the Philosohpy of Nature, and the Philosophy of Spirit. Here we see at once that what we have before us is the Notion. Logic is the universal; Nature is the particular; and Spirit is the singular. Logic, having developed into full *Idea*, passes into the particular as the particular, into externalisation as externalisation, in Nature; and Nature, rising and collecting itself, through sphere after sphere, from externality itself in the form of space, up to *natural* internality in the form of organic life, passes into the Soul, which is the first form of Spirit. The instrument of the evolution all along, we are to understand, is the *Notion*, in its three *Moments*" (p. 15).

So long as Hegel and his satellite Stirling kept to the *notion* and its three moments in the abstract, they are impregnable and unapproachable, like those fishes which are said to make the water muddy all around when an enemy is near. It was when Hegel ventured out of his own mists that he showed his extreme fallibility. Having applied his "notion" to the theory of gravitation, he discovered that Newton was wrong in asserting the curve of motion of a gravitating particle to be any conic section.

"Hegel's idea certainly is that the ellipse is a necessary outcome of *the notion* on this the stage of free motion according to the relations of time and space as moments. If planets do move in circles, or even if planets might move in circles, Hegel would here have to confess a failure. It would be his metaphysic that in that event would suffer, however, rather than his knowledge of physics. In the meantime, the fact is that the curve of movement still remains an ellipse, and Hegel so far is not in error" (p. 99).

Now, inasmuch as the circle is only the extreme case of an ellipse possessing no eccentricity, it is just as likely that a planet would move in a circle as in any one definite ellipse; but astronomers could never discriminate with certainty between a circle and an ellipse of very slight eccentricity; and so far Hegel escapes absolute conflict with fact. Unfortunately, however, it is known that certain comets move in hyperbolic paths (see Chambers' "Handbook of Descriptive and Practical Astronomy," p. 203, 1861), and as the ellipse is the *necessary outcome* of Hegel's notion, we think he must suffer both in his metaphysics and his physics.

In Mr. Stirling's controversy with Mr. W. R. Smith concerning Hegel's notion of the differential calculus, we also think that Hegel suffers. The critical statement of the necessary outcome of Hegel's philosophy is as follows (p. 113):—

"The limit of a qualitative relation is that in which it both is and is not, or, more accurately, that in which the quantum has disappeared, and there remains the relation only as qualitative relation of quantity."

Now the very essence of the differential calculus consists in the fact that quantities, although indefinitely decreasing, or vanishing, as the expression is, preserve all their quantitative relations. Mr. Stirling says (p. 114):—

"What is called infinitely *little* is only qualitative, and is neither little nor great, nor quantitative at all."

On the contrary, the very principle of the calculus is that infinitely little magnitudes are still comparatively little or great, and preserve all their quantitative relations, so that differential co-efficients, or the ratios of such infinitesimals, are definite numbers.

As Hegel's "notion" here again comes into conflict with all that is best established in abstract mathematical science, we must decline to follow Mr. Stirling through his generally incomprehensible vindications of Hegel. When Hegel's philosophy breaks down so sadly at the slightest touch of fact, can we waste our own time, or that of our readers, with endeavouring to attach a meaning to pages of this kind of *philosophy?*—

"The outside *Aarshauung* being viewed as the *con-*

tinuum, the *regula* may be regarded as the *discretum*; but it were a false conception, that of the continuum as made up of an infinite number of *discreta* (regulæ) infinitely small. Such continuum is but the *exemplification*, *proexumbration*, *externalisation* of the regula," &c. (p. 116.) W. S. J.

OUR BOOK SHELF

Junior Course of Practical Chemistry. By H. E. Roscoe, B.A., F.R.S., &c., and Francis Jones. (London: Macmillan and Co.)

THE work now before us represents the course of practical chemistry carried out by students entering the Owens College Laboratory. It commences with the preparation of the ordinary gases, which are, if anything, too shortly described; and then proceeds to the subject of blowpipe analysis and the preliminary examination of simple substances, and afterwards to the reactions of metals, &c., and qualitative analysis itself. The book does not deal in any way with theoretical chemistry, but the student is referred to Prof. Roscoe's "Lessons in Elementary Chemistry" for any explanation of this kind. This, of course, necessitates a considerable amount of extra reading, more particularly in the earlier portions of the book. The course of qualitative analysis, and so forth, through which the student has to pass, seems to be very similar to that which is now in use in most of our laboratories.

The various experiments, reactions, &c., are as a rule clearly described, but we notice one or two which would undoubtedly be better for some slight alteration and addition; thus, on p. 59, we find the following given as a method of testing for Baric sulphate:—"Barium sulphate fused with $Na_2 Co_3$ and HCl added, yields $BaCl_2$ (flame coloration green), precipitated by $SrSo_4$ solution." Now we think that there is a strong probability that a student proceeding as directed in the book would again form the original Baric sulphate, and he would certainly not obtain any precipitate with Strontic sulphate solution, and probably would not obtain the green colouration. The same method is also given for the detection of Strontic sulphate. Another instance in which we think that clearness has perhaps been sacrificed to brevity is in Table A, but with a teacher at hand there need be little fear but that the student will easily overcome such minor difficulties. In fact the book is written with the desire to aid the teacher in his work, and not to dispense with his services altogether; in the former we think the book is very successful, but we do not believe that a student could well work through the book without such aid.

A number of well-selected questions is appended at the end of the book. They seem well adapted to test the student's knowledge of his work, and will in this way considerably lighten the teacher's labours.

We must also not forget to mention in terms of high praise the three short rules for the guidance of students, which are appended by Prof. Roscoe at the end of the preface, and we hope that every student who works by this volume will lay them to heart, and practise them with all sincerity.

The title of this book, "Junior Course," &c. scarcely conveyed to our minds exactly what we have found the book to be. It is more advanced than we anticipated, and yet, perhaps, it is not a thoroughly complete manual of qualitative analysis, although nearly so; but we must still thank the authors for a clear and succinct little manual, which will no doubt prove very useful to both teachers and students.

The Philosophy of Evolution. An Actonian Prize Essay. By B. T. Lowne. (Van Voorst.)

THE author of this short sketch of the theory of evolution is already favourably known by his treatise on the anatomy of the Blow-fly, a strictly anatomical work, abounding in detail, and not going beyond the region of fact. We can scarcely congratulate him, however, on the success of his theoretical attempts, as many of them are but weakly based, and others lead to very unreasonable deductions.

In the discussion of the variations which, according to the Darwinian hypothesis, give rise to the development of new forms, Mr. Lowne terms the greater tendency possessed, as he states, by some animals, to vary, plasticity, and the less tendency among others, rigidity; and he considers that these characters, plasticity and rigidity, are capable of being transmitted from generation to generation like other hereditary characters. At first sight this may appear highly probable, but to any one who considers the subject, it will be evident that it is based on an erroneous conception of the nature of that so frequently employed, but still ill-understood expression, variation. For the assumption of the existence of a struggle, together with the concomitant "Survival of the Fittest," means that the possible variation in a particular advantageous direction is tending to a limit, or in other words, that the continuation of the struggle is correlated with a tendency to the reduction to a minimum of the power to vary, for directly any advantageous tendency is developed, it is immediately run upon and exhausted.

The chapter on nutrition contains more than one proposition open to criticism; the function is incorrectly defined, and the ultimate destination of foods which is said to be in three directions, namely of nutrition, energy, and excretion, is very misleading. But it is in the explanation of the formation of the antlers of the Deer that a theory is given, which is not exceeded in rashness and lack of foundation by any lately put before the scientific world; the following is a sketch of the argument:—Herbivorous animals, specially ruminants, take into their system a superabundance of salines, the excess of which the kidney is not sufficiently developed to eliminate; consequently, on an axiom laid down by Sir J. Paget (who would be one of the first to object to this abuse of his words) that every part of the body may be looked upon as an excretion to every other part in highly complex organisms, this excess is got rid of by the development of the antlers, which contain a large amount of calcium salt, and are shed every year: the females have no horns, because in them the excess of salts is employed in the formation of the bones of their progeny. Such being the case, we do not know how Mr. Lowne explains the elimination of the salts in the Cavicorn ruminants, and their non-development in the males of all other herbivorous animals.

We cannot agree with our author in his attempt to derive all the higher forms of animal life from aquatic ancestors. Upon this supposition he attempts to prove that the Penguins and Auks belong to the early type of birds, and that they show marked reptilian affinities, but as they do nothing of the kind, his endeavour is worse than feeble. We are quite unable to see how the view "that the aquatic penguins belong to an early type of birds has been materially strengthened of late by Professor Marsh's remarkable discovery of an Ichthyornid type of birds in the Cretaceous shales of Kansas."

The elaborate markings of the flint shields of the Radiolaria and Diatomaceæ being somewhat like the curves which are produced on the surface of a vibrating metal plate, on which sand has been scattered, we are told that "nothing appears more probable than that similar points of vibration and rest exist upon the surface of these shield-forming organisms, and that the excreted silica which forms their shields comes to rest at the nodal points." This explanation is bold, to say the least, considering the very different circumstances under which the results are produced. Mr. Lowne should try to produce the curves or the vibrating metal plate under water.

Natural Theology being the subject for which this essay obtained a prize, some of its dogmas are shortly discussed. In answer to the statement that the hypothesis of a soul is objectionable "on the ground that it is not known to exist in nature, and cannot, therefore, be known to be capable of producing the effects ascribed to it," it is shown "that when the effects are such that they cannot be produced by any known cause, they must result from an unknown cause or causes capable of producing the effects ascribed to them." However, in an earlier part of the work it is remarked that Mr. Darwin has done injustice to his theory by comparing it to the undulatory theory of light, because the latter assumes the existence of an ether, which is an unknown agent. It is therefore to be inferred that the Darwinian hypothesis is on a better basis than that of the existence of a soul, from the perusal of an Actonian Prize essay!

Light Science for Leisure Hours. Second Series. Familiar Essays on Scientific Subjects, Natural Phenomena, &c., with a Sketch of the Life of Mary Somerville. By Richard A. Proctor, B.A. Camb., Honorary Secretary of the Royal Astronomical Society, author of "The Sun," "Other Worlds," "Saturn," "Essays on Astronomy," "The Orbs around Us," &c. (Longmans, 1873.)

THE essays in this volume have already appeared in various journals. Besides the life of Mrs. Somerville, the volume contains the following:—"The coming Transit of Venus, and British Preparations for observing it;" "The Ever-widening World of the Stars;" "Movements in the Star-depths;" "The great Nebula in Orion;" "The Sun's True Atmosphere;" "Something Wrong with the Sun;" an article occasioned by the intense heat of July last year; "News from Herschel's Planet;" "The two Comets of the Year 1868;" "Comets of Short Period;" "The Gulf Stream," "Oceanic Circulation," "Addendum in Reply to Dr. Carpenter;" "Climate of Great Britain;" "Low Barometer of the Antarctic Temperate Zone."

LETTERS TO THE EDITOR

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

The Pay of Scientific Men

IT is unfortunately too true, as stated in your last week's leading article, that whether the claims of men of Science in serving their country are generally acknowledged in the future must to a large extent depend upon the men of Science themselves. I say unfortunately because, as a general rule, such claims, at least as far as pecuniary rewards go, could not be left in worse hands. I know so well how utterly repugnant it is to the feelings of all true and earnest workers in Science even to speak of such matters, however much they may be compelled to feel them sometimes, that they will be the last to force public attention to the question. Though this may be a natural and honourable feeling as far as each individual is concerned, I cannot help thinking that it is one which for the sake of the Science they love, it is a duty to place, for the time at least, in abeyance.

Very much has been said and written of la'e about the "Endowment of Scientific Research." I, for one, hold what you would probably consider rather heretical views on the subject, believing that the "protesters" against the report of the Committee on the Organisation of Academical Study, as well as the writer of your recent articles on the subject, are rather running the risk of losing a very substantial and comparatively easily attainable method of reaching the end we all have in view, whilst so keenly pursuing a very shadowy ideal. I think that Scientific Research can be endowed *indirectly*, so effectually and at comparatively so little trouble in overcoming old prejudices, and all the various obstacles to radical changes of organisation which I need not specify, that this should be the first object of all who have its promotion at heart. The far more difficult question of *direct* endowment will follow more appropriately and be carried out more efficiently when the body of educated scientific men in the country is larger than it is now, and the public generally, especially those in high places, have more appreciation of the claims of Science for its own sake.

The educated men of Science in this country are still but a handful; we want more, and there is but one way of obtaining them. Pay them better for their work, that it may be worth while for parents to allow their sons of promise to take up a scientific calling. What our Universities and to a certain extent our Government are now beginning to do to encourage scientific education, viz. offering prizes, scholarships, and even fellowships is a delusion and a snare, unless followed up by something more substantial.

There will never be wanting young minds ardent enough to commence the pursuit of Science for its own attractions, but it is positive cruelty to lure them on by bribes further in a path which will only lead them to the edge of a precipice or into a morass of hopeless difficulties. To be supported in a scientific pursuit when young, is of very doubtful advantage, if you are to find yourself landed in middle or old age, encompassed by all the stern realities of life and all the needs engendered by our complicated social system, with only the miserable and precarious pittance now accorded even to some of the most able veterans of Science. It is this which naturally and rightly discourages scientific research in this country; and it is this which could to a large extent be so easily remedied.

The urgent want is better paid appointments which can be held by men of high scientific attainments, more especially professorships at the Universities. I must confess that I am not one of those who think that a moderate amount of teaching work or even official duties of a scientific nature is any hindrance to a life of healthy and genuine advancement of Science by original research. On the contrary, they may be (if not overdone, as usually is the case in this country) rather an assistance; but that is a long question which I need not discuss on the present occasion.

As such appointments would probably only be given to those who had already shown evidence of their ability by their contributions to knowledge (and this will be more and more the case as the number of available candidates increases, and public opinion forms itself in such matters) the prospect of attaining one would be the greatest possible stimulus to scientific research in young men. Scholarships and Fellowships are valuable adjuncts to the training of such men, but nothing more. What I contend for is that if Science, as a profession, is to compete in its attraction with other callings, as law, medicine, the civil services, to say nothing of trade, we must provide far more liberally than at present for the endowment of the lat er half of the lives of those that follow it. That a man should be able to grow wealthy by Science is not asked for, probably not to be desired. The advantages and pleasures of a life devoted to scientific pursuits are such that for myself (and probably most others would say the same) I would prefer them with a simple competency—by which I mean sufficient to join freely in intellectual society and to give one's children a good education—to the wealth of a millionaire acquired in any other way.

But in the present condition of things Science does not even do this, at least for the branches with which I am best acquainted. Some pursuits, such as chemistry, which bear more directly on the arts and commerce, stand on a different footing; but in biological Science I do not know of a position in the kingdom to which a man, however distinguished he may be in his subject, can aspire, in which he can live as I have described, unless aided by independent means.

To remedy this we want no new organisations; nothing, in act, but the simplest and most intelligible change in the present state of things. In the first place the Government ought at once to increase the pay of all its scientific officers, such as the Astronomer Royal, the Director of Kew Gardens, and especially the Curators of the British Museum referred to in your article.

Secondly, the Universities, as bodies specially interested in the advancement of learning, and having (at least in the revenues of the Colleges) immense resources at their disposal which could legitimately be devoted to such purposes, ought to lose no time in largely increasing the number and the emoluments of their scientific professors, as has been so long and ably urged by the Rector of Lincoln College.

Lastly, certain still more strictly scientific bodies, who have in their own hands the appointment and pay of their fellow-workers, are especially concerned in showing their appreciation of their services, as it may fairly be taken as a standard by which the other cases may be judged. It is gratifying to find that in some of these bodies a liberal spirit is spontaneously showing itself, as in the case of the one with which I have the advantage of being associated. The Council of the Zoological Society is another example, although even here it takes time to shake off the narrow spirit of illiberality or economy which has so long prevailed in such matters. We think nothing (and very properly) of paying a judge or a bishop 5,000*l*. a year, but a fifth part of that sum for a first-class scientific man still seems to many a preposterous extravagance. There are many societies which, being mainly supported by scientific men themselves, are unfortunately without the means of doing justice to their officers, however much it might be their wish; but I cannot conclude without referring to one body which I think really might be expected to set a better example—a body composed solely of scientific men of the highest character, who have the nearly uncontrolled use of a large sum of public money to spend in carrying out a great scientific object; I mean the Meteorological Committee of the Royal Society. Whatever the committee may do personally in the way of suggestion and guidance, the real efficiency of the operations carried out under their care must depend upon the chief executive scientific officers. The committee, in fixing the proportion of the 10,000*l*. annually placed at their disposal by Parliament, which is devoted to the remuneration of these officers, afford, I am afraid, an illustration of what I stated in the beginning of this letter, that scientific men are not the best fitted to take care of their interests or those of their class. Eight hundred and four hundred a year respectively for the Land and Marine Superintendents of the departments, are considered by the committee as sufficient remuneration for such responsible posts. If a body of the first scientific men in the land think it is so, who can wonder that very unscientific Lords of the Treasury should be of the same mind. Doubtless it was with some fear of the same Lords in their eyes, that the committee fixed the lowest possible standard at which they thought they could get the work done. Happily for themselves and the country, they found competent *amateurs* willing to undertake it; but from such a body a different line of action might be expected; they should lead, not follow, the instincts of Chancellors of the Exchequer in such matters. If scientific men are reluctant to speak on such topics for themselves, the lovers of Science among men of influence, wealth, and position, are the more bound to speak for them.

July 21 W. H. FLOWER

Habits of Ants

SOME months ago (vol. vii. p. 443) I sent you an extract from a letter from Mr. Hague, a geologist residing in California, who gave me a very curious account of the terrifying effect on the other ants of the sight of a few which he had killed on one of their paths. Mr. Traherne Moggridge saw this account in NATURE, and wrote to me that he had heard from a gentleman who had lived in Australia that merely drawing a finger across the path deters ants from crossing the line.

Mr. Moggridge tried this experiment with some ants at Mentone with similar effects. I therefore sent the letter to Mr. Hague, and asked him to observe whether his ants were alarmed by the smell left by the finger, or were really terrified by the sight of their dead and dying comrades. The case appears curious, as I believe no one has ever observed an invertebrate animal realising danger by seeing the corpses of a fellow species. It is indeed very doubtful whether the higher animals can draw any such inferences from the sight; but I believe that everyone who has had experience in trapping animals is convinced that individuals who have never been caught learn that a trap is dangerous by seeing others caught.

Here follows Mr. Hague's letter, fully confirming his former statement. CHARLES DARWIN

"By a somewhat singular coincidence the first reappearance, since last winter, of any ants in the room where I then observed them occurred on the day when your last note arrived,—that is, after an interval of several months. Then a few were observed about the tumbler at the middle of the shelf and the vase at the other end from that whence they were first driven, although they all came from a hole near the base of the mantel, directly beneath the vase which they avoided.

"Acting on Mr. M's. suggestion, I first tried making simple finger marks on their path (the mantel is of marble) and found just the results which he describes in his note, as observed by himself at Mentone, that is, no marked symptoms of fear, but a dislike to the spot and an effort to avoid it by going around it, or by turning back and only crossing it again after an interval of time.

"I then killed several ants on the path, using a smooth stone or a piece of ivory, instead of my finger, to crush them. In this case the ants approaching all turned back as before and with much greater exhibition of fear than when the simple finger-marks was made. This I did repeatedly. The final result was the same as obtained last winter. They persisted in coming for a week or two, during which I continued to kill them, and then they disappeared and we have seen none since. It would appear from this that while the taint of the hand is sufficient to turn them back, the killing of their fellows, with a stone or other material, produces the effects described in my first note. This was made clear to me at that time from the behaviour of the ants the first day that I killed any, for on that occasion some of them approaching the vase from below, on reaching the upper edge of the mantel, peeped over and drew back on seeing what had happened about the vase, then turned away a little and after a moment tried again at another and another point along the edge with the same result in the end. Moreover, those that found themselves among the dead and dying, went from one writhing ant to another in great haste and excitement, exhibiting the signs of fright which I described.

"I hardly hope that any will return again, but if they do, and give me an opportunity, I shall endeavour to act further on Mr. M's. suggestion. "JAMES D. HAGUE"

San Francisco, June 26

Fertilisation of Viola tricolor and V. cornuta

ALLOW me to thank Mr. Kitchener for his correction of my spelling. What I object to in the word "be-pollen" is the harsh combination of syllables, which I should have thought would be offensive to any ears, whether scientific or not. The word "pollen," used as a verb, would be free from this fault, and would be objectionable chiefly from the possibility of confusion arising from the novelty of its use in this sense. Neither of these objections could apply to Mr. Kitchener's term "be-dust," but why coin a new word when a simpler one exists ready-made? Does not the ordinary English verb "to dust" equally give the exact meaning of *bestäuben?* I cannot, however, agree with Mr. Kitchener that it would be more expressive than "pollinate," as, unlike the Germans, we do not habitually use the word "dust" as a synonym for "pollen." I have no wish to dispute Mr. Bennett's conclusion that *Viola tricolor* is very commonly fertilised by "very minute insects of the Thrips kind," but only to point out that in its whole structure the flower seems rather adapted for cross-impregnation by larger insects, and that at least some varieties are attractive to humble-bees. On this view, the opening between the two lower anthers, described by Mr. Kitchener, is necessary for the escape of the pollen, which falls, according to Hildebrand, without the help of insects, into the groove beneath, where it is held by the lining hairs until removed by insects. Besides humble-bees, I have seen the small cabbage butterfly (*Pieris rapæ*) sucking the flowers of a cultivated pansy.

With regard to *V. cornuta*, besides the absence of the black mark on the style, mentioned by Mr. Kitchener, which is not universally present in *V. tricolor*, it differs from the latter in the uniform size of the unvariegated, pale blue, or white flowers, the somewhat looser disposition of the petals, the great length of the spur, and the sweetness of the flowers at night, all characters leading to the belief that it is, in fact, a pansy (if I may use the word in a sub-generic sense), adapted to uniform conditions of life, and to fertilisation by *Noctuidæ*. A comparison of the present condition of two beds of this species in our garden, in connection with their surroundings, helps to strengthen this belief, of the practical truth of which I have been able to satisfy myself by the capture of *Cucullia umbratica* in the act of sucking the flowers. One of these beds, in an exposed part of the garden little frequented by moths (as I can testify from long experience), still displays a profusion of blossoms in all their virgin beauty, with only a few small capsules among them; in the other, in a sheltered nook, an old favourite "mothing-ground," the flowers are mostly past their prime, and a great number of well-filled capsules are already formed. By day I have seen the flowers visited by a few humble-bees, which seemed to have difficulty in reaching the nectar, and by the meadow-butterfly (*Hipparchia Janira*). Hosts of small flies run over the petals in bright sunshine, but rarely attempt to enter the nectary, and I have never seen such an attempt succeed. A remarkably long-beaked fly which I watched feeding on the pollen, as it repeatedly inserted and withdrew its proboscis, must probably have left some of the flower's own pollen on the stigma. W. E. HART

Kilderry, Co. Donegal, June 22

Spots on the Cherry-laurel

CAN any of your readers tell me of what use to the plants are the small spots—glands I suppose—on the back of the laurel-leaf near the bottom of the rib? Sometimes there are two pairs, sometimes one; but no leaves seem to be without them. They are most apparent in the young leaves. They evidently contain something delectable to the bees, which frequent the laurels very much this year, and always fly to these spots upon the leaves; and the microscope shows a drop of liquid. J. M. H.

Sidmouth

YOUR correspondent means, I suppose, the cherry-laurel. His observation is quite correct; such glands are to be found in similar situations on other leaves. I know of no explanation of their purpose or origin. W. T. THISELTON DYER

Turnham Green, July 10

Halomitra

THERE is a singular morphological coincidence between the specimen of *Orbitolites tenuissimus* Carpenter, figured on p. 91 of "The Depths of the Sea," and several specimens which I have seen of the corallum of a species of the *Fungia* group, genus *Halomitra* Dana. The *Orbitolites* has the appearance of having been developed on a nucleus formed by a frustum of a former specimen. The outer rings are altogether unconformable with those of the truncated segment composing the nucleus; and it is somewhat interesting to notice, as illustrated by the figure in Prof. Wyville Thomson's work, how the growth of the Foraminifer, oppressed at the corners and advancing *per saltum* at the excavated sides, has shaped itself towards the completion of its normal disc-like form.

An appearance precisely similar has come under my notice in the corallum of *Halomitra*. Two specimens in the Free Public Museum, Liverpool, from the Solomon Islands, exhibit this peculiarity, and of about eight or ten other specimens seen by myself, I cannot recollect more than one in which the large frustum of a former corallum, constituting an unconformable nucleus, did not distinctly appear.

In a single case the presumption would be altogether in favour of attributing the peculiarity to an accidental fracture of a former corallum; but its frequent occurrence suggests that it may be worth while to inquire into the possibility of spontaneous fission taking place in the adult *Halomitra*. Some of the *Fungidæ* are said to possess powers of limited locomotion. It is quite conceivable that a great extension of size in the coral might interfere with its mobility and render division advantageous. That the Zoantharian Actinozoa are able to re-absorb solid portions of their coralla is variously illustrated, no example being more familiar than that of the young of several species of *Fungia*, which are attached to the under side of the parent polype by a strong neck of cœnenchyme, which is subsequently absorbed and the young are liberated.

Rainhill HENRY H. HIGGINS

Periodicity of Rainfall

I HAVE observed in recent numbers of NATURE a discussion upon the subject of the Periodicity of Rainfall, and its connection with sun-spots, and I hoped by an examination of the Rainfall Returns of this island (Barbados), which I have collected for 30 years, 1843 to 1872, to have been able to confirm the theory broached by Mr. Meldrum and Mr. N. Lockyer, which is so interesting in itself, and might lead to such important results. But assuming that sun-spots affect all parts of the globe equally, and that periodicity prevails in all alike, the experience of Barbados is opposed to the theory, and I am led to the conclusion that it was "chance alone" that led to the coincidences noticed by Mr. Symons in his letter published in vol. viii. p. 143.

In the following calculation I state the years separately in order to show that not only the triennial and quinquennial averages, but the individual years, contradict the theory. I am able to furnish six periods—three of maximum and three of minimum sun-spots. Of the triennial averages two of each show an absolute equality; in the third the rainfall is in an *opposite* proportion to the sun-spots. The quinquennial averages do not materially disturb those results. As regards individual years, the rainfall was much above the average in two of the minimum sun-spot years; and was above it only in one of the maximum sun-spot years; in the second it was an average; in the third it was excessively below it. The average of the island for 25 years, from 1847 to 1871, is 57·74 inches, based upon the mean of 3 stations in 1843, and increasing to 141 in 1871.

		Yearly Rainfall.	Average of 3 years.	Average of 5 years.
	43	45·31		
Minimum	1844	74·45	54·56	
	45	43·91		
	46	65·82		
	47	48·10		
Maximum	1848	63·77	54·86	59·67
	49	52·77		
	50	67·88		
	54	50·88		
	55	77·31		
Minimum	1856	48·49	62·23	56·56
	57	60·90		
	58	45·22		
	58	45·22		
	59	56·22		
Maximum	1860	57·91	61·98	58·09
	61	73·82		
	62	59·27		
	65	68·64		
	66	59·68		
Minimum	1867	69·93	58·07	58·27
	68	44·60		
	69	48·52		
	69	48·52		
	70	60·17		
Maximum	1871	41·46	50·00	52·71
	72	48·39		
	73	65·00		

I have ventured to estimate the rainfall of the present year with much confidence upon the data given in the accompanying notice, with which I need not trouble your readers.

Barbados RAWSON W. RAWSON

NOTES FROM THE "CHALLENGER"

IV.

On Saturday, the 15th of March, before going into the harbour of St. Thomas, a sounding was taken in 450 fathoms off the island of Sombrero. The bottom brought up by the sounding machine was globigerina mud largely mixed with broken shells, chiefly those of pteropods. The dredge was put over early, and veered to 1000 fathoms. At noon it was hauled up half

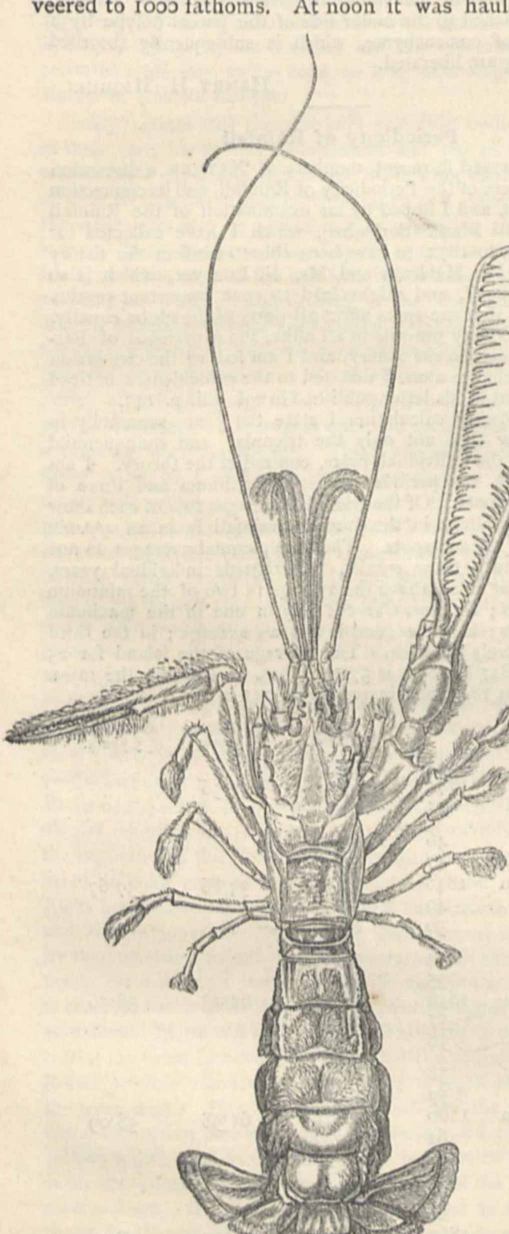


FIG. 1.—Astacus Zaleucus, v. W.-S.

filled with calcareous ooze. It was again sent down, and brought up early in the afternoon with a like freight. These dredgings, which we did not regard as entering into the regular work of the sections, but which were only undertaken to give us a general idea of the deep-water fauna of the West Indian province, may be taken in connection with one or two hauls taken with the same object and under the same circumstances, in waters of nearly equal depth on the 25th of March, after leaving St Thomas. The careful examination of this zone, between 300 and 1,200 fathoms among the West Indian Islands, will undoubtedly add enormously to zoological knowledge. The objects of the present expedition do not, of course, include a detailed investigation of this kind, which must be done quietly in a small steamer, by some one on the spot, and will require the patient work of several years. Even the few hauls of the dredge which we had it in our power to make, brought to light a number of new and highly interesting forms, representing nearly all the invertebrate groups. A thorough investigation of the belt must yield a wonderful harvest.

In those dredgings on the 15th we got several sponges belonging to the Hexactinellidæ, very closely allied to

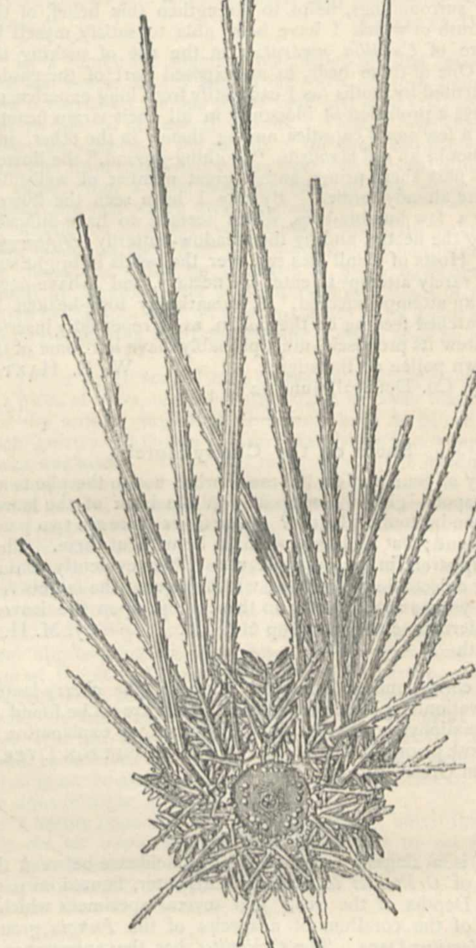


FIG. 2.—Salenica Varispina, A Ag.

those which we had previously met with in moderately deep water oft the coast of Portugal, showing that the distribution of this remarkable order in deep water is very wide. Several stony corals occurred, but of all these, with the exception of a species of *Stylaster*, which was very abundant at this station, we got better examples on a subsequent occasion. The *Stylaster* agrees very closely with the description and figure given by Pourtalès of *S. complanatus*. The only marked difference is that the primary and secondary septa do not unite to the same extent as shown in the figure.

In this dredging two very interesting crustaceans occurred, both belonging to the decapod family Astacidæ, and both participating in a singular deficiency, the total absence of eyes. One of these has been referred by Dr. v. Willemoes-Suhm to his genus Deidamia. It agrees with the species described in my former report in all its leading characters, although certain marked differences must lead to a slight modification of the characters of the genus as formerly defined. In *Deidamia leptodactyla* all the five pairs of ambulatory legs bear chelæ, while it is a character of the typical Astacidæ that chelæ are present on three pairs only. In the new species there are chelæ on four pairs of the ambulatory legs, the fifth pair ending in simple curved claws. The two species agree with one another, and with *Astacus*, in possessing a lamellar appendage at the base of the outer antennæ, and with this they have the flattened carapace of *Palinurus*. These characters have not been hitherto observed in combination, and their so occurring seems to be a more valuable generic character than the variable one of the form of the limbs. The character of this genus will now stand thus :—

Deidamia.—Cephalothorax flattened, with a compressed free lateral margin. A lamellar appendage at

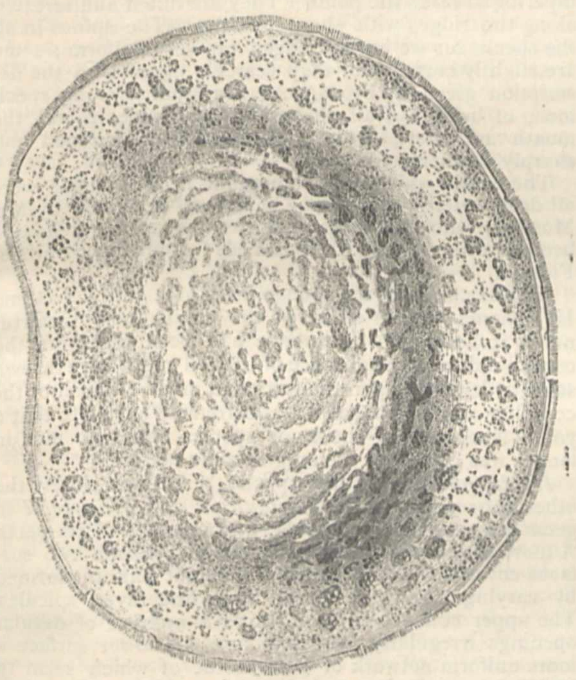


FIG. 3.—Hyalonema Toxeres, Wyville Thomson (Upper surface of sponge body).

base of each of the outer antennæ. Swimmerets, consisting of three joints with two palpi. No trace of eyes or of eyestalks.

D. leptodactyla v. W.-S.—All the ambulatory feet bearing chelæ.

D. crucifer v. W.-S.—Four pairs of the ambulatory feet bearing chelæ.

As in *D. leptodactyla*, not only are the eyes and eyestalks absent, but there is no indication of a space for their accommodation in the position in which eyes are normally developed.

Deidamia crucifer certainly differs widely in general appearance from the recent Astacidæ, at the end of which family we should, however, be inclined to place it for the present. It has a very close resemblance to some fossil forms, particularly the varying species of the genus *Eryon*. It has been already remarked that *Deidamia*, in its flattened cephalothorax, approaches the Palinuridæ; in all the living members of that family, however, the first pair of legs are monodactylous, while in *Deidamia* they are didactylous. The fossil genus *Eryon* forms an exception in this particular among Palinurids, with which it has hitherto been arranged, and has the first pair of limbs didactylous, as in *Deidamia*. It has not yet been ascertained whether *Eryon* has a lamellar appendage at the base of the outer antennæ. If this appendage be absent, there is probably scarcely sufficient ground for separating *Deidamia* generically from *Eryon*. It is very likely that when the recent deep-sea forms near the Astacidæ and Palinuridæ come to be carefully correlated with the cretaceous and Jurassic species, it may be necessary to establish an additional family.

The second crustacean, although having little of the facies of the typical *Astaci*, presents apparently no characters of sufficient value to warrant its separation from that genus.

Astacus zaleucus, v. W.-S. (Fig. 2), with its long compressed cephalothorax, flattened abdomen and unequal chelæ, has at first sight somewhat the appearance of a *Calianassa*.

The total length of the animal is 120 mm.; the cephalothorax, 50, and the abdomen, 60 mm. The

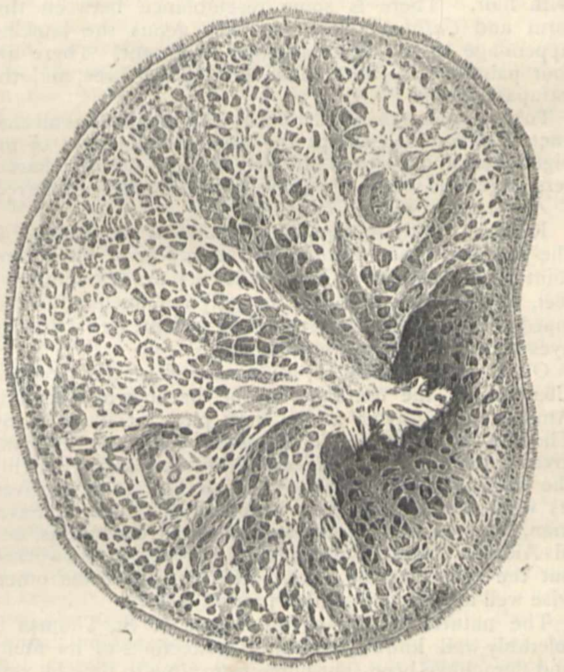


FIG. 4.—Hyalonema (Lower surface).

carapace is hard, and firm, though only slightly calcified. It is greatly compressed laterally, rising into a high arch. It terminates in front in a slender spiny rostrum, 8 mm. in length. The rostrum is covered with a thick felting of hair, which extends backwards, forming two hairy triangles on the anterior part of the cephalothorax In front of the carapace, between its anterior and upper edge and the insertions of the antennæ, in the position of the eyes in such forms as *Astacus fluviatilis*, there are two round vacant spaces which look as if the eyestalks and eyes had been carefully extirpated and the space they occupied closed with a chitinous membrane. The lamellar appendage of the outer antennæ has teeth along its inner border. It extends to the middle of the second basal segment of the antenna, which is remarkably long. The flagella of the outer antennæ are 130 mm. in length. The inner antennæ originate in a line with the outer. The funiculus is shorter, and the flagella, which are equal in length, are much shorter than those of the outer antennæ.

The parts of the mouth are normal. The three first pairs of ambulatory legs are terminated by chelæ, the fourth pair bear recurved claws, and the fifth abortive stump-like claws. The chelæ of the first pair of legs are strangely developed, particularly the right chelæ, which is double the length of the left, and with its formidable ranges of long spines along the inner border of each claw reproduces on a small scale the jaws of the Gangetic gavial. The last segment of the pereion is not covered by the carapace but is in moveable connection with it. The first segment of the abdomen is very small, and the segments gradually increase up to the fourth, which the fifth and sixth equal in size. The abdominal segments are flattened from above downwards. The telson is quadrate, and combines with the two pairs of caudal appendages, which are widely expanded laterally to form the caudal fin. The dorsal surfaces of the second, third, and fourth abdominal segments, and the margin of the tail, are thickly covered with woolly hair. The individual being a male, the first pair of swimmerets consist of long slender appendages, and the four succeeding pairs have one strong, round, basal joint, to which are attached two palpi fringed with hair. There is some resemblance between this form and *Calianassa*, but in this genus the lamellar appendage to the outer antenna is absent. There are four pairs of limbs with chelæ instead of three, and the carapace is soft.

To the genus *Astacus*, therefore, with which it has all characters in common except the great development of the right chela and the total absence of eyes—neither characters of generic value—the present species must be referred.

A. Zaleucus, n. sp. (Fig. 1).

Rostrum spiny, elongated. Lamellar appendage of the outer antennæ reaching to the middle of the second joint of the funiculus. Chelæ on three pairs of ambulatory feet, those on the first pair strongly but unequally developed. Cephalothorax very much compressed laterally, eyestalks and eyes entirely wanting.

On Sunday, March 16, we anchored in the Gregaria Channel, at the entrance of the harbour of Charlotte Amalia. We spent a few very pleasant days at St. Thomas, some of the civilians of our party enjoying greatly their first experience of life and scenery within the tropics. M. Gardé, the Danish Governor, received us with the most friendly hospitality. He is a naval man, and was greatly interested in our investigations, and his Aide-de-Camp, Baron Eggers, had collected and worked out the plants of the Island with care, and was otherwise well acquainted with its natural history.

The natural history of the island of St. Thomas is tolerably well known, and large collections of its fauna and flora have been sent home from time to time by very competent naturalists to the Museum at Copenhagen. On the present occasion our time was much too limited to attempt to make collections, so the naturalists contented themselves with a little shallow water dredging, and such a general survey of the island and shores as might familiarise them with the more characteristic forms of animal and vegetable life; for while the Atlantic Islands Madeira, and the Canaries, although gradually assuming a more tropical character, maintain the most intimate relations in natural products with the south of Europe, in Tropical America everything is changed, and it takes a little time to become familiar with new acquaintances whom one has hitherto known, if he has known them at all, only from descriptions or figures, or at best mummied or pickled, or otherwise in inadequate effigy. Ophiurideas are particularly plentiful at St. Thomas, and we made large collections of these, particularly of the many large and characteristic West Indian species of the genus *Ophioderma*.

On the 24th of March we left the harbour of Charlotte Amalia and proceeded with a light north-easterly breeze towards the Culebra passage. The next morning we sounded in 625 fathoms. The ooze was closer and more free from shells and coral than in the former haul, but otherwise much of the same character. This time the dredge came up about half full, and on sifting its contents many interesting additions were made to our collections. Here we met for the first time with the curious little crinoid, *Rhizocrinus lofotensis*, for which we had been on the outlook since the beginning of the cruise, and *Salenia varispina*, which we now recognise as a very widely distributed inhabitant of the deeper water.

This elegant little urchin (Fig. 2) is about 10 mm. in diameter of the test. It resembles in general appearance young specimens of *Cidaris hystrix*. The ambulacral zones are narrow, the interambulacral correspondingly wide, and both are furnished with double rows of flat, paddle-shaped, secondary spines beautifully striated in purple and white, ranged along the middle line, from which they shed outwards on either side. The primary tubercles are large, imperforate, and distinctly crenated. Some of the larger of the primary spines are 50 mm. in length, ·8 mm. in diameter, and cylindrical, gradually tapering towards the point. They are fluted and serrated along the ridges with sharp prickles. The spines in all the specimens we have dredged are very uniform; some are slightly curved, but they scarcely agree with the description given by Prof. A. Agassiz, from a young specimen, of being "of all shapes." The spines round the mouth are short, some of them slightly flattened and sharply denticulated.

The corals which were abundant in individuals were all deep-water forms. They have been examined by Mr. Moseley, who refers the majority to species which have been described by M. de Pourtalés * from the Straits of Florida.

Two examples of the sponge-body of a very handsome Hyalonema were sifted out of the coral mud. Unfortunately in both cases the sponge had been torn from the central coil, and the absence of the coil might have thrown some little doubt upon the form and mode of finish of the complete animal, so that it was extremely fortunate that a young specimen of the same species about 40 mm. in length was caught in the tangles quite perfect.

Hyalonema toxeres, new species, resembles closely the other known species *H. lusitanicum* and *H. sieboldi* in general appearance and in the arrangement of its parts. A more or less funnel-shaped sponge presents two surfaces covered with a network of different patterns formed by varying arrangements of large fine rayed spicules. The upper concave surface shows a number of oscular openings irregularly arranged, and the lower surface a more uniform network of pores, some of which seem to be inhalent and others exhalent.

The central axis of the sponge is closely warped into the upper part of a coil of long and strong glassy spicules which, as in the other species, serve to anchor the sponge in the soft mud. Both of the species dredged have the sponge more flattened and expanded than it is in *H. lusitanicum*. In one of them it is nearly flat (Fig. 3), forming a reniform cake-like expansion 80 mm. in length by 70 mm. in width, and about 8 mm. in thickness. The upper or oscular surface is covered by an exceedingly close network with groups of large openings at nearly equal intervals. It is slightly raised in the centre. The central elevation is followed by a slight depression, and the upper wall then passes out nearly horizontally to a sharp peripheral edge fringed with long delicate spicules, each consisting of a slender central shaft with a cross of four short transverse processes in the centre. The outer half of the central axis is delicately feathered. The lower surface of the sponge (Fig. 4) is protected by a singularly

* Illustrated Catalogue of the Museum of Comparative Zoology at Harvard College, No. 4—Deep-sea Corals. By L. F. de Pourtalès, Cambridge (Mass.), 1871.

elegant net-work of sarcode with wide oval and round meshes radiating irregularly from a central point. The membrane is traversed by irregularly radiating ridges of firmer substance, which unite in the centre in a projecting boss at the point where, in this specimen, the "glass-rope" has unfortunately been torn out.

WYVILLE THOMSON

(To be continued.)

THE ANCESTRY OF INSECTS

WITHIN a very few days after my last article on the "Origin and Metamorphoses of Insects" appeared in NATURE, I received from Mr. Packard a memoir,* under the above title, in which he developes his latest views on the same subject; and I am happy to find that his views do not differ so much from mine as I had supposed. He lays great stress, as is natural, on the larval forms. "If we compare," he says, "these early stages of mites and myriopods, and those of the true six-footed insects, as in the larval Meloë, Cicada, Thrips, and Dragon-fly, we shall see quite plainly that they all share a common form. What does this mean? To the systematist who concerns himself with the classification of the myriads of different insects now living, it is a relief to find that all can be reduced to the comparatively simple forms sketched above. It is to him a proof of the unity of organisation pervading the world of insects. He sees how Nature, seizing upon this archetypal form has, by simple modifications of parts here and there, by the addition of wings and other organs wanting in these simple creatures, rung numberless changes in this elemental form." And again (p. 151), "Going back to the larval period, and studying the insect in the egg, we find that nearly all the insects yet observed agree most strikingly in their mode of growth, so that, for instance, the earlier stages of the germ of a bee, fly, or beetle, bear a remarkable resemblance to each other, and suggest again, more forcibly than when we examine the larval condition, that a common design or pattern pervades all."

He distinguishes, as in his previous writings (p. 175), two principal types of larvæ:—

"There are two forms of insectean larvæ which are pretty constant. One we call leptiform, from its general resemblance to the larvæ of the mites (Leptus). The larvæ of all the Neuroptera, except those of the Phryganeidæ and Panorpidæ (which are cylindrical, and resemble caterpillars), are more or less leptiform, *i.e.*, have a flattened or oval body, with long thoracic legs. Such are the larvæ of the Orthoptera and Hemiptera, and the Coleoptera (except the Curculionidæ; possibly the Cerambycidæ and Buprestidæ, which approach the maggot-like form of the larvæ of weevils). On the other hand, taking the caterpillar or bee larvæ, with their cylindrical fleshy bodies, in most respects typical of larval forms of the Hymenoptera, Lepidoptera, and Diptera, as the type of the eruciform larva," &c.

At first sight it would appear that Mr. Packard's conclusions differ widely from those which I have advocated. He rejects, indeed, the suggestion made by Haeckel that the "common stem form of all Tracheata" may be found in "Zoeaform Crustacea." It is evident, he says (p. 159), that "the Leptus fundamentally differs from the Nauplius and begins life on a higher plane. We reject, therefore, the crustacean origin of the insects." And elsewhere "we find through the researches of Messrs. Hartt and Scudder that there were highly-developed insects, such as may-flies, grasshoppers, &c., in the Devonian rocks of New Brunswick, leading us to expect the discovery of low insects even in the Upper Silurian rocks. At any rate this discovery pushes back the origin of insects beyond a time when there were true Zoëæ, as the shrimps and other allies are not actually known to exist so far back as the Silurian, not having as yet been found below the coal-measures."

But then he observes that the "larvæ of the earliest insects were probably leptiform, and the eruciform condition is consequently an acquired one, as suggested by Fritz Müller." Again, "for reasons which we will not pause here to discuss, we have always regarded the eruciform type of larva as the highest. That it is the result of degradation from the Leptus or Campodea form, we should be unwilling to admit." And once more, "The Caterpillar is a later production than the young, wingless Cockroach."

Mr. Packard had already expressed these opinions elsewhere, and as I have on the contrary suggested that the grublike, or Lindia-forms were the first to come into existence, then the Tardigrade-form, and lastly, the Campodea-form, I had supposed that our views were in direct opposition to one another: but I am glad to find from other passages that after all there is not so much dfference as these passages would seem to indicate. I cannot, indeed, agree with him in his classification of Insect larvæ; he ranks the Caterpillars with the grubs and maggots of Bees and Flies, as a class for which he proposes the term "eruciform" in opposition to the "leptiform" larvæ of Orthoptera, Hemiptera, and most Coleoptera. It seems to me, on the contrary, that the two great groups are the Hexapod or Campodea-form, and the apod, grublike type, which I have proposed to call the Lindia-form. At the first glance, no doubt, the heavy sluggish Caterpillar seems to have more in common with the grub of a Bee than with the active larvæ of Coleoptera. The difference, however, is one of habit, not of type.

As regards the ancestral forms of Insects, Mr. Packard considers that "while the Poduras (p. 154) may be said to form a specialised type, the Bristle-tails (*Lepisma*, *Machilis*, *Nicolitea*, and *Campodea*) are, as we have seen, much more highly organised, and form a generalised or comprehensive type. They resemble, in their general form, the larvæ of Ephemerids, and perhaps more closely the immature Perla, and also the wingless Cockroaches. Now such forms as these Thysanura, together with the mites and singular Pauropus, we cannot avoid suspecting to have been among the earliest to appear upon the earth; and putting together the facts, first, of their low organisation, secondly, of their comprehensive structure, resembling the larvæ of other insects, and thirdly, of their probable great antiquity, we naturally look to them as being related in form to what we may conceive to have been the ancestor of the class of insects. Not that the animals mentioned above were the actual ancestors, but that certain insects bearing a greater resemblance to them than any others with which we are acquainted, and belonging possibly to families and orders now extinct were the prototypes and progenitors of the insects now known."

As regards the probable origin of this Leptus form, Mr. Packard's views are expressed in the following passage (p. 169):—"While the Crustacea may have resulted from a series of prototypes leading up from the Rotifers, it is barely possible that one of these creatures may have given rise to a form resulting in two series of beings, one leading to the Leptus form, the other to the Nauplius. For the true Annelides (Chætopods) are too circumscribed and homogeneous a group to allow us to look to them for the ancestral forms of insects. But that the insects may have descended from some low worms is not improbable, when we reflect that the Syllis and allied genera of Annelides bear appendages consisting of numerous joints; indeed, the strange *Dujardinia rotifera*, figured by Quatrefages, in its general form is remarkably like the larva of Chloëon."

Moreover, though Mr. Packard says that "the caterpillar is a later production than the young wingless, cockroach," he elsewhere (p. 182) says, "it is evident that in the

* Being a chapter from "Our Common Insects," by A. S. Packard, jun. (Printed in advance.)

young grasshoppers the metamorphoses have been passed through, so to speak, in the egg, while the bee larva is almost embryonic in its build." Mr. Packard admits then that theoretically the Orthoptera do pass through transformations similar to those of metamorphic insects; though, while bees are hatched in an early larval, "almost embyonic" condition, Orthoptera pass through these early stages rapidly, and within the egg.

Mr. Packard then derives the various groups of Insecta as I do from ancestors more or less resembling the hexapod larvæ of Neuroptera, &c.; these from a more acariform type; and these again from lower, more vermiform ancestors.

That the Lindia-type larvæ *of Diptera* are of more recent origin than the Campodea-form larvæ of Neuroptera of course I admit, because the palæontological evidence seems to show that the Neuroptera are a more ancient group than the Diptera; but I am not the less of opinion that the Lindia type itself is more ancient than the Neuropterous.

How far the form of any given existing larva is adaptive and how far it is hereditary, is a comparatively minor, though interesting question, and I am glad to find that there is less difference of opinion than I had supposed between Mr. Packard and myself as to the various stages through which in the long lapse of geological ages the existing types of insects have gradually been evolved.

JOHN LUBBOCK

*NOTES ON THE HONEY-MAKING ANT OF TEXAS AND NEW MEXICO**

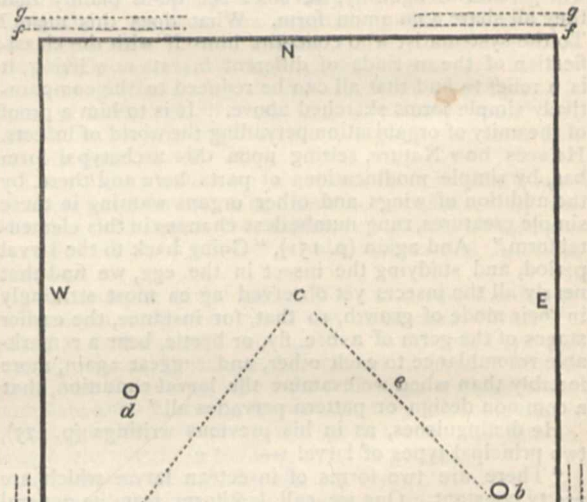
THE natural history of this very curious species (*Myrmecocystus mexicanus* Westwood) is so little known, that the preservation of every fact connected with its economy becomes a matter of considerable scientific importance, and the following observations, gleaned from Capt. W. B. Fleeson of this city, who has recently had an opportunity of studying the ants in their native haunts, may, it is hoped, be not without interest.

The community appears to consist of three distinct kinds of ants, probably of two separate genera, whose offices in the general order of the nest would seem to be entirely apart from each other, and who perform the labour allotted to them without the least encroachment upon the duties of their fellows. The larger number of individuals consist of yellow worker ants of two kinds, one of which, of a pale golden yellow colour, about one-third of an inch in length, acts as nurses and feeders of the honey-making kind, who do not quit the interior of the nest, "their sole purpose being, apparently, to elaborate a kind of honey, which they are said to discharge into prepared receptacles, and which constitutes the food of the entire population. In these honey-seeking workers the abdomen is distended into a large, globose, bladder-like form, about the size of a pea." The third variety of ant is much larger, black in colour, and with very formidable mandibles. For the purpose of better understanding the doings of this strange community, we will designate them as follows:—

No. 1.—Yellow workers; nurse and feeders.
No. 2.—Yellow workers; honey-makers.
No. 3.—Black workers; guards and purveyors.

The site chosen for the nest is usually some sandy soil in the neighbourhood of shrubs and flowers, and the space occupied is about from four to five feet square. Unlike the nests of most other ants, however, the surface of the soil is usually undisturbed, and but for the presence of the insects themselves, presents a very different appearance from the ordinary communities, the ground having been subjected to no disturbance, and not pulverised and rendered loose as is the case with the majority of species.

The black workers (No. 3) surround the nest as guard or sentinels, and are always in a state of great activity. They form two lines of defence, moving different ways, their march always being along three sides of a square, one column moving from the south-east to the south-west corners of the fortification, while the other proceeds in the opposite direction. In most of the nests examined by Captain Fleeson, the direction of the nest was usually towards the north; the east, west and northern sides being surrounded by the soldiers, while the southern portion was left open and undefended. In case of any enemy approaching the encampment, a number of the guards leave their station in the line and sally forth to face the intruder, raising themselves upon their hind tarsi, and moving their somewhat formidable mandibles to and fro as if in defiance of their foe. Spiders, wasps, beetles, and other insects are, if they come too near to the hive attacked by them in the most merciless manner, and the dead body of the vanquished is speedily removed from the neighbourhood of the nest, the conquerors marching back to resume their places in the line of defence, their



object in the destruction of other insects being the protection of their encampment, and not the obtaining of food. While one section of the black workers is thus engaged as sentinels, another and still more numerous division will be found busily employed in entering the quadrangle by a diagonal line bearing north-east, and carrying in their mouths flowers and fragments of aromatic leaves which they deposit in the centre of the square. A reference to the accompanying sketch will give a more clear understanding of their course; the dotted line *a* representing the path of this latter section, while the mound of flowers and leaves is marked *c*. If the line *a* be followed in a south-west direction, it will be found to lead to the trees and shrubs upon which another division of the black workers is settled, engaged in biting off the petals and leaves to be collected and conveyed to the nest by their assistants below. On the west side of the encampment is a hole marked *d* leading down to the interior of the nest, which is probably chiefly intended for the introduction of air, as in case of any individuals carrying their loads into it, they imme-

* By Henry Edwards, Californian Academy of Sciences. Communicated by Mr. Charles Darwin, F.R.S.

diately emerge and bear them to the common heap, as if conscious of having been guilty of an error. A smaller hole near to the south-east corner of the square, is the only other means by which the interior can be reached, and down this aperture, marked *b*, the flowers gathered by the black workers are carried along the line *e*, from the heap in the centre of the square, by a number of smaller yellow workers (No. 1), who, with their weaker frames and less developed mouth organs, seem adapted for the gentler office of nurses for the colony within. It is remarkable that no black ant is ever seen upon the line *e*, and no yellow one ever approaches the line *a*, each keeping his own separate station and following his given line of duty with a steadfastness which is as wonderful as it is admirable. By removing the soil to a depth of about three feet, and tracing the course of the galleries from the entrance (*b*) and (*d*), a small excavation is reached, across which is spread in the form of a spider's web, a net work of squares spun by the insects, the squares being about one-quarter inch across, and the ends of the web fastened firmly to the earth of the sides of the hollow space which forms the bottom of the excavation. In each one of the squares, supported by the web, sits one of the honey-making workers (No. 2), apparently in the condition of a prisoner, as it does not appear that these creatures ever quit the nest. Indeed it would be difficult for them to do so, as their abdomens are so swollen out by the honey which they contain, as to render locomotion a task of difficulty, if not to make it utterly impossible.

The workers (No. 1), provide them with a constant supply of flowers and pollen, which, by a process analogous to that of the bee, they convert into honey. The fact that the remainder of the inhabitants feed on the supply thus obtained, though it is surmised, has not been established by actual observation; indeed with reference to many of the habits of these creatures, we are at present left in total ignorance, it being a reasonable supposition that, in insects so remarkable in many of their habits, other interesting facts are yet to be brought to light respecting them. It would be of great value to learn the specific rank of the black workers (No. 3), and to know the sexes of the species forming the community, their season and manner of pairing, and whether the honey-makers are themselves used as food, or if they excrete their saccharine fluid for the benefit of the inhabitants in general, and then proceed to distil more. I regret that at this time I am only able to bring before the notice of the Academy, specimens of the honey-makers (No. 2), the other members of the community, except from Captain Fleeson's description, being quite unknown to me. It is, however, my hope that at a future meeting I may be enabled to exhibit the other varieties, and to give some more extended information upon this very interesting subject. The honey is much sought after by the Mexicans, who not only use it as a delicate article of food, but apply it to bruised and swollen limbs, ascribing to it great healing properties. The species is said to be very abundant in the neighbourhood of Santa Fé, New Mexico, in which district the observations of Capt. Fleeson were made.

NOTES

THE arrangements for the forty-third meeting of the British Association at Bradford, have been pretty nearly completed. The General Committee will meet on September 17, the opening day, at 1 P.M., for the election of sectional officers, and the despatch of business usually brought before that body. The concluding meeting takes place on September 24. We regret very much to hear that Mr. Joule, on account of ill-health, has been compelled to resign the presidency; Prof. W. A. Williamson, will, it is said, be appointed in his place.

THE forty-sixth meeting of the German Association of Naturalists and Physicians will be held this year at Wiesbaden from September 18 to 24. Communications are to be addressed to Drs. Fresenius and Haas Senior.

WE are glad to see so influential a paper as the *Times* give so prominent a place to a notice of Sir Charles Wheatstone's election to the French Academy, which we ourselves noted a fortnight ago. There is no doubt that if we take into consideration the amount and value of the services Sir Charles has rendered to Science, both in its theoretical and practical aspects, he must be ranked as among the most eminent men of the time. The following is the notice in the *Times*:—

"Sir Charles Wheatstone was elected, on the 30th ult., Foreig Associate of the French Academy of Sciences, to fill the vacancy occasioned by the death of Baron Liebig. He was for many years previously corresponding member of the Academy; but the honour recently conferred upon him is the highest which it is in the power of that body to confer upon a foreigner. The election was nearly unanimous, as he obtained 43 out of 45 votes. Sir Charles has also lately received from the French Society for the Encouragement of National Industry the great medal of Ampère, which is awarded every six years for what is considered the most important application of Science to Industry. The former recipients of this medal were Henri Sainte-Claire Deville, who introduced the manufacture of aluminum; De Lesseps, the Engineer of the Suez Canal; and Boussingault, distinguished for his researches in agriculture.

GUSTAV ROSE, the celebrated mineralogist, died after a few days' illness on the 15th inst., in the 75th year of his age and the 50th of his connection with the University of Berlin. His mind and power of work remained unimpaired almost to the last, and he was able on his sick bed to dictate to his son the results of his last researches.

MR. J. S. DAVENPORT was elected on Wednesday, the 16th inst., Assistant-Secretary to the Royal Horticultural Society, in the place of Mr. Richards, who has accepted a post under the Commissioners of the International Exhibition.

THE Chair of Physiology at Edinburgh is likely to be soon vacant, we believe, by the resignation of Prof. Hughes Bennet, from ill health. There are several likely candidates for the prospective vacancy, all of them good men:—Dr. McKendrick, who has for some time efficiently discharged the duties of the chair, and a paper by whom in conjunction with Mr. James Dewar, on the Physiological Action of Light, we published a fortnight ago; Prof. Rutherford, a former assistant of Prof. Bennet's, and Dr. J. Bell Pettigrew, F.R.S., who has distinguished himself as an investigator in comparative anatomy. There is a rumour that Prof. Burdon Sanderson is also a candidate.

WE regret very much to hear that Mr. Saville Kent has resigned his position in connection with the Brighton Aquarium. We do not desire to express any opinion upon the misunderstanding which has resulted in Mr. Kent's resignation, but we cannot help saying that we consider it a great loss to Science that the Aquarium is now without a resident naturalist. The Brighton Aquarium offers unequalled opportunities for studying the habits of fishes, and during Mr. Kent's short connection with the establishment he has considerably increased our knowledge of this department of Natural History, and we confidently looked to the Aquarium to add still more to scientific knowledge in this direction. It would be a grievous thing, indeed, if the Directors should allow their fine establishment to degenerate into a mere place of popular amusement.

MR. GEORGE SMITH returned on Saturday last from his successful labours in Assyria.

THE number of institutions in America devoted to education of all kinds and of all grades, endowed and supported both by the State and by the generosity of private individuals, theoretically and practically open to all-comers, is almost sufficient to fill a Briton with envy and chagrin, when he contrasts it with the comparative meagreness of the educational means of his own country, hampered with so many traditional restrictions. One of the most admirable, best organised, and most successful of these American institutions is the Sheffield Scientific School of Yale College, the Eighth Annual Report of which for 1872-73 we have just received. The School forms the Scientific Faculty of Yale College, on the same footing as the other faculties of Arts, Medicine, Law, and Divinity, and, to judge from the Report, must be one of the most successful and efficient scientific schools in the world. It owes its name to Mr. Joseph E. Sheffield, who, in 1860, presented it with a magnificent building and a liberal endowment, and has since frequently munificently increased his original gifts, his last one being an additional building of five stories, with ample accommodation, which was very much needed to meet the rapid increase in the number of students, which, during the last session, was 201. The education supplied is in all branches of Science, students being at liberty to choose a course of instruction to fit them for pure scientific research, or for some practical application of scientific principles, as engineering, agriculture, &c. The school is most liberally supplied with scientific apparatus in all departments, seems to have plenty of funds at its command, furnished both by the State and by private individuals, and, to judge from the prospectus, provides students with a thoroughly well-organised and complete course of scientific instruction in each of its numerous departments. "The benefit," the report says, "which the Scientific School has conferred upon the State in turning out young men who, on leaving the institution, are enabled to assume the position of leaders in their several callings, and of educators of the people to a higher grade of culture, increasing the productive brain capacity as well as the material wealth of the country, cannot be estimated in dollars and cents. From all parts of the country come back most favourable reports of the graduates who have been sent out, and their influence, already great, is constantly on the increase. The people of this state cannot do too much for an institution which has already done and is continuing to do so much for them, by developing the material resources of Connecticut, and by extending its reputation throughout the entire country."

IN this month's number of the *American Journal of Science and Art* Mr. Sellack gives a short but interesting account of his photographic work among the southern star-clusters at the Argentine National Observatory, Cordoba, where, for this purpose, he has been for some time at the expense of some gentlemen from Boston, U.S.A. On his arrival at Cordoba Mr. Sellack found the lens of the photographic refractor he was to use, broken, but by dint of perseverance and ingenuity he managed to put the pieces together in such a manner as to enable him to obtain a well-defined, nearly circular, photographic image of stars of the first and second magnitude; and with exposures of eight minutes, even stars of the ninth magnitude, of white colour, give a photographic impression. We have received a lunar photograph obtained by Mr. Sellack, and although it will not bear comparison with the well-known photographs obtained by other astronomers who have devoted attention to the subject, nevertheless the impression submitted to us reflects great credit on Mr. Sellack, considering the difficulties he had to contend with in getting it taken. The picture has suffered somewhat by too long an exposure in the telescope and over development.

WE have received from Mr. Gerard Krefft, Curator of the Sydney Museum, what he calls "a splendid bit of mimicry," in the shape of a photograph of the chrysalis of *Papilio sarpedon*. The chrysalis seems to be attached to a leaf, and has itself contrived to assume the shape of a leaf, or rather of a part of the leaf to which it is attached. Its colour, Mr. Krefft says, is pale green, or sea-green.

THE last number of the Journal of the Linnean Society is entirely occupied by Mr. Bentham's important paper on the structure, classification, and history of development of the Compositæ, the largest and most natural order in the vegetable kingdom. In accordance with the system proposed in the "Genera Plantarum," he divides the order into 13 sub-orders, viz.: 1, Vernoniaceæ; 2, Eupatoriaceæ; 3, Asteroideæ; 4, Inuloideæ; 5, Helianthoideæ; 6, Helenioideæ; 7, Anthemideæ; 8, Senecionideæ; 9, Calendulaceæ; 10, Arctotideæ; 11, Cynaroideæ; 12, Mutisiaceæ; 13, Cichoriaceæ; the most important diagnostic characters depending on the structure of the pistil (in the hermaphrodite flowers), fruit, andrœcium, corolla, and calyx (pappus). A very exhaustive account is given of the geographical distribution of the sub-orders and principal families; and the first appearance of the order is traced with probability to Africa, Western America, and probably Australia; the difference between the forms now observed in the northern and southern hemispheres having become developed only after the tropical belt introduced an impassable barrier between them. It is one of the most important contributions to structural and systematic botany which has issued from this country for many years.

DR. ROBERT SCHLESINGER publishes (from the house of Orell, Füssli & Co., Zurich) a small work on the microscopica examination of Textile Fabrics in the raw and coloured state, with a note on the mode of detecting "shoddy-wool." It contains a complete account of the fabrics made from the various vegetable fibres in more or less common use, also from hair and silk, with their distinguishing characteristics, as exhibited under the microscope, when raw, spun or woven, and dyed, illustrated with 27 woodcuts, and introduced by a preface by Dr. Emil Kopp.

THE current number of the *Zoologist* commences with a paper by Mr. F. H. Balkwill, having the pretentious title "A Difficulty for Darwinists," in which, like many others who do not fully understand the subject, he lays too much stress on the possibility of slight variations in an *infinite* number of directions. No doubt it is theoretically possible for an infinite number of variations to occur in living bodies, if they are within the influence of an infinite number of different forces, just as the result of a very large number of forces acting on a particle, may cause it to take one of almost an infinite number of directions. But the forces acting on the living body are comparatively limited, and when as in the cases of the Thylacine and the Dog, or of the Wombat and the Rodent, which are the author's stumblingblocks, the forces which have been called to act on the Marsupial and Placental types of organism have been practically identical, they having had to undergo the struggle for existence under similar circumstances, it is not to be wondered at, but only to be expected, that similar organisms should be the result, especially as the two types to start with are not separated by any great interval. It is just as probable, external circumstances being similar, that the isolated Marsupial ancestor should give rise to carnivorous, rodent, and herbivorous forms, as that they should be developed from a Placental type.

THE current part of Mr. Dresser's "Birds of Europe" commenced with the description of the Imperial Eagle (*Aquila mogilnik*), to which two plates are devoted, in one of which the young of that species is contrasted with that of the distinctly separated White-shouldered Imperial Eagle (*Ag. adalberti*), from Spain. This is followed by illustrated descriptions of the Algerian Black-headed Jay (*Garrulus cervicalis*), the Siberian Jay (*Perisoreus infaustus*), the White Stalk (*Ciconia alba*), several Anserine birds, and the Isabelline Lark (*Galerita isabellina*), which, by the way, does not occur in Europe.

IT is locally stated that among the collections made by the Chilian exploring expeditions on the west coast of Patagonia in the *Chacabuco*, is a specimen of the huemul, an animal which had altogether been lost sight of. There are five well-prepared skins in the National Museum of Chile. Molina mentions it in his "Natural History of Chile," published in 1782. He describes a species of horse (*Equus bisulcus*), or rather an ass, with its hoofs divided like ruminants. He says it inhabits the most inaccessible parts of the Andes, and is difficult to be taken. Mr. E. C. Reed, of the National Museum of Chile, pronounces it to be a stag of the genus *Cervus*, and as not belonging to any new genus.

THE record of the "Astronomical and Meteorological Observations made during the year 1870 at the U.S. Naval Observatory" occupies a bulky quarto volume of about 1000 pages, and contains in its numerous carefully-constructed tables sufficient evidence of the amount and value of the work done at the Observatory. The U.S. Government contribute liberally to the support of the Observatory, the work of which is performed by an efficient staff. One of the most interesting parts of the record of work for 1870 is that describing the details of the Transit Circle.

WE would recommend to all interested in education a pamphlet by Mr. Henry Leedam, a practical teacher, entitled "Complete School Education." It is evidently the result of much thought and observation, and of advanced views of what constitutes a complete education even for boys intended for business. We are glad to see that in his system he gives great prominence to science, as one of the most efficient instruments in general training.

THE Liverpool papers report that a sharp shock of earthquake was felt at Southport on the evening of Wednesday, July 16, accompanied by a loud report. It was thought at first by many that a colliery explosion must have taken place in some of the collieries near Ormskirk, so loud and distinct was the first report. The other three—for there were four shocks—followed much quicker after each other than did the second after the first. There was no undulatory motion such as accompanied the severe shock which occurred about two years since.

ON May 10 a strong shock of earthquake, lasting two seconds, occurred at Opiape, in North Chile.

A COLLECTION of stone implements from Costa Rica, in Central America, has been sent to the American Museum of Natural History in New York.

DON CARLOS MOESTA, formerly Director of the Astronomical Observatory at Santiago, in Chile, has been appointed Chilian Consul-General in Saxony.

THE sixth annual report of the Provost of the Peabody Institute of Baltimore, to the trustees, dated June 5 of this year, is in all respects very satisfactory, and shows that the Institute forms an important means of education, literary and scientific, in the city to which it belongs. The library is a large one, upwards of 50,000 volumes, and the number of readers has increased considerably during the year, the proportion of scientific works sought for being on the whole, as things go, large. During the year 120 lectures were delivered, of which 20 were popular, and 90 special class lectures in particular departments. Though scientific lectures seem to be much less attractive than lectures in literature, still the Provost rightly thinks they should be persisted in, especially as this is one of the main objects of the institution, which is well supplied with scientific apparatus. We have no doubt that by judicious arrangement of subjects and hours, and by securing competent lecturers who know how to make their subjects attractive, scientific lectures will become increasingly popular.

WE give the following on the authority of the *American Artisan*:—The President of Rutgers College, New Jersey, Dr. Campbell, recently found beneath some of the trees in the campus, numerous carpenter bees, each minus its head. Having called the attention of Rev. Samuel Lockwood, the eminent naturalist, to the fact, careful observations were made with interesting results. It was first noted that these bees were all of the same species, and were all honey-gatherers. The case at first appeared to be one of wanton massacre; the merciless executioners being common Baltimore orioles. On making a more thorough examination of the headless trunks, it was discovered that every body was empty, the insect having been literally eviscerated at the annular opening made at the neck by the separation of the head. The interesting fact disclosed by these observations is that these birds had learned that the body of these particular bees—the stingless males—were filled, or contained honey sipped from the blossoms of the horse-chestnut; and so they watched the insects until they were fully gorged, then, darting upon them, snipped off their heads, and always at one place, the articulation, thus showing themselves acquainted with the anatomy of their victims as well as their habits, and taking advantage of both for the gratification of their love for sweets.

THE *Journal of the Franklin Institute* says that the splendid telescope designed for the National Observatory at Washington will, in all probability, soon be erected and in use. The work upon the new tower and dome, intended for its reception, is being rapidly brought to completion. The object-glass—the largest in the world, twenty-six and a half inches diameter, and thirty-two feet focal length—is now finished, and ready for the instrument. The cost of the new instrument, with the necessary machinery, will be about 30,000 dols., and that of the tower and dome, erected to receive it, about 15,000 dols. If to this we add the list of new apparatus already acquired or in process of construction for the Observatory, for the observation of the coming transit of Venus, the Institution will shortly be as well or, perhaps, better equipped than any other of its kind in the world.

THE additions to the Zoological Society's Gardens during the past week include two Argus Pheasants (*Argus giganteus*) from Malacca, presented by his Excellency, Sir H. Ord; a Jaguar (*Felis onca*) from America, presented by Mr. J. H. Murchison; a Himalayan Bear (*Ursus tibetanus*) presented by Mr. G. R. Taylor; two Mulita Armadillos (*Tatusia hybrida*) from Buenos Ayres, presented by Mrs. Mackinlay; two White-crested Guans (*Pipile jacutinga*) from British Honduras, presented by Mr. S. Carmichael; a Patas Monkey (*Cercopithecus ruber*) from West Africa, presented by Mr. E. Hoal; three Black Vultures (*Cathartes atratus*) from America, presented by Mr. C. C. Lovesy; three Fournier's Capromys (*Capromys pilorides*) from Cuba, presented by Mr. J. R. Watkins; a Rhesus Monkey (*Macacus erythræus*) from India, presented by Miss E. D. Wishart; a Sable Antelope (*Hippotragus niger*), from South Africa, deposited.

RESEARCHES ON EMERALDS AND BERYLS *

PART I. ON THE COLOURING-MATTER OF THE EMERALD.

FROM the time of Vauquelin's analyses, the colour of the emerald was always regarded as due to the presence of oxide of chromium, until the publication of the memoir of Lewy, who ascertained that emeralds contained that element, and concluded that the colour was due to the presence of some organic substance. Lewy also affirmed that the deepest tinted emeralds contained the most carbon. Wöhler and Rose, on the other hand, having exposed emeralds to a temperature equal to the fusing-point of copper for one hour, without their losing colour, and also having fused colourless glass with minute quantities of oxide of chromium and obtained a fine green glass, considered chromium and not organic matter to be the cause of the colour.

Boussingault, in the course of an investigation of the "morallons," arrived at the same conclusion as Wöhler and Rose; and although admitting them to contain carbon, denied that it was the cause of their colour, inasmuch as they endured heating to redness for one hour without loss of colour. This result has been confirmed by Hofmeister. I have carefully repeated and extended these experiments. The emeralds employed were canutillos from Santa Fe de Bogota. Their specific gravity was 2·69.

One of the above emeralds was exposed for three hours in a platinum crucible to a bright reddish-yellow heat. At the end of the operation it was rendered opaque on the edges, but the green colour was not destroyed. This experiment completely confirms those of Wöhler and Rose and Hofmeister. The power of the colouring-matter to resist a red heat having made me inclined to disconnect the question of the colour from that of the presence of carbon, I made experiments to determine whether beryls contained that element, and, if so, to what amount. The experiments given further on, were made at this stage of the inquiry, and the result showed that the beryl analysed† contained the same amount of carbon as Lewy's emerald.

Although demonstration had been obtained of the presence of carbon in the beryl A, it was still possible that it might have been derived from the decomposition of a carbonate. To settle this question, an apparatus was so arranged that the beryl could be treated with sulphuric and chromic acids successively. It was found that no carbonic anhydride was liberated by sulphuric acid, but the addition of chromic acid caused it to appear immediately. The numerous precautions taken are fully described in the original paper.

Strictly comparative experiments were then made upon minute quantities of charcoal and graphite, the results indicating the carbon contained in the beryl A to be in a condition which is more slowly attacked than either charcoal or graphite, and it is probably in the form of diamond, as has been shown to occur with the carbon contained in artificially crystallised boron.

The presence of carbon in beryls does not appear to be invariable. After repeated experiments upon another large beryl from Haddam County, North America, I was unable to satisfy myself that it contained carbon.

The next point I wished to ascertain was the relation borne by the quantity of carbon in the beryl A to that in the emerald. For this purpose I employed a similar apparatus to that used by Dumas in his researches on the atomic weight of carbon previously alluded to. The following percentages were obtained:—

	Beryl A. I.	Beryl A. II.	Emerald.	Lewy. Emerald (mean).
Carbon anhydride	0·31	0·31	0·26	0·28
Water	1·35	1·73	1·20	1·89

II.—ON THE EFFECTS OF FUSION UPON EMERALDS AND BERYLS.

On the Effects of Fusion upon Opaque Beryls.—In order to study the effects of fusion upon beryls or emeralds, I found it necessary to use the oxyhydrogen blowpipe. My first experiments were made upon the beryl A; it weighed 62·54 grms., and its density was 2·65.

The phenomena observed on submitting a fragment of beryl to the action of the flame are very beautiful. Having so adjusted the flame that the beryl fuses tranquilly, and is yet at the exact point of maximum heat (if the substance is not too large for the apparatus), it no longer lies as a shapeless mass on the carbon support, but gathers together, rises up, and forms a perfect bead—round, clear, and brilliant. To obtain the adjustment of position necessary for this result, it is indispensable to wear very dark glasses, so dark, indeed, that objects can scarcely be discerned through them in broad daylight. Without this precaution, the minute details of the globule cannot be observed. The heat and glare would also seriously affect the sight. If all is working properly, the bead should be quite mobile; and advantage of this must be taken to keep it incessantly rolling, and yet not remove it from the point where it gives out the most brilliant light. By this means the whole globule is rendered transparent. If, on the other hand, it is allowed to remain without motion on the carbon (unless the globule be very minute), it will be found, when cold, to have a white opaque base, passing into the centre of the bead in a conical form, and entirely destroying its beauty.

The globules thus obtained from the beryl A were clear and colourless, but generally contained a few minute air-globules and striæ, which become obvious under the lens. Towards the end of this part of the investigation I succeeded in almost entirely avoiding these defects; but I have been compelled for a time to abandon experiments in this direction in consequence of the strain thrown upon the eyes.

When chromic oxide is added to the beads, and they are again carefully fused, they acquire a fine green colour; the tint is, however, inferior to that of the emerald. The green beads may, by an intense and prolonged heat, be rendered colourless. With cobalt oxide the beads afford beautiful blue glasses of any desired shade; and in all cases the results are the same as with the artificial mixture of beryl ingredients to be described further on.

The effect of fusion upon the beryl is to lessen the hardness and lower the specific gravity. The globules may be scratched by quartz. The specific gravity was found to be 2·41.

The beryl, therefore, lost nine per cent. of its density in passing from the crystalline to the vitreous state.

I was desirous of carefully comparing this loss of density undergone by beryls with that of rock crystal fused under the same circumstances. I have repeated with great care the determination of the specific gravity of rock-crystal, both before and after fusion. Before fusion it was 2·65, and afterwards, 2·19.

Rock-crystal loses, therefore, no less than seventeen per cent. of its specific gravity on passing from the crystalline to the amorphous state, or about half a per cent. less than is undergone by garnets, according to the observations of Magnus; whereas the beryl A only lost nine per cent., or little more than half as much.

On the Effects of Fusion upon Emeralds.—On heating alone before the oxyhydrogen blowpipe, emeralds bear a bright red heat without losing their colour; and at a heat which causes incipient fusion, the edges turn colourless and opaque, while the centre remains green. After fusion for a short time they yield an opalescent greenish glass, which, kept for a long time at the maximum temperature of the blowpipe, becomes quite transparent and almost colourless. The addition of chromic oxide causes the bead to become of a dull green colour, which is not improved by moderate heating. The fact that emeralds endure a temperature capable of fusing the edges, without the centre losing colour, appears conclusive against the idea of the colouring-matter being organic. The beads produced by the fusion of emeralds resemble those formed in the same manner from beryls; the phenomena during the fusion are also nearly alike; but it takes longer and a higher temperature to produce a colourless transparent bead with emeralds than with colourless beryls. The beads can be scratched by quartz, and the density is reduced to 2·40. The density of fused emeralds is therefore almost exactly the same as the globules obtained in a similar manner from the beryl A.

On the Effects of Fusion upon an Artificial Mixture of Beryl Ingredients.—Being desirous of trying the effects of fusion upon an artificial mixture of the same composition as that of a beryl, I made a series of careful analyses of the beryl A. Even my earlier analyses enabled me to obtain a sufficiently close approximation to the compositions of the beryl A. The following were the proportions used:—

Silica	67·5
Alumina	18·5
Glucina	14·0
	100·0

* Abstract of paper read before the Royal Society, June 19. By Greville Williams, F.R.S.

† As this beryl will be repeatedly alluded to in this paper, and especially in the second part, I shall, for convenience of reference, call it "beryl A." It was found in Ireland.

I did not introduce any iron or magnesia, as I regard them as accidental impurities varying in amount.

When a mixture of the above composition is exposed to the flame of the oxyhydrogen blowpipe, it fuses with almost exactly the same phenomena as with the natural beryl. It is, however, as might be anticipated from the absence of iron and chromium, much easier to get a colourless transparent bead with the mixture than with either emeralds or beryls. The greatest difficulty in this respect is, of course found with emeralds. The specific gravity of the artificial fused globules was 2·42, or almost exactly the same as the density of native emeralds and beryls after fusion.

When a small portion of chromic oxide is added to the artificial mixture and the whole is subjected to fusion, the resulting bead is of a rich yellowish green, and in many experiments approached to the emerald tint; but, as a rule, the colour is more of a faded leaf-green: and, although I have never obtained a globule of the vivid tint of a fine emerald, the glasses, when well cut, are quite beautiful enough to serve as jewels. Prolonged heating gradually diminishes the colour, the bead gradually becoming of the palest bottle-green, and, finally, nearly colourless. This result is the same as with the emerald.

The metallic oxide which yields the finest tints when fused with opaque beryls, or the artificial mixture, is that of cobalt. The manner in which this oxide withstands the intense heat of the oxyhydrogen flame is remarkable. All tints, from nearly black to that of the palest sapphire, can be obtained, and the resulting glasses, when cut, are extremely beautiful, and have almost the lustre of crystallised gems.

The globules obtained by fusing the artificial mixture of beryl ingredients with didymium oxide show the characteristic absorption-spectrum of that metal in a very perfect manner, the lines being intensely black. Even when the bead is quite opalescent from insufficient heating, the black lines are beautifully distinct in the spectroscope. With a large quantity of didymium oxide the beads are of a lively pink, becoming more intense by artificial light, and, when cut, form very pretty gems. The presence of didymium in sufficient quantity raises the specific gravity to 2·59, being nearly the same as that of the emerald before fusion.

Conclusions.—The evidence given in this paper, showing that colourless beryls may contain as much carbon as the richest tinted emerald, taken in conjunction with the ignition experiments, and the results of the fusion of chromic oxide with colourless beryls, and with an artificial mixture of the same composition, leave me no room to doubt the correctness of Vauquelin's conclusion, that the green colour of the emerald is due to the presence of chromic oxide.

The fact that emeralds and beryls lose density when fused cannot properly be cited as proving that they have been made in nature at a low temperature; for it is quite possible that they were crystallised out of a solution in a fused mass, originally formed at a temperature high enough to keep the constituents of the emerald in a state of fusion, and that the crystals developed themselves during a slow process of cooling or evaporation. The method employed by Ebelmen for the artificial production of chrysoberyl, namely, heating alumina, glucina, and carbonate of lime with boracic acid in a porcelain furnace until a portion of the menstruum had evaporated, yielded crystals of the true specific gravity, showing the density of minerals to be less dependent on the temperature at which they are produced than upon their crystalline or amorphous state.

One crystalline gem (the ruby) has undoubtedly been produced in nature at a high temperature. I have frequently repeated Gaudin's experiment on the artificial formation of this stone, and can confirm most of his results. I did not, however, find the density to be quite the same as the native ruby or sapphire, which is, in different specimens, from 3·53 to 3·56. Artificial rubies of the finest colour made by me by Gaudin's process had a specific gravity of 3·45, which is not 3 per cent. lower than that of the ruby. The reason for this close approximation will be found in the fact that fused alumina crystallises on cooling. The crystallisation is, however, confused and imperfect, which causes the resulting product to be only partially transparent, and to have a slightly lower specific gravity than the natural gem. It is consequently scarcely correct to call the fused stones made by Gaudin's process "artificial rubies."

I have convinced myself that rubies have been formed in nature at a temperature equal, or nearly equal, to that of the fusing-point of alumina, from the circumstance that the reaction between chromic oxide and alumina, which results in the development of the red colour of the gem, is not effected at low or even moderately high temperatures, but requires a heat as high as that of the oxyhydrogen blow-pipe. It is not necessary that the chromium should be presented to the alumina in the form of chromic acid. It appears, therefore, that the red colour of the ruby is not caused by the presence of chromic *acid*. It is, in fact, a colour reaction *sui generis* between alumina and chromic oxide, which, as far as my experiments have gone, only takes place at very elevated temperatures.

SOCIETIES AND ACADEMIES

London

Royal Horticultural Society, June 18.—Scientific Committee.—Dr. Hooker, C.B., F.R.S., in the chair.—Dr. Capanema, from Rio Janeiro, described the destruction in Brazil of orange, peach, and cotton plants, more especially at Milagres, in the province of Ciara, from the attacks of a Coccus. An orange tree of historic interest more than 200 years old had been destroyed by this insect.—Dr. Masters, F.R.S., reported upon a double-flowered variety of *Lobelia erinus*. The calyx was normal, the corolla was affected by a *dédoublement*, the stamens were more or less petaloid, the ovary was represented by obscure carpellary leaves bearing ovules on the margins.—Mr. Lane, of Berkhampstead, sent a cutting of a yellow-leaved variety of Laburnum which had broken from an old stem of the ordinary kind previously budded some time before with the yellow one. The buds which were inserted died, but as in other cases the tendency to variegation in the foliage had been communicated to the stock.—The Rev. M. J. Berkeley stated that he had provisionally referred the thread blight which had attacked the tea plantations in India to *Corticium repens* Berk.

July 2.—A. Smee, F.R.S., in the chair.—Prof. C. Babington sent flowers of a potato in which the petals were replaced by stamens.—Dr. Denny sent a Pelargonium which showed an interesting reversion to one of the original wild forms (*P. inquinans*). It had been raised from Wellington as the seed parent, and Marathon as the pollen parent, both varieties of the nose-gay class.

Edinburgh

Scottish Meteorological Society, July 2.—Sir Thomas Buchan Hepburn in the chair.—The Council reported to the General Meeting, that there are 92 Stations in Scotland in connection with the Society, 5 in England, 4 on the Continent, 2 in Iceland, 1 in Farö, and 1 in South America; that there are 9 honorary, 16 corresponding, and 557 ordinary members; that the value of the Instruments at the Society's Stations amounts to 1,173*l*., of which 218*l*. belongs to the Society, and the rest to local parties; and that during the past ten years, 63 certified Barometers, 59 louvre-boarded boxes, on Stevenson's pattern, for holding thermometers, had been despatched to the Society's Stations, and about 800 thermometers compared in the office. In reply to an application from a Committee of the British Association, the Council have intimated that they will, as hitherto, be glad to make the unpublished meteorological observations in their possession available to scientific men, and free of charge, in so far as the limited means of copying at their disposal will enable them to do so.—Mr. Buchan gave in the report from the Committee which had been appointed to inquire into the subject of the Herring Fisheries in relation to Meteorology. The returns of the fishings at Wick, Buckie, Peterhead, and Eyemouth, for six seasons of thirteen weeks each (1867-1872) had been examined, and the catches of herring compared with the mean daily temperature of the sea and that of the air with the height of the barometer, the direction and force of the wind, storms of wind, thunderstorms, Auroras, and rain. The fishing season at these places, in common with the whole of the east coast of Great Britain, from Scotland to Flamborough Head, occurred during July, August, and September, ending somewhat earlier at the northern than at the southern stations. From the mean daily catch at Wick and Buckie, from which daily returns had been made, it is seen that during the six years the largest average catches were taken between the 13th and 22nd August, and the whole herring season began about the 19th July, and ended on the 2nd September. That period agreed exactly with the highest mean daily temperatures of the sea during the year, and the period of the heaviest catches coincided with that of the absolute maximum temperature of the sea. It is premature to affirm that there is any absolute connection between those two facts, seeing, for example, that the herring season at Stornoway occurred in May and June, but it is, to say the least, a striking coincidence. The relations of the temperature of the sea to the migrations of the herrings will receive further elucidation when, the returns from Stornoway and other places being discussed, it is exactly determined with what critical epochs of the annual march of the temperature of the sea, the herring seasons, and the periods of maximum catches in different districts correspond. In almost all cases the largest catches occurred with a high, steady barometer and light winds, indicating settled weather; and very light catches, in the height of the season, with thunder-storms, a low and unsteady barometer, northerly and easterly winds, and weather more or less stormy. It was recommended that, in the further prosecution of the inquiry, attention be given to investigate the causes which determine the time of the commencement of the fishing, the fluctuations of the catches in different districts or on different days, and the end of the fishing season. Self-registering thermometers, similar to those now in operation at Peterhead Harbour, established at different points on the coast, and observations on the temperature of the sea, by the more intelligent fishermen on their fishing excursions, could not fail to contribute very material assistance to this difficult inquiry. The Committee was re-appointed to contiuue their investigation of this important question, Mr. Thomas Stevenson, convener.—Mr. Robert Louis Stevenson then read a paper on "Local Conditions influencing Climate in Scotland;" in which the effect of shelter from the East and West, and of relative proximity to the sea, were chiefly considered. The mean annual temperature of Unst and Monach, two of the Society's stations, which, being situated on outlying islands, are almost wholly removed from the influence of the land, was found to coincide with the mean sea temperature in their neighbourhood. A series of observations was proposed at three or four stations, provided with thermometers similarly placed and protected, one set being close to the shore, another a mile inland, and the others at intermediate distances, in order to decide in what manner the climatic influence of the sea extends inland. Mr. Milne Home stated his belief that the Society would be able to carry out the proposal.

BERLIN

German Chemical Society, July 14.—C. Böttinger has obtained a new acid from pyruvic acid, by heating it to 130° with a small quantity of baryta. It is well crystallised, and having two atoms of hydrogen more than uritric acid, has obtained the name of hydruritic acid. Its mode of formation is expressed by the formula

$$4C_3H_4O_3 = \underset{(new\ acid)}{C_9H_{10}O_4} + \underset{(oxalic\ acid)}{C_2H_2O_4} + CO_2 + 2H_2O.$$

A. Kekulé and A. Fleischer have treated camphor with iodine and thus transformed it into oxy-cymol, a phenotic body boiling at 231° of the formula $C_{10}H_{14}O$. Prof. Kekulé considers this reaction as a proof for a new graphic formula for camphor, which he intends to prove by further researches.—F. Landolph reported on the action of nitric acid on various cymols. Camphor-cymol yields mono-nitrocymol and mono-nitro-toluyic acid, which is volatile below its fusing point. Cymol from ptychotis-oil yields dinitro-cymol and a mononitrotoluyic acid different from the above and fusing at 184°.—F. Fittica has obtained identical products from the cymols of camphor, ptychotis-oil and thymol. All of them yield two different mono-nitro-cymols, one solid, the other liquid.—A. Kekulé has found amongst the products of PCl_5 on phenol-parasulfuric acid a body of the formula $PO\cdot\genfrac{}{}{0pt}{}{OC_6H_4Cl}{Cl_2}$, yielding with water a corresponding acid and chlorophenol.—V. v. Richter has found that benzoate and formate of potassium fused together yield both terephthalic and isophthalic acids, a fact which renders untrue many conclusions on the constitution of aromatic bodies which have been founded on the production of either one or the other of the above acids with derivatives of benzol and formate of potash. Prof. Richter thinks that either one or the other of those isomeric acids are formed according to the temperature employed in fusing.—F. Baumstark has found in urine a new neutral crystallised substance of the formula $C_3H_8N_2O$, which with alkalis yields lactic acid and ethylamine.—K. Birnbaum reported on the attraction of water by superphosphate of calcium exposed to moist air.—G. Barbaglia reported on the impurities contained in commercial isobutylic aldehyde (chiefly acetone) derived from propylic alcohol, and on the conditions under which isobutylic alcohol yields acetone.—A. Oppenheim communicated the continuation of his researches on cymoles derived from various $C_{10}H_{16}$ isomers. Those from terpene and from citrene yielding both paratoluyic as well as terephthalic and acetic acids, can only differ in the position of the 2 atoms of hydrogen which they contain in addition to cymol. This renders improbable that all $C_{10}H_{16}$ yielding cymoles should be constituted according to the view lately expressed by Kekulé.

PARIS

Academy of Sciences, July 7.—M. Bertrand, president.—The proceedings commenced with the announcement, by the perpetual secretary of the award of the Albert Medal of the Society of Arts to M. Chevreul.—During the meeting the commission charged with the recommendation of a candidate for the place left vacant by the decease of M. de Verneuil, presented its report. It recommends, 1st, M. de Lesseps; 2nd, MM. Bréguet, du Moncel, Jacqmin, and Sedillot.—The following papers were read:—Theory of the planet Saturn, by M. N. J. Leverrier.—On an isochronous regulator constructed by M. Bréguet for the Transit of Venus at Yokohama, by M. Yvon Villarceau.—On the method of action of the water during the reactions accompanying the mixing of neutral, acid, and alkaline solutions, by M. Becquerel.—On the definition attainable with small astronomical telescopes, by M. d'Abbadie.—A direct demonstration of the fundamental principles of thermo-dynamics; the laws of friction and concussion, by M. A. Ledieu.—Thermal researches on saline solutions by M. P. A. Favre.—On the fossils of the phosphatic chalk of Quercy, by M. P. Gervais.—On the development of the plague in the mountainous countries and plateaus of Europe, Africa, and Asia, by Dr. Tholozan.—On the iron ores of the department of Ille-et-Villaine, by M. Delage.—Experiments on the action of ammonia and the prolonged action of water on the Phylloxera, by M. Gueyraud.—On magnetism, by M. du Moncel.—On the variable period of the closing of a Voltaic circuit, by M. Cazin.—On an "absolute" barometer, by MM. Hans and Hermary.—On the dissociation of mercuric oxide, by M. H. Debray.—On a method of comparing different gunpowders, by M. de Tromenec.—On the oxalins, or ethers of glycerin and the polyatomic alcohols, by M. Lorin. Oxalin is produced by the action of oxalic acid on glycerin.—On the zoological position and rôle of the acarians known as *Hypopus*, *Homopus*, *Trichodactylus*, by M. Mégnin.—Experimental contributions to the history of digestion in birds, by M. Jobert.—Observations on certain of the organic liquids of fish, crustacea, and cephalopoda, by M. F. Papillon.—On the heat of combustion of explosive substances, by MM. Roux and Sarrau.—New experiments relating to the theory of the thrust of earthworks, by M. J. Curie.

DIARY

FRIDAY, JULY 25.

QUEKETT CLUB, at 8.—Anniversary.

SATURDAY, JULY 26.

BOTANIC SOCIETY, at 3 45.

CONTENTS

PAGE