REPORT

OF THE

THIRTY-EIGHTH MEETING

OF THE

BRITISH ASSOCIATION

FOR THE

ADVANCEMENT OF SCIENCE;

HELD AT

NORWICH IN AUGUST 1868.

LONDON:
JOHN MURRAY, ALBEMARLE STREET.
1869.

ADDRESS

OF

JOSEPH D. HOOKER, F.R.S.,

D.C.L. OXON.; LL.D. CANTAB.; &c.

PRESIDENT.

My Lords, Ladies, and Gentlemen,

Thirty years will to-morrow have elapsed since I first attended a Meeting of the British Association; it was the one which opened at Newcastle on the 20th of August, 1838. On that occasion, the Council of the Association resolved to recommend to Her Majesty's Government the despatch of an expedition to the Antarctic regions, under the command of Captain James Ross; and it was from Newcastle that I wrote to my friends announcing my resolve to accompany it, in whatever capacity I could obtain a situation amongst its officers. It was thus that my scientific career was first shaped; and it is to this expedition, which was one of the very earliest results of the labours of the British Association, that I am indebted for the honour you have conferred upon me, in placing me in your President's chair.

If I now look back with pride to those immediately following years, when I had a share, however small, in the discovery of the Antarctic Continent, the Southern Magnetic Pole, the Polar Barrier, and the Ice-clad Volcanos of Victoria Land, I do so also with other and far different feelings. Thirty years, as statisticians tell us, represent the average duration of human life; I need not say, that, as measured by the records of the British Association, a human lifetime is far shorter than this; for of the fourteen officers who presided over us in 1838, but two remain, your former President and devoted adherent for thirty-five years, Sir Roderick Murchison, who delivered the opening address on that occasion, and whose health, I regret to add, prevents his attendance at this Meeting; and your faithful and evergreen Secretary, Professor Phillips, upon whose presence here I congratulate both you and him.

Again, looking back beyond thirty years ago in the pages of your Records, I find those to have been halcyon years for Presidents, when the preparation and delivery of the Addresses devolved upon the Treasurer, Secretary, or other officer than the President; and that in fact Presidential Addresses date from the first Meeting after that at Newcastle. Of late years these Addresses have been regarded, if not as the whole duty of the President, certainly as his highest; for your sakes, as well as for my own, I wish this were not so; both because there are amongst your officers so many men far more competent than I am, and because I believe that the responsibility which the preparation of these Addresses entails, disadvantageously limits your choice of Presidents. The impression is very prevalent that the Address should either be a scientific *tour de force*, philosophical and popular, or a *résumé* of the progress of one or more important branches of science; and this view of the duty has greatly embarrassed me, inasmuch as I am unable

to fulfil either of these requirements. On various occasions during the last half year I have essayed to fulfil the wishes of my botanical friends, that I should either discuss the phenomena of the Vegetable kingdom in their relation to collateral sciences, or sketch the rise and progress of Scientific Botany during the present century, or a portion of it; but every such essay has been quickly frustrated by the pressure of official duties. Such themes require much research, much thought, and, above all, some continuous leisure, during which the whole mind may be concentrated on the method of treatment, as well as on the material to be treated of; and this leisure was incompatible with the discharge of my duties as administrator of a large public department, entailing a ceaseless correspondence with the Government offices, and with Botanical establishments all over the globe. And I do not ask your indulgence for myself alone, for there are at this Meeting official men of scientific attainments, who have accepted the Presidentships of Sections, but who, on leaving their posts to do your bidding, drag a lengthening chain of correspondence after them, and sacrifice no short portion of those brief holidays which are allowed to public officers. After all, it is deeds, not words, that we want from them; and I am proud to find our Sections presided over by men who have won their spurs in their respective sciences, and who will wear them in the chairs they occupy, and use them, too, if needs must.

For my own part I propose to offer you some remarks upon several matters to which the attention of your Committee was directed when at Dundee, and then upon some of the great advances that have been made in Botany during the last few years; this will infallibly drag me into Darwinism: after which I shall allude to some matters connected with that dawning science, the Early History of Mankind, a theme which will be a distinguishing collateral feature of the Norwich Association. If in all this I disappoint you, it will be my solace to hope that I may thereby break the fall of some future President, who, like myself, may have the will, but not the time, adequately to meet your great expectations.

Before commencing, however, I must advert to a circumstance which cannot but be uppermost in the minds of all habitual attendants at these annual gatherings; it is, that but for a severe accident there would have been present here to-night the oldest surviving, and indeed the first but two of the Presidents of the British Association: my geological friends will understand to whom I allude, as that Rock of Science in whom age and the heat and shocks of Scientific Controversy have wrought no metamorphosis, and developed no cleavage planes—a man of whom both Norwich and the Association are proud—your Canon, our father, Sedgwick.

My first duty as President is the pleasant one of introducing to you the members of the International Congress of Pre-historic Archæology, who, under the Presidency of Sir John Lubbock, himself a master of this branch of knowledge, open their third session to-morrow in this city. The researches which specially occupy the attention of the Congress are perhaps the most fascinating that ever engaged the faculties of man; and pursued as they now are in a scientific spirit, and in due subjection to scientific methods, they will command all the sympathy, and their meetings will receive all the support that my fellow members of the British Association can afford to them. And there is one way in particular by which we can show our goodwill and give our support, so simple that I hope no one will neglect it; and that is that we shall all call at their official residence at the Free Library, inscribe our names in their books, and obtain cards for their meetings.

The next subject which I have to bring officially before you will interest the members of the Congress no less than ourselves, and relates to the action of your Committee appointed last year to represent to the Secretary of State for India "the great and urgent importance of adopting active measures to obtain reports on the physical form, manners, and customs of the indigenous populations of India, and especially of those tribes which are still in the habit of erecting Megalithic monuments."

Upon consideration the Committee decided that it would be better in the first instance, to direct the attention of the Secretary of State to the last-mentioned subject only, both because the whole inquiry was so vast, and because systematic efforts are now being made by the Indian Government to obtain photographs and histories of the native Indian tribes. Their efforts are, as regards the photographs obtained in India, eminently successful, which renders it all the more disappointing that the descriptive matter appended to them in this country, and which is happily anonymous, is most discreditable to the authority under which it is issued*.

It will, no doubt, surprise many here to be told that there exists within 300 miles of the British capital of India, a tribe of semi-savages who habitually erect dolmens, menhirs, cysts, and cromlechs, almost as gigantic in their proportions as the so-called Druidical remains of Western Europe, which they greatly resemble in appearance and construction; and what is still more curious, though described and figured nearly a quarter of a century ago by Col. Yule, the eminent oriental geographer, except by Sir John Lubbock these erections are scarcely alluded to in the modern literature of prehistoric monuments. In the Bengal Asiatic Journal for 1844, you will find Col. Yule's description of the Khasia people of East Bengal; an Indo-Chinese race, who keep cattle but drink no milk, estimate distances traversed by the mouthfuls of pawn chewed *en route*, and amongst whom the marriage tie is so loose that the son commonly forgets his father, while the sister's son inherits property and rank. Dr. Thomson and I dwelt for some months amongst the Khasia people, now eighteen years ago, and found Col. Yule's account to be correct in all particulars. The undulatory eminences of the country, some 4–6000 feet above the level of the sea, are dotted with groups of huge unpolished square pillars, and tabular slabs supported on three or four rude piers.

In one spot, buried in a sacred grove, we found a nearly complete circle of menhirs, the tallest of which was thirty feet out of the ground, six feet broad, and two feet eight inches thick; and in front of each was a dolmen or cromlech of proportionately gigantic pieces of rock.

The largest slab hitherto measured is thirty-two feet high, fifteen feet broad, and two feet thick. Several that we saw had been very recently erected, and we were informed that every year some are put up, but not during the rainy season, which we spent in the country. The method of separating the blocks is by cutting grooves, along which fires are lighted, and into which, when heated, cold water is run, which causes the rock to split along the groove; the lever and rope are the only mechanical aids used in transporting and erecting the blocks. The objects of their erection are various—sepulture, marking spots where public events had occurred, &c. It is a curious fact that the Khasian word for a stone, "Mau," as commonly occurs in the names of their villages and places, as that of Man, Maen, and Men, does in those of

* I am informed that measures have been taken to repair this, and that Col. Meadows Taylor, than whom a more competent man could not be found, has been appointed to undertake the literary and scientific portions in future.

Brittany, Wales, Cornwall, &c.; thus Mausmai signifies in Khasia the Stone of Oath; Mamloo, the Stone of Salt; Mauflong, the Grassy Stone, just as in Wales, Penmaenmawr signifies the Hill of the Big Stone; and in Brittany a Menhir is a Standing Stone, and a Dolmen a Table Stone, &c.

At the date of Col. Yule's, as of my visit to these people, our intercourse with them was limited, and not always friendly; we were ignorant of their language, and they themselves were far from communicative. Of late, however, the country has been more opened up, and the establishment of a British cantonment amongst them renders it all the more important that the inquiry into their origin, language, beliefs, customs, &c. should be followed up without delay. This will now be done, thanks to your representations; and I cannot doubt that it will throw great light upon that obscure and important branch of Prehistoric Archæology, the Megalithic monuments of Western Europe.

The Council of the Association, upon the recommendation of the Biological Section, appointed a committee to report upon the subject of the Government of the Natural-History Collections of the British Museum; which resulted in a deputation which represented to the Prime Minister in the name of the Council, that it was desirable that these collections should be placed under the control of a single officer, who should be directly responsible to a Minister of the Crown; and that this opinion was shared by an overwhelming majority of British naturalists. The reasons stated were, that there appeared no reason why the National Collections of Natural History should be administered in a way different from that which was found applicable to the Royal Gardens and Botanical Collections at Kew, the Museum of Practical Geology, and the Royal Observatory at Greenwich*, and that the interposition of any Board or Committee between the Superintendent of the Collections and the Government must interfere with the responsibility of the Superintendent and the efficient control of the Minister.

It was not the first time that this subject had been brought before Her Majesty's Government; since ten years previously a few Naturalists, consisting of Messrs. Bentham, Busk, Darwin, Huxley, Dr. Carpenter, and myself, together with the late Professors Lindley, Henslow, Harvey, and Henfrey, had presented a memorial to Mr. Disraeli, then Chancellor of the Exchequer, embodying precisely the same views as to the government of the Natural-History Department of the British Museum, together with a scheme for the administration of the whole Metropolitan Natural-History Collections, Geological and Botanical; and I have only to add, regarding this document, that the surviving memorialists have not during the ten intervening years, found reason to alter the views therein expressed on any vital point.

Of the objections to the present system of government by Trustees, some of the most grave have been stated by Mr. Andrew Murray in a communication †

* Since writing the above, I have been reminded of the constitution of the Board of Visitors to the Royal Observatory by the Astronomer Royal, who has favoured me with copies of the Regulations of the Royal Observatory (1852), and of his Report (for 1868) to the Board of Visitors.

From a perusal of this document, I find that the Board of Visitors is authorized to direct the Astronomer Royal to make such observations as the Board shall think proper; to inspect the instruments, and to communicate with the Lords of the Admiralty upon the arrangements for keeping them in order; to make any suggestions to the Lords of the Admiralty touching the Observatory, and to require of the Astronomer Royal every three months, a copy of the observations made, with a view to printing them. I also gather that, for the efficient administration of all the duties of the Observatory, the Astronomer Royal is solely responsible to the Lords of the Admiralty.

† Report for 1867. Transactions of Sections, p. 95.

made to the Biological Section at Dundee; to which I would only add, that though the Zoological Collections are the finest in the world, and the Geological and Palæontological of prodigious extent and value, there are of the forty-five Trustees, only three who have any special knowledge whatsoever of the branches of science these collections illustrate; that since Sir Joseph Banks's death, nearly half a century ago, no Botanist has ever been appointed a Trustee, though the Banksian Herbarium and Botanical Library, then amongst the most valuable in Europe, were left by their owner to the nation; and, in fine, that the interests of Botany have by the Trustees been greatly neglected.

Much as has been written upon the uses of museums, I believe that the subject is still far from being exhausted, for in the present state of education in this country, these appear to me to afford the only means of efficiently teaching to schools the elements of Zoology and Physiology. I say in the present state of education, because I believe it will be many years before we have schoolmasters and mistresses trained to teach these subjects, and many more years before either provincial or private schools will be supplied with such illustrative specimens as are essential for the teacher's purposes.

Confining myself to the consideration of provincial and local museums, and their requirements for educational purposes, each should contain a connected series of specimens illustrating the principal and some of the lesser divisions of the Animal and Vegetable Kingdoms, so disposed in well-lighted cases, that an inquiring observer might learn therefrom the principles upon which animals and plants are classified, the relations of their organs to one another and to those of their allies, the functions of those organs, and other matters relating to their habits, uses, and place in the economy of nature. Such an arrangement has not been carried out in any museum known to me, though partially attained in that at Ipswich; it requires some space, many pictorial illustrations, magnified views of the smaller organs and their structure, and copious legible descriptive labels, and it should not contain a single specimen more than is wanted. The other requirements of a provincial museum are, complete collections of the plants and animals of the province, which should be kept entirely apart from the instructional series, and from everything else.

The Curator of the Museum should be able to give elementary demonstrations (not lectures, and quite apart from any powers of lecturing that he may possess) upon this classified series, to schools and others, for which a fee should be charged, which should go to the support of the Institution. And the museum might be available (under similar conditions of payment) for lectures and other demonstrations.

Did such an illustrated typical collection exist in your rich and well-arranged Norwich Museum, I am sure that there is not an intelligent schoolmaster in the city who would not see that his school profited by the demonstrator's offices, nor a parent who would grudge the trifling fee.

You boast of a superb collection of Birds of Prey; how much would the value of this be enhanced, were it accompanied by such an illustration of the nature, habits, and affinities of the Raptores, as might well be obtained by an exhibition of the skeleton and dissected organs of one Hawk and one Owl, so laid out and ticketed that a schoolboy should see the structure of their beak, feet, wings, feathers, bones, and internal organs—should see why it is that Hawks and Owls are preeminent amongst birds for powers of sight and of flight; for circling and for swooping; for rapacity, voracity, and tenacity

of life,—should see, in short, the affinities and special attributes of Birds of Prey*.

A series of illustrated typical specimens, occupying some 500 to 800 feet of wall space, would give at a glance a connected and intelligible elementary view of the classification and structure of the whole animal kingdom; it would stand in the same relation to a complete Museum and Systema Naturæ as a chart on which the principal cities and coast-lines are clearly laid down does to a map crowded with undistinguishable details.

Excellent manuals of many branches of Zoology are now published which are invaluable to the advanced student and demonstrator, but from which the schoolboy recoils, who nevertheless would not refuse to accept objects and pictures as memory's pegs, on which to hang ideas, facts, and hard names. To schoolboys skeletons have often a strange fascination, and upon the structure of these the classification of the vertebrata much depends. What boy, who had ever been shown their skulls, would call a Seal or Porpoise a fish, or believe that a hedgehog could milk cows! as I am told many boys in Norfolk and Suffolk (as elsewhere) do implicitly believe.

Much of the utility of Museums depends on two conditions often strangely overlooked, viz. their situation, and their lighting and interior arrangements. The provincial Museum is too often huddled away, almost out of sight, in a dark, crowded, and dirty thoroughfare, where it pays dear for ground-rent, rates and taxes, and cannot be extended; the object, apparently, being to catch country people on market days. Such localities are frequented by the town's people only when on business, and when they consequently have no time for sight-seeing. In the evening, or on holidays, when they could visit the Museum, they naturally prefer the outskirts of the town to its centre.

Hence, too, the country gentry scarcely know of the existence of the Museum; and I never remember to have heard of a provincial Museum that was frequented by schools. I do not believe that this arises from indifference to knowledge on the part of the upper classes or of teachers, but to the generally uninstructive nature of the contents of these Museums, and their uninviting exterior and interior. There are plenty of visitors of all classes to the Museums at Kew, despite the counter attractions of the gardens; and I know no more pleasing sight than these present on Sunday and Monday afternoons, when crowded by intelligent visitors, directing their children's attention to the ticketed objects in the cases.

The Museum should be in an open grassed square or park, planted with trees, in the town, or its outskirts; a main object being to secure cleanliness, a cheerful aspect, and space for extension. Now vegetation is the best interceptor of dust, which is injurious to the specimens as well as unsightly, whilst a cheerful aspect and grass and trees will attract visitors, and especially families and schools.

If the external accessories of provincial Museums are bad, the internal arrangements are often worse; the rooms are usually lighted by windows on one side only, so that the cases between the windows are dark, and those opposite the windows reflect the light when viewed obliquely, whilst the visitor standing in front is in his own light. For provincial Museums, where space is an object, there is no better plan than rectangular long rooms, with opposite windows on each side, and buttress cases projecting into the room between

* This, which refers to the teaching of Natural History, is an operation altogether apart from training the mind to habits of exact observation; which, as is now fully admitted, is best attained in schools by Professor Henslow's method of teaching Botany.

each pair of windows. This arrangement combines economy of space with perfect illumination, and affords facilities for classification*.

In respect of its Natural-History Collections, the position of the British Museum appears to me disadvantageous; it is surrounded by miles of streets, including some of the principal Metropolitan thoroughfares, which pour clouds of dust, and the products of coal-combustion into its area day and night; and I know few more disappointing sights, to me, than its badly lighted interior presents on a hot and crowded public holiday, when whole families from London and its outskirts flock to the building. Then young and old may be seen gasping for fresh air in its galleries, with no alternative but the hotter and dustier streets to resort to. How different it would be were these Collections removed to the townward end of one of the great parks! where spacious and well-lighted galleries could be built, amongst trees, grass, and fountains; and where whole families need not be cooped up for the day in the building, but avail themselves of the fresh air and its accessories at the same time as they profit by the Museum.

Norwich, I hear with surprise, has no Public Park worthy of the name. That she may soon have one should be the endeavour of every citizen, and to have a good instructional series added to your admirable Museum, and this transferred to the Park, should be the aspiration of all who are interested in the education and moral well-being of their townsmen.

My remarks on the British Museum convey no reflection on the able officers who have, in so short a time, formed this wonderful Collection. Lawrence, in his Lectures delivered in 1818, congratulates his audience on the formation of a Zoological Collection having just been determined upon; in 1838, when I first knew the Museum, in Old Montague House, I was told it ranked about the sixth in Europe—now, and for some years past, it has been considered to be the finest in the world. This is due to the energy and ability of the Keepers and Curators; and in mentioning them, I would wish to pay a passing tribute to the merits of the venerable Dr. Gray, who has devoted his life to the development of the Zoological Department, with a singleness of purpose, liberality, and zeal that are beyond all praise.

At the time when Old Montague House contained the National Collections, there was but one Museum in the Metropolis in which the Naturalist could study to much purpose; this was the Hunterian (belonging to the Royal College of Surgeons), then under the superintendence of the late Mr. Clift and of Professor Owen, the friend of my early youth, when preparing myself to accompany the Antarctic Expedition, and who instructed me in the use of that now unrivalled series of Catalogues, that owes so much to himself. From the Museum of the Royal College of Surgeons, the national and provincial Museums of England have much to learn and to copy; and, thanks to the wisdom and munificence of the Council of the College, and to the zeal

* Upon this plan the large Museum in Kew is built, where the three principal rooms are 70 ft. long by 45 ft. wide, and each accommodates 1000 square feet of admirably lighted cases, 600 or 700 feet of wall-room for pictures and for portraits of naturalists, besides two fireplaces, four entrances, and a well-staircase, 11 feet square. A circular building, with cases radiating from the wall between the windows, would probably be the best arrangement of all. A light spiral staircase in the centre would lead to the upper stories. Two or more of the bays might be converted into private rooms, without disturbing the symmetry of the interior or intercepting the lighting of the cases. The proportions of the basement and first floor might be such as to admit of additional stories being added, and the roof might be so constructed as to be removable without difficulty, when an additional story was required; furthermore, rectangular galleries might be built, radiating from the central building, and lighted by opposite windows, with buttress cases between each pair of windows.

and ability of the present Conservator, Mr. Flower, it retains the position it attained thirty years ago, of being the best and richest institution of the kind in Europe.

In my own special science, the greatest advances that have been made during the last ten years have been in the departments of Fossil Botany and Vegetable Physiology.

In the past history of the globe two epochs stand prominently forward (the Carboniferous and the Miocene) for the abundant materials they afford, and the light they consequently throw on the early conditions of the vegetable kingdom. Why plants should have been so much more abundantly preserved during these than during some of the intervening or earlier epochs, we do not rightly know; but the comparative poverty of the floras of these latter is amongst the strongest evidences of the imperfection of the geological record.

Our knowledge of coal plants, which, since the days of Sternberg, Brongniart, and Lindley and Hutton, has been chiefly advanced by Gœppert and Unger on the Continent, and by Dawson in Canada, has of late received very important accessions through the untiring energy of Mr. Binney, of Manchester, who has devoted nearly thirty years to the search for those rarely found specimens which exhibit the internal structure of the plant. His elaborate descriptions of the most abundant, and, before his researches, the least understood plant of the coal-measures, *Calamites*, have just appeared in the memoirs of the Palæontographical Society; and some of Mr. Binney's materials having also formed the subject of a very recent and valuable paper by Mr. Carruthers, of the British Museum, I may quote their joint results as one. These show that *Calamites* is an actual member of the existing family of Equisetaceæ, which contained previously but one genus, that of the common mare's tails of our river-banks and woods; as also, that nearly a dozen other genera of coal-measure plants may be referred to it. This affinity of *Calamites* had, indeed, been guessed at before, but the genera now referred to it, having been founded on mere fragments, were always doubtful; but the value of these positive identifications is none the less on this account. It may hereafter prove of some significance, that these *Calamites*, which, in the coal epoch, assumed gigantic proportions, and presented multitudinous forms and very varied organs of growth, are now represented by but one genus, differing most remarkably from its prototype in size, and in the simplicity and uniformity of its vegetable organs.

Passing to the Tertiary Flora, the labours of Count Saporta in France, of Gaudin and Strozzi, and of Massolonghi in Italy, of Lesquereux in America, and above all, of Heer in Switzerland, have within the last ten years accumulated a vast number of species of fossil plants; and if the determinations of the affinities of the majority are to be depended on, they prove the persistence, throughout the Tertiary strata, of many existing families and genera, and the rarity of others than these. Here, however, much value cannot be attached to negative evidence. Almost the only available materials for determining the affinities of the vast majority of these Tertiary plants are their mutilated leaves, and, unlike the bones of vertebrate animals and the shells of Mollusks, the leaves of individual plants are extremely variable in all their characters. Furthermore, the leaves of plants of different natural families, and of different countries, mimic one another to such a degree that, in the case of recent plants, every botanist regards these organs as most treacherous guides to affinity. Of the structural characters, which are drawn from the internal organs of plants, and especially from their fruits, seeds, and flowers,

few traces are to be found in fossils; and it is from these exclusively that the position of a recent plant in the vegetable kingdom can be certified. An instructive instance of over-reliance on leaves, and perhaps too on preconceived ideas, happened not long ago to a Palæontologist of such distinguished merit that his reputation cannot suffer from an allusion to it. In the course of his labours upon some imperfect specimens from a most interesting locality, he referred three associated impressions of fossil leaves to three genera, belonging to as many different families of plants; and was thus helped to what would have been some important conclusions as to the vegetation of the period in which they were deposited. A subsequent observer, who is a botanist but not a palæontologist, declares the leaves thus referred to three genera to be the three leaflets of the leaf of one plant, and this the common blackberry, which still grows on the spot. Which of the two is right, I do not say; the fact shows to what opposite conclusions different observers of the same fossil materials may be led.

In this most unreliable of sciences—Fossil Botany—we do but grope in the dark; of the thousands of objects we stumble against, we here and there recognize a likeness to what we have elsewhere known, and rely on external similitude for a helping hand to its affinities; of the great majority of specimens we know nothing for certain, and of no small proportion we are utterly ignorant. If, however, much is uncertain, all is not so, and the science has of late made sure and steady progress, and developed really grand results. Heer's labours on the Miocene and Pliocene floras especially, are of the highest value and interest; his conclusions regarding the flora of the Bovey Tracey Coal-beds (for the publication of which, in a form worthy of their value and of their author's merit, we are indebted to the wise liberality of Miss Burdett Coutts) are founded on a sufficient number of absolute determinations; and his more recent 'Flora Fossilis Arctica' threatens to create a revolution in Tertiary Geology. In this latter work Professor Heer shows, on apparently unassailable evidence, that forests of Austrian, American, and Asiatic trees flourished during the Miocene period in Iceland, Arctic Greenland, Spitzbergen, and the Polar American Islands, in latitudes where such trees could not now exist under any conceivable conditions or positions of land, sea, or ice; leaving little doubt that an arboreous vegetation once extended to the Pole itself. Discoveries such as these appear at first actually to retard the progress of science, by confounding all previous geological reasoning as to the climate and condition of the globe during the Tertiary epoch.

I have said that the greatest botanical discoveries made during the last ten years have been physiological; and I here alluded especially to the series of papers on the Fertilization of Plants which we owe to Mr. Darwin. You are aware that this distinguished naturalist, after accumulating stores of facts in geology and zoology during his circumnavigation of the globe with Captain Fitzroy, espoused the doctrine of the continuous evolution of life, and by applying to it the principles of Natural Selection, evolved his theory of the Origin of Species. Instead of publishing these views as soon as conceived, he devoted twenty more years to further observation, study, and experiment, with the view of maturing or subverting them. Amongst the subjects requiring elucidation or verification, were many that appertained to Botany, but which had been overlooked or misunderstood by botanical writers; and these he set himself to examine rigorously.

The first fruit of his labours was his volume on the 'Fertilization of Orchids,' undertaken to show that the same plant is never continuously fertilized by its own pollen, and that there are special provisions to favour

the crossing of individuals. As his study of the British species advanced, he became so interested in the number, variety, and complexity of the contrivances he met with, that he extended his survey to the whole family; and the result is a work, of which it is not too much to say that it has thrown more light upon the structure and functions of the floral organs of this immense and anomalous family of plants, than had been shed by the labours of all previous botanical writers. It has further opened up entirely new fields of research, and discovered new and important principles that apply to the whole vegetable kingdom.

This was followed by his paper on the well-known forms of the Primrose and Cowslip*, popularly known as the pin-eyed and thrum-eyed: these forms he showed to be sexual and complementary, their diverse functions being to secure, by their mutual action, full fertilization, which he proved could only take place through insect agency. In this paper he established the existence of homomorphic or legitimate, and heteromorphic or illegitimate unions amongst plants, and detailed some curious observations on the structure of the pollen. The results of this, perhaps more than any other of Mr. Darwin's papers, took botanists by surprise, the plants being so familiar, their two forms of flower so well known to every intelligent observer, and his explanation so simple. For my own part I felt that my botanical knowledge of these homely plants had been but little deeper than Peter Bell's, to whom

A primrose by the river's brim
A yellow primrose was to him,
And it was nothing more.

Analogous observations on the dimorphism of flax and its allies† formed a subsequent paper; during the course of which observations he made the wonderful discovery that, in the common flax, the pollen of one form of flower is absolutely impotent when applied to its own stigma, but invariably potent when applied to the stigma of the other form of flower; yet the pollens and stigmas of the two kinds are utterly undistinguishable under the highest powers of the microscope.

His third investigation was a very long and laborious one on the Common Loosestrife‡ (*Lythrum salicaria*), which he showed to be trimorphic; this one species having three kinds of flowers, all annually abundantly produced, and as different as if they belonged to different species; each flower has, further, three kinds of stamens, differing in form and function. We have in this plant, then, six kinds of pollen, of which five at least are essential to complete fertility, and three distinct forms of style. To prove these various differences, and that the co-adaptation of all these stamens and pistils was essential to complete fertility, Mr. Darwin had to institute eighteen sets of observations, each consisting of twelve experiments, 216 in all. Of the labour, care, and delicacy required to guard such experiments against the possibility of error, those alone can tell who experimentally know how difficult it is to hybridize a large-flowered plant of simple form and structure. The results in this case, and in those of a number of allied plants experimented on at the same time, are such as the author's sagacity had predicted; the rationale of the whole was demonstrated, and he finally showed, not only how nature might operate in bringing these complicated modifications into harmonious operation, but how through insect agency she does do this, and also why she does it.

* Journal of the Linnean Society of London, vol. vi. p 77.
† Ibid. vol. vii. p. 69. ‡ Ibid. vol. viii. p. 169.

It is impossible even to enumerate here the many important generalizations that have followed from these and other papers of Mr. Darwin on the fertilization of plants; some that appear to be commonplace at first sight are really the most subtle, and like many other apparent commonplaces, are what, somehow, never occur to commonplace minds: as, for instance, that all plants with conspicuously coloured flowers or powerful odours or honeyed secretions are fertilized by insects; all with inconspicuous flowers, and especially such as have pendulous anthers or incoherent pollen, are fertilized by the wind: whence he infers that, before honey-feeding insects existed, the vegetation of our globe could not have been ornamented with bright-coloured flowers, but consisted of such plants as pines, oaks, grasses, nettles, &c.

The only other botanical paper of Mr. Darwin to which I can especially allude, is that "On the Habits and Movements of Climbing Plants" *, which is a most elaborate investigation into the structure, modification, and functions of the various organs by which plants climb, twine, and attach themselves to foreign objects. In this he reviews every family in the vegetable kingdom, and every organ used by any plant for the above purposes. The result places the whole subject in a totally new light. The guesses, crude observations, and abortive experiments that had disfigured the writings of previous observers are swept away; organs, structures, and functions, of which botanists had no previous knowledge, are revealed to them; and the whole investigation is made as clear as it is interesting and instructive.

The value of these discoveries, which add whole chapters to the principles of botany, is not theoretical only: already the horticulturist and agriculturist have begun to ponder over them, and to recognize in the failure of certain crops, the operation of laws that Mr. Darwin first laid down. What Faraday's discoveries are to telegraphy, Mr. Darwin's will assuredly prove to rural economy, in its widest sense and most extended application.

Another instance of successful experiment in Physiological Botany is Mr. Herbert Spencer's observations on the circulation of the sap and the formation of wood in plants †. As is well known, the tissues of herbs, shrubs, and trees, from the tips of their roots to those of their petals and pistils, are permeated by tubular vessels. The functions of these have been hotly disputed, some physiologists affirming that they convey air, others fluids, others gases, and still others assigning to them far-fetched uses, of a wholly different nature. By a series of admirably contrived and conducted experiments, Mr. Spencer has not only shown that these vessels are charged at certain seasons of the year with fluid, but that they are intimately connected with the formation of wood. He further investigates the nature of the special tissues concerned in this operation, and shows not merely how they may act, but to a great extent how they do act. As this paper will, I believe, be especially alluded to by the President of the Biological Section, I need dwell no further on it here, than to quote it as an example of what may be done by an acute observer and experimentalist, versed in Physics and Chemistry, but above all, thoroughly instructed in scientific methods.

Mr. Darwin's recent volumes "On Animals and Plants under Domestication," contain a harvest of data, observations, and experiments, such as assuredly no one but himself could have gathered. It is hard to say whether this book is most remarkable for the number and value of the new facts it discloses, or for its array of small forgotten or overlooked observations,

* Journal of the Linnean Society, vol. ix. p. 1.
† Linnean Transactions, vol. xxv. p. 405.

neglected by some naturalists, and discarded by others, which, under his mind and eye, prove to be of first-rate scientific importance. An eminent surgeon and physiologist (Mr. James Paget) remarked to me, *à propos* of these volumes, that they exemplify in a most remarkable manner that power of utilizing the waste materials of other men's laboratories which is a very characteristic feature of their author. As one of those *pièces justificatives* of his previous work, 'The Origin of Species,' which have been waited for so long and impatiently, these volumes will probably have more than their due influence; for the serried ranks of facts in support of his theories which they present, may well awe many a timid naturalist into swallowing more obnoxious doctrines than that of natural selection.

It is in this work that Mr. Darwin expounds his new hypothesis of Pangenesis, which certainly correlates, and may prove to contain the rationale of all the phenomena of reproduction and of inheritance. You are aware that every plant or animal commences its more or less independent life as a single cell, from which is developed an organism more or less closely similar to its parent. One of the most striking examples I can think of is afforded by a species of Begonia, the stalks, leaves, and other parts of which are superficially studded with loosely attached cellular bodies. Any one of those bodies, if placed under favourable conditions, will produce a perfect plant, similar to its parent. You may say that these bodies have inherited the potentiality to do so; but this is not all, for every plant thus produced, in like manner developes on its stalks leaves and myriads of similar bodies, endowed with the same property of becoming new plants, and so on, apparently interminably. Therefore the original cell that left the grand parent, not only carried with it this so-called potentiality, but multiplied it and distributed it with undiminished power through the other cells of the plant produced by itself, and so on, for countless generations. What is this potentiality? and how is this power to reproduce thus propagated, so that an organism can, by single cells, multiply itself so rapidly, and within very narrow limits, so surely and so interminably? Mr. Darwin suggests an explanation, by assuming that each cell or fragment of a plant (or animal) contains myriads of atoms or gemmules, each of which gemmule he supposes to have been thrown off from the separate cells of the mother-plant, the gemmules having the power of multiplication, and of circulating throughout the plant: their future development he supposes to depend on their affinity for other partially developed cells in due order of succession. Gemmules which do not become developed, may, according to his hypothesis, be transmitted through many succeeding generations, thus enabling us to understand many remarkable cases of reversion or atavism. Hence the normal organs of the body have not only the representative elements of which they consist diffused through all the other parts of the body, but the morbid states of these, as hereditary diseases, malformations, &c., all actually circulate in the body as morbid gemmules.

As with other hypotheses based on the assumed existence of structures and elements that escape our senses, by reason of their minuteness or subtlety, this of Pangenesis will approve itself to some minds and not to others. To some these inconceivably minute circulating gemmules will be as apparent to the mind's eye as the stars of which the Milky Way is composed; others will prefer embodying the idea in such a term as potentiality, a term which conveys no definite impression whatever, and they will like it none the less on this account.

Whatever be the scientific value of these gemmules, there is no question

but that to Mr. Darwin's enunciation of the doctrine of Pangenesis we owe it that we have the clearest and most systematic *résumé* of the many wonderful phenomena of reproduction and inheritance that has yet appeared; and against the guarded entertainment of the hypothesis, or speculation if you will, as a means of correlating these phenomena, nothing can be urged in the present state of science. The President of the Linnean Society, a proverbially cautious naturalist, thus well expresses his own ideas of Pangenesis:—"If," he says, "we take into consideration how familiar mathematical signs and symbols make us with numbers and combinations, the actual realization of which is beyond all human capacity, how inconceivably minute must be those emanations which most powerfully affect our sense of smell and our constitutions, and if, discarding all preventions, we follow Mr. Darwin, step by step, applying his suppositions to the facts set before us, we must, I think, admit that they may explain some, and are not incompatible with others; and it appears to me that Pangenesis will be admitted by many as a provisional hypothesis, to be further tested and to be discarded only when a more plausible one shall be brought forward."

Ten years have elapsed since the publication of 'The Origin of Species by Natural Selection,' and it is therefore not too early now to ask what progress that bold theory has made in scientific estimation. The most widely circulated of all the journals that give science a prominent place on their title-pages, the 'Athenæum,' has very recently told to every country where the English language is read, that Mr. Darwin's theory is a thing of the past, that Natural Selection is rapidly declining in scientific favour, and that, as regards the above two volumes on the variations of animals and plants under domestication, they "contain nothing more in support of origin by selection, than a more detailed reasseveration of his guesses founded on the so-called variations of pigeons."

Let us examine for ourselves into the truth of these inconsiderate statements. Since the 'Origin' appeared ten years ago, it has passed through four English editions, two American, two German, two French, several Russian, a Dutch, and an Italian; whilst of the work on Variation, which first left the publisher's house not seven months ago, two English, a German, Russian, American, and Italian editions are already in circulation. So far from Natural Selection being a thing of the past, it is an accepted doctrine with almost every philosophical naturalist, including, it will always be understood, a considerable proportion who are not prepared to admit that it accounts for all Mr. Darwin assigns to it.

Reviews on 'The Origin of Species' are still pouring in from the continent; and Agassiz, in one of the addresses which he issued to his collobora-teurs on their late voyage to the Amazons, directs their attention to this theory as a primary object of the expedition they were then undertaking. I need only add, that of the many eminent naturalists who have accepted it, not one has been known to abandon it; that it gains adherents steadily; and that it is *par excellence* an avowed favourite with the rising schools of naturalists; perhaps, indeed, too much so, for the young are apt to accept such theories as articles of faith, and the creed of the student is but too likely to become the shibboleth of the future professor.

The scientific writers who have publicly rejected one or both of the theories of continuous evolution and of natural selection, take their stand upon physical or metaphysical grounds, or both. Of those who rely on the metaphysical, their arguments are usually strongly imbued with theological prejudice and even odium, and as such are beyond the pale of scientific

criticism. Having myself been a student of Moral Philosophy in a northern University, I entered on my scientific career full of hopes that metaphysics would prove a useful mentor, if not a guide in science. I soon, however, found that it availed me nothing, and I long ago arrived at the conclusion, so well put by Agassiz, when he says, "we trust that the time is not distant when it will be universally understood that the battle of the evidences will have to be fought on the field of Physical Science, and not on that of Metaphysical" *. Many of the metaphysicians' objections have been controverted by that champion of Natural Selection, Mr. Darwin's true knight, Alfred Wallace, in his papers on "Protection" † and "Creation by Law" ‡, &c., in which the doctrines of "Continual Interference," the "Theory of Beauty," and kindred subjects, are discussed with admirable sagacity, knowledge, and skill. But of Mr. Wallace and his many contributions to philosophical biology, it is not easy to speak without enthusiasm; for, putting aside their great merits, he, throughout his writings, with a modesty as rare as I believe it to be in him unconscious, forgets his own unquestioned claims to the honour of having originated, independently of Mr. Darwin, the theories which he so ably defends.

On the score of geology, the objectors chiefly rely on the assumed perfection of the geological record; and since almost all who believe in its imperfection, and many of the other school, accept the theories both of evolution and natural selection, wholly or in part, there is no doubt that Mr. Darwin claims the great majority of geologists. Of these, one is in himself a host, the veteran Sir Charles Lyell, who, after having devoted whole chapters of the first editions of his 'Principles' to establishing the doctrine of special creations, abandons it in the 10th edition, and this, too, on the showing of a pupil; for, in the dedication of his earliest work, 'The Naturalist's Voyage,' to Sir C. Lyell, Mr. Darwin states that the chief part of whatever merit he or his works may possess, has been derived from studying the 'Principles of Geology.' I know no brighter example of heroism, of its kind, than this, of an author thus abandoning, late in life, a theory which he had for forty years regarded as one of the foundation stones of a work that had given him the highest position attainable amongst contemporary scientific writers. Well may he be proud of a superstructure, raised on the foundations of an insecure doctrine, when he finds that he can underpin it and substitute a new foundation; and after all is finished, survey his edifice, not only more secure, but more harmonious in its proportions than it was before; for assuredly the biological chapters of the tenth edition of the 'Principles' are more in harmony with the doctrine of slow changes in the history of our planet, than were their counterparts in the former editions.

To the astronomers' objections to these theories I turn with diffidence; they are strenuously urged in what is in my opinion the cleverest critique of them that I have hitherto met with, and which appeared in the North British Review. It is anonymous, I am wholly ignorant of its author, and I regret to find that, in common with the few other really able hostile critiques, it is disfigured by a dogmatism that contrasts unfavourably with Mr. Darwin's considerate treatment of his opponents' methods and conclusions. The author starts, if I read him aright, by professing his unfamiliarity with the truth and extent of the facts upon which the theories of Evolution and Natural Selection are founded, and goes on to say, that "the superstructure based on

* Agassiz on the Contemplation of God in the Kosmos. Christian Examiner, 4th Series, vol. xv. p. 2.

† Westminster Review. ‡ Journal of Science, October, 1867.

them may be discussed apart from all doubts as to the fundamental facts." The liberty thus to discuss no one may dispute or curtail, but the biologist will ask, to what end can discussion lead? Who would attach much weight to the verdict of a judge passed on evidence of which he knew neither the truth nor the extent? As well might a boy guiltless of mathematics, set himself to test the 47th proposition of the 1st book of Euclid, by constructing paper squares corresponding to the sides of a right-angled triangle, then cutting up the smaller squares, try to fit the pieces into the larger, and failing to do this with exactitude, conclude of the problem, as the reviewer does of the theory, that it is "an ingenious and plausible speculation, marking at once the ignorance of the age and the ability of the philosopher."

The most formidable argument urged by the reviewer is, that "the age of the inhabited world as calculated by solar physics, is proved to have been limited to a period wholly inconsistent with Darwin's views." This would be a valid objection if these views depended on those of one school of geologists; and if the 500,000,000 years, which the reviewer adopts as the age of the world, were, as an approximate estimate, accepted by either astronomers or physicists. But, in the first place, the reviewer assumes that the rate of change in the condition of the earth's surface was vastly more rapid at the beginning than now, and has gradually slackened since; but overlooks the consequence, that according to all Mr. Darwin's principles the operations of natural selection must in such cases have been formerly correspondingly more rapid: and in the second, are these speculations as to the solidity of the earth's crust dating back only 500,000,000 years, to be depended upon? In his great work, the author* quoted for these numbers, gives as possible limits 20,000,000, or 400,000,000 years, whilst other philosophers assign to the habitable globe an age far exceeding the longest of these periods. Surely, in estimates of such a nature as the above, which are calculated from data themselves in a great degree hypothetical, there are no principles upon which we are warranted in assuming the speculations of the astronomer to be more worthy of confidence than those of the biologist.

A former most distinguished President, and himself an astronomer, Professor Whewell, has said of astronomy that "it is not only the queen of sciences, but the only perfect science, the only branch of human knowledge in which we are able fully and clearly to interpret nature's oracles, so that by that which we have tried we receive a prophecy of that which is untried"†. Now, whilst fully admitting, and proudly as every scientific man ought, that astronomy is the most certain in her methods and results of all the sciences, that she has called forth some of the highest efforts of the intellect, and that her results far transcend in grandeur those of any other science, I think we may hesitate before we therefore admit her queenship, her perfection, or her sole claims to interpretation and to prophecy. Her methods are those of the mathematicians; she may call Geometry and Algebra her handmaidens, but she is none the less their slave. No science is really perfect, certainly not that which lately erred nearly 4,000,000 miles in so fundamental a datum as the earth's distance from the sun. Have Faraday and Von Baer interpreted no oracles of nature fully and clearly? Have Cuvier and Dalton not prophesied, and been true prophets? Claims to queenship do not accord with the spirit of science; rather would I liken the domain of natural knowledge to a hive, in which every comb is a science, and truth the one queen over them all.

* Thomson and Tait, Treatise on Natural Philosophy, vol. i. p. 716.
† Rev. W. Whewell. Reports, 1833, p. xiii.

It remains to say a few words on some prospects which this Norwich Meeting opens.

A new science has dawned upon us, that of the Early History of Mankind. Prehistoric archæology (including as it does the origin of language and of art) has been the latest to rise of a series of luminaries that have dispelled the mists of ages and replaced time-honoured traditions by scientific truths. Astronomy, if not the queen, yet the earliest of sciences, first snatched the torch from the hands of dogmatic teachers, tore up the letter and cherished the spirit of the law. Geology next followed, but not till two centuries had elapsed, nor indeed till this our day, in divesting religious teaching of many cobwebs of scientific error. It has told us that animal and vegetable life preceded the appearance of man on the globe, not by days but by myriads of years; and how late this knowledge came we may gather from the fact that Lawrence in his previously quoted lectures *, delivered so late as 1818, says of the extinct races of animals, "that their living existence has been supposed, with considerable probability, to be of older date than the formation of the human race."

And, last of all, this new science proclaims man himself to have inhabited this earth for perhaps many thousands of years before the historic period—a result little expected less than thirty years ago, when the Rev. W. V. Harcourt, in his address to the Association at Birmingham †, observed that "Geology points to the conclusion, that the time during which mankind has existed on the globe, cannot materially differ from that assigned by Scripture," referring, I need not say, to the so-called Scripture chronology, which has no warrant in the Old Testament, and which gives 5874 years as the age of the inhabited globe.

Pre-historic Archæology now offers to lead us where man has hitherto not ventured to tread. Can we, whilst truthfully and fearlessly pursuing this inquiry, separate its physical from its spiritual aspect? will be the uppermost thought in the minds of many here present. To separate them is, I believe, indeed impossible, but to search out common truths that underlie both is permitted to all. Mr. Disraeli ‡ has well said of Truth, that it is the sovereign passion of mankind. And it should be emphatically so in the minds engaged in this search, where religion and science should speak peace to one another, if they are to walk hand in hand in this our day and generation.

A great deal has of late been said and written about the respective attitudes of Religion and Science; and my predecessor, the Duke of Buccleuch, dwelt on this in his address last year with great good sense and good taste, and pointed out how much the progress of knowledge depended on this attitude being mutually considerate and friendly. During the first decades of my scientific life, science was rarely, within my experience, heard of from the pulpits of these islands: during the succeeding, when the influence of the 'Reliquiæ Diluvianæ' and the Bridgewater Treatises was still felt, I often heard it named, and always welcomed. Now, and of late years, science is more frequently named than ever, but too often with dislike or fear, rather than with trust and welcome.

The Rev. Dr. Hanna, in an eloquent and candid contribution to the 'Contemporary Review'§, has adduced a long list of eminent clergymen of various denominations, who have adorned science by their writings, and religion by their lives. I do not ignore their contributions, still less do I overlook the many brilliant examples of educated preachers who give to science the respect

* Lectures on Physiology, Zoology, &c., p. 52. † Report, p. 17.
‡ Life of Lord George Bentinck. § Vol. vi. No. 21, September, 1867.

due to it. But Dr. Hanna omits to observe that the majority of these honoured contributors were not religious teachers in the ordinary sense of the term; nor does he tell us in what light many of their scientific writings were regarded by a large body of their brother clergymen, those resident in the country especially, from whom alone an overwhelming proportion of the population ever hear the name of science.

To return, let each pursue the search for truth, the archæologist into the physical, the religious teacher into the spiritual history and condition of mankind. It will be in vain that each regards the other's pursuit from afar, and turning the object-glass of his mind's telescope to his eye, is content when he sees how small the other looks.

To search out the whence and whither of his existence, is an unquenchable instinct of the human mind; to satisfy it, man in every age, and in every country, has adopted creeds that embrace his past history and his future being, and has eagerly accepted scientific truths that support the creeds; and but for this unquenchable instinct, I for one believe that neither religion nor science would have advanced so far as they have into the hearts of any people. Science has never in this search hindered the religious aspirations of good and earnest men; nor have pulpit cautions, which are too often ill-disguised deterrents, ever turned inquiring minds from the revelations of science.

A sea of time spreads its waters between that period to which the earliest traditions of our ancestors point, and that far earlier period, when man first appeared upon the globe. For his track upon that sea man vainly questions his spiritual teachers. Along its hither shore, if not across it, science now offers to pilot him. Each fresh discovery concerning pre-historic man is as a pier built on some rock its tide has exposed, and from these piers arches will one day spring that will carry him further and further across its depths. Science, it is true, may never sound the depths of that sea, may never buoy its shallows, or span its narrowest creeks; but she will still build on every tide-washed rock, nor will she deem her mission fulfilled till she has sounded its profoundest depths and reached its further shore, or proved the one to be unfathomable and the other unattainable, upon evidence not yet revealed to mankind. And if in her track she bears in mind that it is a common object of religion and of science to seek to understand the infancy of human existence, that the laws of mind are not yet relegated to the domain of the teachers of physical science, and that the laws of matter are not within the religious teacher's province, these may then work together in harmony and with good will.

But if they would thus work in harmony, both parties must beware how they fence with that most dangerous of all two-edged weapons, Natural Theology; a science, falsely so called, when, not content with trustfully accepting truths hostile to any presumptuous standard it may set up, it seeks to weigh the infinite in the balance of the finite, and shifts its ground to meet the requirements of every new fact that science establishes, and every old error that science exposes. Thus pursued, Natural Theology is to the scientific man a delusion, and to the religious man a snare, leading too often to disordered intellects and to atheism.

One of our deepest thinkers *, Mr. Herbert Spencer, has said:—"If religion and science are to be reconciled, the basis of the reconciliation must be this deepest, widest, and most certain of facts, that the power which the universe manifests to us is utterly inscrutable." The bonds that unite the

* First Principles, by Herbert Spencer, ed. ii. p. 16.

physical and spiritual history of man, and the forces which manifest themselves in the alternate victories of mind and of matter over the actions of the individual, are, of all the subjects that physics and psychology have revealed to us, the most absorbing; and are, perhaps, utterly inscrutable. In the investigation of their phenomena is wrapped up that of the past and the future, the whence and the whither, of his existence; and after a knowledge of these the human soul still yearns, and thus passionately cries, in the words of a living poet:—

"To matter or to force
The all is not confined;
Beside the law of things
Is set the law of mind;
One speaks in rock and star,
And one within the brain,
In unison at times,
And then apart again;
And both in one have brought us hither,
That we may know our whence and whither.

"The sequences of law
We learn through mind alone;
We see but outward forms,
The soul the one thing known;—
If she speak truth at all,
The voices must be true
That give these visible things,
These laws their honour due,
But tell of One who brought us hither,
And holds the keys of whence and whither.

* * * * * *

"He in His science plans,
What no known laws foretell;
The wandering fires and fix'd
Alike are miracle:
The common death of all,
The life renew'd above,
Are both within the scheme
Of that all-circling love.
The seeming chance that cast us hither,
Accomplishes His whence and whither" *.

* The Reign of Law, by F. T. Palgrave. Macmillan's Magazine, March 1867.