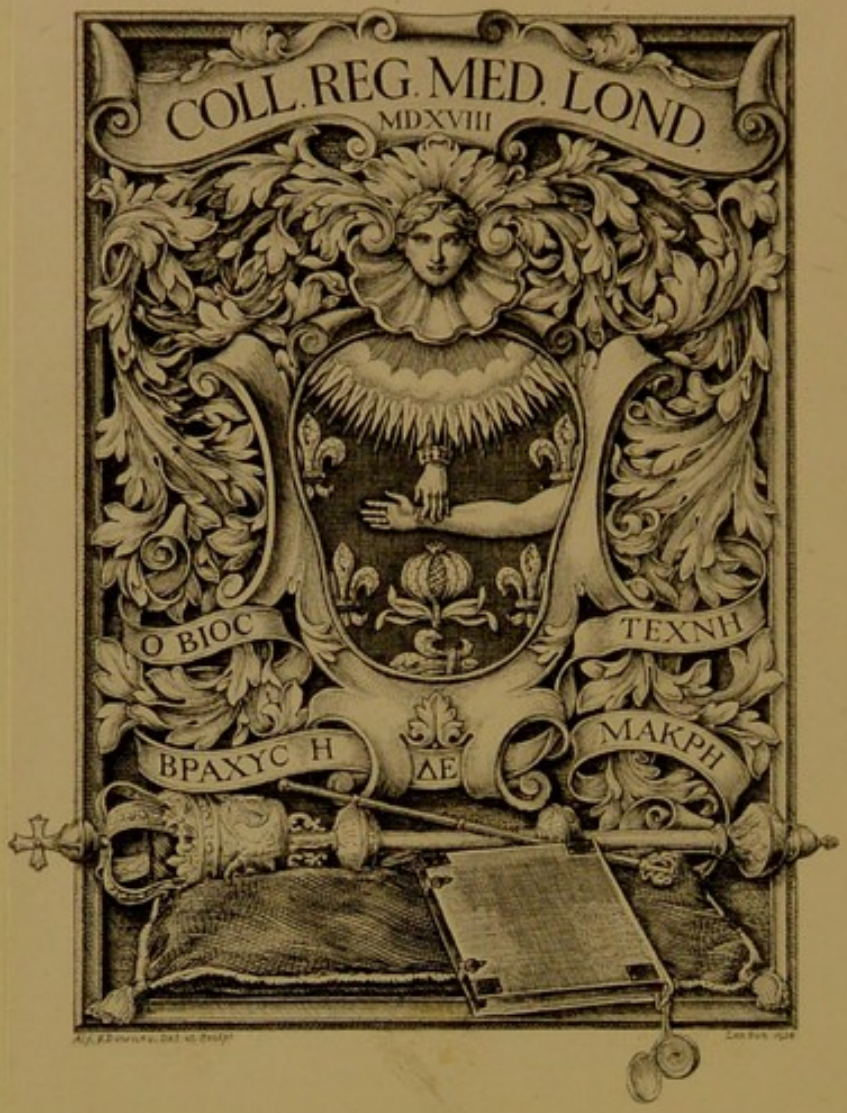
First report of the proceedings, recommendations, and transactions of the British Association for the Advancement of Science.



FIRST REPORT

OF THE

PROCEEDINGS, RECOMMENDATIONS,

AND

TRANSACTIONS

OF THE

BRITISH ASSOCIATION

FOR THE

ADVANCEMENT OF SCIENCE.

PRINTED BY ORDER OF THE GENERAL COMMITTEE.

York:

THOMAS WILSON AND SONS, HIGH-OUSEGATE.

1832.

PREFACE.

In giving to the public a Report of the Proceedings of the British Association for the Advancement of Science, it has been considered an important object to add to the account of the past Meeting a distinct view of what is to be expected from the next, and to announce the result of the applications which have been made to individuals, requesting them, in the name of the Association, to undertake the reports and researches recommended by its Committees in different branches of science.

The success of these applications will appear from the following statement.

REPORTS.

1. The Rev. George Peacock has undertaken to present to the next Meeting, a Report on the recent progress of Mathematical Analysis, in reference particularly to the differential and integral calculus.

2. Professor Airy has undertaken a Report on the state and progress of Astronomical Science, in reference particularly to Physical Astronomy.

3. J. W. Lubbock, Esq. has consented to furnish such information respecting the data and desiderata for calculating the time and height of High-water as he may be able to offer.

4. James D. Forbes, Esq. has undertaken to present a Report on the present state of Meteorological Science.

5. Dr. Brewster has undertaken a Report on the progress of Optical Science.

6. The Rev. Robert Willis has undertaken a Report on the state of our knowledge concerning the Phenomena of Sound, in reference especially to the additions recently made to it.

7. The Rev. Professor Powell has undertaken a similar Report respecting the Phenomena of Heat.

8. The Rev. Professor Cumming has undertaken a Report on Thermo-Electricity and on the allied subjects, in reference to the discoveries recently made in them.

9. James F. W. Johnston, Esq. has undertaken a Report on the recent progress of Chemical Science, especially in foreign countries.

10. The Rev. Professor Whewell has undertaken a Report on the state and progress of Mineralogical Science.

11. Robert Stevenson, Esq. has undertaken the Report recommended by the Geological and Geo-

graphical Committee, on the waste and extension of the land on the east coast of Britain, and on the question of the permanence of the relative level of the sea and land.

12. Professor Lindley has undertaken to give an account of the principal questions recently settled, or still agitated, in the Philosophy of Botany.

RESEARCHES.

There is reason to hope that the earnest wish expressed by the Mathematical and Physical Committee, that a register of the Thermometer, during every hour of the day and night, should be kept at some station in the South of England, will be realized at Plymouth under the superintendence of Mr. Harvey, with the enlightened concurrence of those who have the power of enabling him to render this public service to science.

The law of the decrease of Temperature with increasing elevations in the atmosphere, will be illustrated by a continuation of experiments with balloons by the Earl of Minto.

The Secretaries of the Yorkshire Philosophical Society have commenced the observations recommended, on the comparative quantities of rain falling on the top of York Minster and near its base; and the society has formed a Meteorological Committee, by whose labours other researches, which have been recommended in that branch of science, may be expected to be advanced.

The observations on the intensity of terrestrial Magnetism, proposed by the Mathematical and Physical Committee, have been undertaken by Dr. Traill; and the Royal Society of Edinburgh have lent for his use their standard needle, constructed under the superintendence of Professor Hansteen.

A summary of the observations which Mr. Henwood is making on the electro-magnetic condition of metalliferous veins will be presented to the Meeting, and it is probable that the suggestion of the Committee may be followed, in regard to the extension of these experiments to veins which traverse horizontal and dissimilar strata.

There is reason to expect that the objects contemplated by the Chemical Committee, in recommending a revision of some of the primary data of chemistry, will derive light from the labours of Dr. Prout and Professor Turner, in addition to those of the eminent philosopher from whom the recommendations originated.

Professor Daubeny and Mr. Johnston have undertaken the analytical researches respectively entrusted to them; and specimens of iron in different stages of its manufacture have been transmitted to the latter gentleman from the principal iron works in Yorkshire.

In Geology, the inquiry respecting parallelism in the lines of disturbance of the British strata will receive, it is hoped, the joint consideration of the Rev. Wm. Conybeare and the Rev. Professor Sedgwick.

In Botany, the comprehensive inquiry proposed by the Committee will be illustrated by contributions which Professor Henslow proposes to add to the Flora Cantabrigiensis, and by a systematic catalogue of the native plants of the County of York, which the Sub-curator of the Yorkshire Philosophical Society is preparing for the press.

Lastly, in Zoological research, for which no provision was made at the late meeting, the officers of the Association have received from Dr. Knox the promise of a memoir on the natural history of the Salmon.

It will be observed that the object to which the Committees have in general paid the first attention has been, to procure reports on the state and desiderata of the several branches of science, preliminary to measures which may be hereafter adopted to advance them. To the investigation, however, of a few points of prominent interest and importance they have at once proceeded to invite attention; and of these there are some which it is highly desirable should receive the consideration of experimenters and observers who cannot be individually solicited to take a share in them. Such is the examination of those first data of chemistry, (*Recommendations, p.* 53), which, lying at the very foundation of the science, are proposed to be settled by the common consent of experienced chemists, and

to which it is hoped that every one possessing the necessary means and habits of accurate experiment will lend his assistance; such, also, are those meteorological and botanical researches, (*Recommendations*, p. 50, 55), which, belonging to a lower order of facts, are open to a much wider class of observers, and are capable of being extended through all parts of the country by the exertions of individuals, and still more effectually by those of societies.

The nature and value of the aid which Provincial Societies might render to science through the system of the British Association, and the advantages which they may themselves derive from it, have been lately adverted to by the Council of the Yorkshire Philosophical Society in the following manner. *

"The effect of such a system will be not only to give connection to the efforts of insulated inquirers, but to link societies themselves together in unity of purpose, and in a common participation and division of labour. There are many important questions in philosophy, and some whole departments of science, the data of which are *geographically* distributed, and require to be collected by local observations extended over a whole country; and this is true

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* Report of the Council of the Yorkshire Philosophical Society for 1831—2.

not only of those facts on which single sciences are founded, but of many which are of more enlarged application. Thus, for instance, were the elevation above the sea of all the low levels, and chief heights and eminences, of a country ascertained so generally, that every observer of nature might have a station within his reach from which he could fix the relative position in this respect of whatever might be the object of his research, of how many questions, in how many sciences, would these facts contribute to the solution? Again, supposing it to be ascertained also, at these stations, what is the temperature of the air, and of the water,—as it falls from the sky, and as it is held in the reservoirs of the earth—these are data of the same kind, interesting not only to meteorological science, but to the philosophy of organized and animated existence. Yet, extensive as might be the importance of such facts, and simple as are the processes for ascertaining them, and numerous as are the individuals capable of contributing to their investigation, how little, nevertheless, even of this elementary work has yet been accomplished, either by insulated observers, or by those who are associated together for the express purpose of advancing those sciences to which it is of so much interest.

"None of our societies has ever pretended to collect observations of this kind on a regular system, nor to form a national catalogue of the scattered particulars of any one science, accurately detailed; and yet the great value which would attach to such collections of facts, when reduced and analyzed,

must often have occurred to the enlightened conductors of such institutions; but that which has prevented any single body from venturing on the undertaking, has been the impracticability of carrying it on over so extensive a territory as an entire kingdom. There *is* a method, however, by which these important objects might be achieved. Were there in every county one or more provincial societies, having some members competent to superintend, and others ready to execute, the observations within definite limits, and were these societies willing to work together under a common plan, the natural history of the country, and all the geographical data of philosophy included within it, might easily be collected in a manner far more perfect than has ever yet been attempted.

"With a just sense, therefore, of the consequence to science of combining the Philosophical Societies dispersed through the provinces of the empire in a general co-operative union, the British Association has not only invited them to join its meetings, but has given to those whom they may specially depute to represent them, the privilege of becoming members of the Committee by which its affairs are conducted.

"It appears to the Council that in availing themselves of the bond of connection thus offered, Societies, at the same time that they will contribute most essentially to the success of this extensive plan, will add greatly to their own efficiency. When individuals meet for scientific objects, the effect of the general effort, emulation, and example, is to produce

a spirit of exertion which gives to such meetings their principal value. And if societies shall concur in thus meeting each other, in proposing certain common objects, in communicating from year to year the means which they are employing and the progress which they are making,—it seems impossibe that this should be done in the presence of an assembly concentrating a great part of the scientific talent of the nation, without kindling an increased ardour of emulous activity ; it seems impossible that the deputies of any society should attend such meetings without bringing back into its bosom an enlargement of views and communicating to its members new lights of knowledge, new motives for inquiry, and new encouragement to perseverance.

" The actual assembling of one of the meetings at the place in which any society is established, has a tendency to produce the same effect in a still more powerful degree, and the Council does not hesitate to state that this institution has received a sensible impulse in all these respects, from the visit with which it has recently been honoured. The plan indeed on which it was first founded, and on which it has been since conducted, was in the spirit of the design which may now be contemplated for the whole kingdom. Its especial aim has been to collect information respecting its own County, and the end to which it aspires has been described in a former Report to be the execution of such a history of Yorkshire as the Natural Philosopher and the Antiquary may be contented to possess. But how greatly will the importance of this object be heightened

when it is incorporated into a national system, and when all the results of our inquiries become part of the materials of a far more extensive analysis. It could not but be felt before by a provincial Society, that, in executing the task which it had undertaken, advice and consultation were wanted. With how much more confidence may it proceed when it has the advantage of consulting with the Committee of this great national Association. In comparing the views which it entertains, and the methods which it employs, with those that may be offered to its consideration, how largely may it profit by such a commerce, without sacrificing any portion of its real dignity or independence."

Should views like those which are here expressed be generally adopted, should the Societies established in different districts be disposed to combine their exertions through the medium of this Association, for the purpose of carrying a general system of observations into effect, each Society would then become a centre of instruction to its own neighbourhood, from which correct means and methods of investigation might be derived. Thus, for instance, a large proportion of the philosophical instruments at present in use are so imperfectly constructed, and so discordant in their indications, as to be of little service to science; *but if Societies will send to the next Meeting of the Association the Thermometer or portable Barometer which they employ*, in order that they may be examined, and that any error which may be found in them may be

rectified or estimated, the instruments will thenceforward not only speak the same language among themselves, but will become *standards* with which in every part of the kingdom those of insulated observers may be compared.

The principles which have been already noticed as having regulated the choice of some of the subjects of investigation recommended in the present Report, are important to be borne in mind, *at the ensuing Meeting, by those who may take a share in proposing matter of inquiry or discussion.* To come to a common understanding on unsettled questions of general interest, to fix the data on which important points of theory hinge, to collect and connect extensive series of observations ; these appear to be the objects which peculiarly belong to the Association, and which should therefore be chiefly, if not exclusively, contemplated. It is also very material that *those who propose any subject of inquiry should have considered it well in a practical point of view.* It is not enough to put forth general recommendations of inquiries without making specific arrangements for their being actually undertaken. The Committee which met for the first time at York laboured under a disadvantage in this respect, from not knowing on what auxiliaries to reckon. Much was in consequence left to subsequent correspondence with the members of the different Sub-committees, which, had it been possible, ought to have been settled at the Meeting itself.

These deficiencies, however, have been so far surmounted, that a highly valuable store of appropriate

scientific communications, as has been seen, is already provided for the approaching Meeting; and in this respect also it will possess a great advantage over the last. The *Transactions*, of which an account is given in the Report, were miscellaneous contributions not expressly designed for the use of this Institution, and in consequence they occupy but a small space in the present publication. It is a principle of the Association to claim no right of property in the papers which it receives; and, with the exception of one Essay, which, by leave of the accomplished writer, has been printed at length, the remainder of this part of the Report consists of abstracts or notices of memoirs which will be communicated to the public through other channels. A few interspersed memoranda of the occasional discussions which followed the reading of the papers, have been inserted, chiefly to illustrate the plan of proceeding which was pursued at the meeting.

It only remains to be added, that the time which has been fixed upon as that on which it will be most convenient for the Association to assemble at Oxford, is the 18th day of June, 1832.

York, *February*, 1832.

PROCEEDINGS

OF THE

GENERAL MEETING.

On the morning of September the 27th, 1831, the Theatre of the Yorkshire Museum was filled by an assemblage of more than three hundred persons,* including many distinguished members of learned and scientific bodies in different parts of the united kingdoms, who were collected together in consequence of a general invitation to the friends of science, which had been issued by the Yorkshire Philosophical Society. At half past twelve o'clock, on the motion of Dr. Brewster, Viscount Milton, the President of the Society, was called to the Chair, and addressed the Meeting nearly in the following words:

"Gentlemen,

You have been kind enough to call me to the Chair of this Meeting, which is indeed one of the most important description; and I only regret, that you have not turned your eyes towards a person, whose acquirements would render him more qualified to fulfil the duties imposed on him. But I trust that, although I may be in some respects deficient, at least I am not deficient in an anxious desire to promote those objects which have been in the view of the authors of the Philosophical Society established in this city, and also those which will be brought under the consideration of the Meeting now assembled. It must undoubtedly be highly satisfactory

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* The number of Tickets issued, was three hundred and fifty-three.

to the Members of the Society who have taken an active part in making the arrangements for the purpose, to see that we are honoured with the attendance of persons from all parts of the kingdom, who testify, by coming from so great a distance, their desire to co-operate with the movers of this Meeting, and to carry its objects into effect. Similar Meetings, it is well known, have taken place on the continent of Europe, which have been attended by the most beneficial effects, and I trust that the same effects will attend those that we are now commencing here. In our insular and insulated country, we have few opportunities of communicating with the cultivators of science in other parts of the world. It is the more necessary, therefore, to adopt means for opening new channels of communication with them, and at the same time of promoting a greater degree of scientific intercourse among ourselves. Nor do I see any reason to doubt the successful issue of this undertaking. When I consider what the Yorkshire Philosophical Society has accomplished,—when I view the establishments it has founded, and when I recollect, that it has not existed for more than eight or ten years; having owed its origin, I believe, to the curious discoveries which were made at Kirkdale,—when, I say, we can trace the progress of a body now so considerable, to so inconsiderable a source,—may we not entertain a confident hope, that the Meetings thus auspiciously begun, will rapidly advance to still greater importance, and become the source of incalculable advantage to science hereafter? In addition to other more direct benefits, I hope they will be the means of impressing on the government of this country the conviction, that the love of scientific pursuits, and the means of pursuing them, are not confined to the metropolis; and I hope, that, when the government is fully impressed with the knowledge of the great desire entertained to promote science in every part of the empire, they will see the necessity of affording it due encouragement, and of giving every proper stimulus to its advancement. Perhaps the most effectual method of

promoting science is by removing the obstacles, which oppose its progress; though I am aware of the fact, that there are some investigations which require to be carried on upon so great a scale, as to be beyond the reach of individual enterprise; and to these, undoubtedly, the energies of government should be directed. We all know, that the laws of this country,—I mean in particular the fiscal laws of this country,—offer numerous obstacles to scientific improvements. I will name only one instance. In the science of optics very serious obstacles are found to result from the regulations relative to the manufacture of glass. I mention only this; but it must occur to many of the persons present, that there are various other instances, in which the laws interfere materially with the progress of science. With regard to the more direct advantages which we have a right to anticipate from these Meetings, I have no doubt, that, if they shall be extended to different parts of the country, and held in well-selected places, this result will be obtained: the men of science, now scattered over the empire, will be enabled to meet each other, and mutually communicate their ideas; they will state the advances which have been made in their own respective spheres of action, and also what the deficiencies may be. Thus not only will an extraordinary impulse be given, but the individuals and the Societies taking part in the Meetings, will learn what parts of science they can cultivate with the greatest utility, and will give their researches the most advantageous direction. Such, Gentlemen, are a few of the benefits which, it appears to me, will be derived from Meetings of this description, and if they shall be extensively held, and shall be found thus pregnant with important consequences, sure I am, that it will redound to the honour of this Society to have been the first to set the example."

Lord Milton concluded by expressing the sense which he entertained of the services which, his friend and predecessor in the office of President, Mr. W. V. Harcourt, had rendered to the Institution, within whose walls they were assembled.

The Rev. William Vernon Harcourt, Vice-President of the Yorkshire Philosophical Society, and Chairman of the Committee of Management, then addressed the Meeting:

"Gentlemen,

"I am desired by the Council of the Yorkshire Philosophical Society to submit to your consideration a plan, which they beg leave to propose for the conduct of this Meeting, and for the establishment of a system, on which similar Meetings may continue to be conducted hereafter.

"The Meeting, Gentlemen, owes its origin to some distinguished cultivators of science* here present, who were of opinion that great advantage might be expected from an Association for scientific intercourse in these kingdoms, formed upon the model of that which has subsisted in Germany for several years,—an Association which appears to have answered the hopes of its founders, as well in approximating men of science to each other, and promoting among them friendly feelings and an instructive interchange of ideas, as in giving to their union a collective efficacy, and bringing their aims and views more prominently into public notice.

"Fully concurring in the utility of such objects, our Society cordially embraced the proposal which was made to us, that the first Meeting should be held in these apartments—happy if the accommodation which we have to offer could be made serviceable to a purpose of so much public interest, and not insensible, Gentlemen, to the honour and advantage which the presence of so distinguished an assembly would confer upon our own Institution.

"In conformity also with the express desire of the promoters

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* The Meeting was proposed by Dr. Brewster to the Yorkshire Philosophical Society in a letter to one of the Secretaries, (Mr. Phillips). The proposal was approved and encouraged by the Society, and it received the most zealous and effective support from Mr. Robison, Mr. Forbes and Mr. Johnston in Edinburgh, and from Mr. Murchison in London.

of the Meeting, we undertook to make all the arrangements for it, and to prepare the plan of a permanent Association. I will request the Secretary of the Committee of Management to state, in the first place, what arrangements were made, and will afterwards proceed to give an account of the plan which I have to offer to your consideration."

Mr. Phillips, Secretary of the Society and of the Committee of Management, made the following statement:

"The Committee, Gentlemen, being of opinion that the invitations to this preliminary Meeting should be co-extensive with whatever desire there might be in the country to promote the objects of Science, drew up in the first instance a circular letter inviting the attendance of all persons interested in scientific pursuits, which, in case any one who is here present should not have received it, it may be proper for me to read:—

"Sir,

"The Council of the Yorkshire Philosophical Society having received intimation from men of scientific eminence in various parts of the kingdom, of a general wish that a Meeting of the Friends of Science should be held at York during the last week in September next, we are directed to announce that the Society has offered the use of its apartments * for the accommodation of the Meeting, and that arrangements will be made for the personal convenience of those who may attend it. It will greatly facilitate these arrangements, if all who intend to come to the Meeting, would signify their intention as early as possible to the Secretaries.

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* The Museum of this Society stands upon ground lately granted to it by the Crown, having been part of the site of the palace built by James I. The platform on which it is placed overlooks the river and combines views of the Minster, the ancient walls of York, and the hills of Severus. Within the garden at either extremity are the remains of the old Roman fortifications and the mutilated but beautiful ruins of the Abbey of St. Mary. The Collections of Natural History are distributed in five apartments, the three largest of which are arranged round the Lecture

"The apartments, which the Yorkshire Philosophical Society has to offer for the use of the Meeting, consist of a spacious Theatre, three large rooms containing the Museum of Natural History, a Library, Council Room, &c.

"All persons interested in scientific pursuits are admissible to the Meeting.

WILLIAM VERNON HARCOURT, VICE-PRESIDENT.
JOHN PHILLIPS, SECRETARY.

"*Yorkshire Museum, York,*
July 12, 1831.

"Copies of this circular letter were sent to the Presidents and Secretaries of all the Scientific Institutions in England, metropolitan and provincial, which were known to the Committee, with a request that the invitation might be communicated to any members of those Institutions who might be disposed to accept it. The number of Societies in London thus addressed was THIRTEEN; the number in other parts of England was TWENTY-SIX, NINE of these being in the County of York.

"The letter was sent individually to the more distant Members of our own Society, and to persons, whether belonging to any Society or not, who were known to be active cultivators and promoters of science. One hundred and eighty-nine copies were issued on the latter account. In this

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room and lighted from above. In one of these are the cabinets of minerals, in another a suite of 12,000 geological specimens disposed in the order of the strata, and the third contains collections in the various departments of Zoology. The two remaining rooms are filled with several series of rock specimens, and with an anatomical collection belonging to the Curator of Anatomy. The Lecture room affords seats for three hundred persons. The Society possesses also a Library of works of Science, a Laboratory, and several other rooms adapted to the purposes of the Institution. In one of these is contained a series of Roman and British coins and various objects of antiquarian interest, in another an architectural collection of sculptured Gothic remains, discovered in the excavations on the ancient site of the Abbey. The architecture of the façade of the Museum is Grecian Doric, and was designed by Mr. Wilkins.

list, and even in the list of Societies, it is more than possible that the Committee may have been guilty of some omissions, which they hope, however, will be pardoned, when the number of letters sent out is considered, amounting, in the whole, to more than four hundred. One hundred copies were also transmitted for similar distribution to Societies and individuals, by the correspondents of the Committee in Scotland and Ireland; and two or three eminent foreigners were in like manner individually invited, though the Committee did not deem it prudent to extend invitations abroad, till it should be seen what reception the plan of the Association might meet with at home. Lastly, to ensure more general publicity, advertisements of the Meeting were inserted in the Philosophical Magazine for the months of August and September, an announcement of it having before appeared in the Edinburgh Journal of Science."

Mr. Phillips then proceeded to read the answers which had been received to these invitations from persons who had been prevented, by unavoidable engagements, from being present at the Meeting:—answers, which, whilst they excited a deep regret for the absence of the distinguished writers, shewed what valuable support the Association might justly count upon receiving from them hereafter. He stated, "that in several instances deputations had been appointed by provincial Institutions to attend the Meeting, and that gentlemen were present, who had come for that purpose from London, Edinburgh, and Dublin, from Newcastle, Manchester, Liverpool, and Birmingham, and even from Bath and Bristol. The great distance of the Plymouth Institution had prevented any of its members from being present; but the official letter received from that body was a gratifying proof of the general interest felt in these proceedings, and of the benefit to be expected from a migratory Association, which might another year be as conveniently attended by the Southern, as on this occasion by the Northern Societies.

"When the time appointed for the Meeting drew nearer, the Committee of Management put into circulation another notice, specifying more particularly the nature of the regulations which they proposed to adopt. The second circular notice was as follows:

"GENERAL SCIENTIFIC MEETING AT YORK.

"It is requested that persons proposing to attend the Meeting will give notice of their intention to the Secretaries of the Yorkshire Philosophical Society.

"Models of Inventions, Specimens of Natural and Artificial Products, to be exhibited at the Meeting, Instruments or Drawings to illustrate any communication, and Materials for Experiments, will be received by the Secretaries, and may be transmitted to them previous to the Meeting.

"It is also desirable that Memoirs intended to be read, or a short statement of their contents should be sent beforehand, in order to their being registered; and that any Memoir which may be too detailed to admit of being read at length, should be accompanied by an abstract of its principal contents.

"On Monday, the 26th inst. the Managing Committee will receive, at the Museum, the names of Persons intending to be present; and will deliver Tickets for the Morning and Evening Meetings, and Dinners, and references for Lodgings. The Committee will think it right to pay regard to economy, as well as convenience, in these arrangements. *

"The Apartments of the Society will be opened on Monday Evening, and the first Morning Meeting for scientific purposes, will be on Tuesday, the 27th, at Twelve o'clock.

"YORKSHIRE MUSEUM,
September 7, 1831.

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* On Tuesday a public dinner was provided at Twelve Shillings a Ticket; on the other days, during the session, ordinaries at from Five to Seven Shillings a head: venison, game, and fruit being contributed by Earl Fitzwilliam, the Earl of Carlisle, Paul Beilby Thompson, Esq. and Richard John Thompson, Esq. The Archbishop of York gave a public dinner to the Members of the Association on Friday. The Evening refreshments were furnished by a subscription among the Members of the Yorkshire Philosophical Society.

"To this account of the regulations of the Committee, it only remained to be added, that the number of scientific papers to be brought forward, was so considerable, as to demand the employment of the evenings as well as the mornings of the week, and the Committee recommended that the communications of the least abstract nature should be allotted to the evening Meetings, as it was proposed to admit a more popular audience to these."

Mr. Phillips having concluded his statement,—Mr. Vernon Harcourt again rose and read extracts from letters which had been addressed to him by Mr. Chantrey, Mr. Faraday, and Dr. Buckland, who had been reluctantly prevented from attending the Meeting by pressing engagements. Mr. Chantrey, he said, had given the Yorkshire Philosophical Society another proof of his liberal disposition to promote science, by presenting to its Museum, on this occasion, a Cast of the celebrated specimen of Plesiosaurus in the Duke of Buckingham's collection. He then read a letter which he had received from the Duke of Sussex, who had been invited to honor the Meeting with his presence. The letter stated, that nothing would have afforded his Royal Highness greater pleasure than to have complied with the invitation, if he had not been unfortunately pre-engaged. "You will, therefore," His Royal Highness added, "be so kind as to express my regret on the occasion, accompanied with my best wishes for the success of so praiseworthy an object, and an assurance on my part, of my warm co-operation in promoting any measure which may be suggested, and sanctioned by such a respectable Meeting."

Mr. Harcourt then commenced his exposition of the OBJECTS AND PLAN OF THE ASSOCIATION.

"When we came to meditate, Gentlemen, on the means of giving stability and continuance to such Meetings as these, when we considered how little command of time men of science in this country enjoy, and how difficultly they are

drawn from their occupations and homes, we could not but entertain a doubt whether the inducement of meeting one another, without a more imperative call, would be powerful enough to bring them annually together, from distant parts of the kingdom. But, if there were objects of more essential consequence, which a yearly aggregate Meeting might propose to accomplish, objects now unattempted, and yet of the highest moment to the advancement of science, then we apprehended, that those who have any zeal to advance it would not lightly absent themselves from such a Meeting, and that thus the benefit of personal intercourse would follow in the train of still more important advantages.

"Views of this extent, however, were not to be indulged without consultation; and, before we ventured to bring them forward, we inquired the opinions of several of the most distinguished among the lights of British science: from some of those who were consulted, we received warm encouragement and valuable suggestions, whilst to others we were indebted for cautions, of which we also knew the value, and for a fair representation of the obstacles opposed to our success. These different opinions have been weighed with the attention which they deserved; and I present this plan to the Meeting, as one of which all the bearings have been considered, and of which the deliberate consideration has led us to hope, that a great preponderance of advantage may be derived from its adoption.

"I propose then, Gentlemen, in the first place, that we should found a BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, having for its objects, to give a stronger impulse and more systematic direction to scientific inquiry, to obtain a greater degree of national attention to the objects of science, and a removal of those disadvantages which impede its progress, and to promote the intercourse of the cultivators of science with one another, and with foreign philosophers.

"On the first and most important of these objects, some difference of opinion may exist; a difference of opinion, I

mean, as to the want in which we stand of a new Association, to give a stronger impulse and more systematic direction to scientific inquiry.

"I do not rest my opinion, Gentlemen, of this want upon any complaint of the decline of science in England. It would be a strange anomaly if the science of the nation were declining, whilst the general intelligence and prosperity increase. There is good reason, indeed, to regret that it does not make more rapid progress in so favourable a soil, and that its cultivation is not proportionate to the advantages which this country affords, and the immunity from vulgar cares which a mature state of social refinement implies. But, in no other than this relative sense, can I admit science to have declined in England. What three names, if we except the name of NEWTON, can be shewn in any one age of our scientific history which rank higher than those of men whose friendship we have enjoyed, by whose genius we have been warmed, and whose loss it has been our misfortune prematurely to deplore, the names of DAVY, WOLLASTON, and YOUNG! And there are men still remaining among us, individuals whom I must not mention, present in this Meeting, and absent from this Meeting, whose names are no less consecrated to immortality than theirs.

"But it is not by counting the great luminaries who may chance to shine in this year, or that,—in a decade of years, or a generation of men,—that we are to inform ourselves of the state of national science. Let us look rather to the numbers engaged, effectually, though less conspicuously, in adding by degrees to our knowledge of nature; let us look to the increase of scientific transactions and journals; let us look, Gentlemen, at the list produced this day of Philosophical Societies which have grown up in all parts of the kingdom. The multiplication of these new and numerous institutions indicates a wide extension of scientific pursuits. The funds so liberally contributed to their support bear evidence of an enlarged disposition in the public to promote such pursuits.

"It is on this very ground I rest the necessity and the practicability of establishing in science a new impulsive and directive force, that there are new and more abundant materials to be directed and impelled. The mining-field of discovery seems to me to shew, on the one part, the ore breaking out on every side; veins of the precious metal scarcely opened or imperfectly wrought; and on the other a multitude of hands ready to work it; but no one engaging them to labour, or shewing them in what manner they may employ their industry to the best advantage. And therefore it is that I propose to you to found an Association including all the scientific strength of Great Britain, which shall employ a short period of every year in pointing out the lines of direction in which the researches of science should move, in indicating the particulars which most immediately demand investigation, in stating problems to be solved and data to be fixed, in assigning to every class of mind a definite task, and suggesting to its members, that there is here a shore of which the soundings should be more accurately taken, and there a line of coast along which a voyage of discovery should be made.

"I am not aware, Gentlemen, that in executing such a plan we should intrude upon the province of any other Institution. There is no society at present existing among us, which undertakes to lend any guidance to the individual efforts of its members, and there is none perhaps which can undertake it. Consider the difference, Gentlemen, between the limited circle of any of our scientific councils, or even the Annual Meetings of our societies, and a Meeting at which all the sciences of these kingdoms should be convened, which should be attended, as this first Meeting you see already promises, by deputations from every other Society, and in which foreign talent and character should be tempted to mingle with our own. With what a momentum would such an Association urge on its purpose! what activity would it be capable of exciting! how powerfully would it attract and

stimulate those minds, which either thirst for reputation or rejoice in the light and sunshine of truth !

" The eldest of our scientific Institutions contemplated, in its origin, the objects which we now propose to pursue. The foundation, Gentlemen, of the Royal Society was an attempt to reduce to practice the splendid fiction of the New Atlantis.*

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* The actual and immediate effect produced by Bacon on the general spirit of philosophy has been underrated: His writings were quickly circulated through Europe, and their value was appreciated abroad even sooner than at home: he himself translated the New Atlantis into Latin, "in gratiam exterorum apud quos expeti inaudiverat," and his most important works were rendered into that language and into French before his death. His letter to Baranzon, who lectured on Natural Philosophy at Annecy in Savoy, and who, it appears, had consulted him on the substitution of his inductive method for the syllogisms of Aristotle, deserves attention not only as containing the most perspicuous summary of his views, but as shewing how far the authority and influence of his writings had reached in 1621. It has been said by Playfair that Descartes, who became afterwards the head of so numerous a school, " does not seem to have been acquainted with Bacon's works ;" and another eminent historian of philosophy, Dugald Stewart, has admitted that, " if he ever read them he has no where alluded to them in his writings." But the fact is that in the correspondence of Descartes with Mersenne, published in 1642, there are, in several of his letters, passages in which he has referred to the works of " Verulam" with a respect which he yielded to no other writer, and has shewn that he had both studied them and adopted the methods which they contain ; so that there is no longer any difficulty in accounting for the remarkable coincidence with Bacon's views and language which Mr. Stewart has noticed in the principles laid down by Descartes for studying the phenomena of the mind. The passages to which I refer are these: " Scribis præterea velle te scire modum aliquem faciendi experimenta utilia ; ad quod nihil est quod dicam *post Verulamium* qui hac de re scripsit, nisi quod omissis minutioribus circumstantiis oporteret in qualibet materia potissimum facere generales observationes rerum omnium maxime vulgarium et certissimarum et quæ sine sumptu cognosci possint, ut, ex. gr. cochleas omnes in eandem partem esse contortas, atque utrum idem obtineat trans æquinoctialem ; omnium animalium corpus esse divisum in tres partes, caput, pectus, et ventrem, et alia id genus, hujusmodi enim observationes ad veritatis investigationem certo deducunt. *(Ep. LXV.)*

The same comprehensive mind which first developed the true method of interpreting nature, sketched also the first draft of a national Association for undertaking by a system of distributed and combined exertion, the labour of that work.

"Gratias tibi ago pro qualitatibus quas ex Aristotele desumpsisti; majorem illorum catalogum, partim ex *Verulamio* desumptum, partim a me collectum jam conscripseram, illasque imprimis conabor explicare. *(Ep. C. V.)* Scripsisti ad me aliquando esse tibi notos viros quibus volupe erat scientiis propagandis dare operam, (these were probably the persons whose meetings at Mersenne's house laid the foundation of the French Academy,) adeo ut nullum non experimentorum genus propriis sumptibus se facturos profiterentur. Illorum siquis vellet conscribere historiam phenomenorum cœlestium secundum methodum *Verulamii*, atque omissis rationibus et hypothesibus accurate describeret cœlum prout nunc apparet, quem situm singulæ stellæ fixæ respectu circumjacentium obtineant, quæ sit aut magnitudinis, aut coloris, aut luminis, aut scintillationis, &c. differentia; item numquid ea consentiunt cum iis quæ de illis veteres Astronomi scripserunt, quave in re differant, (neque enim dubito quin stellæ situm inter se suum aliquantulum mutent quamvis fixæ habeantur) hisque subjiceret observationes Cometarum, tabellam conficiens de uniuscunque motu, quemadmodum Tycho de tribus aut quatuor a se observatis fecit, denique variationes Eclipticæ et apogoeorum planetarum, opus esset utilius quam forte primo intuitu videatur, essetque mihi magnum operæ compendium; sed non spero id facturum quenquam. *(Ep. LXVII.)* If any one will compare these suggestions with the letter to Baranzon before referred to, he will find them almost a literal transcript of Bacon's request to the Savoyard philosopher to undertake this identical task. These extracts shew the philosophical character of Descartes in a light somewhat different from that in which it is commonly regarded; like other great geometers before and since, he carried the use of abstractions and hypotheses too far and too soon into physical reasoning; but though he did not, with the wisdom of Newton, abide by the fundamental principle, laid down by Bacon, "non fingendum, nec excogitandum, sed inveniendum, quid natura faciat aut ferat," he was no stranger to the inductive method of collecting axioms from observation and experiment. In a letter addressed to Descartes, and prefixed to his celebrated treatise on the passions, a strong appeal is made to the public liberality to enable him to pursue those multiplied experiments for which he had occasion in order to carry on his investigations into nature. It is stated in this

"This philosophical romance was not composed by its great author to amuse the fancy, but to dispose the minds of the legislature towards the foundation of a public establishment for the advancement of science. His plan for its maintenance is detailed in 'a speech, touching the recovering of drowned mineral works, prepared for the parliament by the Viscount of St Albans, then Lord High Chancellor of England.' For that end he would have proposed, by legislative enactment, 'to bring those deserted mineral riches into use by the assiduous labours of felons and the industry of converted penitents, whose wretched carcasses the impartial laws have dedicated, or shall dedicate, as untimely feasts to the worms of the earth.' 'By this unchargeable way, my Lords, have I proposed to erect the academical fabric of this island's Solomon's house, modelled in my New Atlantis, and my ends are only to make the world my heir, and the learned fathers of my Solomon's house the

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letter, that Gilbert had expended more than 50,000 crowns on the magnet alone, and that to execute all the experiments which Bacon had designed, would require more than the revenue of two or three kings. The writer (probably Mersenne) refers to "l'Instauratio magna et le Novus Atlantis du Chancelier Bacon, qui me semble estre de tous ceux qui ont escrit avant vous celuy qui a eu les meilleures pensées touchant la methode qu'on doit tenir pour conduire la Physique en sa perfection."

In England meanwhile an experimental school was forming, more faithful to the principles of the inductive philosophy. Foremost among the founders of the Royal Society, "Mr. Boyle, the ornament of his age and country, succeeded to the genius and inquiries of the great Chancellor Verulam" *; and he has left us no doubt as to the master by whom he had been taught; for in recording his experiments he has retained not only the method, but the peculiar idiom and technical phrases of Bacon. Thus this great interpreter of nature stood among philosophers like the pilot among the crew; he constructed the chart of knowledge, he marked upon it the place of the ship, he took the bearings of the land, he pointed out the variation of the compass, he noted the force and direction of the winds, and taught the adventurer to steer a certain course over the wide and trackless sea.

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* Boerhaave.

successive and sworn trustees, in the dispensation of this great service, for God's glory, my prince's magnificence, this parliament's honour, our country's general good, and the propagation of my own memory.' From this speech it appears that the basis of the great Institution, which Bacon meditated, was a public provision for the maintenance and promotion of science. It was one of the defects noted by him in his masterly survey of the state of learning, that science had never possessed a *whole man;* and he exerted all the influence of his high station and commanding talents, to promote the supply of that defect. In a letter to the king respecting the foundation of the hospital at Dulwich by Allen the actor, he remarked, that though he was glad to see him play the last act of life so well, yet he thought Sir H. Savile's endowments of geometrical and astronomical Professorships of much greater necessity and more deserving of royal encouragement; and his own last bequest was one which, had it been executed, would have endowed two similar offices with salaries of two hundred pounds a year. In his opinion it was 'necessary to the progression of sciences, that those who are to generate and propagate them should be placed in such a condition as may content the ablest man to appropriate his whole labour, and continue his whole age, in that function and attendance;' and he added, 'there will hardly be any main proficiency in the disclosing of nature, except there be some allowances for expenses about experiments, whether they be experiments appertaining to Vulcan or Dædalus, furnace or engine, or any other kind; and therefore, as secretaries and spials of princes and states bring in bills for intelligence, so you must allow the spials and intelligencers of nature to bring in their bills, or else you shall be ill advertised.'

"These desiderata no means have yet been found of supplying in an adequate degree, and science even to the present day can scarcely be said to possess more than *fractions of men.* The Royal Society did not attempt to execute this part of Bacon's plan; but in other respects it copied

as closely as possible, the model of the *six days College*. It was not then an association of individuals throwing their contributions casually into a common stock, but a body politic of philosophers acting in a corporate capacity and with systematic views, allotting to its members their respective tasks, and conjunctively debating and consulting for the advancement of knowledge. It had, in the figurative language of Bacon, its *merchants of light*, who were dispatched in various directions at home and abroad, to gather information and bring back specimens of the productions of nature; it had its *depredators* who were deputed to examine histories of *countries*, and to question the travellers who had visited them, in order that queries might be framed which were then addressed to the Society's correspondents in foreign lands, among whom Consuls and Ambassadors were proud to be numbered. It employed some of its members as auxiliaries to the arts, to some it proposed the solution of the most important problems in mathematics, whilst it referred to others the charge of experimental researches, the mode of conducting which was discussed before-hand, and the results re-examined by a public meeting. I may mention as examples of the effect of this system, that we are indebted to it, practically, for *Evelyn's History of Forest Trees*, by which the planting of the country was so materially promoted, and, theoretically, for the determination of *the law of the collision of bodies*, simultaneously obtained from Huygens, Wallis, and Wren.

"This was indeed to execute a noble plan in the spirit in which it was designed. The noise of works and inventions resounded on every side; new facts and original discoveries of the laws of the universe were daily brought to light; the conveniences and safeguards of life, the measurements of time, the construction of ships, the tilling and planting of the earth began to be rapidly improved. But the vigour of these exertions soon declined, and within thirty years we find Leibnitz suggesting to one of the original

founders * of the Royal Society that it wanted new warmth to be infused into its constitution, and recommending that it should be remodelled after the example of the French Academy.

"Leibnitz indeed had no right to consider a Society effete, which within a few years had elicited a work † from Newton, that eclipsed the fame even of the great German philosopher. Nor to this hour has it ever lost its title to public respect. It still embodies in its list every name which stands high in British science; it still communicates to the world the most important of our discoveries, it still crowns with the most coveted honours the ambition of successful talent, and when the public service requires the aid of philosophy, it still renders to the nation the ablest assistance, and the soundest counsel. Nevertheless it must be admitted, Gentlemen, that the Royal Society no longer performs the part of promoting natural knowledge by any such exertions as those which we now propose to revive. As a body, it scarcely labours itself, and does not attempt to guide the labours of others.

"Hence it happens, that when any science becomes popular, and those who interest themselves in its advancement perceive the necessity of working for it by united exertions, that science is detached from the central body; first one fragment falls off, and then another; colony after colony disseversitself from the declining empire, and by degrees the commonwealth of science is dissolved. The new societies distinguish themselves by their diligence and activity; the parts of knowledge which thus receive more distinct attention, and are propelled by more undivided labour, make rapid advances; and each separate undertaking justifies itself by the most promising appearances and undeniable fruits.

"This is a new stage, Gentlemen, in the progress of science; a new state of things, which, whilst it is attended certainly

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* Dr. Wallis.

† The Principia, as well as the Optics, of Newton were published at the solicitation of the Royal Society.

with great advantages, has some consequences of doubtful aspect to the highest aims of philosophy. As the facts and speculations in any department of knowledge are multiplied, the study of it has a tendency to engross and confine the views of those by whom it is cultivated; and if the system of separate societies shall encourage this insulation, science will be in the end retarded by them more than it is at first advanced. The chief Interpreters of nature have always been those who grasped the widest field of inquiry, who have listened with the most universal curiosity to all information, and felt an interest in every question which the one great system of nature presents. Nothing, I think, could be a more disastrous event for the sciences, than that one of them should be in any manner dissociated from another, and nothing can conduce more to prevent that dissociation, than the bringing into mutual contact men who have exercised great and equal powers of mind upon different pursuits; nothing more fitted to shame men out of that unphilosophical contempt which they are too apt to feel for each other's objects; nothing more likely to open to them new veins of thought, which may be of the utmost importance to the very inquiries on which they are more peculiarly intent.

"I remember, at the Meeting of a foreign Society, to have heard a memoir read, in which a specific and original difference was inferred between two animals, (commonly considered of one species) not from any difference in the higher and more essential parts of their organization, but from a dissimilarity of colour in the skin or fur, and from minute anatomical distinctions; and I heard the error of the Zoologist corrected by a Botanist, one of the most eminent in Europe, who illuminated the whole subject of generic, specific and individual difference, by the light of a powerful mind which had been directed to the study of the question, considered in a different aspect, and with a more extensive survey. In like manner it is easy to conceive on the one hand, how much advantage might be derived to geological debates from the

presence of a sober and rigorous mathematician; and how on the other hand, the abstract analyst and geometer might have his calculations restricted and promoted by listening to the detail of facts, which those could give him who cultivate the sciences more directly dependent on observation and experiment.

But there is a defect in these separate Societies, in respect to their own immediate objects, which I am sure no member of them would wish to dissemble, and which arises from the narrow basis on which they are of necessity built. It is not only, that the constant converse of men, who, to borrow the expression of Goldsmith, have often travelled over each other's minds, is not half so effectual in striking out great and unexpected lights, as the occasional intercourse of those who have studied nature at a distance from each other, under various circumstances and in different views; but it is also, Gentlemen, that none of our existing Societies is able to concentrate the scattered forces even of its own science; they do not know, much less can they connect or employ that extensive and growing body of humble labourers who are ready, whenever they shall be called upon, to render their assistance. I have the pleasure of seeing here the President of the Geological Society of London, and I beg leave to ask him, whether in a science, the most complex of all sciences in its object, because it aims at decyphering the history of nature not only as it is but as it has been, in a science of which very few even among the lowest generalisations are as yet so settled as to be able to bear the weight of any theoretical superstructure whatever, I ask him whether in the science of Geology there is not a multitude of facts to be ascertained in every district, on which he would be glad to see a much greater number of observers employed? and if it be so, let me remind him that we have heard to day of nine Philosophical Societies in this county alone, which could doubtless find members ready to prosecute any local inquiry that this Meeting might, at his suggestion, request them

to undertake. It is the same with all parts of Natural History, with Meteorology, and indeed with every science which is founded upon observation, or even upon experiment; for the lower order of experiments, in subjects of the utmost ultimate abstractness, such as the relations, for instance, of heat and of light, are not only abundantly wanted, but by a moderate degree of industry and talent are by no means difficult to be supplied.

"What numberless suggestions, what a crowd of valuable but abortive hints are continually floating in the thoughts of philosophers, for the pursuit of which time is wanting to themselves! Now I say, Gentlemen, that we have among us, scattered through the country, men willing to adopt these unexecuted hints, as they arise out of the profound and varied meditations of more experienced minds, men not incapable of surveying with accuracy a limited district, though they may not pretend to draw the general outline of the map, or fill up the whole of its details. Many such there are who only wait for instructions, and who require no other stimulus than that of being invited, to render the most essential service to researches and calculations of the highest order; and it is upon this ground especially that we venture to pronounce an Institution wanting, which shall not hesitate to make such invitations and to offer such instructions; it is upon this ground that if we now propose to revive in the nineteenth century a plan devised two centuries ago,—we see a difference, Gentlemen, in the probability of success. Scientific knowledge has of late years been more largely infused into the education of every class of society, and the time seems to be arrived for taking advantage of the intellectual improvement of the nation. Let Philosophy at length come forth and shew herself in public; let her hold her court in different parts of her dominions; and you will see her surrounded by loyal retainers, who will derive new light and zeal from her presence and contribute to extend her power on every side.

"Much, indeed, is not to be gained in the more recondite subjects of investigation from the first essays of inexpert inquirers; but let the number of those inquirers only be increased, collect around you, Gentlemen, a school fired with a zeal for truth, confess to them how little you know compared with what remains to be known, apprise them that there is not a subject to which they can apply themselves where new materials are not wanted to advance the fabric or secure the foundations, let them see that the more multiplied have been your discoveries, the more additional openings to discovery have appeared,—and if you will then draw the precise line of what is, and what is not made out in every science, if you will indicate to them those promising points and *inlets* of inquiry which bid fair to lead to promising results,—if you will thus put before them right subjects, and at the same time suggest the right methods of treating those subjects; whatever more may be wanting to accurate and successful investigation, natural sagacity and a longer experience will easily supply to men possessing only common abilities, and walking in the common paths of life.

"But even the experienced in science will benefit by consultation with each other; for there are different degrees of experience, and no solitary industry or talent can ever hope to equal the power of combined wisdom and concerted labour. Above all consider, Gentlemen, the excitement to exertion which will be felt by those who are solicited to undertake an inquiry at one of these Meetings, and pledged to produce the investigation at another. The greatest minds require to be urged by outward impulses, and there is no impulse more powerful than that which is exercised by publicly-esteemed bodies of men. Even Newton's papers might have remained unfinished, but for the incentive of such a solicitation. In a letter which I have lately received from Mr. Conybeare, and in which he expresses a deep regret at finding himself unexpectedly prevented from attending this Meeting, the benefit in these respects which may be looked for from a

general scientific combination is described with the energy of his ardent and comprehensive genius. "Your proposal," he says, 'for ingrafting on the annual reunion of scientific men, a system for effecting such a concentration of the talent of the country as might tend more effectually to consolidate and combine its scattered powers, to direct its investigations to the points which an extensive survey thus generalised would indicate as the most important,—benefited by all the aids which the union of powerful minds, the enlarged comparison of different views, and a general system of intellectual co-operation could not fail to afford, fills me with visions too extensive almost to allow me to write with sufficient calmness of approbation. The combined advantages, including at once the most powerful stimulus and the most efficient guidance of scientific research, which might emanate from such a point of central union, seem to me to be beyond calculation. If views like those you have sketched could be realised, they would almost give a local habitation and a name to the philosophical academy of Bacon's Atlantis, when "divers Meetings and consults" of the united body of DEPREDATORS, COMPILERS, PIONEERS, &c. suggested new experiments of a higher light and more penetrating nature to the LAMPS, and these at length yielded materials to the INTERPRETERS of nature.'

"To that great model of a national Institution for the advancement of science, I have already adverted to-day, as I have formerly directed to it the attention of the Yorkshire Philosophical Society; it is here referred to by Mr. Conybeare, and by a remarkable coincidence of ideas we have the same reference from Mr. Harvey, who in a letter from Plymouth, which he has addressed to the Secretary of the Meeting, observes, that "Bacon alludes to circuits or visits of divers principal cities of the kingdom as forming a distinguished feature of the New Atlantis. What Bacon,' he adds, 'foresaw in distant perspective, it has been reserved to our day to realise, and as his prophetic spirit pointed out

the splendid consequences that would result generally from institutions of this kind, so may we hope that the new visions which are opening before us may be productive of still greater effects than have yet been beheld, and that the bringing together the cultivators of science from the North and the South, the East and the West, may fulfil all the anticipations of one of the greatest minds that ever threw glory on our intellectual nature.'

"I have now laid before this Meeting the reasons for which I think it would be expedient to form a national Association, having for its first object to give a stronger impulse and more systematic direction to scientific inquiry. On the two remaining objects which I have before mentioned, it is not necessary for me to enlarge much. It is not necessary to recommend the promotion of a more general intercourse among the cultivators of science, to those who have come in many instances from a great distance expressly to enjoy the gratification of meeting men of kindred minds and congenial pursuits. I shall content myself with remarking that nothing can be better calculated to prevent those interferences, and reconcile those jealousies which sometimes disturb the peace of philosophy than the mutual intelligence and amicable communion of such a Meeting as this. On the grounds which subsist for seeking to obtain a greater degree of national attention to the objects of science, I have little to add to what the Chairman has said. In confirmation of his remarks on the obstacles which some of our fiscal laws oppose to the progress of knowledge, I may adduce the recent experience of this Museum. There is nothing more indispensible to the utility of such an Institution than a complete display of the specimens which it contains; and for that purpose, where the specimens are numerous, extensive glazing is required. Now there is a most serious impediment to this in the high price of glass, and of that price we find that two thirds consist in the duty paid to Government. So that more than one department of science is injured by this tax; the weight of the impost restrains the public exhibition of the objects of

natural history; whilst the regulations of the excise oppose an obstacle to the improvement of astronomical instruments, still more to be regretted. Among the subjects to which a Scientific Association may be justly expected to call the public attention, I would particularly instance a revision of the law of Patents. The protection which is given to every other species of property is not given in the same extent to the property of *scientific invention*. The protection which it does receive must be bought of the state at a high price; an expense, varying from two to four or five hundred pounds, is first to be sustained. Then, after encountering the risk of this outlay, the Patentee is compelled to specify publicly and with legal precision, the particulars of his invention; thus it is exposed to be pirated, with the redress only of ruinous proceedings at law; and the consequence is, that no Patent is considered of any value till it has actually maintained a litigation; and though Patents are still taken out, their chief use is understood to be, not so much to secure a right as to advertise a commodity. Such is the present policy of our laws respecting the remuneration of practical science, a policy which seems to have no other end than to restrain the multiplicity of inventions.

"With regard to the direct national encouragement which is due to scientific objects and scientific men, I am unwilling to moot any disputed or disputable question. There is a service of science to be rendered to a state with which it cannot dispense; and all, I think, must allow that it is neither liberal nor politic to keep those, who employ the rarest intellectual endowments in the direct service of the country, upon a kind of *parish allowance*. It would be difficult also to withhold our assent from the opinion that a liberal public provision would have a powerful effect in promoting those studies of *abstract science* which most require artificial encouragement; and that 'to detach a number of ingenious men from every thing but scientific pursuits; to deliver them alike from the embarrassments of poverty and the temptations of

wealth; to give them a place and station in society the most respectable and independent, is to remove every impediment and to add every stimulus to exertion.' * But I will not on this occasion enter upon a subject on which any difference of sentiment can be supposed to exist, nor pretend to decide whether Playfair judged rightly of the degree in which a provision of this kind has actually improved the state of science in a neighbouring country, when he added, that 'to such an Institution operating upon a people of great genius and indefatigable activity of mind, we are to ascribe that superiority in *the mathematical sciences*, for which, during the last seventy years they have been so conspicuous.'

"One great benefit, at least, in addition to her maritime expeditions, England, as a nation, has conferred on the science of the world. She has had reason to be proud of her astronomical observations; though perhaps it is not equally gratifying to reflect that these observations have been turned to account, of late years, less by her own geometers than by the national school of mathematicians in France. But there are many other sciences, Gentlemen, on which the resources of states are no less dependent, and in them also there are physical data, (I do not here speak of loose and subordinate facts, but of those more important physical axioms from which the general laws of nature are deduced,) in many other sciences, I say, of practical application, there are physical data which require to be ascertained by masters in science, with the most rigorous precision, and not without the most persevering labour; and I may be permitted to think with Mr. Herschel, that 'it may very reasonably be asked, why the direct assistance afforded by governments to the execution of continued series of observations, adapted to this especial end, should continue to be, as it has hitherto almost exclusively been, confined to Astronomy.'

"The Chairman of the Meeting adverting to this subject has said that 'there are enterprises in science which none but a nation can undertake;' let me add also that there are

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* Second Dissertation prefixed to the Supplement to the Encyclop. Brit.

establishments for science which none but a nation can support. I remember, Gentlemen, to have heard the greatest philosopher of this age for variety and extent of attainments, M. de Humboldt, speak of Great Britain, as he was shewing me the splendid collections of natural history in the Louvre. What country in the world, said he, has such opportunities as England for collecting in her capital all the productions of the earth! I reflected, Gentlemen, on those unrivalled advantages,—but felt, I confess, no elation of national pride when I recollected the state of the British Museum. Since that time however one material step has been taken towards improvement, and when an adequate building shall have been prepared, let us hope that we may at length see a public school of natural history in London, so furnished, and so appointed, as not to be unworthy of the British nation. I am persuaded that even our statesmen would have no cause for regret, if whilst the stores of this national repository were replenished by scientific missions judiciously employed, a more accurate knowledge were at the same time obtained of our distant possessions, and of their natural riches, than has been sometimes discovered in our diplomatic transactions.

"All the remarks, Gentlemen, which I have this day made, have been made with an anxious desire to say neither more nor less than the truth. I have spoken both of scientific societies and of the national policy with all freedom, because I take free speech upon points in which the interests of science are deeply concerned, to be one of the principal purposes for which we are now assembled; but I hope I have spoken also without any disposition to exaggerate the deficiencies which I have thought it right to notice, or to elevate a new institution by detracting from the merits of elder establishments. It only remains for me to lay before you the particulars of the plan by which we propose to accomplish the objects which I have stated; the subordinate details would be most advantageously revised by a Committee, but the material principles on which it is framed are points to which I would request the attention of this Meeting.

"The material principles of the plan are included in the *composition of the Association, in the constitution of its government, and in the selection of the work on which it is to be employed.*

"Having objects in view more extensive and at the same time more specific than those of the German Association, we do not recommend the adoption of the same rules. It is not our desire in the general composition of the Society to separate writers from readers, the professor of natural knowledge from the student. A public testimonial of reputable character and zeal for science is the only passport into our camp, which we would require. We propose therefore, that all *members of Philosophical Societies* in the British empire shall be entitled to become MEMBERS OF THE ASSOCIATION, on enrolling their names, and engaging to pay such subscription as may be agreed upon, the amount of which subscription, we think, ought to be *low;* and we propose that the members shall meet for one week in every year at *different* places in rotation; in order by these *migratory* visits to extend the sphere of the Association, to meet the convenience of distant districts in turn, and to animate the spirit of philosophy in all the places through which the Meetings may move, without rendering them burthensome to any.

"But the governing or executive power of the Association, we think, should be vested in a more select, though still numerous body, and placed in the hands of those who appear to have been actually employed in working for science. We propose therefore, that the GENERAL COMMITTEE shall consist of *all Members present at a Meeting who have contributed a paper to any Philosophical Society, which paper has been printed by its order or with its concurrence;* taking this as the safest definition of the class of persons intended, but leaving power to the Committee to *add to its own number, and to admit into the Association other members at its discretion;* and we propose that it shall sit during the time of the Meeting or longer if necessary, *to regulate the general*

affairs of the Association, to manage the business of the session, and to settle the principal scientific arrangements for the ensuing Meeting.

"We recommend however, that these arrangements should be first digested, and the particular advancement of every science specially looked to by SUB-COMMITTEES, which the general Committee shall appoint, placing severally on each those Members who are most conversant with the several branches of science. We propose that the Sub-Committees should *select the points in each science which most call for inquiry, and endeavour, under the authority of the General Committee, to engage competent persons to investigate them; that where the subject admits of the co-operation of scientific bodies, the Sub-Committees should recommend application to be made for that assistance; and that they should attend especially to the important object of obtaining Reports in which confidence may be placed, on the recent progress, the actual state and the deficiencies of every department of science.*

"On the last of these points I beg leave to quote the opinion of an able and zealous philosopher, the Professor of Mineralogy at Cambridge, who has been prevented by his public duties at the University from attending the Meeting, but who nevertheless takes the deepest interest in its objects. 'A collection of Reports,' says Professor Whewell, 'concerning the present state of science, drawn up by competent persons, is on all accounts much wanted; in order that scientific students may know where to begin their labours, and in order that those who pursue one branch of science may know how to communicate with the inquirer in another. For want of this knowledge we perpetually find speculations published which shew the greatest ignorance of what has been done and written on the subjects to which they refer, and which must give a very unfavourable impression of our acquirements to well informed foreigners.'

"I must add, however, to Mr. Whewell's remarks, that this want of knowledge is not by any means confined to our own

country. I do not remember any where a more remarkable instance of it than that which occurred in France, to one of the most distinguished improvers of optical science. * As late as the year 1815 M. Fresnel re-observed Dr. Young's important law of the interference of the rays of light; he re-constructed the same mathematical formularies for the application of that law to various phenomena, and he announced these researches as new, in a memoir read before the French Academy. One of the members of that eminent body,† better acquainted with the *progress* of optics than the writer of the memoir, happily preserved an author, to whose original and profound researches the science has been so largely indebted, from printing as his own, the celebrated discoveries long before published by another philosopher; but had this information been earlier acquired, it would have saved all the time and labour which were lost in a retrograde inquiry. Even four years after this, when general attention had been drawn to the subject, and the prize offered by the Academy for the best Memoir on the diffraction of light was adjudged to M. Fresnel, the following animadversions were made by the Reporter ‡ on the unsuccessful competitor, whom he nevertheless represents as an experienced physical inquirer ('Physicien exercé'). 'L'auteur paraît n'avoir connu ni les travàux dont on est redevable au Dr. Thomas Young, ni le memoire que M. Fresnel avait inséré en 1816 dans les *Annales de Chimie et de Physique:* aussi la partie de son travail qui se rapporte aux influences que les rayons de la lumière exercent ou semblent exercer les uns sur les autres en se mêlant, loin de rien ajouter à ce qui était déjà connu, renferme plusieurs erreurs évidentes.

"Having thus entrusted to the Sub-Committees, Gentlemen, the most active share in advancing their respective sciences, and considered them as the instruments by which, through the medium of the General Committee, the impulse

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* M. Fresnel. † M. Arago.

‡ Rapport lu à l'Academie 15 Mars, 1819. par M. Arago.

of the Association must be principally directed, we recommend that *they should not be dissolved with the Meeting at which they have been appointed, but continue in action till the Society re-assembles in the following year.* We do not presume that the persons who may happen to compose them, far removed as they may be from each other, may often have it in their power to meet in the interval; but we conceive that they will feel themselves engaged individually to keep the objects, which they have agreed to forward, in their view, and that the correspondence which they may be induced to maintain between themselves, and with the Officers of the Association, may be highly conducive to that combined exertion, the introduction of which into science would save much labour and ensure a better progress.

"The appointments to the HIGHER OFFICES of the Society, we propose should be not only annual, like the rest of the machinery by which it is kept in motion, but *annually changed;* in order at once to extend the interest which they may be supposed to kindle, and to limit the burthen which they will impose; leaving it for future consideration, whether the appointment of *more permanent* SECRETARIES may not be necessary to secure a steady and uniform course; and we recommend that, *when the General Committee is not sitting, the whole business of the Association shall be committed to the Office-bearers, assisted in scientific matters by the Members of the Sub-Committees, and in promoting the interests and objects of the Association in particular places, by the co-operation of* LOCAL COMMITTEES.

"I have now arrived at the last point to which it remains for me to advert—namely, the selection of the matter which is to engage the attention of the Meetings. It is evident that if the plan which I have thus far explained should be carried into effect, *the deliberations of the Committee to be formed at the present Meeting will provide the chief materials for the consideration of the next.* Those investigations and those surveys of science which shall have been suggested and

procured by the Committees and Officers of the Association, will be entitled to the priority, though other communications may be accepted as far as the duration of the session will allow. Professor Whewell conceives 'that if this Meeting were to request from one or two among the most eminent men in the various branches of science, statements to be presented next year of the recent advances made in each department, and the subjects of research which they consider at present the most important and promising, such a request would be respectfully attended to.' Gentlemen, I do not doubt that it would; neither do I doubt that a simple request from this Meeting, would be successful in procuring new researches to be made; and should the funds of the Association hereafter admit of its going further, and offering PRIZES for particular investigations,—then would another prolific source be opened from which the scientific materials of our Meetings would be derived.

This, indeed, would only be another and a very powerful method of carrying on the system which we recommend of advancing science in *determinate lines of direction;* a method, which, though scarcely practised in this country, has been found eminently successful abroad. Dr. Brewster, I believe, will confirm me in this statement; for he will recollect that we owe to a prize-memoir, the first announcement of that great optical discovery, that light may be polarised by reflection from the surface of transparent bodies, a discovery which has since been productive of so many new and admirable observations, and which has been in no hands more fertile than his own; and he will remember also, that the first accurate investigation of all the phenomena of diffraction, and the first complete explanation of them by the doctrine of undulations, was contained in a memoir produced by a similar competition.* The award of medals, indeed, is

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* This Memoir, written by M. Fresnel, gained the physical prize proposed by the French Academy for 'a general examination of the phenomena of the diffraction of light,' in 1819.

an honourable encouragement not altogether withheld from successful researches in British science. But the principle on which they are given is of a more vague and general nature. The objects of these rewards have never been so *distinct* as to give a direct stimulus to *specific* inquiries. I may add, without imputing any mercenary feelings to men of science, that where the inquiry involves expense, a sum of money instead of a medal would, perhaps, be found a more useful and operative offer. It is well known that the important improvements which have been made in Chronometers have arisen, both in France and England, directly out of the public rewards munificently offered by the British Parliament; and I see no reason why adequate and well devised premiums should not be efficacious in the sciences as well as in the arts. No man, however high may be his literary or scientific pretensions, disdains to receive a pecuniary remuneration for the labour which he employs in the composition of his works; and there can be nothing derogatory to the character of a man of science in accepting a similar compensation for the successful exercise of his talents in researches especially which require an expenditure of money as well as time.

"Such, Gentlemen, are the provisions of the plan which we propose for your consideration, and you will perceive that the methods which it embraces are new in practice, though not in principle. How otherwise indeed, than by new methods, can we hope to exchange the present desultory, and tardy progress of philosophy, for a more regular, energetic, and rapid advancement? There is a light in the distant horizon to which we have long eagerly looked, and complained that the current did not set us more quickly towards it; and the question now before you, Gentlemen, is no less than this: whether you are satisfied still to float passively on the waters, or whether you will raise the sail, and ply the oar, and take the helm into your hands. The methods now proposed are new, and therefore cannot place us in collision with any other

Society. It has never yet been seen in this country, that twenty Chemists for instance, or twenty Mineralogists, have met together, for the purpose of settling the nomenclature of their respective sciences, or attempting to fix with one consent the foundations on which they rest. It has never yet been seen, that the Chemical, Mineralogical, and Optical inquirers have assembled for the purpose of mutually explaining and learning what light the sciences of Chemistry, Mineralogy, and Optics are capable of reflecting reciprocally upon each other. You will perceive also, Gentlemen, that the Transactions, which we contemplate, are not to be collected by trespassing upon ground which was already occupied. In this respect there is on our part not only no design, but no possibility of interference. The course of an Association which meets once a year, and but for a few days, is necessarily different from that of more abiding Institutions; we have no time, if we wished it, to encroach upon the office, or to drain away the scientific resources of any other Society. It will be enough for us, if we can compress into the compass of a week's deliberations our own restricted objects,—specific investigations into fundamental points of science, reviews of its recent advances, and recommendations of subjects and methods for future research. Our plan contains within it a new power which may perhaps accelerate the wheels that are already in action; but its machinery is exclusively its own. The enlightened Institutions with which it hopes to be associated will regard it, therefore, not as a rival, but a coadjutor, and I trust it may prove such a coadjutor to them as the steam engine has been to all other kinds of mechanism, in every mine, and in every manufactory; a coadjutor, by the aid of whose powerful movements all their operations have been facilitated, and their productions multiplied a hundred fold.

"An enterprise like this has no danger to fear, but from a deficiency of zeal and union in carrying it into effect. It must undoubtedly fail, if it meets only with imperfect co-operation and cold support. But if it shall recommend

itself to the full approbation of men of science, if it appears to you, Gentlemen, desirable to undertake it, the Association will have competent sponsors in the present assembly, who will stand pledged not only for its early encouragement, but for those future exertions which will be required to ensure its success. The Council of the Yorkshire Philosophical Society have not the presumption to dictate to this Meeting the course which it may be for the interests of Philosophy to pursue. They collected, in the first instance, the best opinions which they could obtain, before they proceeded to mature their plan, and they now wait for the opinion of the eminent persons who are here assembled, before they can assure themselves that it is as feasible in practice as it appears in theory. My own judgement waits with theirs, Gentlemen, on that of the High Priests of the temple, in the porch of which I am only an humble worshipper,—'parcus Deorum cultor et infrequens',—and I shall be the first to withdraw the resolutions which I am now ready to propose, unless I find them, by the deliberate and cordial concurrence of this Meeting, stamped with authority and endued with permanence."

A string of Resolutions in which were embodied the Objects and Rules of the Association as stated in Mr. Harcourt's speech, were then moved by him *seriatim*, and seconded by Dr. Brewster, by Mr. Murchison, President of the Geological Society of London, by Dr. Pearson, Vice-President of the Astronomical Society of London, by Mr. Robison, Secretary to the Royal Society of Edinburgh, &c. It was resolved unanimously—'that an Association be formed, to be called the British Association for the advancement of Science, the objects of which shall be to give a stronger impulse and more systematic direction to scientific inquiry, to promote the intercourse of those who cultivate science in different parts of the British

Empire, with one another, and with foreign philosophers, and to obtain a greater degree of national attention to the objects of science and a removal of any disadvantages of a public nature which impede its progress.' In the next resolution purporting 'that the members of Philosophical Societies in any part of the British Empire may become members of the Association on enrolling their names and contributing a small subscription', several alterations were proposed; but it was finally passed, with the remaining resolutions, subject to the revisal and report of a Committee, constituted, according to the proposed plan, of all members present who had contributed a scientific paper to any Philosophical Society, which paper had been printed with its concurrence.

The thanks of the Meeting were then voted to the Chairman, and to the Rev. Mr. Harcourt for his statement of the plan of the Association, and the further consideration of it was adjourned till the following day.

On Wednesday, at 12 o'clock, Viscount Milton was again called to the chair, and the Meeting resumed its deliberations.

The Rev. W. V Harcourt, as chairman of the Committee, announced that the Resolution respecting the admission of members, in which alterations had been suggested on the previous day, had been revised, and that the Committee recommended that the following persons should be entitled to become members of the Association, upon subscribing an obligation to conform to its rules:—1st. all persons assembled at the present Meeting: 2nd. the Fellows and Members of all Chartered Societies in the British Empire: 3rd the Office-bearers and Members of the Council or Managing Committee of all Philosophical Societies:—4th. all Members of such a Society recommended by the Council or Committee thereof. They also proposed that the amount of the annual subscription should be One Pound, and that the composition for it should

be Five Pounds; that the accounts should be audited annually by Auditors appointed by the Meeting itself, and that the Treasurer of the Yorkshire Philosophical Society should be Treasurer of the Association for the ensuing year.

Resolutions founded on these recommendations having been moved and seconded by Sir Thomas Brisbane, Mr. Robison, Mr. Dalton, Dr. Daubeny, the Rev. Mr. Scoresby, Dr. Pearson, Mr. Murchison, Mr. Marshall, &c. were passed by the Meeting, and it was resolved that any further revision which the rules might require should be left to the Committee.

On the motion of Mr. Murchison, seconded by Sir Thomas Brisbane, it was resolved, 'that the Rev. Mr. Harcourt be requested to publish for the Association the exposition of its objects and plan which he delivered yesterday.' Mr. Harcourt, in assenting to the desire of the Meeting, asked permission to revise what he had said, previous to its publication.

The business of forming the Association being completed, the Chairman proceeded to announce the papers to be read that morning on subjects of science, a report of the contents of which, as well as of the other communications made during the Session, will be found in the subsequent account of the Scientific Transactions.

On Thursday morning it was stated to the Meeting that the Committee had chosen Viscount Milton, the Rev. W. V. Harcourt, and the Secretaries of the Yorkshire Philosophical Society, to be the actual President, Vice-President, and Secretaries of the Association, that the Rev. Dr. Buckland had been chosen President *elect*, Dr. Brewster and the Rev. Professor Whewell Vice-Presidents *elect*, Dr. Daubeny and the Rev. Professor Powell, Secretaries *elect*, and that the next Meeting was appointed to be held at Oxford.

On Saturday evening, the scientific communications and discussions having been closed by some remarks of Dr. Brewster, in which, adverting to a method of rendering visible the legends of ancient coins, he stated that he had never been more struck than by observing on an old coin, which he had placed on hot iron, an inscription make its appearance which he could read in a dark room, bearing the words 'benedictum sit nomen Dei'—Viscount Morpeth rose, and addressed the Meeting as follows:—

"Ladies and Gentlemen, an office has been assigned to me, which, although most entirely without any qualification or pretension to fulfil, I nevertheless accept, and will discharge, to the utmost of my ability, with the utmost alacrity. To the character of a man of science I have, unfortunately for myself, no claim whatsoever; but I have the good fortune to be intimately connected with the county, and consequently with the city of York; and I feel that they have both received great benefit and additional credit from the Meeting which is now brought to a conclusion. I say this, both with reference to the positive instruction we have received upon so many most interesting and important subjects, and also to the circumstance of this town and this edifice, already so much indebted to the zeal, perseverance, and ability of our Vice-President, having been now selected as the birth place of an Association, which, I trust, is destined to confer fresh lustre on British science, to give a new motive and a new guarantee to the friendly intercourse and continued concord of nations; to make farther inroads into the untravelled realm of discovery, and glean fresh harvests from the unexhausted field of Nature; to promote the comforts and augment the resources of civilized man; and to exalt above and over all the wonder-working hand of Heaven. For it will always come out from the pursuit of knowledge as surely as from the rusty medal of which we have this moment heard, '*Benedictum sit nomen Dei.*' Observe well, if you wish to appreciate rightly the true value and nobility of science, that while it proposes to itself dis-

tinct courses and definite spheres of its own, its general tendencies conduce to peace, and minister to piety. With these views and these hopes, it is natural and it is becoming that there should be mixed feelings of gratitude to those whose efforts have contributed so largely to our future progress. An assembly like that which I have the honour to address will appreciate, far more justly than I can pretend to do, the several papers and productions which have been submitted to our notice; I have no scruple in leaving to your more competent and accurate discrimination, the indications of enlightened and powerful thought which they have exhibited; but I feel sure that, if you pardon me for this intrusion of myself, the proposition I now make will command, upon this occasion, both the grave assent of science and the soft sanction of beauty. I move that the thanks of this Meeting be given to Dr. Brewster, and the other authors who have favoured us with their communications."

Mr. Murchison then rose, and 'on the part of Dr. Brewster and his other scientific friends, begged leave to return thanks for the high honour done to the contributors of scientific memoirs, and for the valuable aid which had been received from the residents of York and its neighbourhood, in the promotion of the objects of the Meeting. He explained the motives which induced the original promoters of it to select the city of York for their first assembly. "To this city," he said, "as the cradle of the Association, we shall ever look back with gratitude; and, whether we meet hereafter on the banks of the Isis, the Cam, or the Forth, to this spot, to this beautiful building, we shall still fondly revert, and hail with delight the period at which in our periodical revolution we shall return to this the point of our first attraction." Mr. Murchison, after expressing his sense of the kind reception and hospitality which the strangers there collected had experienced from the Archbishop, and from all classes of the inhabitants of the city and neighbourhood, concluded with a motion of thanks as follows:—'That the cultivators of science, here as-

sembled, return their most grateful thanks to His Grace the Archbishop of York, and the other Members of the Yorkshire Philosophical Society, for the very liberal manner in which, by the use of their Halls and Museum, and by their obliging and unwearied efforts to provide every accommodation and comfort to those who have visited York on the present occasion, they have so essentially contributed to the success and prosperity of this Association.'

This motion was seconded by Dr. Brewster, and supported by Mr. Dalton. Mr. Vernon Harcourt, who was in the chair, then said, that "it was quite unnecessary, from the feelings which he knew to pervade the breasts of all, both strangers and residents, to put to the vote of the Meeting either of the proposals so eloquently brought forward. In the long period of its existence the ancient city of York had never greater reason to be proud, than of the genius and talent it contained within its walls at that moment, and of the honour it had acquired in being the birth-place of an Association destined, he firmly believed, greatly to enlarge the boundaries of science, and in so doing to advance the many interests of human nature which depend upon the improvement of knowledge." He then declared the meeting to be adjourned to Oxford.

PROCEEDINGS

OF THE

GENERAL COMMITTEE.

The General Committee was employed from the 27th of September to the 2nd of October in revising the Rules of the Association, in appointing the Office-bearers, in embodying the Local and Sub-Committees, and in receiving the recommendations of the latter, and making arrangements for carrying their suggestions into effect.

The care of completing the objects which the Committee had in view, and of printing the results of its deliberations, together with the proceedings and transactions of the General Meeting, was entrusted to the Officers of the Association at York, who have drawn up from its minutes the following summary of the Objects and Rules of the Association; to which are subjoined the appointments of Officers and Committees. The particulars of the scientific business brought before the General Committee are included in the account of the *recommendations of the Sub-Committees*, and the success which has attended the applications, made in the name of the Association, to eminent individuals, requesting them to undertake the services in science which had been so recommended, has been stated in the *Preface* to the Report.

OBJECTS OF THE ASSOCIATION.

The Association contemplates no interference with the ground occupied by other Institutions. Its objects are,—To give a stronger impulse and a more systematic direction to scientific inquiry,—to promote the intercourse of those who cultivate Science in different parts of the British Empire, with one another, and with foreign philosophers,—to obtain a more general attention to the objects of Science, and a removal of any disadvantages of a public kind, which impede its progress.

RULES.

MEMBERS.

All Persons who have attended the first Meeting shall be entitled to become Members of the Association, upon subscribing an obligation to conform to its Rules.

The Fellows and Members of Chartered Societies in the British Empire shall be entitled, in like manner, to become Members of the Association.

The Office-Bearers, and Members of the Councils or Managing Committees, of Philosophical Institutions shall be entitled, in like manner, to become Members of the Association.

All Members of a Philosophical Institution, recommended by its Council or Managing Committee, shall be entitled, in like manner, to become Members of the Association.

Persons not belonging to such Institutions shall be eligible, upon recommendation of the General Committee, to become Members of the Association.

SUBSCRIPTIONS.

The amount of the Annual Subscription shall be One Pound, to be paid in advance upon admission; and the amount of the composition in lieu thereof, Five Pounds.

Subscriptions shall be received by the Treasurer or Secretaries.

MEETINGS.

The Association shall meet annually, for one week, or longer. The place of each Meeting shall be appointed by the General Committee at the previous Meeting; and the Arrangements for it shall be entrusted to the Officers of the Association.

GENERAL COMMITTEE.

The General Committee shall sit during the time of the Meeting, or longer, to transact the Business of the Association. It shall consist of all Members present, who have communicated any scientific Paper to a Philosophical Society, which Paper has been printed in its Transactions, or with its concurrence.

Members of Philosophical Institutions, being Members of this Association, who may be sent as Deputies to any Meeting of the Association, shall be Members of the Committee for that Meeting.

SUB-COMMITTEES.

The General Committee shall appoint, at each Meeting, Sub-Committees, consisting severally of the Members most conversant with the several branches of Science, to advise together for the advancement thereof.

The Sub-Committees shall report what subjects of investigation they would particularly recommend to be prosecuted during the ensuing year, and brought under consideration at the next Meeting. They shall engage their own Members, or others, to undertake such investigations; and where the object admits of being assisted by the exertions of scientific bodies, they shall state the particulars in which it might be desirable for the General Committee to solicit the co-operation of such bodies.

The Sub-Committees shall procure Reports on the state and progress of particular Sciences, to be drawn up from time to time by competent persons, for the information of the Annual Meetings.

LOCAL COMMITTEES.

Local Committees shall be appointed, where necessary, by the General Committee, or by the Officers of the Association, to assist in promoting its objects.

Committees shall have the power of adding to their numbers those Members of the Association whose assistance they may desire.

OFFICERS.

A President, two Vice-Presidents, two or more Secretaries, and a Treasurer, shall be annually appointed by the General Committee.

PAPERS AND COMMUNICATIONS.

The General Committee shall appoint, at each Meeting, a Sub-Committee, to examine the papers which have been read, and the register of communications; to report what ought to be published, and to recommend the manner of publication. The Author of any paper or communication shall be at liberty to reserve his right of property therein.

ACCOUNTS.

The Accounts of the Association shall be audited, annually, by Auditors appointing by the Meeting.

OFFICERS.

President.—Charles William, Viscount Milton, F.R.S. &c. President of the Yorkshire Philosophical Society.

President elect.—Rev. William Buckland, D.D., F.R.S. &c. Professor of Geology and Mineralogy, Oxford.

Vice-President.—Rev. William Vernon Harcourt, F.R.S. &c. Vice-President of the Yorkshire Philosophical Society.

Vice-Presidents elect.—David Brewster, L.L.D., F.R.S. L. & E. Corresp. Member of the Institute of France, &c. Rev. William Whewell, F.R.S. &c. Professor of Mineralogy, Cambridge.

Treasurer.—Jonathan Gray, Esq. York.

Secretaries.—York.—William Gray, jun. John Phillips, F.G.S. &c. Secretaries of the Yorkshire Philosophical Society.

London.—Rev. J. Yates, F.L.S., G.S. &c.

Edinburgh.—J. Robison, Secretary of the Royal Society of Edinburgh, &c.

Oxford.—Charles Daubeny, M.D., F.R.S. Professor of Chemistry, Oxford. Rev. Baden Powell, F.R.S., Savilian Professor of Geometry, Oxford.

LOCAL COMMITTEES.

London.—G. B. Greenough, F.R.S., Vice-President of the Geological Society. R. I. Murchison, F.R.S., President of the Geological Society. Rev. James Yates, F.L.S. &c.

Edinburgh.—James D. Forbes, F.R.S. E., &c. James F. W. Johnston, A.M. John Robison, Sec. R.S.E. &c.

Dublin.—W. R. Hamilton, F.R.S. &c. Astronomer Royal of Ireland. Rev. B. Lloyd, D.D., Provost of Trinity College, Dublin.

India.—George Swinton, Esq. Chief Secretary to the Government in India, has been requested to form a Committee at Calcutta, with the aid of Major Benson, J. Calder, Esq., Dr. Christie, J. Herbert, Esq., J. A. Prinsep, Esq. and Sir Edward Ryan.

SUB-COMMITTEES.

MATHEMATICAL AND PHYSICAL SCIENCE.

David Brewster, L.L.D., F.R.S. L. & E. &c. Sir Thomas Brisbane, K.C.B., F.R.S. L. & E., Corresp. Member of the Institute of France. James D. Forbes, F.R.S.E., &c. W. R. Hamilton, F.R.S. &c. Rev. William Pearson, L.L.D., F.R.S., Vice-President of the Astronomical Society. Rev. Baden Powell, F.R.S., &c. Rev. William Scoresby, F.R.S. L. & E., Corresp. Member of the Institute of France. Rev. W. Whewell, F.R.S. &c. Rev. R. Willis, F.R.S. &c.

CHEMISTRY.

Rev. John Cumming, F.R.S. Professor of Chemistry, Cambridge. John Dalton, F.R.S., President of the Literary and Philosophical Society at Manchester, Corresp. Member of the Institute of France. Charles Daubeny, M.D., F.R.S. &c. Rev. W. V. Harcourt, F R.S. &c. J. F. W. Johnston, A.M. Edward Turner, M.D., F.R.S. L. & E. Professor of Chemistry in the University of London. William West, Secretary of the Leeds Philosophical Society.

MINERALOGY.

Thomas Allan, F.R.S. L. & E. Robert Allan, F.G.S. &c. David Brewster, L.L.D., F.R.S. &c. J. F. W. Johnston, A.M. Rev. W. Whewell, F.R.S. &c.

GEOLOGY AND GEOGRAPHY.

Rev. William Buckland, D.D., F.R.S. &c. Rev. W. D. Conybeare, F.R.S. &c. Vice-President of the Geological Society, Corresp. Member of the Institute of France. Sir Philip Grey Egerton, Bart. F.R.S., &c. James D. Forbes, F.R.S. E., &c. G. B. Greenough, F.R.S. &c. William Hutton, F.G.S. &c. R. I. Murchison, F.R.S. &c. John Phillips, F.G.S. &c. Rev. Adam Sedgwick, F.R.S., &c. Woodwardian Professor, Cambridge. William Smith, Author of the Geological Map of England. Henry Witham, F.G.S. &c. Rev. James Yates, F.L.S., &c.

ZOOLOGY AND BOTANY.

Charles Daubeny, M.D., F.R.S. &c. J. K. Greville, M.D., F.R.S. E. &c. Rev. J. S. Henslow, F.L.S., Professor of Botany, Cambridge. John Lindley, F.R.S., L.S. &c. Professor of Botany in the University of London. J. C. Prichard, M.D., F.R.S.

MECHANICAL ARTS.

J. H. Abraham, F.L.S. &c. John Robison, Sec. R.S. E. &c. Benjamin Rotch, F.S.A. &c.

RECOMMENDATIONS

OF THE

SUB-COMMITTEES.

COMMITTEE OF MATHEMATICAL AND PHYSICAL SCIENCE.

MATHEMATICS.

The Committee recommend that the Vice-President of the Association residing at Cambridge be requested to use his utmost efforts to procure, from some competent individual, a Report to the next Meeting on the progress of Mathematical Science.

ASTRONOMY.

That Professor Airy be requested to favour the Association with a Report on the state and progress of Physical Astronomy, together with such remarks on the improvements of Practical Astronomy, as he may deem it useful to add.

THEORY OF TIDES.

That J. W. Lubbock, Esq. be requested to furnish a statement of the means which we possess, or which we want, for forming accurate tables for calculating the time and height of High-Water at a given place.

METEOROLOGY.

That James D. Forbes, Esq. be requested to draw up a Report for the next Meeting, on the present state of Meteorological Science.

The Committee, considering that the science of Meteorology is in more want than, perhaps any other, of that systematic direction which it is one great object of the Association to

give, has thought it advisable to propose the following points for investigation.

I. That the Association should employ all the means in its power to procure *a Register of the Thermometer during every hour of the day and night, to be kept at some military or naval station in the South of England.*

*Note.** Until the phenomena and distribution of diurnal temperature are more thoroughly understood than at present, we can hardly hope that any very sure footing has been obtained in the study of meteorology. The hourly register kept for several years at the military station of Leith Fort in lat. 56°. has shewn that we want nothing but the combination of a sufficient number of trustworthy observations, in order to obtain results of primary importance to the science, and which may one day enable us to arrive at the true form of the daily and annual curves of mean temperature with a precision almost mathematical. In order, however, to extend the benefit of such investigations, it is absolutely necessary that they should be pursued in different latitudes. The application to rendering available registers otherwise almost without value, from not being made at the proper hours, will be best illustrated by a reference to the account of the Leith observations. (Transactions of the Royal Society of Edinburgh, Vol. X.)

II. That the establishment of such an *hourly meteorological register* be pointed out as a highly interesting object, in reference especially to the important point of *intertropical* climate, *to* THE COMMITTEE OF THE ASSOCIATION IN INDIA.

III. That *the Committee in India* be requested to endeavour to institute such observations as may throw light on *the phenomena of the horary oscillations of the barometer, near the equator.* Should the concurrence of the Committee on these points be obtained, it would probably be

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* The notes appended to the Recommendations have been drawn up by some of the Members of the Committees since the Meeting.

desirable that the Association should take measures for sending out delicate and accurate instruments.

IV. That Mr. Phillips and Mr. Wm. Gray, jun. of York, be requested to undertake *a series of experiments on the comparative quantities of rain falling on the top of the great tower of York Minster, and on the ground near its base.* The Committee has been induced to propose this specific question in consequence of the local fitness of the situation, and the facilities offered for its solution by the authorities; but it is to be wished that similar experiments should be made elsewhere, that by an extended comparison of observations, light may be thrown upon the anomalies which have been observed at Paris and in other places.

V. That the Association should express its desire to receive *a satisfactory exposition of the theory of the moistened bulb hygrometer*, and that observers be also invited to institute *series of comparative experiments on the indications of the moistened thermometer and the temperature of the dew point.*

Note. These indications may be ascertained by Mr. Dalton's process, or by Mr. Daniell's Hygrometer, or by both. Notwithstanding the ingenious and laborious researches of Hutton, De Saussure, Leslie, Anderson, and Gay Lussac upon this subject, scientific deductions drawn from more extended experiments are greatly wanted. The simplicity and certainty of the experiment by which the cold produced by the evaporation of water is measured, renders an accurate theory of the result peculiarly desirable. The experimenter would do well to consult Mr. Dalton's views on the theory of Hygrometry, contained in his *Meteorological Essays*, and in *the Manchester Transactions*, and to examine the investigations of Professor Leslie, (*Relations of Heat and Moisture*, and *Supplement to the Encyclopædia Britannica, Article* METEOROLOGY;) of Dr. Anderson, (*Edinburgh Encyclopæ-*

dia, Article HYGROMETER,) and of M. Gay Lussac, *(Biot, Traité de Physique, Tom. II.)* A good series of observations at high temperatures will be found recorded in Nos. II. and III. of a Calcutta Journal, entitled, *Gleanings in Science.*

VI. That experiments *on the Decrease of Temperature at increasing heights in the Atmosphere* be recommended as an important subject for the contributions of observers.

Note. Series of observations for considerable periods of time on the mean temperature of the air at fixed hours, and at stations of which the difference of height has been accurately measured, are the most valuable. The best hours for observation are those which give most accurately the mean temperature of the period of observation. The hourly observations at Leith Fort have determined the hours which give the annual mean temperature in this country to be about $9\frac{1}{4}$ A. M. and $8\frac{1}{2}$ P. M. Experimental balloons have lately been employed to assist the solution of this problem which is one of the most interesting in Meteorology, but the investigation of it is nearly brought to a stand for want of sufficiently numerous observations. The observer may be referred for information to Ramond, *Memoires sur la formule Barometrique de la Mechanique Celeste ;* to the Researches of Humboldt ; to Professor Leslie, *Supplement to the Encyclopædia Britannica, Article Climate ;* to Pouillet, *Elemens de Physique ;* to Mr. Atkinson's Paper on Refractions in the *Memoirs of the Astronomical Society ;* and to Mr. Ivory's Memoir on the same subject in *the Philosophical Transactions,* and his Papers in *the Annals of Philosophy.*

VII. That the observation of *the Temperature of Springs at different heights and depths* should be pointed out as an object of great interest, in prosecuting which insulated inquirers may render essential aid to science.

Note. When springs are copious, a few observations in the course of the year, suffice to give with great accuracy their mean temperature. The height of the springs above the mean level of the sea, and the depth of Artesian wells should be carefully observed, and where the corresponding mean temperature of the air can be obtained, it should be stated. In two points of view these observations are important, independently of the inferences which they may furnish as to the decrease of heat in the atmosphere. The great interest attached to the phenomenon of the progressive increase of temperature of the globe, as we descend through the Strata, renders of value observations on the temperature of springs at considerable heights, of springs in mines, and of those brought to the surface from some depths by the process of boring. This question has been treated with great success by M. Cordier, in several Memoirs, some of which have been translated into English. Again, the researches of Humboldt, Buch, Wahlenberg, and most recently Kupffer in a Memoir on *Isogeothermal Lines*, read before the Academy of St. Petersburg, in 1829, have shewn that the temperature of the earth differs in many parts of the globe from that of the air, being generally in defect below lat. 56°. and in excess beyond it. The progressive increase of temperature with that of the depth in Artesian wells, and the deviation of the mean temperature of the Earth from that of the Air in different latitudes, have opened new fields for discussion; and by the zealous co-operation of observers cannot fail to present results of which, at present, we can form but an imperfect idea.

MAGNETISM.

It appears to the Committee highly desirable that a series of observations upon the *Intensity of Terrestrial*

Magnetism in various parts of England be made by some competent individual, similar to those which have recently been carried on in Scotland by Mr. Dunlop.

Should the Committee succeed in finding some individual ready to undertake the task, they propose that an application should be made to the Royal Society of Edinburgh, for permission to make use of the Standard Needle belonging to them, and constructed under the direction of Professor Hansteen of Christiania.

It appears to the Committee of considerable importance, that a certain number of observations should be made throughout Britain with *the Dipping Needle*, in order to reduce the Horizontal to the true Magnetic Intensity.

Note. The time of three hundred vibrations should be observed, and the methods of observation and reduction should be the same as have been employed and described by Humboldt, Hansteen, and others.

ELECTRO-MAGNETISM.

The Committee recommend as an important subject for farther prosecution, the examination of the *Electro-Magnetic condition of Metalliferous Veins.* The Committee would refer for the details of what has been already done upon this subject, to the Paper of Mr. Fox in the Philosophical Transactions for 1830, and would propose that the experiments should be extended to veins which traverse, as in some of our mines, horizontal and dissimilar strata.

OPTICS.

That Dr. Brewster be requested to prepare for the next Meeting, a Report on the progress of Optical Science.

ACOUSTICS.

That the Rev. Robert Willis be requested to prepare for the next Meeting, a Report on the state of our knowledge concerning the phenomena of Sound, and the additions which have been recently made to it.

HEAT.

That Professor Powell be requested to prepare for the next Meeting a similar Report respecting heat.

ELECTRICITY.

That Professor Cumming be requested to prepare for the next Meeting a similar Report on Thermo-Electricity, and the allied subjects in which recent discoveries have been made.

CHEMICAL COMMITTEE.

It appears to the Committee of supreme importance, that Chemists should be enabled, by the most accurate experiments, to agree in the *relative weights of the several elements, Hydrogen, Oxygen, and Azote*, or, which amounts to the same thing, that the specific gravity of the three gases should be ascertained in such a way as would insure the reasonable assent of all competent and unprejudiced judges.

They think it highly desirable that the doubts which remain respecting the *proportions of Azote, Oxygen, &c. in the atmosphere* should be removed; that the *proportions of Azote and Oxygen in nitrous gas and nitrous oxide* should be strictly determined; and that *the specific gravities of the compound gases in general* should be more accurately investigated.

They recommend that the members of this Committee, and British Chemists in general, be invited to make experiments on these subjects, and communicate their results to the next Meeting at Oxford.

That Mr. Johnston be requested to present to the next Meeting a view of the recent progress of Chemical science, especially in foreign countries.

That Dr. Daubeny be requested to undertake an investigation into the sources from which organic bodies derive their fixed principles.

That Mr. Johnston be requested to undertake the inquiries which have been suggested to the Committee into the com-

parative analysis of iron in the different stages of its manufacture.

That Mr. West be requested to pursue the experiments contemplated by him into the combinations of gaseous bodies when passed through heated tubes.

That the Rev. W. Vernon Harcourt be requested to prosecute the inquiries contemplated by him into the chemical phenomena from which the materiality of what are sometimes called etherial substances has been inferred.

MINERALOGICAL COMMITTEE.

The Committee recommend that the Rev. Professor Whewell be requested to present to the next Meeting a report on the state and progress of Mineralogy.

GEOLOGICAL AND GEOGRAPHICAL COMMITTEE.

The Committee recommend that Geologists be requested to examine strictly into the truth of that part of the theory of M. Elie de Beaumont, in its application to England, Scotland, and Ireland, which asserts that *the lines of disturbance of the strata assignable to the same age are parallel*, and that a report to the next Meeting on this subject should be procured.

That Mr. Phillips be requested to draw up, with such co-operation as he may procure, *a systematic catalogue of all the organized fossils of Great Britain and Ireland*, hitherto described, with such new species as he may have an opportunity of accurately examining, with notices of their localities and geological relations.

The Committee propose that Mr. Robert Stevenson, Civil Engineer, be requested to prepare a report upon the *waste and extension of the land on the East coast of Britain, and the question of the permanence of the relative level of the sea and land;* and that individuals who can furnish observations, be requested to correspond with him on the subject.*

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* Communications may be addressed to Robert Stevenson, Esq. Engineer to the Northern Lighthouse Board, Edinburgh.

The importance which, especially of late years, has been attached to facts of this nature, in illustration of the sciences of hydrography and geology, and the mass of uncombined materials which have recently been accumulating have induced the Committee to make the present recommendation; and in doing so it feels pleasure in being able to have in its view an individual whose practical acquaintance with the coast in general, and more particularly the minute survey made by him some years since, gives reason to expect from his report much important and accurate information.

BOTANICAL COMMITTEE.

The Committee recommend that Professor Lindley be requested to prepare for the next Meeting an account of the principal questions recently settled, or at present agitated, in the philosophy of Botany, whether in this country or abroad.

That Botanists in all parts of Great Britain and Ireland be invited to compose and communicate to the Meetings of the Association, Catalogues of *County or other local Floras* with *indications* of those species which have been *recently introduced*, of those which are *rare* or *very local*, and of those which *thrive, or which have become or are becoming extinct*, with such remarks as may be useful towards determining the connection which there may be between the *habitats* of particular plants and *the nature of the soil and the strata* upon which they grow; with statements of the *mean winter and summer temperature* of the air and water at the highest as well as the lowest elevation at which species occur, the *hygrometrical* condition of the air, and any other information of an historical, economical, and philosophical nature.

Note. If upon this plan a complete botanical survey of the British islands could be obtained, the results would be important when the Flora in the aggregate came to be compared with its relations of soil, climate, elevation, &c.

SCIENTIFIC TRANSACTIONS

OF THE

MEETING.

MONDAY EVENING.

Mr. Phillips, one of the Secretaries of the Yorkshire Philosophical Society, delivered an extemporaneous account of the most remarkable phenomena in the Geology of Yorkshire, illustrated by drawings and specimens selected from the Museum, and contributed by the visitors to the Meeting.

He observed that though the principal design in opening the Museum that evening was to promote mutual acquaintance and friendly intercourse, among those who were soon to engage in more important scientific labours, yet it was thought conducive to these objects that some observations should be offered by him from the Lecture Table, on the geological relations of the County in which they were assembled. In attempting therefore, a rapid sketch of some of the more prominent and peculiar features in the Geology of Yorkshire, he was influenced by a natural desire to call the attention of the eminent individuals now assembled in York to the phenomena most worthy of observation in passing through the County. He should thus have the opportunity of illustrating the value of some remarkable specimens which within a few hours had arrived for the inspection of the Meeting, and offer the most appropriate welcome which the City and County of York, and the Institution they had founded for the advance-

ment of science, could give to those who now came amongst them to lay the basis of a wide Association for the same important purpose.

The points embraced in the continuation of Mr. Phillips's address were the following:

1. The peculiar character of the Carboniferous and Oolitic systems in Yorkshire,—both of these great systems of Calcareous Rocks being here diversified by large interpolations of sandy and argillaceous strata, with thin seams of Coal, and remains of Plants. In both systems these interpolations thicken to the northwards. Thus the nearly undivided mass of limestone under Ingleborough becomes separated into many distinct calcareous beds, with sandstones, shales, and bad coal, in Teesdale, Tynedale, and Swaledale, which are still further modified by the introduction of coarse pebbly sandstones, and workable seams of coal, in the western and northern parts of Northumberland:—and the Oolites of Lincolnshire, diminished in thickness and debased in purity, are almost lost in several hundred feet of sandstone, shale, and coal, which form the northeastern Moorlands of Yorkshire. Mr. Phillips referred these interpolations of sandstone, &c. to the originally littoral, or perhaps æstuary, situation of those parts of the calcareous deposit, while the thicker and more homogeneous limestone masses were probably produced under the deeper and more tranquil waters of the ancient oceans. The bearing of these deductions upon the important subject of the relative form and extent of the land and sea in this part of the globe at those periods respectively, was briefly illustrated.

2. The remarkable history of the deposit near Market Weighton (first observed by W. H. Dikes, Esq. Curator of the Hull Society and afterwards more completely investigated by some of the members of the Yorkshire Philosophical Society) in which the bones of several kinds of quadrupeds, including species considered as extinct, were found mingled with many shells belonging to thirteen existing species of land, marsh, and fresh-water mollusca, and covered with gravel from the neigh-

bouring hills, together with some larger stones from very distant localities.

3. The general character of the alluvial deposits, inclosing timber and many remains of quadrupeds, in the eastern part of Yorkshire, and the peculiar condition of some bones of deer obtained by Mr. W. Casson, from the Peat near Thorne. These bones appear to have been deprived of a large portion of their hardening earth, and are nearly in the state of leather,—quite flexible, and much altered from their original shape.

4. The traces of the action of the atmosphere in the rain channels which furrow the sides of the monumental stones of Boroughbridge, and form miniature valleys on the broad surfaces of the limestone scars on the mountains of Western Yorkshire and Westmoreland.

5. The occurrence of three specimens of unknown scaly fishes, with ferns and other fossil plants, in the ironstone bands in the lower part of the coal formation of Leeds and Bradford; two of them indicating an individual of considerable size, the third smaller, and perhaps of a distinct species.*

TUESDAY MORNING.

This morning having been almost exclusively occupied in the business of forming the Association, the only communication read was the following extract of a letter from Geo. Harvey Esq. F.R.S. L. & E.

"It was my intention had I been able to enjoy the privilege of attending at York, to have drawn the attention of the Meeting to the very remarkable circumstance of the Geometrical Analysis of the ancients having been cultivated with eminent success in the northern counties of England, and particularly in Lancashire. The proofs of this may be gathered from a variety of periodical works, devoted almost

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* Since the Meeting Mr. Phillips has had the opportunity of observing another specimen of a different species of fossil fish, in the possession of C. Rawson, Esq. from a still lower part of the coal strata at Halifax.

exclusively to this lofty and abstract pursuit. I have now before me several exquisitely beautiful specimens of the geometry of the Greeks, produced by men in what for distinction sake we call the inferior conditions of life. The phenomenon, for such it truly is, has long appeared to me a remarkable one, and deserving of an attentive consideration. Playfair, in one of his admirable papers in the Edinburgh Review, expressed a fear that the increasing taste for analytical science would at length drive the ancient geometry from its favoured retreat in the British Isles; but, at the time he made this desponding remark, the Professor seemed not to be aware that there then existed a devoted band of men in the North, resolutely bound to the pure and ancient forms of geometry, who in the midst of the tumults of steam engines cultivated it with unyielding ardour, preserving the sacred fire under circumstances which would seem from their nature most calculated to extinguish it. In many modern Publications, and occasionally in the Senate-House Problems proposed to the Candidates for Honours at Cambridge, questions are to be met with derived from this humble but honourable source.

"The true cause of this remarkable phenomenon I have not been able clearly to trace. A taste for pure geometry, something like that for Entomology among the weavers of Spitalfields, may have been transmitted from father to son; but who was the distinguished individual first to create it, in the peculiar race of men here adverted to, seems not to be known. Surrounded with machinery, with the rich elements of mechanics in their most attractive forms, we should have imagined that a taste for mechanical combinations would have exclusively prevailed; and that inquiries locked up in the deep, and to them unapproachable, recesses of Plato, Pappus, Apollonius, and Euclid, would have met with but few cultivators. On the contrary, Porisms and Loci, Sections of Ratio and of Space, Inclinations and Tangencies,—subjects

confined among the ancients to the very greatest minds, were here familiar to men whose condition in life was, to say the least, most unpropitious for the successful prosecution of such elevated and profound pursuits.

"The contrast also between the Northern and Southern parts of England, in this particular, was most remarkable. In the latter the torch of geometry emitted but a feeble ray; while in the former it existed in its purést and most splendid form. The two great restorers of the ancient geometry, Mathew Stewart and Robert Simson, it may be observed, lived in Scotland. Did their proximity encourage the growth of this spirit? or were their writings cultivated by some teacher of a village school, who communicated by a method, which genius of a transcendental order knows so well how to employ, a taste for these sublime inquiries, so that at length they gradually worked their way to the anvil and the loom?"

TUESDAY EVENING.

Mr. Abraham delivered a Lecture on Magnetism, and particularly described several useful applications of this science, which he had employed for the advantage of the arts. He exhibited the model of a machine used for *needle pointing*, the labouring at which has been found so prejudicial to health, owing to the particles of steel inhaled during the process, that although the men were employed at it only six hours in the day, few ever attained the age of forty years, most dying at thirty or thirty-five, and several not surviving twenty-five. These deadly effects had been in a great measure obviated by Mr. Abraham's contrivance of placing several magnets around a mouth-piece, to attract the particles of steel as they came off in the process of grinding, or floated in the dusty atmosphere of the small apartments. This invention, for which the Society of Arts awarded their large gold medal, has not been so universally employed in the manufactories

as its importance deserved, owing partly to the disinclination of the workmen to adopt methods which, by rendering their avocation less injurious to health, should lower the price of their labour.

Mr. Abraham exhibited another Magnetical Instrument, intended to guard the eyes of the grinders from the dispersion of fragments of steel, communicated several poles to the same magnetic bar, and detailed the method which he had found most effectual for communicating, combining, and increasing the magnetic influence.

He then exhibited his simple process for demagnetizing the steel balance-wheels of watches. Having dipped a balance-wheel, previously rendered magnetical, into iron filings, and thus discovered the situation of its poles,—he presented to one of these, at the distance of an inch, the *similar pole* of a small magnet. The filings immediately fell from the wheel, and it was found to be perfectly demagnetized. (Mr. Abraham's inventions having been presented to the Society of Arts, are described in their Transactions, Vol. XL. p. 135, Vol. XLIII. p. 48, Vol. XLIV. p. 19.)

WEDNESDAY MORNING.

Dr. Brewster communicated a paper, which was read by Mr. Robison, presenting a general view of the progress of the science of mineralogy during the last thirty years, and of the principles of classification now adopted for minerals; and suggesting the propriety of adding to the four systems of crystallization now employed by Mohs and other mineralogists (the Rhomboidal, Pyramidal, Prismatic, and Tessular systems) a fifth, viz. the Composite system, as combining a series of crystalline structures not included under the other heads, and mostly discovered by the agency of polarized light. This new system of crystallization, the Author proposes to divide into two classes, the *first* of which embraces those minerals in which the physical properties of the individual crystals are not altered by the com-

bination; and the *second*, those minerals in which the physical properties of the individual crystals are altered by the combination. These classes were again divided into different orders, and the Composite minerals were enumerated, which the Author proposed to place under each division.

The following Essay by Dr. Henry, was then read by Mr. Phillips.

An Estimate of the Philosophical Character of Dr. Priestley, by William Henry, M.D., F.R.S. &c. &c.

The principal source of the materials of the following pages, is the work, in which the discoveries of Dr. Priestley were originally announced to the public. It consists of six volumes in octavo, which were published by him, at intervals between the years 1774 and 1786; the first three under the title of "Experiments and Observations on different kinds of Air;" and the last three under that of "Experiments and Observations relating to various Branches of Natural Philosophy, with a continuation of the Observations on Air." These volumes were afterwards methodised by himself, and compressed into three octavos, which were printed in 1790. As a record of facts, and as a book of reference, the systematized work is to be preferred. But as affording materials for the history of that department of science, which Dr. Priestley cultivated with such extraordinary success; and, still more, for estimating the value of his discoveries, and adjusting his station as an experimental philosopher, the simple narrative, which he originally gave in the order of time, supplies the amplest and the firmest ground-work.

In every thing that respects the history of this branch of experimental philosophy, the writings and researches of Dr. Priestley, to which I have alluded, are peculiarly instructive. They are distinguished by great merits, and by great defects; the latter of which are wholly undisguised by their author. He unveils, with perfect frankness, the whole process of

reasoning, which led to his discoveries; he pretends to no more sagacity than belonged to him, and sometimes disclaims even that to which he was fairly entitled; he freely acknowledges his mistakes, and candidly confesses when his success was the result of accident, rather than of judicious anticipation; and by writing historically and analytically, he exhibits the progressive improvement of his views, from their first dawnings, to their final and distinct development. Now, with whatever delight we may contemplate a systematic arrangement, the materials of which have been judiciously selected, and from which every thing has been excluded, that is not essential to the harmony of the general design, yet there can be no question that as elucidating the operations of the human mind, and enabling us to trace and appreciate its powers of invention and discovery, the analytic method of writing has decided advantages.

To estimate, justly, the extent of Dr. Priestley's claim to philosophical reputation, it is necessary to take into account the state of our knowledge of gaseous chemistry, at the time when he began his inquiries. Without underrating what had been already done by Van Helmont, Ray, Hooke, Mayow, Boyle, Hales, Macbride, Black, Cavendish, and some others, Priestley may be safely affirmed to have entered upon a field, which, though not altogether untilled, had yet been very imperfectly prepared to yield the rich harvest, which he afterwards gathered from it. The very implements, with which he was to work, were for the most part to be invented; and of the merits of those, which he did invent, it is a sufficient proof that they continue in use to this day, with no very important modifications. All his contrivances for collecting, transferring, and preserving different kinds of air, and for submitting those airs to the action of solid and liquid substances, were exceedingly simple, beautiful, and effectual. They were chiefly, too, the work of his own hands, or were constructed under his directions by unskilled persons; for

the class of ingenious artists, from whom the chemical philosopher now derives such valuable aid, had not then been called into existence by the demands of the science. With a very limited knowledge of the general principles of chemistry, and almost without practice in its most common manipulations;—restricted by a narrow income, and at first with little pecuniary assistance from others;—compelled, too, to devote a large portion of his time to other pressing occupations, he nevertheless surmounted all obstacles; and in the career of discovery, outstripped many, who had long been exclusively devoted to science, and were richly provided with all appliances and means for its advancement.

It is well known that the accident of living near a public brewery at Leeds, first directed the attention of Dr. Priestley to pneumatic chemistry, by casually presenting to his observation the appearances attending the extinction of lighted chips of wood, in the gas which floats over fermenting liquors. He remarked, that the smoke formed distinct clouds floating on the surface of the atmosphere of the vessel, and that this mixture of air and smoke, when thrown over the sides of the vat, fell to the ground; from whence he deduced the greater weight of this sort of air than of atmospheric air. He next found that water imbibes the new air, and again abandons it when boiled or frozen. These more obvious properties of fixed air having been ascertained, he extended his inquiries to its other qualities and relations; and was afterwards led by analogy to the discovery of various other gases, and to the investigation of their characteristic properties.

It would be inconsistent with the scope of this Essay to give a full catalogue of Dr. Priestley's discoveries, or to enumerate more of them, than are necessary to a just estimate of his philosophical habits and character. He was the unquestionable author of our first knowledge of oxygen gas, of nitrous oxide, of muriatic, sulphurous, and fluor acid gases, of ammoniacal gas, and of its condensation into a solid form by the acid gases. Hydrogen gas was known before his

time; but he greatly extended our acquaintance with its properties. Nitrous gas, barely discovered by Dr. Hales, was first investigated by Priestley, and applied by him to eudiometry. To the chemical history of the acids derived from nitre, he contributed a vast accession of original and most valuable facts. He seems to have been quite aware that those acids are essentially gaseous substances, and that they might be exhibited as such, provided a fluid could be found that is incapable of absorbing or acting upon them.* He obtained, and distinctly described,† the curious crystalline compound of sulphuric acid with the vapour of nitrous acid, or, more correctly, of sulphuric and hyponitrous acids, which, being of rare occurrence, was forgotten, and has since been rediscovered, like many other neglected anticipations of the same author. He greatly enlarged our knowledge of the important class of metals, and traced out many of their most interesting relations to oxygen and to acids. He unfolded, and illustrated by simple and beautiful experiments, distinct views of combustion; of the respiration of animals, both of the inferior and higher classes; of the changes produced in organized bodies by putrefaction, and of the causes that accelerate or retard that process; of the importance of azote as the characteristic ingredient of animal substances, obtainable by the action of dilute nitric acid on muscle and tendon; of the functions and economy of living vegetables; and of the relations and subserviency, which exist between the animal and vegetable kingdoms. After trying, without effect, a variety of methods, by which he expected to purify air vitiated by the breathing of animals, he discovered that its purity was restored by the growth of living and healthy vegetables, freely exposed to the solar light.

It is impossible to account for these, and a variety of other discoveries, of less importance singly, but forming altogether a tribute to science, greatly exceeding, in richness and ex-

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* Series I. Vol. ii. p. 175. † Series II. Vol. i. p. 26.

tent, that of any contemporary, without pronouncing that their author must have been furnished by nature with intellectual powers, far surpassing the common average of human endowments. If we examine, with which of its various faculties the mind of Dr. Priestley was most eminently gifted, it will, I believe, be found that it was most remarkable for clearness and quickness of apprehension, and for rapidity and extent of association. On these qualities were founded that apparently intuitive perception of analogies, and that happy facility of tracing and pursuing them through all their consequences, which led to several of his most brilliant discoveries. Of these analogies many were just and legitimate, and have stood the test of examination by the clearer light, since reflected upon them from the improved condition of science. But, in other cases, his analogies were fanciful and unfounded, and led him far astray from the path, which might have conducted him directly to truth. It is curious, however, as he himself observes, that in missing one thing, of which he was in search, he often found another of greater value. In such cases, his vigilance seldom failed to put him in full possession of the treasure upon which he had stumbled. Finding by experience, how much chance had to do with the success of his investigations, he resolved to multiply experiments, with the view of increasing the numerical probabilities of discovery. We find him confessing, on one occasion, that he "was led on, by a random expectation of some change or other taking place." In other instances, he was influenced by theoretical views of so flimsy a texture, that they were dispersed by the first appeal to experiment. "These mistakes," he observes, "it was in my power to have concealed; but I was determined to show how little mystery there is in the business of experimental philosophy; and with how little sagacity, discoveries, which some persons are pleased to consider great and wonderful, have been made." Candid acknowledgments of this kind were, however, turned against him by persons envious of his growing fame; and it was asserted that *all* his discoveries, when

not the fruits of plagiarism, were "lucky guesses," or owing to mere chance. * Such detractors, however, could not have been aware of the great amount of credit, that is due to the philosopher, who at once perceives the value of a casual observation, or of an unexpected result; who discriminates what facts are trivial, and what are important; and selects the latter, to guide him through difficult and perplexed mazes of investigation. In the words of D'Alembert, "*Ces hazards ne sont que pour ceux qui jouent bien.*"

The talents and qualifications, which are here represented as having characterized the mind of Dr. Priestley, though not of the rarest kind, or of the highest dignity, were yet such, as admirably adapted him for improving chemical science, at the time when he lived. What was then wanted, was a wider field of observation;—an enlarged sphere of chemical phenomena;—an acquaintance with a far greater number of individual bodies, than were then known; from the properties of which, and from those of their combinations, tentative approximations to general principles might at first be deduced; to be confirmed or corrected, enlarged or circumscribed, by future experience. It would have retarded the progress of science, and put off, to a far distant day, that affluence of new facts, which Priestley so rapidly accumulated, if he had stopped to investigate, with painful and rigid precision, all the minute circumstances of temperature, of specific gravity, of absolute and relative weights, and of crystalline structure, on which the more exact science of our own times is firmly based, and from which its evidences must henceforward be derived. Nor could such refined investigations have then been carried on with any success, on account of the imperfection of philosophical instruments. It would have been

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* These charges, especially that of plagiarism, which had been unjustly advanced by some friends of Dr. Higgins, were triumphantly repelled by Dr. Priestley, in a pamphlet entitled, "Philosophical Empiricism," published in 1775.

fruitless, also, at that time, to have indulged in speculations respecting the ultimate constitution of bodies ;—speculations that have no solid ground-work, except in a class of facts developed within the last thirty-five years, all tending to establish the laws of combination in definite and in multiple proportions, and to support the still more extensive generalization, which has been reared by the genius of Dalton.

It was, indeed, by the activity of his intellectual faculties, rather than by their reach or vigour, that Dr. Priestley was enabled to render such important services to natural science. We should look, in vain, in any thing that he has achieved, for demonstrations of that powerful and sustained attention, which enables the mind to institute close and accurate comparisons ;—to trace resemblances that are far from obvious ;—and to discriminate differences that are recondite and obscure The analogies, which caught his observation, lay near the surface, and were eagerly and hastily pursued ; often, indeed, beyond the boundaries, within which they ought to have been circumscribed. Quick as his mind was in the perception of resemblances, it appears (probably for that reason) to have been little adapted for those profound and cautious abstractions, which supply the only solid foundations of general laws. In sober, patient, and successful induction, Priestley must yield the palm to many others, who, though far less fertile than himself in new and happy combinations of thought, surpassed him in the use of a searching and rigorous logic ; in the art of advancing, by secure steps, from phenomena to general conclusions ;—and again in the employment of general axioms as the instruments of farther discoveries.

Among the defects of his philosophical habits, may be remarked, that he frequently pursued an object of inquiry too exclusively, neglecting others, which were necessarily connected with it, and which, if investigated, would have thrown great light on the main research. As an instance, may be mentioned his omitting to examine the relation of gases to water. This relation, of which he had indistinct glimpses,

was a source of perpetual embarassment to him, and led him to imagine changes in the intimate constitution of gases, which were in fact due to nothing more than an interchange of place between the gas in the water and that above the water, or between the former and the external atmosphere. Thus he erroneously supposed that hydrogen gas was transmuted into azotic gas, by remaining long confined by the water of a pneumatic cistern. The same eager direction of his mind to a single object, caused him, also, to overlook several new substances, which he must necessarily have obtained, and which, by a more watchful care, he might have secured and identified. At a very early period of his inquiries, (viz. before November, 1771), he was in possession of oxygen gas from saltpetre, and had remarked its striking effect on the flame of a candle; but he pursued the subject no farther until August 1774, when he again procured the same kind of gas from the red oxide of mercury, and, in a less pure state, from red lead. Placed thus a second time within his grasp, he did not omit to make prize of this, his greatest, discovery. He must, also, have obtained chlorine by the solution of manganese in spirit of salt; but it escaped his notice, because, being received over mercury, the gas was instantly absorbed. * If he had employed a bladder, as Scheele afterwards did, to collect the product of the same materials, he could not have failed to anticipate the Swedish philosopher, in a discovery not less important than that of oxygen gas. Carbonic oxide early and repeatedly presented itself to his observation, without his being aware of its true distinctions from other kinds of inflammable air; and it was reserved for Mr. Cruickshank of Woolwich to unfold its real nature and characters. It is remarkable, also, that in various parts of his works, Dr. Priestley has stated facts, that might have given him a hint of the law, since unfolded by the sagacity of M. Gay Lussac, 'that gaseous substances combine in definite volumes.'

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* Series II. p. 253.

He shows that

1 measure of fixed air unites with 1½ measure of alkaline air,
1 measure of sulphurous acid with 2 measures of do.
1 measure of fluor acid with 2 measures of do.
1 measure of oxygen gas with 2 measures nitrous, very nearly;

and that by the decomposition of 1 vol. of ammonia, 3 vols. of hydrogen are evolved.

Let not, however, failures such as these, to reap all that was within his compass, derogate more than their due share from the merits of Dr. Priestley; for they may be traced to that very ardour of temperament, which, though to a certain degree a disqualification for close and correct observation, was the vital and sustaining principle of his zealous devotion to the pursuit of scientific truth. Let it be remembered, that philosophers of the loftiest pretensions are chargeable with similar oversights;—that even Kepler and Newton overlooked discoveries, upon the very confines of which they trod, but which they left to confer glory on the names of less illustrious followers.

Of the general correctness of Dr. Priestley's experiments, it is but justice to him to speak with decided approbation. In some instances, it must be acknowledged, that his results have been rectified by subsequent inquirers, chiefly as respects quantities and proportions. But of the immense number of new facts originating with him, it is surprising how very few are at variance with recent and correct observations. Even in these few examples, his errors may be traced to causes connected with the actual condition of science at the time; sometimes to the use of impure substances, or to the imperfection of his instruments of research; but never to carelessness of inquiry or negligence of truth. Nor was he more remarkable for the zeal, with which he sought satisfactory evidence, than for the fidelity, with which he reported it. In no one instance is he chargeable with mis-stating, or even with straining or colouring, a fact, to suit an hypothesis. And though this praise

may, doubtless, be conceded to the great majority of experimental philosophers, yet Dr. Priestley was singularly exempt from that disposition to view phenomena through a coloured medium, which sometimes steals imperceptibly over minds of the greatest general probity. This security he owed to his freedom from all undue attachment to hypotheses, and to the facility, with which he was accustomed to frame and abandon them ;—a facility resulting not from habit only, but from principle. "Hypotheses" he pronounces, in one place, "to be a cheap commodity ;" in another to be "of no value except as the parents of facts ;" and so far as he was himself concerned, he exhorts his readers "to consider new facts only as discoveries, and to draw conclusions for themselves." The only exception to this general praise is to be found in the pertinacity with which he adhered, to the last, to the Stahlian hypothesis of phlogiston; and in the anxiety which he evinced to reconcile to it new phenomena, which were considered by almost all other philosophers as proofs of its utter unsoundness. But this anxiety, it must be remembered, was chiefly apparent at a period of life, when most men feel a reluctance to change the principle of arrangement, by which they have been long accustomed to class the multifarious particulars of their knowledge.

In all those feelings and habits that connect the purest morals with the highest philosophy, (and that there is such a connection no one can doubt), Dr. Priestley is entitled to unqualified esteem and admiration. Attached to science by the most generous motives, he pursued it with an entire disregard to his own peculiar interests. He neither sought, nor accepted when offered, any pecuniary aid in his philosophical pursuits, that did not leave him in possession of the most complete independence of thought and of action. Free from all little jealousies of contemporaries or rivals, he earnestly invited other labourers into the field, which he was cultivating ; gave publicity, in his own volumes, to their experiments ; and, with true candour, was as ready to record the evidence which

contradicted, as that which confirmed, his own views and results. Every hint, which he had derived from the writings or conversation of others, was unreservedly acknowledged. As the best way of accelerating the progress of science, he recommended and practised the early publication of all discoveries; though quite aware that, in his own case, more durable fame would often have resulted from a delayed and more finished performance. "Those persons," he remarks, "are very properly disappointed, who, for the sake of a little more reputation, delay publishing their discoveries, till they are anticipated by others."

In perfect consistency with that liberality of temper, which has been ascribed to Dr. Priestley, it may be remarked also, that he took the most enlarged views of the scope and objects of Natural Science. In various passages of his works he has enforced, with warm and impressive eloquence, the considerations, that flow from the contemplation of those arrangements in the natural world, which are not only perfect in themselves, but are essential parts of one grand and harmonious design. He strenuously recommends experimental philosophy as an agreeable relief from employments, that excite the feelings or overstrain the attention; and he proposes it to the young, the high-born, and the affluent, as a source of pleasure unalloyed with the anxieties and agitations of public life. He regarded the benefits of its investigations, not merely as issuing in the acquirement of new facts, however striking and valuable; nor yet in the deduction of general principles, however sound and important; but as having a necessary tendency to increase the intellectual power and energy of man, and to exalt human nature to the highest dignity, of which it is susceptible. The springs of such enquiries he represents as inexhaustible; and the prospects, that may be gained by successive advances in knowledge, as in themselves "truly sublime and glorious."

Into our estimate of the intellectual character of an individual, the extent and the comprehensiveness of his studies must always enter as an essential element. Of Dr. Priestley

it may be justly affirmed, that few men have taken a wider range over the vast and diversified field of human knowledge. In devoting, through the greater part of his life, a large portion of his attention to theological pursuits, he fulfilled, what he strongly felt to be his primary duty as a minister of religion. This is not the fit occasion to pronounce an opinion of the fruits of those inquiries, related as they are to topics, which still continue to be agitated as matters of earnest controversy. In Ethics, in Metaphysics, in the philosophy of Language, and in that of General History, he expatiated largely. He has given particular histories of the Sciences of Electricity and of Optics, characterized by strict impartiality, and by great perspicuity of language and arrangement. Of the mathematics, he appears to have had only a general or elementary knowledge; nor, perhaps, did the original qualities, or acquired habits, of his mind fit him to excel in the exact sciences. On the whole, though Dr. Priestley may have been surpassed by many, in vigour of understanding and capacity for profound research, yet it would be difficult to produce an instance of a writer more eminent for the variety and versatility of his talents, or more meritorious for their zealous, unwearied, and productive employment.

APPENDIX.

Since the foregoing pages were written, I have added a few remarks on a passage contained in a recent work of Victor Cousin, in which that writer has committed a material error as to the origin of Dr. Priestley's philosophical discoveries. "La chimie," he observes, "est une création du dixhuitième siècle, une création de la France; c'est l'Europe entière qui a appelé chimie Française le mouvement qui a imprimé à cette belle science une impulsion si forte et une direction si sage; c'est à l'exemple et sur les traces de Lavoisier, de Guyton, de Fourcroy, de Berthollet, de

Vauquelin, que se sont formés et que marchent encore les grands chimistes étrangers, ici Priestley et Davy; là Klaproth et Berzelius." (Cours de l'Histoire de la Philosophie, tom. i. p. 25.)

It is to be lamented that so enlightened a writer as Victor Cousin, yielding, in this instance, to the seduction of national vanity, should have advanced pretensions in behalf of his countrymen, which have no foundation in truth or justice. Nothing can be more absurd or unprofitable than to claim honours in science, either for individuals or for nations, the title to which may be at once set aside by an appeal to public and authentic records.

It was in England, not in France, that the first decided advances were made in our knowledge of elastic fluids. To say nothing of anterior writers, Dr. Black had traced the causticity acquired by alkalies, and by certain earths, to their being freed from combination with fixed air; and Mr. Cavendish, in 1766, had enlarged our knowledge of that gas and of inflammable air. In England, the value of these discoveries was fully appreciated; in France, little or no attention was paid to them, till the philosophers of that country were roused by the striking phenomena exhibited by the experiments of Priestley. Lavoisier, it is true, had been led, by an examination of evidence derived from previous writers, to discard the hypothesis of phlogiston. The discovery of oxygen gas by Dr. Priestley not only completed the demonstration of its fallacy, but served as the corner-stone of a more sound and consistent theory. By a series of researches executed at great expence, and with consummate skill, the French philosopher verified in some cases, and corrected in others, the results of his predecessors, and added new and important observations of his own. Upon these, united, he founded that beautiful system of general laws, chiefly relating to the absorption of oxygen by combustible bodies, and to the constitution of acids, to which, alone, the epithet of the Antiphlogistic or French theory of chemistry is properly applied. Of the genius

manifested in the construction of that system, and the taste apparent in its exposition, it is scarcely possible to speak with too much praise. But it is inverting the order of time to assert, that it had any share in giving origin to the researches of Priestley, which were not only anterior to the French theory, but were carried on under the influence of precisely opposite views. This, too, may be asserted of the discoveries of Scheele, who, at the same period with Dr. Priestley, was following, in a distant part of Europe, a scarcely less illustrious career.

It is the natural progress of most generalizations in science, that at first too hasty and comprehensive, they require to be narrowed as new facts arise. This has happened to the theory of Lavoisier, in consequence of its having been discovered, that combustion is not necessarily accompanied with an absorption of oxygen, and that acids exist independently of oxygen, regarded by him as the general acidifying principle. But after all the deductions, that can justly be made on that account from the merits of Lavoisier, he must still hold one of the highest places among those illustrious men, who have advanced chemistry to its present rank among the physical sciences. It is deeply to be lamented that his fame, otherwise unsullied, should have been stained by his want of candour and justice to Dr. Priestley, in appropriating to himself the discovery of oxygen gas. This charge, often preferred and never answered, would not have been revived in this place, but for the claim so recently and indiscreetly advanced by M. Victor Cousin. To the credit of Dr. Priestley it may be observed, that in asserting his own right, he exercised more forbearance, than could reasonably have been expected under such circumstances. In an unpublished letter to a friend, he thus alludes to the subject of M. Lavoisier's plagiarism. "He," (M. Lavoisier) "is an *Intendant of the Finances*, and has much public business, but finds leisure for various philosophical pursuits, for which he is exceedingly well qualified. He ought to have acknowledged that my giving him an account of the air

I had got from *Mercurius Calcinatus*, and buying a quantity of M. Cadet while I was at Paris, led him to try what air it yielded, which he did presently after I left. I have, however, barely hinted at this in my second volume." * The communication alluded to was made by Dr. Priestley to M. Lavoisier in October, 1774; and the Memoir, in which the latter assumes to himself the discovery that *mercurius calcinatus* (red oxide of mercury) affords oxygen gas when distilled *per se*, was not read to the Academy of Sciences before April, 1775. † In evincing so little irritability about his own claim, and leaving its vindication with calm and just confidence to posterity, the English philosopher has lost nothing of the honour of that discovery, which is now awarded to him, by men of science of every country, as solely and undividedly his own.

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* Letter to the late Mr. Henry, dated Calne, Dec. 31, 1775.

† See an Abstract of this Memoir in the *Journal de Rozier*, Mai, 1775.

WEDNESDAY EVENING.

Mr. R. Potter, jun. read a *description of his new construction of Sir Isaac Newton's reflecting microscope*, and exhibited the instrument, with a variety of finely executed elliptical mirrors, &c. In the reflecting microscope of Sir Isaac Newton the object is placed directly in the focus of the speculum, and the image is formed in that of the eyeglass; and thus, having only one additional surface in the essential parts of the instrument it must be considered as next in simplicity to the single-lens microscope.

In this construction the object must be placed in the axis of the tube, where it is difficult to provide sufficient illumination, and it is this defect which the new construction is intended to obviate. A large hole is cut in the tube between the object and the speculum, to allow the light to fall upon the former when it requires to be viewed as an opaque object, and all the lower parts of the tube are lined with black velvet, to absorb the irregular light. A large lens is also occasionally employed to concentrate the light. Transparent objects require a small oval mirror to be placed immediately behind them; this mirror receiving a concentrated light from a lens, fixed in a sliding piece on the side of the tube, reflects it through the object to the speculum. The objects, to be placed in the centre of the tube, are attached to thin brass wires in wooden handles, and kept separately in a box.

This construction of the reflecting microscope has a great advantage in point of distinctness, from there being only one necessary reflection between the object and the image, and will be found particularly suitable for the examination of opaque objects, on account of the large aperture of the speculum, compared to its focal length.—It is therefore recommended as an excellent working tool to the scientific enquirer, who will disregard the little trouble required in its management.

The Secretary then read a description by Dr. Brewster of an *Instrument for distinguishing Precious Stones and Minerals.* The object of this instrument is to distinguish mineral bodies by the relative quantity and colour of the light reflected from their surfaces, when placed in contact with fluids of different refractive powers. The surfaces employed for this purpose may be either natural or artificial, so that the method is equally applicable to regular crystals, and to gems cut into artificial forms. If a fluid, of a given refractive and dispersive power, is placed on the surface of a mineral of the very same refractive and dispersive power, there will be no light whatever reflected from their separating surface; but in proportion as the fluid and the solid differ in these respects, in the same proportion will the quantities of light differ which are reflected at the separating surface, and its colour will undergo corresponding changes.

The principal part of the instrument is a triangular prism of glass, between the lower surface of which and the upper surface of the mineral the oil is placed. This oil will form a parallel film, but, by the mechanism of the instrument, the two surfaces which bound this film can be inclined to each other, so that an eye looking into the prism will see at once the images of a luminous body, such as the sun, &c, reflected from the separating surface of the oil and the prism, and from that of the oil and the mineral. The first of these images is constant both in its colour and quantity of light, while the oil is the same, but the second will vary with the mineral. The comparison of the colour and quantity of light obtained from different minerals furnishes the nicest tests for discriminating them.

The author illustrated his explanations of the principle of the instrument by means of diagrams, and the instrument itself, as constructed by Dollond, was exhibited to the Meeting.

THURSDAY MORNING.

Mr. Dalton read a paper written for the Literary and Philosophical Society of Manchester, containing a series of *experiments on the quantity of food, taken by a person in health, compared with the quantity of the different secretions; with chemical remarks and deductions.*

Mr. Dalton, whose regular habits of life and uniform good health enabled him to make these Experiments upon himself to great advantage, commenced them about 40 years since at Kendal, and prosecuted them for periods of a week or a fortnight at various seasons of the year, to ascertain the proportion between the weight of food, and the ordinary evacuations. Particular observations were made on the effects occasioned by drinking an infusion of Carbonate of Potash, and a train of experiments was continued for three weeks to determine the loss of weight by perspiration for the whole day, and for certain hours of the morning, afternoon, and night. The mean daily loss by perspiration was 37½ oz.

From these experiments, the state of organic chemistry 40 years since did not permit Mr. Dalton to make any deductions, but he was now enabled to return to the subject with the powerful aid of exact analysis. He shewed that the quantity of Carbon contained in the solid and liquid food taken into the stomach daily was .. .. .. 11½ oz.
of which there passes off sensibly 1

Leaving for the waste by insensible perspiration 10½ oz.

Mr. Dalton had ascertained from experiments on his own respiration that the quantity of Carbonic acid gas expelled from his lungs contained of Carbon .. 10¼ oz.

His daily loss by perspiration of aqueous vapour from the lungs was at the same time found to be 20½ oz. to which adding 10¼ oz. Carbon, we have the total loss by perspiration from the lungs, 30¾ oz., which taken from 37½, leaves 6¾ oz.

per day for the insensible perspiration of the skin, of which $6\frac{1}{2}$ oz. are water, and $\frac{1}{4}$ oz. is Carbon.

The element Azote, of which $1\frac{1}{2}$ oz. per day was taken into the stomach, appears to have passed off by evacuation. Of the 6 lbs of aliment taken in a day, 1 lb. consists of Azote and Carbon, and 5 lbs. of water, and nearly the whole quantity of food taken into the stomach enters the circulation,—the residual part constituting only $\frac{1}{15}$ of the whole,—of which about half is thrown off by the kidneys, more or less according to season and climate, another part passes off by insensible perspiration, $\frac{5}{6}$ being perspired from the lungs, and $\frac{1}{6}$ from the skin.

The next paper was read by Mr. R. Potter, jun. and contained his *remarks on a theory of the late M. Fresnel concerning the reflection of light from the surfaces of bodies.*

M. Fresnel in a paper read before the Academy of Sciences in Paris, and of which he published an abstract in the Annales de Chimie for 1820, proposed to account for the reflection of light at the surfaces of bodies, on the undulatory theory, by its impinging on the ponderable particles. He appears to have afterwards in some measure modified his views, but not, to the writer's knowledge, ever to have *formally* renounced his former proposition. Hence the subject may fairly be considered as still open to discussion: and the manner of considering reflection, as caused by the light striking the ponderable parts of bodies, being the one which almost every person would recur to, on first commencing the study of physical optics, it will perhaps be considered not entirely useless, on this account also, to enter into a regular examination of M. Fresnel's hypothesis.

Now if reflection were caused immediately by the ponderable matter in any surfaces, it ought to be some function of the quantity of matter in the bodies furnishing such surfaces; but even a superficial view of the small quantity of light reflected at a perpendicular incidence in transparent bodies, compared with the large quantity reflected at the same incidence in

metals, is sufficient to convince us that reflection has no relation to the densities of bodies. To remove, however, an objection which might be urged, that the extension of the particles of bodies may not bear an invariable ratio to their weight, it will be necessary to examine cases where a metal, by combining with a new element or elements, has acquired the property of transparency, and thus possesses an evident refractive power. By knowing the comparative weights of the metal in the two states, it is easy to calculate the relative numbers of similar particles in equal surfaces, and of course to calculate the relative quantities of light which ought to be reflected, if caused only by the ponderable particles of metal. Experience is so much at variance with the hypothesis under examination, that the other elements in the compound may be considered even as lending no assistance at all.

The results obtained by Photometry shew that the metals, with the exception, perhaps, of two or three, reflect two-thirds and upwards, of the light incident perpendicularly on them. For the reflective power of the transparent bodies we may use the analytical formula of M. Poisson, (which was admitted by M. Fresnel,) to calculate it from the refractive index, though it gives most probably, in all cases, quantities too large and of course proportionally favourable to the controverted hypothesis.

Proceeding in this manner for glass of Antimony, the reflection according to Fresnel's hypothesis, should have been at least 46 rays of every 100 incident, whilst the quantity given by the analytical formula is only 19.3 rays.

In the white oxide of arsenic or arsenious acid the reflection should have been 31.9 (taking even the old number for the specific gravity of the metal) in place of less than 8.3 which it really is.

In the red silver ore it should have been at least 37.5 rays if the hypothesis were correct, instead of less than 19.2 as determined by the analytical formula.

If the metals of the alkalis and earths might be assumed of equal reflective powers with the other metals, and it is most

likely they are, the chloride of sodium would form one of the strongest cases which could be brought forward; for whilst it really reflects only about two per cent, it ought according to the controverted hypothesis to have reflected upwards of 60 rays of every 100 incident, from the metal in the chloride being almost as dense as in its proper state.

Mr. Wm. Hutton read a paper *upon the Whin Sill of Cumberland and Northumberland.*

A bed of Stratiform Basalt is well known to occur extensively in connection with the Mountain Limestone Rocks of the North of England, aud is called in Alston Moor and the djoining mining districts, "the Whin Sill." This *bed* has naturally a good deal of geological interest attached to it, from the circumstance that rocks of its class are *generally* found under conditions which indicate that their production is entirely independent both as to antiquity and origin of that of the Strata which they divide,—and upon which, at the points of contact, they have produced mechanical and chemical changes which afford the most conclusive evidence of their violent intrusion since the deposition and consolidation of those Strata.

The Whin Sill is visible in many of the streams running into the South Tyne from the West and may be seen in the bed of the Tyne itself at Tyne-head. It occurs in the bed of the Wear, in Teesdale, where it is extensively developed, and in the Lune, in short, throughout the whole district wherever the water-courses, or the operations of the miner, pierce deep enough; its basset edge may also be traced almost uninterruptedly from Helton in Westmoreland to Tindale Fell in Northumberland.—Here the whole carboniferous formation is broken through by the "great Stublick Dyke" which throws down the Whin Sill along with the other beds of the formation, to an immense depth; its edge reappears on the north side of this dyke at Wall Town Crags, near Glenwhelt, in Northumberland, rising rapidly to the North, and

from this spot it can be traced almost throughout the county of Northumberland to the sea coast near Newton; it occurs again with other beds of the carboniferous formation in consequence of a general depression of the strata a little south of Bamborough, from whence it sweeps round by Belford to Kyloe on the coast, near to which place it finally disappears.

In the course of this bed northward from Alston Moor, it appears to rise in the series of strata, from 'the *putting in*' of new beds, as the miners term it; and of course it is found in contact with all the varieties of rock composing the carboniferous formation. It is generally in one bed, sometimes in two, and once at least it occurs in three beds.

The action of heat in hardening the rocks near it and rendering the limestone crystalline, can generally be observed accompanying this bed, but no where to such an extent as in High Teesdale.

After an attentive examination of the appearances exhibited throughout its whole course, the conclusion of the writer is, that this bed of Basalt was produced by an overflowing of lava during the deposition of the Mountain Limestone Group, after those beds, which are found below, and prior to those above it.

After Mr. Hutton's Paper had been read,

Mr. Murchison rose to bear testimony to the general value and accuracy of the memoir. His own observations, however, on the evident violence which in High Teesdale accompanied the arrangement of the basaltic matter, the altered character of the limestone, sandstone, and shale both above and below it, and the occasional ramification of its substance through the contiguous and superior Strata, led him to confirm the opinion of Professor Sedgwick, that the Whin of that district had not been injected into the Carboniferous Limestone till after the deposition of that whole system of rocks. He thought it very desirable that the views of Professor Sedgwick respecting

the Whin Dykes of Durham should be further pursued, with reference to this theory, to ascertain whether they were emanations from the great Whin Sill, or were posterior to it. Some of these Dykes break off into various branches all pointing to the Whin Sill, and thus appearing at least to be related to it in age.

Mr. Phillips had formerly examined the whole range of the Whin Sill, and was happy in being able to agree in opinion with both the Author of the Paper and the President of the Geological Society. The definite geological situation, between the same Limestone bands, of the great portion of the Basalt, its wide lateral extension, the general limitation of the effects of its heat upon the contiguous rocks to the lower surface of the mass, its course for miles together without furnishing a single dyke, or even entering at all into the many natural fissures of the Limestone, and its division by metallic veins, obliged him to infer that a large portion of the Whin Sill was formed by periodical submarine eruptions of Lava, at intervals during the deposition of the Carboniferous Strata with which it is associated. On the other hand, the instances described of violent eruption and local intrusion of the Basalt into the Strata above its general range, seemed to shew that Teesdale had been the theatre of more than one such eruption. The views of Professor Sedgwick and Mr. Hutton were, therefore, by no means irreconcilable, and it might be very possible hereafter to fix upon the foci or centres from which, as probably at Caldron Snout in Teesdale, the principal basaltic *coulées* had flowed.

Mr. Johnston gave an account of *the Metal Vanadium and its ores.*

He stated that this metal was first observed, though without being distinctly made out, by Del Rio in Mexico 25 years ago, and afterwards rediscovered by Seftström, and nearly at the same time by himself, about the end of last year.

He exhibited and described the mineral from Wanlockhead in which he found it, detailed the process for extracting it, enumerated its most interesting properties when in the metallic state, and the characters by which in all its states it may be distinguished from Chromium, the only other metal with which the analytical chemist is likely to confound it. He exhibited various compounds and salts of the metal, among which were some beautiful crystals of Vanadic Acid, which were transparent, of a brown colour by transmitted light, but reflecting a purplish tint. They were in the form of flat prisms of a high degree of lustre, and had been ascertained by Dr. Brewster to possess a refractive power approaching that of the diamond, to have at least one axis of double refraction, and to belong to the prismatic system of Mohs.

Mr. Witham read a Paper *on the general results of botanical investigation concerning the character of the Ancient Flora, which by its decomposition has furnished the materials of coal-seams.* He described the discoveries which the art of slicing and polishing the fossil stems of plants had enabled him to make, concerning the internal structure of these large coniferous trees which especially abound in the lower part of the Carboniferous Series of Berwickshire; and stated that Geologists are now agreed that the plants of these ancient periods are of more diversified and complicated types than a distinguished foreign writer supposed.

The following *Notice of a fact observed in the torrefaction of Yellow Copper Pyrites* at Amlwch, in Anglesey, by Dr. Henry, was read by the Secretary.

'When on a visit, a few years ago, to the Copper-Mines and Works at Amlwch in Anglesey, a fact was mentioned to me by an intelligent superintendent of the processes carried on there, (Mr. Joseph Jones) which struck me to be interest-

ing and curious. The poorer part of the ore (a native mixture of yellow copper pyrites with so much foreign matter as to contain only about 5 per cent. of copper) is roasted in kilns on the spot, in order to expel a considerable part of the sulphur. The combustion, after the kiln has been once lighted, is supported by the inflammable matter of the ore itself, and a smouldering heat, never, I was assured, sufficient to occasion fusion, is kept up for several months. On examining the lumps of roasted ore, small nodules are observed of an iron grey colour, with some lustre, resembling in appearance the vitreous copper ore (cuivre sulfuré of Haüy). These nodules have been found, when assayed, to be very much richer in copper than the original ore. Their specific gravity I found to be 4.6, very nearly that of vitreous copper ore. By a few general experiments, I ascertained that they are not entirely soluble in heated nitric acid, and that the solution contains a small proportion of peroxide of iron, with a much larger one of oxide of copper. The yellow copper pyrites, in its natural state, was determined by Mr. Richard Phillips, to consist of

2 atoms of protosulphuret of iron,
1 atom of bisulphuret of copper.

'It should appear, therefore, that during torrefaction the bisulphuret of copper, by parting with one atom of sulphur, is converted into protosulphuret, which, by its aggregative attraction, is collected into small nodules. This fact furnishes an additional example, to the few which were before known, of changes of molecular arrangement in bodies heated below their point of fusion; with this further circumstance, that the attraction, which causes the aggregation of the particles, is sufficient to overcome the obstacle of interposed matter of a different kind. The only other instances of similar facts that at present occur to me, are presented by *crystallites*, and by the products of Mr. Gregory Watt's experiments on Basalt, some of the appearances of which he sup-

poses to have taken place after the fused mass had returned to a solid state.

'In the second volume of Breislac's *Institutions Geologiques*, I was pleased to observe, two or three years after the foregoing fact had occurred to me, that a precisely similar observation had been made by Brocchi on the roasted copper ore of Agardo, which is also the yellow pyrites, and of quality, as to its proportion of copper, not exceeding that of the Parys Mountain. On breaking the lumps of roasted ore, similar nodules were observed; and these, when assayed, were found to contain two-thirds of their weight of copper, while the surrounding ore had lost greatly of its original proportion of that metal. In the central parts of some of those nodules, small fibres and plates of metallic copper were visible, an appearance which I have not observed in the roasted ore of Anglesey. The nodules, thus enriched in their proportion of metal, are picked out, and subjected to reducing processes.

M. Breislac adds, that the torrefaction of the ore, at Agardo, is carried on with the careful avoidance of such a heat as would occasion the fusion of the ore; for this is ascertained to be very injurious to the subsequent operation.'

It was remarked by Mr. Johnston, that a similar observation had been made some years ago by Professor Brodberg, of the school of Mines at Fahlun, and was detailed by him in a Paper published in the Swedish Transactions, and reprinted in the Edinburgh Journal of Science.

THURSDAY EVENING.

On Thursday Evening Mr. Scoresby gave "*An exposition of some of the laws and phenomena of Magnetic Induction, and of the mutual influences of magnets on each other*, with an account of *a method of application of the magnetic influences for the determination of the thickness of solid substances not otherwise measurable.*"—In the introductory observations, Mr. Scoresby considered the general nature, as far as it is understood, of the magnetic principle, and described a magnetic bar as a battery of magnetic particles, the arrangement of which being regular and consistent, transmits to the poles, like the galvanic pile, the general aggregate of their individual energies. He defined *induced magnetism*, "as the development of the latent magnetism in iron or steel by the juxta position of any substance in a magnetic condition." His investigations on the law of induced magnetism extended to the different qualities of iron and steel; to the proportion of influence acquired by similar masses at different distances from the proximate magnet; and to the relation of capacity in masses in all other respects similar except as to thickness. The proportion of influence was shown, at different distances, of the magnetism induced upon the nearer and more remote ends of a bar of soft iron, and the quantity transmitted, compared with the portion directly induced, was numerically stated. A bar of very soft iron, placed directly over a magnet of similar dimensions, was found at the distance of 5 inches, to acquire $\frac{1}{30}$th of the power of the magnet. At 4 inches above, the inductive influence of the magnet was $\frac{1}{19}$th of its own power; at 3 inches, $\frac{1}{13}$th; at 2 inches, $\frac{1}{7}$th; at 1 inch, $\frac{1}{4}$th. At $\frac{1}{4}$ of an inch above, the power induced was equal to $\frac{1}{2}$ that of the magnet, and at the distance of $\frac{1}{16}$th, it amounted to $\frac{2}{3}$ds. Several new and curious illustrations of the phenomena of induced magnetism were then exhibited to the Meeting.

FRIDAY MORNING.

Mr. Scoresby concluded his account of his Magnetical experiments. He described the *action of magnets of different dimensions on the needle of the compass*, and the investigation of the law of the deviation at different distances, and with magnets of various sizes. With a beautiful pair of three feet bar magnets, he was able to produce a very perceptible action on the compass, through a variety of intervening solid substances, at a distance of more than 61 feet; and to measure with tolerable precision various masses of solid rock of from 3 feet to more than 40 feet in thickness by the magnetic deviations. The phenomena now communicated to the Association, with their different important applications, were the results of original investigations and discoveries, accomplished, for the most part, within the last ten months.

A Paper by Dr. Brewster *on the structure of the crystalline lens in fishes, birds, reptiles, and quadrupeds*, was read by the Secretary, and illustrated with drawings and models by the Author. After giving an account of the previous observations of Leeuwenhoek and others, the Author explained the method in which he conducted his enquiries. The lenses of almost all animals are composed of distinct fibres, and when any of the laminæ are removed, the surface appears fibrous or grooved. In large lenses, the direction of these lines may be easily traced by the microscope alone, but in many cases this is quite impracticable. In order to get rid of this difficulty, the author observed the image of a candle or bright luminous object, when reflected from a fresh surface of the lens, and he found this colourless image invariably accompanied by coloured images on each side, as in mother of pearl, and in Mr. Barton's *Iris* ornaments. As the direction of the fibres is necessarily perpendicular to the line joining these coloured images, and as

the distance of the coloured images varies inversely with the diameters of the fibres, Dr. Brewster was able to trace these fibres to their points of convergency or terminations, even when the fibres themselves were no longer visible. When the crystalline lens is dried, a furrowed impression of its surface may be taken upon wax, and the impression will, like that from mother of pearl, exhibit the same coloured images.

By the process now described, Dr. Brewster has examined many hundreds of the lenses of animals brought from all parts of the world, and has found that there are five different modes in which the fibres are arranged, the same mode being invariably found in the same animal. These different arrangements of the fibres were illustrated by elegant drawings from the pencil of Dr. Greville, and by wooden models, which exhibited all the inflexions of the fibres and the dimensions of their diameter as they approached to their termination.

In the greater number of lenses the structure is perfectly symmetrical in relation to the anterior and posterior surfaces, or to the poles of the axis of vision: but Dr. Brewster discovered in some lenses a remarkable deviation from this symmetry; the anterior surface having the fibres arranged according to one law, and the posterior surface according to another. The object of this singular structure he conceived to be to obtain a more perfect correction of the spherical aberration of the eye to which it belongs.

Mr. Murchison, President of the Geological Society, communicated, verbally, observations "*on certain accumulations of clay, gravel, marl, and sand around Preston in Lancashire, which contain marine shells of existing species.*"

The marine shells of existing species in this district were first noticed by Mr. Gilbertson of Preston; and Mr. Murchison was desirous of calling the attention of the Meeting to the merits of that able naturalist.

He had this year visited the localities and found the deposit in question to consist, near the surface, of clay

with boulders of distant rocks, covering great thicknesses of marl, gravel, and sand, the sand usually being the lowest. These accumulations are not only spread over the broad delta extending from the coast at Blackpool to Preston in the interior, but they rise at the latter place into considerable eminences extending in plateaux on the banks of the Ribble and the Darwent, for several miles inland.

In certain places the marls, sands, and gravels contain shells of existing species, (Mr. Gilbertson enumerates about 20 species) not differing from those of the adjoining sea, above which they were found at various heights from 80 to 300 feet. The accumulations seldom offer proofs of regular bedding or tranquil deposit, but rather resemble the detritus formed upon an agitated shore; although from their diversity of structure they present distinct evidence of having been heaped up during a long protracted period. Seeing the height above the sea at which these shells are found, and that they are usually buried under a cover of clay, containing large boulders of Cumbrian rocks, Mr. Murchison infers that one of the last elevations of the central ridge of the North of England is thereby proved to have taken place after the creation of existing species of animals.

The deposit was described as resting on inclined and contorted strata of millstone grit, and shale, and an overlying red sandstone, (banks of the Ribble and Darwent,) and upon the edges of the productive coal measures near Chorley.

This communication was followed by a discussion, in which Mr. Greenough, Mr. Murchison, and Mr. Phillips took part, on the application of these observations to resolve the question of the change of level on the coast of Lancashire, and on that of Yorkshire, where gravel deposits containing marine shells of existing species have been described by Mr. Phillips as diluvium.

Dr. Daubeny gave a Lecture *on the connexion of Hot Springs with Volcanos.*

Hot Springs, he observed, are met with for the most part in one of these situations. 1st. in the vicinity of Volcanos. Of this kind of position, the active volcanos of Iceland, Italy, and Sicily, and the extinct ones of France, Hungary, and the Rhenish provinces, afford numerous examples. In these cases, it cannot be doubted but that the heat of the springs is derived from the volcanos contiguous to them.

2nd. At the foot of chains of mountains which have been uplifted. Now as the elevation of such chains may with some probability be referred to a volcanic cause, it seems most natural to attribute the occurrence of their hot springs to the same, and this is confirmed by observing that they are found for the most part either near the line at which the elevation seems to have commenced, or else near the axis of the chain, in places where the valleys penetrate to the greatest depth. Of both these positions, the Pyrenees afford abundant examples.

3rd. Hot springs occur in some cases at a distance from any great chain of mountains, but then there is in these cases often strong evidence of some fracture or dislocation of the strata, such as may reasonably be attributed to a volcanic cause. Instances of this are supplied by the hot springs of Clifton in this country, Carlsbad in Bohemia, and Pfeffers in Switzerland.

It appears, then, that the great majority of hot springs are attributable to volcanic action, and this is confirmed by considering the gaseous products which they evolve, for these are the *same* as those given off by volcanos.

The first of these is sulphuretted hydrogen, which is common also to volcanos, especially when in a state of languid action.

Another kind of gas given off by many hot springs, is carbonic acid, which abounds also in cold springs, but when this is the case, the latter often exist in *valleys of elevation*,

to use Dr. Buckland's nomenclature, which in the structure of the beds surrounding them, bear evidence of sudden uplifting. Such are the springs of Pyrmont in Westphalia, and of Tunbridge in this country.

The third gas given off by hot springs, is nitrogen. It had been previously found at Bath and Buxton, but Dr. Daubeny has likewise detected it in several other tepid springs in Derbyshire, and in that of Taafe's well near Cardiff in Glamorganshire. He met with it also in a state of purity in the hot springs of St. Gervais, Cormayeur, St. Didier, and others, on the skirts of the Alps, and accompanying carbonic acid in those of Mont Dor, St. Nectaire, and Chaudes Aigues in France; and from these observations of his own, combined with those of others, he concluded that nitrous gas is disengaged from the generality of hot springs.

The presence of nitrogen is also an argument for adopting that *chemical* theory of volcanic action, which supposes it to arise from a species of combustion or oxidation, in preference to the *mechanical* hypothesis which regards it merely as a consequence of the law of distribution of temperature within the earth, and excludes the idea of chemical agency altogether.

On the latter part of this paper, it was remarked, that the gases mentioned by Dr. Daubeny are evolved from decompositions known to be going on at the surface, and at various depths from the surface of the earth, independently of hypothetical causes.

With respect to the occurrence of remarkable dislocations in connexion with mineral springs, Mr. Smith observed, that in the neighbourhood of the Bath waters, the dislocations must have been occasioned in very ancient geological æras, since the strata of the lias series, through which the hot springs rise, are unaffected by the disturbances of the coal and limestone series beneath.

FRIDAY EVENING.

Mr. Potter communicated the following *observations on Electrical Phenomena, exhibited in the Torricellian vacuum.*

Though early experimenters had directed their attention to the phenomena of Electricity shewn in passing through space as void of matter as they were able to procure, yet the question whether electricity can pervade a perfect vacuum, or cannot do so, is still far from being decided. The experiments with the air pump would lead us to conclude that electricity would pervade an actual vacuum without sensible resistance, and without exhibiting light. But Mr. Walsh, Mr. Morgan, and other experimenters, had asserted that electricity could not pervade a perfect Torricellian vacuum. Sir Humphry Davy has maintained that the Torricellian vacuum is permeable to electricity, with an exhibition of more or less light according to the temperature. But as the appearances he describes are similar to those given by Mr. Morgan, when a very minute portion of air remained in his tube, it must be considered a question still open to further investigation.

From the writer's experiments, made with the object of learning something which might throw a light on the nature of Aurora Borealis, it has appeared, in conformity with the previous experiments of Sir Humphry Davy, Mr. Morgan, and others, that the passage of electricity through space containing only a very minute portion of air, was attended with a very considerable display of light, and this when the mercury in the tube stood scarcely perceptibly lower than that in a good barometer.

Dr. Warwick exhibited the method of making a powerful temporary Magnet, by coiling round a horse shoe of soft iron a quantity of copper wire, connecting the poles of a galvanic battery, as originally performed by Professor Moll of Utrecht.

Dr. Daubeny exhibited a new instrument composed of finely reticulated wire, intended to illustrate the effects of capillary attraction.

A description of the New Volcanic Island, by Mr. Osborn, communicated by Captain Hotham, R. N. was read to the Meeting.

SATURDAY MORNING.

Mr. Dalton, President of the Manchester Society, read his *Physiological Investigations arising from a consideration of the mechanical effects of atmospheric pressure on the animal frame.*

In this essay Mr. Dalton endeavours to answer the question, how the animal body is enabled to resist the pressure of the external atmosphere, which varies in amount from 15 to 20 tons on a middle sized man, without being sensible of the whole or any part of this enormous and fluctuating pressure.

The average specific gravity of the human body being taken according to Robertson's experiments at 0.9, Mr. Dalton observes that the mean specific gravity of all the solids and fluids which are in it is about 1.05. The air contained in the lungs and other receptacles of the body is estimated at 150 cubic inches; the average bulk of the body 4,500 cubic inches, of which consequently 4,350 cubic inches, are solid and liquid parts. The mean specific gravity of these parts, taken separately when dead, being 1.05, their total weight should be equal to 4,567 cubic inches of water, but it was found by actual weighing, when alive, equal to 4,044 cubic inches, a difference of weight equal to 523 cubic inches of water, or more than $\frac{1}{9}$ of the whole weight of the body. The general conclusion deduced by Mr. Dalton from these data, combined with other considerations, is that the whole substance of the body is pervious to air, and that a considerable portion of air constantly exists in the body during life, subject to increase and diminu-

tion according to the pressure of the atmosphere, in the same manner as it exists in water: and further, that when life is extinct, this air in some degree escapes and renders the parts specifically heavier than when the vital functions were in a state of activity. *(This Paper will be printed in the Manchester Memoirs, Vol. V.)*

Mr. Allan communicated a *Notice of a magnificent specimen of aqua marine in the possession of Don Pedro.*

The largest mass of *precious* beryl known to mineralogists is an aqua-marine belonging to Don Pedro; it is nearly as large as the head of a calf, its extreme length being $9\frac{1}{8}$ inches, its breadth $6\frac{5}{8}$ inches; it weighs 225 ounces Troy, or eighteen pounds nine ounces. On one side there are slight indications of the plane of a crystal; but it is otherwise entirely water worn. Its surface is consequently dull; but beneath it the mass is perfectly clear and transparent, and, large as it is, without a flaw. It is of a beautiful pale bottle-green colour.

Mr. Robison, Secretary of the Royal Society, Edinburgh, described and illustrated by diagrams the principles and mode of construction of *his Linseed Oil Barometer*, and detailed the mechanical processes by means of which he had been enabled entirely to free the oil from atmospheric air and other gaseous admixtures.

Mr. Forbes read to the Meeting his *Essay on the Horary Oscillations of the Barometer near Edinburgh.*

In the former part of this communication, the Author, after a short view of the progress of his researches on this subject, states the circumstances under which his observations commenced. The place of observation is 4 miles S. W. of Edinburgh, lat. 55° 55′ 20″ N. long. 12′ 57.5″ west of Greenwich, at an elevation of 410.5 feet above the mean level of the sea. Five observations were made daily of the barometer and attached ther-

mometer, from 8 to 8½ a. m., at 10 a. m., about 4 p. m., and at 8 and 10 p. m., in order to detect the morning and evening maximum and afternoon minimum. The number of observations was 4410, which, being reduced to a standard hour, (10 p. m.) by methods described at length in the paper, yielded the following results.

The maximum of oscillation occurred in spring and summer at 8 or 8½ a. m., and 10 p. m., in autumn and winter at 10 a. m. and 8 p. m.

Taking these hours, and selecting the actual maxima, the amounts of Oscillation are found to be

	Morning.	Evening.
In Spring ..	.0213 ..	.. .0202
Summer ..	.0181 ..	.. .0151
Autumn ..	.0136 ..	.. .0079
Winter ..	.0031 ..	.. .0031

After comparing the results of his observations with an extensive collection of those of other observers in various latitudes, Mr. Forbes proceeded to investigate formulæ which should express with the least error the general amount of oscillations in different latitudes, at the level of the sea. For this the paper itself, which will appear in the Transactions of the Royal Society of Edinburgh, must be consulted, as also for various indications of the influence which elevation above the sea, the season of the year, and the absolute mean temperature of the place, have in modifying the amount and period of occurrence of the phenomenon.

THE FOLLOWING EXTRACT of a letter from Sir James South to Dr. Brewster, dated Observatory, Kensington, Sept. 29, 1831, was read by the Secretary.

"Should the York Meeting not have terminated its labours, and should you think it worth the trouble, I wish you would call the attention of any astronomers that may be there, to the anomaly which sometimes attends the transits of the satellites of Jupiter, over the planet's face. Generally speak-

ing, the satellite may be seen to glide on the face as a bright planetary disc, and remains so till it has proceeded one-sixth or one-eighth of the planet's diameter. It then becomes invisible till it approaches the opposite limb within one-sixth or one-eighth of the diameter of the planet, when it may be again detected as a bright disc, and remains so till it passes entirely off the face of the planet.

This anomaly I have witnessed three or, I believe, four times, and the last on Saturday fortnight, when the satellite itself instead of being invisible, except near the limbs, was perfectly visible as a black disc, and, with its attendant shadow, was distinctly seen with the five feet equatorial. The point to be settled is,—why should this fact be presented sometimes and not always?

The approaching disappearance of Saturn's Ring, and even its present intersection, will be very advantageous for obtaining a knowledge of the various phenomena of the Satellites, and of the actual figure of the planet. Of the former, we know next to nothing; of the latter but little that is satisfactory. Sir William Herschell's observations are entirely at variance with mine.

If Lord Oxmantown, or any person possessing a large Reflector, would turn it every fine night on the Georgium Sidus, it would be well; for although Sir William Herschel expressed to me orally his doubts as to the accuracy of his observations, which assigned to that planet two rings perpendicular to each other, still I know not if this suspicion of his has even been promulgated. One Satellite has certainly been seen with my Achromatic, and one also by myself and Struve with the twenty feet Reflector. Laplace doubted the existence of more than two. If the others are not greatly more faint than the one I have seen, Lord Oxmantown will certainly detect them instantly with the immense quantity of light afforded by his Reflector."

SATURDAY EVENING.

Dr. Daubeny read an account of *Experiments on the combustion of Coal Gas* performed at York, by the Rev. W. Taylor, from which it appeared that by regulating the quantity and mode of admission of the atmospheric air to the flame of a common argand gas burner, the *quantity* of light might be much increased without increased expenditure of gas, while the *colour* of the light so produced varied according to circumstances. He referred the effects to the principle laid down by Sir H. Davy as to the luminosity of flame depending on the amount of solid matter maintained in a state of ignition at any given time.

The Rev. Wm. Vernon Harcourt shewed *a Lamp constructed upon a new principle*, and explained the principle and construction of it. He gave it the name of an *oil gas lamp;* not because it was lighted by gas formed at a temperature below that of flame, for this was common to all lamps, but because, as in the gas lights of the streets, the gas issued from a *reservoir*, and owed the perfection of its combustion not to an ascending current of hot air, but to the force with which it was propelled from the reservoir and carried the air along with it. It differed, however, from the common gas lights in these circumstances,—that the reservoir formed part of the burner; that the gas was formed as it was consumed; and that it was propelled, not by a *vis a tergo* and in a state of condensation, but by the expansive force of its own heat. In consequence of this circumstance the current of the gaseous jet was more rapid in proportion to the quantity of matter contained in it than in the common gas lights, whilst it was also at a much higher temperature, so that it could issue with a greater velocity without being liable to blow itself out. The practical difficulty of the construction consisted in the obtaining a steady supply of oil, especially with the cheap oils. This difficulty had been in

great measure surmounted, but the instrument was still imperfect, and had been charged by some accident that evening with a vegetable oil from which a clear light could not be obtained.

An Essay by Dr. Brewster *on a new Analysis of Solar Light* was read by Mr. Phillips.

According to Sir Isaac Newton's Analysis of Solar Light by the prism, *white light* consists of seven different colours, each of which has a peculiar range of refrangibility occupying distinct spaces in the prismatic spectrum, "to the same degree of refrangibility ever belonging the same colour, and to "the same colour ever belonging the same degree of refrangibility."

While examining the specific action of different coloured bodies in absorbing particular portions of the prismatic spectrum, Dr. Brewster was led to observe that rays of two different colours in the same spectrum had actually the very same degree of refrangibility, the one colour being superimposed upon the other. By extending this inquiry and availing himself of the aid of various methods of insulating rays which the prism could not separate, he was conducted to the new Analysis of Solar Light which it was the object of this paper to explain and establish. The following propositions contain a general view of the results.

1. White Light, whether it be that of the sun or of artificial flames, consists of *three* simple colours only, *Red*, *Yellow*, and *Blue*, by the union of which all other colours are composed.

2. The solar spectrum and that of artificial flames, whether formed by prisms of transparent solids and fluids, or by grooves in metallic and transparent bodies, or by the diffraction of light passing through a narrow aperture, consist of *three* spectra of equal length, beginning and terminating at the same points, (viz. a Red, a Yellow, and a Blue Spectrum) and having their *maximum* of illumination at different points of their length, and their *minimum* at their two extremities.

3. All the seven colours in the solar spectrum, as they were

observed by Newton and Fraunhofer, are compound colours, each of them consisting of Red, Yellow, and Blue Light in different proportions.

4. A certain portion of *White Light* incapable of being decomposed by the prism, in consequence of all its component rays having the same refrangibility, exists at every point of the spectrum, and may at some points be exhibited in an insulated state.

(Since this paper was read, an abridgement of it has been published in the Edinburgh Journal of Science, No. X. New Series, pp. 197—207; and the original Memoir, illustrated with coloured drawings will appear in the next Part of the Transactions of the Royal Society of Edinburgh, Vol. XII. Part I.)

Mr. Wm. Gray, jun. then read the Translation of a memoir by Professor Gazzari of Florence, *on a method of detecting the traces of writing which has been fraudulently erased.*

The Author of this paper having been frequently appointed by the Tribunals to give professional evidence in trials of this nature, instituted experiments on the subject, which, by shewing him the possibility of *removing entirely not only the ink, but also the materials employed in its removal*, proved that cases might arise, when the fraud could not be detected in any other manner than by examining *the condition of the paper or other material written on.* For this purpose optical means were tried in vain, and immersion in water did not shew such a difference in the absorptive power of the written and unwritten parts as happens in the employment of certain sympathetic inks; but on exposure of the suspected paper near to a moderate fire, the paper, which, in consequence of the corrosive effects of the ink, was in those parts altered in its nature, was unequally acted on by the process of carbonization, and thus the number and length of the lines, and often the whole of the erased portion was distinctly revealed.

EXHIBITIONS, &c.

Mr. Gould, Member of the Zoological Society of London, exhibited select specimens of Birds figured and described in his work on the Ornithology of the Himalya Mountains, and copies of this work were laid upon the tables for inspection.

Mr. R. Havell exhibited Drawings of Birds for Mr. Audubon's great work on American Ornithology.

Mr. Hey, Curator to the Philosophical Society of Leeds, shewed some remarkable specimens of Fishes from the Yorkshire coal district, which belong to the Museum of that Institution.

Mr. Williamson, Keeper of the Museum to the Philosophical Society of Scarborough, brought for examination a series of the reliquiæ of fossil Crustacea recently discovered in the strata of that coast.

Mr. Wm. Gilbertson, of Preston, displayed an instructive suite of Crinoidal remains with other remarkable fossils from the vicinity of Clithero, and marine shells belonging to existing species from the gravel deposit on the banks of the Ribble.

Copies of recent publications lay upon the tables from Dr. Boswell Reid, from Mr. John V. Thompson of Cork, from Mr. Ashley of Edinburgh, Mr. Harrison of Barton, and others.

Mr. Smith, Author of the Map of the Strata of England, shewed a Geological Map of the district round Hackness.

Mr. Murchison, President of the Geological Society, shewed coloured Maps representing the Transition Rocks, the old Red Sandstone, and Carboniferous Limestone, on the border of Wales; the basin of new Red Sandstone (as Mr. Murchison has determined it to be) in the Vale of Clwydd; and other Maps, Sections, and Notices relating to parts of South Wales, Lancashire, Durham, and Yorkshire.

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ADDITIONS.

Insert, page 45, as Secretary to the Local Committee of the Association in Dublin, The Rev. Thomas Luby, Fellow of Trinity College, Dublin.

Insert, page 104, Carne, Joseph, F.R.S., F.G.S., M.R.J.A. Penzance, Cornwall.