ADDRESS

BY

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Jacksonian Professor, &c.

Gentlemen of the British Association,—I have the honour to announce to you that we are now opening the Thirty-second Meeting of the British Association, and are for the third time assembled in this University.

At its first coming hither in 1833 its organization was scarce completed, its first Meeting having been devoted to explanations, discussions, and allotment of work to willing labourers; its second Meeting, to the reception of the first instalment of those admirable preliminary Reports which served as the foundation of its future labours, and to the division of scientific communications to the Sectional Committees.

But it was at Cambridge that the original plan of the Association bore fruit, by the receipt of the first paper which contained the results of experiments instituted expressly at the request of the Association. The success of the Association was now confirmed by the number of compositions and annual subscriptions paid in, and by the help of these funds a most important measure was introduced, namely, the practice of granting, in aid of philosophical researches to be undertaken by individuals or committees at the request of the Association, sums of money to meet the outlay required for apparatus or other expenses, which could not be asked from persons who were otherwise willing to devote their time to the advancement of science. It was at Cambridge that the importance and authority of the Association had become so manifest, that the first of its applications for Government assistance towards scientific objects was immediately complied with by a grant of £500 to reduce the Greenwich Observations of Bradley and Maskelyne. At the third Meeting improvements were made in the distribution of the Sciences to the Sections, and a Section of Statistics added. The only change in this respect that was subsequently found necessary was the establishment of a separate Section for Mechanical Science applied to the Arts, in 1837. The employment of alphabetical letters to distinguish the Sections had been introduced in 1835.

I have said enough to claim for the Cambridge Meeting the honour of completing the development of the Association; and I may be permitted to quote from our fourth Report the gratifying assurance, that so obvious was the utility of the proposed undertaking, that, in its very infancy, there were found several distinguished individuals, chiefly from the University of Cambridge, who volunteered to undertake some of the most valuable of those Reports which appeared in the first volume of the Proceedings.

With a mixture of regret and shame I confess, that although my name is enrolled in the honourable list of those who undertook Reports, it will be

sought in vain amongst those who promptly performed their promises. Yet I may be permitted to say that I still hope to be enabled at some future time to complete the Report on Acoustics, of which I delivered merely an oral sketch at the second Meeting of the Association, in 1832.

The Association quitted Cambridge to pursue, with its matured organization, and with continually increasing stability and influence, the career of brilliant and useful labours in every branch of Science that it has never ceased to run during the two-and-thirty years that have elapsed since its foundation. It revisited Cambridge after an interval of twelve years, in 1845; and now, after a lapse of seventeen years, we have the high gratification of welcoming once more the Association to this scene of its early meetings.

This appears a fitting occasion for a concise review of the leading principles and prominent labours of the body.

Scientific Societies, as usually constituted, receive and publish papers which are offered to them by individuals, but do not profess to suggest subjects for them, or to direct modes of investigation, except in some cases by offering prizes for the best Essay in some given branch.

This Association, on the contrary, is not intended to receive and record individual originality. Its motto is, SUGGESTION AND COOPERATION, and its purpose is thus to advance science by cooperation, in determinate lines of direction laid down by suggestion.

To give form and authority to this principle, the admirable conception of suggestive Reports was in the first place developed; a collection that should constitute a general survey of the Sciences as they stood at the foundation of the Association, each branch reported by some member who had already shown his devotion to the cultivation of it by his own contribution to its advancement, and each Report passing in review its appointed subject, not for the purpose of teaching it, but of drawing forth the obscure and weak places of our knowledge of it, and thus to lay down the determinate lines of direction for new experimental or mathematical researches, which it was the object of the Association to obtain.

The requests for these Reports were zealously responded to, and so rapidly that at the second Meeting ten were received, and at the third eight others. In this manner in five or six years the cycle of the Sciences was well nigh exhausted; but the series of such Reports has been maintained in succeeding years, even to the present time, by the necessity of supplemental Reports, to point out not merely the advances of each science already treated, but the new lines of direction for inquiry that develope themselves at every step in advance.

The Reports thus described were entitled "On the progress and desiderata of the respective branch of Science," or "On the state of our knowledge respecting such Science," and must be considered as merely preparations for the great work for which the Association was formed. They constitute the suggestive part of the scheme: the cooperative mechanism by which each new line of research recommended in the Reports was to be explored, was energetically set in motion by the annual appointment of Committees or individuals to whom these especial investigations were respectively assigned, with adequate sums at their disposal.

These Committees were requested to report their labours from year to year, and thus a second set of documents have been produced, entitled "Reports of Researches undertaken at the request of the Association," which are entirely distinct from the "suggestive Reports," but immediately derived from them, and complementary to them.

Such is a concise view of the system at first laid down by the wisdom of our founders, and which, with some modifications, has produced the inestimable contents of our printed volumes. In practice the "suggestive Report" is often a paper contributed by some able investigator to some meeting of the Association, which produces a request from the body that he will pursue his researches with their sanction and assistance, and write a Report complementary to his own suggestions.

Again, although we did not profess to receive and publish individual researches, the number of these received at each meeting is very great; the merit of some of them so eminent, that they are authorized to be printed entire amongst the Reports; and the Notices and Abstracts of the remainder, which at first occupied a small proportional part of each volume, now occupy nearly half of it.

I will now direct your attention to the principal objects to which our funds have been directed.

To appreciate the value of an investigation by the money it costs, may appear at first sight a most unworthy test, although it be a thoroughly British view of the subject.

But there are undoubtedly a great number of most important inquiries in science that are arrested, not for want of men of zeal and ability to carry them out, but because from their nature they require an outlay of money beyond the reach of the labourers who ardently desire to give their time and thoughts to them, and because the necessity and value of the proposed investigation are wholly unappreciable by that portion of society who hold the purse-strings.

But it is in the cases above alluded to of expensive investigation that the direct use and service of our body has been made the most manifest. The British Association holds its own purse-strings, and can also perfectly understand when they should be relaxed. Nay, more, by its influence and character, established by the disinterested labours and successful exertions of more than thirty years, it may be said to command the national funds; for the objects in aid of which Government assistance has been requested, have been so judiciously chosen, that such applications have very rarely been unsuccessful, but have been, on the contrary, most cordially acceded to.

Indeed it may be observed, that from the period of the foundation of the Association the Government of this country has been extending its patronage of Science and the Arts. We may agree with the assertion of our founder, Sir David Brewster, in supposing that this change was mainly effected by the interference of this Association and by the writings and personal exertions of its members.

For the above reasons it appears to me that by a concise review of the principal objects to which the funds of our body have been applied, and of those which its influence with the Government has forwarded, we obtain a measure of the most important services of the British Association.

But in considering the investigations carried out by committees or individual members by the help of the funds of the Association, it must always be remembered that their labours, their time and thoughts, are all given gratuitously.

One of the most valuable gifts to Science that has proceeded from our Association is the series of its printed Reports, now extended to thirty volumes. Yet these must not be supposed to contain the complete record even of the labours undertaken at the request and at the expense of the body. Many of these have been printed in the volumes of other societies, or in a separate form. Several, unhappily, remain in manuscript, excluded from the public by the great expense of publication.

I am the more induced to direct attention to this great work at present because I hold in my hand the first printed sheets of a general Index to the series from 1831 to 1860, by which the titles and authors of the innumerable Memoirs upon every possible scientific subject, which are so profusely but promiscuously scattered through its eighteen thousand pages, are reduced to order, and reference to them rendered easy. This assistance is the more necessary because so many investigations have been continued with intermissions through many years, and the labour of tracing any given one of them from its origin to its termination through the series of volumes is extremely perplexing.

For this invaluable key to the recorded labours of the Association we are indebted to Professor Phillips, and the prospect of its speedy publication may be hailed as a great subject of congratulation to every member of our body.

In every annual volume there is a table of the sums which have been paid from the beginning on account of grants for scientific purposes. The amount of these sums has now reached £20,000; and an analysis of the objects to which this expenditure is directed will show that if we divide this into eighteen parts, it will appear, speaking roughly, that the Section of Mathematics and Physics has received twelve of these parts, namely two-thirds of the whole sum, the Sections of Geology and Mechanical Science two parts each, while one part has been given to the Section of Botany and Zoology, and one divided among the Sections of Chemistry, Geography, and Statistics.

The greater share assigned to the first Section is sufficiently accounted for by the number and nature of the subjects included in it, which require innumerable and expensive instruments of research, observatories, and expeditions to all parts of the globe.

If we examine the principal subjects of expenditure, we find, in the first place, that more than £1800 was expended upon the three Catalogues of Stars, namely, the noble Star Catalogue, which bears the name of the British Association, commenced in 1837, and completed in eight years, and the Star Catalogues from the observations of Lalande and Lacaille, commenced in 1835 and 1838, and reduced at the expense of the British Association, but printed at the expense of Her Majesty's Government. £150 was applied principally to the determination of the Constant of Lunar Nutation, under the direction of Dr. Robinson, in 1857, and to several other minor Astronomical objects.

At the very first Meeting at York, the perfection of Tide Tables, Hourly Meteorological Observations, the Temperature of the atmosphere at increasing heights, of Springs at different depths, and observations on the Intensity of Terrestrial Magnetism, were suggested as objects to which the nascent organization of the Association might be directed.

Its steady perseverance, increasing power and influence as successive years rolled on, is marked by the gradual carrying out of these observations, so as to embrace nearly the whole surface of the globe.

Thus, under the direction of Dr. Whewell, a laborious system of observations, obtained by the influence and reduced at the expense of the Association, who aided this work with a sum of about £1300, has determined the course of the Tide-wave in regard to the coasts of Europe, of the Atlantic coast of the United States, of New Zealand, and of the east coast of Australia. Much additional information has been since collected by the Admiralty through various surveying expeditions; but it appears that much is still wanting to complete our knowledge of the subject, which can only be obtained by a vessel specially employed for the purpose.

More than £2000 have been allotted to Meteorology and Magnetism, for the construction of instruments, and the carrying out of series of observations

and surveys in connexion with them. To this must be added a sum of between £5000 and £6000 for the maintenance of Kew Observatory, of which more anon. The advance made in these important sciences, through the labours of the Committees of the British Association, may be counted among the principal benefits it has conferred.

To the British Association is due, and to the suggestion of General Sabine, the first survey ever made for the express purpose of determining the positions and values of the three Isomagnetic Lines corresponding to a particular epoch over the whole face of a country or state.

This was the Magnetic Survey of the British Islands, executed from 1834 to 1838, by a Committee of its members, General Sabine, Prof. Phillips, Sir J. Ross, Mr. Fox, and Mr. Lloyd, acting upon a suggestion brought before the Cambridge Meeting in 1833. It was published partly in the volume for 1838, and partly in the Philosophical Transactions for 1849. This was followed by a recommendation from the Association to Her Majesty's Government, for the equipment of a naval expedition to make a magnetic survey in the southern portions of the Atlantic and Pacific Oceans. This recommendation, concurred in by the Royal Society, gave rise to the voyage of Sir James Clark Ross in the years 1839 to 1843. In a similar manner was suggested and promoted the magnetic survey of the British possessions in North America, authorized by the Treasury in 1841; the completion of the magnetic survey of Sir James Ross, by Lieutenant Moore and Lieutenant Clark in 1845, in a vessel hired by the Admiralty; the magnetic survey of the Indian Seas, by Captain Elliot, in 1849, at the expense of the Directors of the East India Company; and the magnetic survey of British India, commenced by Captain Elliot in 1852, and completed between 1855 and 1858 by Messrs. Schlagintweit. Finally, in 1857 the British Association requested the same gentlemen who had made the survey of the British Islands in 1837, to repeat it, with a view to the investigation of the secular changes of the magnetic lines. This has been accomplished, and its results are printed in the new volume for 1861*.

The Association also, aided by the Royal Society, effected the organization in 1840 of the system of simultaneous Magnetical and Meteorological Observatories, established as well by our own Government as by the principal foreign Governments at different points of the earth's surface, which have proved so eminently successful, and have produced results fully equalling in importance and value, as real accessions to our knowledge, any anticipations that could have been formed at the commencement of the inquiry†.

General Sabine, whose labours have so largely contributed to these investigations, has given to the University an admirable exposition of the results during the present year, in the capacity of Sir Robert Rede's Lecturer.

In 1854, in consequence of representations originating with the British Association, our Government created a special department, in connexion with the Board of Trade, under Admiral FitzRoy, for obtaining Hydrographical and Meteorological observations at sea, after the manner of those which had been for some years before collected by the American Government at the instance and under the direction of Lieut. Maury.

Observations on the wind have been carried on by means of the various self-registering Anemometers of Dr. Whewell, Mr. Osler, Dr. Robinson, and Mr. Beckley, which instruments have been improved, tested, and thoroughly brought into practice by the fostering care of our body; and by the aid of its funds, experiments have been made on the subterranean temperature of deep mines; and on the temperature and other properties of the Atmosphere

* *Vide* volume for 1859, p. xxxvii. † Report, 1858, p. 298.

at great heights by means of Balloon Ascents. Four of these were made in 1852, in which heights between nineteen and twenty thousand feet were reached. But in the present year Mr. Glaisher has attained an altitude of nearly thirty thousand feet. We may hope that some account of this daring achievement, and its results to science, may be laid before the Association at its present Meeting.

Earthquake shocks were registered in Scotland by a Committee of the Association, from 1841 to 1844; and Mr. Mallet commenced, in 1847, a most valuable series of Reports on the Facts and Theory of Earthquake Phenomena from the earliest records to our own time, which have graced our volumes even to the one last published.

One of the most remarkable and fruitful events in our history, in relation to Physical observations, is the grant by Her Majesty, in 1842, of the Observatory erected at Kew by King George the Third, which had been long standing useless. It gave to the Society a fixed position, a depository for instruments, papers, and other property, when not employed in scientific inquiry, and a place where Members of the Association might prosecute various researches. This establishment has been, during the twenty years of its existence, gradually moulded into its present condition of a most valuable and unique establishment for the advancement of the Physical Sciences.

After the first few years its existence was seriously perilled, for in 1845 the expediency of discontinuing this Observatory began to be entertained; but upon examination, it then appeared that the services to science already rendered by this establishment, and the facilities it afforded to Members of the Association for their inquiries, were so great as to make it most desirable to maintain it. Again, in 1848, the burthen of continuing this Observatory in a creditable state of efficiency pressed so heavily upon the funds of the Association, then in a declining state, that the Council actually recommended its discontinuance from the earliest practical period. This resolution was happily arrested.

In 1850 the Kew Committee reported that the Observatory had given to science self-recording instruments for electrical, magnetical, and meteorological phenomena, already of great value, and certainly capable of great further improvement; and that if merely maintained as an *Experimental Observatory*, devoted to open out new physical inquiries and to make trial of new modes of research, but only in a few selected cases to preserve continuous records of passing phenomena, a moderate annual grant from the funds of the Association would be sufficient for this most valuable establishment for the advancement of the Physical Sciences.

In this year it fortunately happened that Lord J. Russell granted to the Royal Society the annual sum of £1000 for promoting scientific objects, out of which the Society allotted £100 for new instruments to be tried at Kew, —the first of a series of liberal grants which have not only very greatly contributed to the increasing efficiency of the establishment, but have ensured its continuance. It now contains a workshop fitted with complete tools, and a lathe and planing machine, &c. by which apparatus can be constructed and repaired, and a dividing engine for graduating standard thermometers, all presented by the Royal Society. The work done, besides the maintenance of a complete set of self-recording magnetographs, established in 1857, at the expense of £250, by the Royal Society, consists in the construction and verification of new apparatus and in the verification of magnetic, meteorological and other instruments, sent for that purpose by the makers. For example, all the barometers, thermometers, and hydrometers required by the

Board of Trade and Admiralty are tested, standard thermometers are graduated, magnetic instruments are constructed, and their constants determined for foreign and colonial observatories, and sextants are also verified.

An example of its peculiar functions is given in the very last Report (1861), where it appears that an instrument contrived by Professor William Thomson, of Glasgow, for the photographic registration of the electric state of the atmosphere, has been constructed by Mr. Beckley in the workshop of this Observatory, with mechanical arrangements devised by himself, and that it has been in constant and successful operation for some time. Those who have experienced the difficulty of procuring the actual construction of apparatus of this kind devised by themselves, and the still greater difficulty of conveniently carrying out the improvements and alterations required to perfect it when brought into use, will agree that the scientific importance and utility of an establishment cannot be overrated, in which under one roof are assembled highly skilled persons not only capable of making and setting to work all kinds of instruments for philosophical research, but also of gradually altering and improving them, as experience may dictate.

The creation of this peculiar Observatory must be regarded as one of the triumphs of the British Association.

As far as the Association is concerned, its maintenance has absorbed between five and six thousand pounds, the annual sum allotted to it from our funds having for each of the last six years reached the amount of £500.

The construction of the Photoheliograph may be also quoted as an example of the facilities given by this establishment for the developing and perfecting of new instruments of observation.

A suggestion of Sir John Herschel in 1854, that daily photographs of the sun should be made, has given birth to this remarkable instrument, which at first bore the name of the Solar Photographic Telescope, but is now known as the Kew Photoheliograph. It was first constructed under the direction of Mr. De la Rue by Mr. Ross. The British Association aided in carrying out this work by assigning the dome of the Kew Observatory to the instrument, and by its completion in 1857 in their workshops by Mr. Beckley the assistant; but the expense of its construction was supplied by Mr. Oliveira, amounting to £180. This instrument was conveyed to Spain under the care of Mr. De la Rue on occasion of the eclipse in 1860, who most successfully accomplished the proposed object by its means, and it was replaced at Kew on his return. But to carry on the daily observations for which it was constructed requires the maintenance of an assistant, for which the funds of the Association are inadequate, although it has already supplied more than £200 for that purpose. Mr. De la Rue, in consequence of the presence of the Heliograph at Kew being found to interfere with the ordinary work of the establishment, has kindly and generously consented to take charge for the present of the instrument and of the observations, at his own Observatory, where celestial photography is carried on. But it is obvious that the continuation of these observations for a series of years, which is necessary for obtaining the desired results, cannot be hoped for unless funds are provided.

I cannot conclude this sketch of the objects in the Physical Section to which the funds of the Association have been principally devoted, without alluding to Mr. Scott Russell's valuable experimental investigations on the motion and nature of waves, aided by £274.

If we now turn to Geology we find £2600 expended, of which £1500 were employed in the completion of the Fossil Ichthyology of Agassiz, and upon

Owen's Reports on Fossil Mammalia and Reptiles, with some other researches on Fossils.

The remainder was principally devoted to the surveys and measurement, in 1838, of a level line for the purpose of determining the permanence of the relative level of sea and land, and the mean level of the Ocean; and to the procuring of drawings of the geological sections exposed in railroad operations before they are covered up—a work which was carried on from 1840 to 1844, when the drawings were deposited in the Museum of Practical Geology, and the further continuance of it handed over to the geological surveyors of that establishment.

£2300 have been devoted to the carrying out of various important experimental investigations in relation to the Section of Mechanical Science.

Of this sum £900 were paid between 1840 and 1844, in aid of a most important and valuable series of experiments on the Forms of Vessels, principally conducted by Mr. Scott Russell, in connexion with the experiments on Waves. This investigation was ready for press in 1844, but it is greatly to be regretted that the great expense of printing and engraving it has hitherto prevented its publication.

Nearly the same sum has given to us various interesting and instructive experiments and facts relating to steam-engines and steam-vessels, carried on by different Committees from 1838 to the present time; amongst which may be especially noted the application of the Dynamometric instruments of Morin, Poncelet, and Moseley, to ascertain the Duty of Steam-engines, from 1841 to 1844.

Experiments on the Strength of Materials, the relative strength of Hot and Cold Blast Iron, the effect of Temperature on their tensile strength, and on the effect of Concussion and Vibration on their internal constitution, carried on principally by our late President and by the late Mr. Eaton Hodgkinson, at different intervals from 1838 to 1856, have been aided by grants amounting to £400.

The remainder of the sum above mentioned was principally devoted to the experimental determination of the value of Railway Constants, by Dr. Lardner and a Committee in 1838 and 1841.

The Section of Botany, Zoology, and Physiology has absorbed about £1400, of which nearly £900 have been applied to Zoology, partly for the expense of Dredging Committees for obtaining specimens of Marine Zoology on our own coasts and in the Mediterranean and other localities—whose useful labours have been regularly reported from 1840 to 1861—but principally for zoological researches in different districts and countries.

In Botany may be remarked the labours of a Committee, consisting of Professors Daubeny and Henslow and others, formed in 1840, to make experiments on the preservation of Vegetative Powers in Seeds; who continued their work for sixteen successive years, reporting annually, and assisted by a sum of £100. The greatest age at which the seeds experimented upon was found to vegetate was about forty years.

Another Committee, with Mr. Hunt, was engaged during seven years, from 1841, in investigating the influence of coloured light on the germination of seeds and growth of plants.

These are specimens of the admirable effect of the organization of our Association in stimulating and assisting with the funds the labours of investigators in new branches of experimental inquiry.

It would occupy too much time to particularize a variety of interesting researches in the remaining sections of Chemistry and in the sections of

Statistics, Geography, and Ethnology, to which small sums have been assigned.

The newly issued Report of our Manchester Meeting is admirably calculated to maintain the reputation of the Association. Besides a number of excellent Reports which are the continuation of researches already published in our volumes, it contains elaborate and important Reports by Mr. Stewart on the Theory of Exchanges in Heat; by Dr. Smith and Mr. Milner on Prison Diet and Discipline; by Drs. Schunck, Angus Smith, and Roscoe on the progress of Manufacturing Chemistry in South Lancashire; Mr. Hunt on the Acclimatisation of Man; Dr. Sclater and M. Hochstetter on the Apteryx of New Zealand; Professor Phillips and Mr. Birt on the Physical Aspect of the Moon. Professor Owen contributes a most interesting paper on the Natives of the Andaman Islands. The President of the Royal Society reports the Repetition Magnetic Survey of England; and Mr. Fairbairn, our late President, reports on the Resistance of Iron-Plate Pressure and Impact.

The Transactions of the Sections occupy nearly as much space as the Reports, and are replete with valuable and original matter, which it would be impossible to particularize.

Many of my predecessors in their Addresses have alluded to the most striking advances that have been made in the various sciences since the last Meeting; I will mention a few of these in Astronomy, Chemistry, and Mechanics.

In Astronomy, M. Delaunay has communicated to the Academy of Sciences of Paris the results of his long series of calculations in the Lunar Theory, destined to fill two volumes of the Memoirs of the Academy. The first volume was published in 1861; the printing of the other is not yet begun. This theory gives the expressions for the three coordinates of the moon under an analytic form, and carries those for longitude and latitude to terms of the seventh order inclusive, that of Plana extending generally only to terms of the fifth order. The addition of two orders has required the calculation of 1259 new terms for the longitude, and 1086 new terms for the latitude. It was by having recourse to a new process of calculation, by which the work was broken up into parts, that M. Delaunay has been able to advance the calculation of the lunar inequalities far beyond the limits previously reached.

The Earl of Rosse has given to the Royal Society (in a paper read June 20, 1861) some further account of researches in Sidereal Astronomy carried on with a Newtonian telescope of six-feet clear aperture. These researches are prefaced by an account of the process by which the six-feet specula were made, a description of the mounting of the instrument, and some considerations relative to the optical power it is capable of. A selection from the observations of nebulæ is given in detail, illustrated by drawings, which convey an exact idea of the bizarrerie and astonishing variety of form exhibited by this class of cosmical bodies.

Argelander, the eminent director of the Observatory at Bonn, is carrying on with great vigour the publication of his Atlas of the Stars of the Northern Heavens within 92° of Polar Distance. A large portion of this enormous work is completed, and two volumes, containing the data from observation for the construction of the Charts, were recently published. These volumes contain the approximate places of 216,000 stars situated between the parallels of 2° south declination and 41° north declination.

Simultaneously with the construction of Star-charts, among which those of M. Chacornac of the Paris Observatory deserve particular mention, additions have been made to the number of the remarkable group of small planets

between the orbits of Mars and Jupiter, their discovery being facilitated by the use of charts. The last announced, which is No. 74 of the Series, was discovered on the morning of Sept. 1 of this year, by M. Luther of Bilk, near Düsseldorf, whose diligence has been rewarded by the discovery of a large number of others of the same group.

The present year has been signalized by the unexpected appearance of a comet of unusual brightness, which, although its tail was far from being as conspicuous as those of the comets of 1858 and 1861, exhibited about its nucleus phenomena of a distinct and remarkable character, the records of which may possibly at some future time aid in the discovery of the nature of that mysterious action by which the gaseous portion of these erratic bodies is so strangely affected.

On an application made by the Council of the Royal Astronomical Society, Government has granted £1000 for the establishment, during a limited period, under the superintendence of Captain Jacob, of an Observatory at a considerable altitude above the level of the sea, in the neighbourhood of Bombay. The interesting results of the ascent by Professor Piazzi Smyth a few years since of the Peak of Teneriffe, for the purpose of making astronomical and physical observations, suggested to the President and Council of the Society the desirableness of taking this step.

In Chemistry, the greatest advance which has been made during the past year is probably the formation of compounds of Carbon and Hydrogen by the direct union of those elements. M. Berthelot has succeeded in producing some of the simpler compounds of carbon and hydrogen by the action of carbon intensely heated by electricity or hydrogen gas; and from the simpler compounds thus formed he is able to produce, by a succession of steps, compounds more and more complex, until he bids fair to produce from inorganic sources all the compounds of carbon and hydrogen which have hitherto been only known as products of organic origin. Mr. Maxwell Simpson has also added to his former researches a step in the same direction, producing some organic products by a synthetical process. But these important researches will be fully laid before you in the lecture on Organic Chemistry which Dr. Odling has kindly promised for Monday evening next.

Dr. Hofmann has continued his indefatigable researches on Poly-ammonias, as well as on the colouring matters produced from coal-tar. M. Schlæsing proposes a mode of preparing chlorine by a continuous process, which may perhaps become important in a manufacturing point of view. In this process nitric acid is made to play the same kind of part that it does in the manufacture of sulphuric acid, the oxides of nitrogen acting together with oxides of manganese as carriers of oxygen from the atmosphere to the hydrochloric acid.

The methods of dialysis announced last year by the Master of the Mint, and of spectrum analysis are now in everybody's hands, and have already produced many interesting results.

In Civil or Mechanical Engineering there is nothing very new.

The remarkable series of experiments carried on at Shoeburyness and elsewhere have developed many most interesting facts and laws in relation to the properties of iron, and its resistance to projectiles at high velocities, which will doubtless be fully laid before you at some future period; but in the present imperfect state of the investigation, and in consideration of the purpose of that investigation, prudential reasons forbid the complete publication of the facts. My able predecessor in this Chair, who has taken so prominent a part in these experiments, has given an account of some of the

results in a communication to the Royal Institution in May last, and also in the new volume for 1861; and is, as he informs me, engaged with a long series of experiments on this subject, which, with his experience and ability, cannot fail to develope new facts, and will, in all probability, ultimately determine the law of penetration.

In London we may direct attention to the commencement of the Thames Embankment and to the various works in progress for the concentration of the Metropolitan Railways; especially to the proximate completion of the Underground Railway. The lamentable disaster in the Fens of last summer has been most ably subdued, but the remedial measures adopted are not fully completed, and the interests involved are of so great a magnitude and complexity, that it is scarcely possible for this event to be discussed on the present occasion with due impartiality.

The magnificent collection of machinery in the Great Exhibition shows a great advance in construction; but this is not the proper occasion to enter in detail into the various contrivances and processes which it displays.

Before I conclude I have the painful duty of reminding you that since our last meeting we have had to deplore the loss of that most illustrious patron of science and art, His Royal Highness the Prince Consort, the President of our Association at Aberdeen and the Chancellor of this University. In the latter capacity he afforded us many opportunities of observing his scientific attainments and genuine zeal and love for all branches of knowledge: his gracious kindness and respect to men of science and literature have left an impression upon us that can never be effaced.

I must also ask a tribute to the memory of our late Professors of Chemistry and Botany, both of whom have done in their lifetime excellent good service to science, and especially to the British Association; Professor Cumming by contributing one of the invaluable primary Reports upon which our proceedings were based, as well as other communications; Professor Henslow by various Reports, some of which I have already alluded to. We have had also to lament the loss of that able scientific navigator, Sir J. Clark Ross.

It remains for me to express my sense of the high and undeserved honour conferred upon me by the position in which you have placed me, and in the name of the University to welcome you hither, and wish you a prosperous and fruitful meeting, alike conducive to the progress of science and impulsive to its cultivation in the place of your reception.

REPORT

OF THE

THIRTY-SECOND MEETING

OF THE

BRITISH ASSOCIATION

FOR THE

ADVANCEMENT OF SCIENCE;

HELD AT CAMBRIDGE IN OCTOBER 1862.

LONDON:
JOHN MURRAY, ALBEMARLE STREET.
1863.