particular its universities. It would have been better if these strictures, now forgotten, had not been adverted to, especially with reference to the Association. The truth is, they formed the chief difficulty in carrying such a proposal as had been made into effect. It was clear that any attempt at scientific association not headed or joined by many persons who could not but feel aggrieved by the strictures referred to, and who have been since among the chief lights of the institution, would probably have led to results more mischievous than beneficial to science.

"As soon as Dr. Brewster's proposal was made, and before it could be acceded to, I thought it needful to enter into correspondence with numerous individuals thus situated, and finding that, agreeing for the most part in the opinion that such *réunions* would operate for the benefit of science, they lost sight of all personal feelings, and consented to co-operate on certain conditions, I proceeded to draw up the scheme which was ultimately followed.

"It is a mistake to consider this Association as having been formed on any foreign model. My conception of the manner in which a great scientific combination might be effectually worked in England was founded on different principles. No one could be insensible of the advantage to be derived from bringing men of science together to confer and discuss; but even this point I considered it impossible to gain without extending our views considerably further. I did not believe that the great labourers in science would undergo the inconvenience and interruption of travelling to various places to meet one another, as a continuous system, on mere invitation, and for the sole purpose of discussion, and I knew that if such men should absent themselves from the meetings, those meetings would become no better than *foci* of *sciolism* and vanity.

"I therefore proposed to found the Association on the principle of *acquiring funds* to be devoted to the expenses of unremunerative objects of science, of levying such funds from the multitudes of persons who might be expected to feel interested in scientific discussions at populous places, and giving the appropriation of them first to the selection of committee-men attached to the various sections of science, and secondly to the final determination of the whole body of actual scientific labourers at the meeting assembled in general committee.

"To this principle in the constitution of the British Association its success has been mainly due. To this principle we owed, for instance, the unintermitting attendance, to the time of his lamented death, of one of its ablest members, Mr. Baily, under whose direction one of the largest applications of its funds was made.

"These grants of assistance, conjoined with requests to individuals to execute particular tasks for the interests of science, have given the exertions of the Association as a body a direct utility peculiarly its own, tending far beyond the promiscuous discussions of the sections both to advance material objects and to maintain the attendance at its meetings of persons pursuing such objects.

"The wealth, the public spirit, the intelligence, the curiosity, of the great cities of the United Kingdom, offered great encouragement to the financial part of this plan, which by its adoption has enabled the Association to carry out its entire objects not only in regard to liberal grants for scientific objects and in defraying all expenses incidental to its operations and essential to its permanence, but even in maintaining an establishment of its own for experimental research.

"This plan, proposed by me at York, was adopted in all its detail, and my acceptance of the office of general secretary enabled me, with able and zealous co-operation, to work a machine of great magnitude and complexity with a success surpassing my expectations from 1831 to 1837, during which years I was charged with its chief management, and revised all that was printed in its name.

"The cordial reception of the first meeting of the British Association by the city of York, the hospitality of Bishopthorpe, the countenance of the Royal President of the Royal Society, the presence of Lord Fitzwilliam, the aid of Prof. Phillips, the attendance of the distinguished philosopher Brewster, with Brisbane, Robison, Forbes, and Johnston, the attendance from London of Murchison, from Dublin of Provost Lloyd, from Oxford of Daubeny, from Manchester of Dalton, the concurrence of Buckland and Whewell and Conybeare, and many others of known repute, these incidents helped to launch the vessel; of the early history of which, if any one would write accurately of that part of its history, he may record that Brewster first proposed that a craft should be built wherein the united crew of British science might sail, and manfully embarked in it all his high scientific reputation; but for myself I must be allowed to claim that I manned the ship, that I constructed her charts, and piloted the vessel for six years. The labour which I bestowed on this service has since been divided among more capable hands; but none of us could have worked the vessel at all without the constant and invaluable helping hand of the assistant-secretary, Prof. Phillips.

"I am induced to put down on paper and transmit to you, as actual President of the Association, a statement of the real facts, without the least intention, however, of involving either you or any one else in controversy on the subject."

THE INTERNATIONAL EXHIBITION AND CONGRESS OF ELECTRICITY AT PARIS

THE Exhibition must be pronounced a great success. Even those who are well read in electricity are taken by surprise at the display of power presented; and the first favourable impression is strengthened as further examination discloses the immense variety of applications exhibited and the beauty of much of the machinery.

The first thing seen on approaching the Exhibition from the city is the Siemens electrical railway. It is about a quarter of a mile long, with a sharp turn at one place. The carriage is a good-sized tramcar, and presents no special feature to a casual observer, except two wires which travel with it, and connect it by running contacts with two aërial guides suspended on posts like telegraph posts. The prime mover is a steam-engine near the centre of the Exhibition, which drives a dynamo-electric machine. The continuous current which the latter furnishes is led to the aërial guides, and is conducted by the two travelling wires to an electro-magnetic engine beneath the floor of the carriage which drives the wheels. Passengers are conveyed by this tramcar at a small charge between an outdoor station and a station just within the Exhibition.

On entering the building by this tramway one of the most prominent features is the collection of powerful engines which occupies the whole of the space under one of the side galleries. They are for the most part dynamo-machines driven by steam-engines. The dynamos are close to us as we walk down the main passage on this side; the steam-engines, which drive them by belts, are a little further back; the furnaces and boilers are close to the outer wall. Wires are led from the dynamos to electric lamps, some of them close at hand, and others on the opposite side of the building, or overhead.

Every variety of electric lamp is of course to be seen, and their regulators furnish a very interesting study. To illustrate their diversity we may mention that in the Brush system the regulation depends on the variation of resistance in a series of carbon plates as they are more or less strongly pressed together; in the Crompton it depends on the frictional support of a vertical metallic rod by two pieces which pinch it between them, and pinch it more or less strongly according to the strength of the current; while in the Pilsen lamp a spindle-shaped piece of iron is the common core of two electromagnets one above the other, and is drawn up or down as the contact in one or the other prevails. Then again there are the Serrin and other well-known forms of lamp, in which the carbons are caused to approach by means of clockwork, which is regulated by the strength of the current. There is the Jablochkoff candle, in which the two carbons are parallel and separated by plaster of Paris; the Jamin, which is something like the Jablochkoff, with the plaster of Paris removed, and only air between the carbon pencils; the Werdermann, in which a carbon point below bears against a flat block of carbon above (the point being the positive, and the block the negative terminal); the Joel, in which a carbon point below bears against a disk of copper

above; and the Soleil, in which the point of contact between the carbon point and the copper is surrounded by chalk or lime, which is rendered incandescent.

Then there are the "incandescent lamps," specially so called, in which a thread of carbon a few inches long is inclosed in a vacuous space where, as there is no oxygen, there will be no combustion, and the carbon does not waste. Swan's light, which is of this class, occupies a very conspicuous place in the Exhibition, and is used for the illumination of the Salle des Séances, in which the meetings of the Congress are held. Edison's two rooms are nightly thronged by visitors, who come to see not only his lights, but his numerous other inventions, which are here exhibited. Lane-Fox's light and Maxim's (which has been stopped by some accident) belong to the same class. No opal or ground glass is necessary with incandescent lights, as they are less dazzling than arc lights. They certainly give very beautiful illumination to a room, and their convenience for lecture-room purposes was well seen on the occasion of an illustrated lecture given by M. Mercadier in the Salle des Séances at the meeting of the Society of Telegraph Engineers on Thursday last. They can be extinguished in a moment and re-lighted in a moment.

The Exhibition is open in the daytime from 10 till 6, and in the evening from 8 till 11. The largest attendance is in the evening, when the lights are in full action. Besides those inside, which make the interior almost like daylight, there are two very powerful lights above the roof, which are furnished with reflectors, and throw beams of light like comets' tails in various directions.

The Congress commenced its sittings on the 15th inst., when an opening address was delivered by M. Cochéry, the official president, and the hours of meeting and other details of organisation were arranged. The foreign members were called upon to elect three vice-presidents to join the three French vice-presidents (all official) who had already been named. After a brief conference Sir William Thomson, Prof. Helmholtz, and Prof. Govi of Naples were proposed and unanimously elected. It was agreed to divide the Congress into three sections, devoted respectively to theoretical electricity, telegraphy with telephony, and miscellaneous applications of electricity, including the electric light; the first section meeting at 9.30 a.m., the second at 2, and the third at 4 p.m. Each section has sat for about two hours daily, an interval of two hours between the first and second being allowed for *déjeuner*.

M. Dumas was elected president of the first section, with Prof. Kirchhoff and Dr. De La Rue as vice-presidents, Prof. Mascart and M. Gérard being secretaries. The discussion of the subject of international electrical units, the choice of which is regarded as the most important work of the Congress, was then begun, and occupied the rest of the sitting. Sir William Thomson introduced the question in a very lucid speech, in which he described the course which had been taken by the British Association, and recommended a substantial adoption of the British Association system. He was followed by Professors Wiedemann and Helmholtz, who favoured the adoption of a mercurial unit of resistance; and a large committee, containing men of both views, was appointed to draw up a Report. This Report was anxiously awaited, and was presented on the 19th inst. It consisted of the following seven recommendations, which had received the unanimous consent of the Committee, and have now been formally adopted by the Congress.

1. The fundamental units for electrical measurements to be the centimetre gramme and second (C.G.S.).

2. The practical units ohm and volt to retain their present definitions, 10^9 for the ohm and 10^8 for the volt.

3. The unit of resistance (ohm) to be represented by a column of mercury of a square millimetre section, at the temperature zero Centigrade.

4. An international commission, to be charged with the duty of determining by new experiments, for practical purposes, the length of the column of mercury, of a square millimetre section, at zero Centigrade, which represents the value of the ohm.

5. The name Ampère to be given to the current produced by a volt in an ohm.

6. The name Coulomb to be given to the quantity of electricity defined by the condition that an Ampere gives one Coulomb per second.

7. The name Farad to be given to the capacity defined by the condition that a coulomb in a farad gives a volt.

It will be observed that the "weber," a unit familiar to British electricians, is not mentioned in these resolutions. The reason, as stated by Prof. Helmholtz to the Congress, is that Weber himself employs a unit of current derived from the millimetre, milligramme, and second, and this unit, which is one-hundredth of the C.G.S. unit, or one-tenth of the weber, as commonly understood by British electricians, is known as "the weber" in Germany.

The reason for adopting a mercurial standard defined by size was explained by Sir William Thomson to be the desire to guard as much as possible against secular change.

It transpired in the discussions which took place in committee that mercurial standards, as actually constructed, are glass tubes which must be refilled with mercury every time they are to be used. The external communications are made by means of platinum wires attached to plates of the same metal, the latter being well amalgamated before use. It is obvious that these operations involve much more labour and risk of error than comparison with a standard coil; and we therefore do not anticipate that recourse will be had to the mercurial standard except on rare occasions. Coils will as heretofore continue to be used for all ordinary measurements of resistance. The international committee which is to make the new determination will be nominated by the governments of the various countries concerned, and independent determinations will doubtless be made by different members of the committee in different laboratories. It will thus be seen what amount of consistency is attainable in such measurements, and whether it is sufficient to render the standard practically accurate. The German authorities assert that accuracy to one part in two thousand can thus be ensured.

THE CAUSE OF COLLIERY EXPLOSIONS

ONE of the most instructive documents ever penned on the subject of the cause of explosions in collieries has recently appeared, in a lately-issued Blue-book, in the form of a Report to the Home Secretary by Prof. Abel, C.B., F.R.S., of Woolwich, who, at the request of the Home Department, conducted a series of experimental researches upon the cause of the terrible disaster at the Seaham Colliery on September 8, 1880. In 1845 Faraday and Lyell first directed attention to the influence exerted by the presence of *coal-dust* in mines upon the magnitude of an explosion of fire-damp. In 1867 and 1875, the subject was further advanced in France by Messieurs Verpilleux and Vital, the latter of whom showed that air charged with fine coal-dust, rich in inflammable material, may explode when there is present a much smaller proportion of true fire-damp than is of itself sufficient to constitute the atmosphere an explosive one. Still more recently Mr. W. Galloway has conducted a valuable series of investigations and experiments, the results of which have been communicated to the Royal Society in three very important memoirs. In the first of these he showed that a certain mixture of air and coal-dust, not itself inflammable, became so when there was also present a much smaller proportion of fire-damp than any Davy lamp could detect. In the second he showed