

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 resistance 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

that the return-air from the ventilating shaft of a mine may actually contain enough fire-damp to become inflammable when coal-dust is diffused into it. In the third he concludes that the influence of the coal-dust must not be considered as merely aggravating and increasing the explosion originating with the presence of fire-damp, but that the presence of the dust must be regarded as the one thing which, if a small explosion takes place anywhere, will accumulate and carry forward the force of the explosion with ever-increasing energy into every empty space in the workings, however ramified.

During the current year, experiments have also been made on the subject; at Harton Colliery (Durham) by Mr. Wood and Prof. Marreco, at Broad Oaks Iron-works by the Chesterfield Committee of Engineers, at Garswood Hall Colliery (Wigan), by Mr. Smethurst and the Royal Commission on Accidents in Mines, and lastly at Woolwich by Prof. Abel. The general character of the experiments has been on a plan originally devised by Mr. Galloway: viz. to expose to a flame, or to the flash of a small cannon, a stream of air in a miniature gallery into which any desired percentage of coal-gas or fire-damp was introduced, and into which coal-dust could be diffused by a hopper; arrangements also being made to raise the temperature of the gases, and to increase their velocity at will. The majority of the experimenters believe that in no case does a mixture of air and coal-dust *without fire-damp* explode, although the Chesterfield Committee think they have evidence that flame will travel in dust-laden air without a trace of fire-damp being present. This matter is of great importance, for it has been shown that in flour-mills explosions which have occurred may be traced to the presence of combustible dust in the air.

Prof. Abel had placed in his care thirteen samples of dust, some burnt, others unburnt—collected from different parts of the Seaham mine; which samples were subjected to careful examination in the microscope, and to chemical analysis. They were found to contain from 64.83 to 99.75 per cent. of pure coal-dust, some of them containing ash, grit, and fine sand in various proportions. They were then tested as to their power to aid in producing explosions in an experimental gallery. The gas employed was an explosive pit-gas, of such a quality that a mixture containing only 3.5 per cent. of the gas with air when travelling with a moderate velocity (from 200 to 1000 feet per minute) was ignited by the flame of a naked Davy lamp. In perfectly still air from 4 to 4.5 per cent. of the same gas was necessary to produce the same result. Currents of mixtures of this gas were conveyed into the experimental gallery at a velocity of 600 feet per minute, and at a temperature of 80° F.; a naked Davy lamp, its flame protected from the draught by a small screen, being placed in the gallery at about 12 feet from the place where the dust was supplied to the current. More and more fire-damp was gradually added until explosion took place; that dust being regarded as *most sensitive* which produced explosion with the least percentage of fire-damp. When the relative sensitiveness of the various samples of dust had thus been ascertained, it was found that, of the four which stood head of the list in point of sensitiveness, three headed the list also in point of richness in combustible matter and in point of fineness of texture. But the sample which stood third in point of sensitiveness was not only not the finest, but stood absolutely bottom of the list, in point of richness. It therefore appeared that porosity and mechanical condition are more important than combustibility of the dust in bringing about the ignition of a fully explosive gas. Prof. Abel was led, in consequence, to try whether the ignition of a mixture of air and fire-damp in a low percentage not inflammable of itself by contact with a lamp-flame could be brought about by the agency of a wholly incombustible dust. Accordingly dust such as calcined magnesia, pow-

dered chalk, and slate-dust was tried; and it was found that instantaneous explosion was thereby produced in currents of air containing only 3 to 3.5 per cent. of fire-damp. It appears then that *dust of any kind*, as a finely-divided solid, can operate in determining the explosion of an otherwise harmless mixture of gas and air; probably by furnishing, as the particles pass through the flame, successive red-hot nuclei, by which the heat is localised and rendered more intense.

In the special case of dust that is both fine and combustible, as coal-dust may be, it was proved that so small a proportion of fire-damp as 2 per cent. in moderate currents may determine the propagation of a flame by coal-dust. Now, as it is stated on the best authority that the most experienced eye cannot detect the presence of 2 per cent. of fire-damp by its effect on the flame of the ordinary Davy lamp; and as (in spite of all the host of little inventions to detect smaller percentages) the Davy lamp remains the only practical test of the presence or absence of fire-damp in fiery mines, it follows that, in every mine where there is any fire-damp *at all*, the mere dust of the mine constitutes an element of danger of which the risk is simply incalculable. When we add to this that experiments, made by firing such small blasts as eighty *grains* of gunpowder may represent, show that dust may cause the propagation of flame in air-currents containing percentages of fire-damp *far smaller than any* of those mentioned above, it is clear that whatever the risks with Davy lamps may be, they sink into insignificance beside the frightful dangers attending the firing of a shot for purposes of blasting. The practice of blasting the coal cannot be too emphatically condemned. It is at best a lazy and slovenly process of getting the coal, and considering the risks it entails, ought to be stringently and at once put down by legislation.

The practical moral is that, while the Davy lamp is to be regarded more than ever as a necessary of work in the pit, it cannot be regarded in any way as a safeguard of absolute kind against explosion; still less can it be regarded as an indicator of the presence or absence of impending danger, inasmuch as it is absolutely incompetent to detect such feeble percentages of gas as Prof. Abel has shown to be dangerous in the presence of the inevitable dust of the mine.

Science, which gave us the safety-lamp, must therefore be called upon once more to provide efficient substitutes. (1) A new lamp, electric or otherwise, must be devised, which shall be wholly independent of a supply of air from the galleries in which it is used; (2) an indicator must be invented to do what the Davy lamp fails to do, viz. to detect in the workings of the mine the presence of a proportion of fire-damp less than 2 per cent., and to indicate rapidly and accurately its amount. Let us hope that Prof. Abel will crown his labours by giving us such new instruments.

THE LANDSLIP AT ELM

THE Swiss papers contain valuable information as to the landslip which occurred on September 11 in the valley of the Sernft River, in the canton of Glarus. The month of September is notable in Switzerland for landslips. Thus the great landslip of the year 1618, which buried the whole of the town of Plurs in Graubünden, with its 2340 inhabitants, occurred on September 4; and the great downfall of the Rossberg Mountain, which destroyed the village of Goldau, with three other small villages, burying 111 houses and 457 persons, and filled up the Lake of Lowerz, occurred on September 2, 1807. The very heavy rains of the last few weeks have softened the rocks on the slopes of the Plattenberg Mountain, at the foot of which, at a height of 3330 feet, was situated the village of Elm, now almost completely destroyed by the landslip. The clay-slate quarries which were worked