Meteor Showers

The two principal showers of this week are the Taurids II., radiant R.A. 80°, Decl. 23° N., near ζ Tauri; and the Geminids, radiant near α Geminorum; the former should be specially looked for on December 6, the latter December 9–12. Fireballs have frequently been seen during the latter period. Another shower from Taurus, R.A. 56°, Decl. 6° N., near ν Tauri; and another from Gemini, R.A. 108°, Decl. 20° N., near ζ Geminorum, have also been sometimes observed during this week.

Objects with Remarkable Spectra

257 Schj.—R.A. 21h. 50m. 58s., Decl. 49° 57′·2 N. Mag. 9·1 Secchi's fourth type. The dark band in the yellow is abnormally broad.

19 Piscium.—R.A. 23h. 40m. 31s., Decl. 2° 51′·0 N. Mag. 6·2. One of the finest examples of the fourth type of spectrum.

Mr. Marth has called attention to the following conjunction of Saturn with DM. 22° 1383, which should be watched, as it may possibly prove to be an occultation:—

	h.			
Dec. 9 ...	16·4	* δ	with *p* edge of ring,	$y = -\ 8''\cdot0$
	18·4	* δ	with centre of Saturn,	$y = -\ 12''\cdot2$
	20·5	* δ	with *f* edge of ring,	$y = -\ 16''\cdot4$

The magnitude of the star is 8·7.

GEOGRAPHICAL NOTES

THE *Invalide Russe* publishes the following telegram from Col. Prjevalsky from Pishpek, but dated Karakol, 2nd (N.S. 14th) November:—"Our voyage has ended happily, and with the most encouraging scientific results."

AT the meeting of the Paris Geographical Society on the 20th ult., M. Alphonse Milne Edwards in the chair, the return of M. de Brazza was announced, as well as his promise to read a paper before the Society on his journeys in the Congo. The President also reported the return of M. Aubry from more than two years' exploration in Choa and part of the country of the Gallas, Danakils, and Somalis. During that time he determined the course of the Haouach River and its affluents, the Mongueur, Goudredet, and Ganjad, as well as the heights of various mountains. He was also able to make numerous observations on the geology, palæontology, and mineralogy of the region. M. Duveyrier stated that the altitude of Fez, which has never before been determined, is about to be calculated by M. Feraud, by the barometer, to within 10 metres. He has found it necessary to make no fewer than 127 observations in order to obtain this result. M. Coudreau referred to the latest stage of the dispute between France and Brazil with regard to the territory lying between French Guiana and Para.

THE *Bulletin* (1885, No. 5) of the Belgian Society of Geography contains a long paper by M. Leclercq on Mexico, which is really a translation and *résumé* of a recent Mexican publication. The present paper is arranged under the following heads:—Situation and boundaries, institutions, political divisions and population, ethnography, with an approximate census of the Indian tribes, industries, railways, and other methods of communication, orography, climate, and productions. It is thus, it will be perceived, a tolerably complete account of the Mexican States.

THE *Boletin* of the Geographical Society of Madrid for October (vol. xix. No. 4), is, as might be expected, mainly occupied with the Caroline Island question. The only map attached to the number is one of the Western Pacific from the Philippines on the west and New Guinea on the south, including the Pelew, Caroline, Marshall, Gilbert, and Ladrone or Marianne groups. The first contribution is a letter from the Society by its authorised officers to the Government on the question, and claiming the islands as belonging historically to Spain.

IT is stated that an accurate survey of the Island of Yezo, and the neighbouring islands (especially the Kuriles), is to be made by the Japanese Naval Department. It is anticipated that the work will occupy four years.

AN Exhibition of Appliances used in Geographical Education in England and on the Continent will be opened by the Royal Geographical Society at 53, Great Marlborough Street, on December 9, and will remain open till January 31.

THE latest numbers of the *Verhandlungen* of the Berlin Geographical Society (Band xii. Nos. 7 and 8) contain papers by Dr. Penck, on the mountain systems of Central Germany; and by Dr. Schulz, on a journey from Port Natal to the Kalahari, and especially the exploration of the Rivers Chobe and Cubango. Dr. Rath (in No. 8) contributes a geographico-geological study of the Pacific regions of North America, and the substance of a lecture by Dr. Buchner on the Cameroons is also given.

A CORRESPONDENT with General Scratchley in New Guinea reports that Mr. H. O. Forbes is going to attempt to reach the summit of Mount Owen Stanley, 13,205 feet high, and hitherto untrodden by the foot of man. Mr. Forbes will form a depôt camp at Sogeri, 25 miles inland, and survey, collect specimens, &c., in the neighbourhood of the lower ranges. Next spring, when the weather will be suitable, he will make the attempt to climb to the highest point. He may, the correspondent says, spend several years in New Guinea, for his wife is following him, and his heart is thoroughly in his work.

THE Swedish Society of Anthropology and Geography has commissioned Baron Schwerin, Professor of Geography at the University of Lund, to proceed on a scientific expedition to the Congo, the chief objects being to make geographical, meteorological, botanical, and zoological studies in the new State, and to collect ethnographical objects. Barons Nordenskjöld and Dickson have lent the Expedition a number of valuable instruments. The Swedish Government have requested Prof. Schwerin to report on the commercial opportunities afforded on the Congo and the position of Scandinavian subjects there.

EXPLOSIONS IN COAL MINES[1]

THE address to which the members of the Society of Arts were so good as to afford a favourable reception at the opening meeting of last Session, was in great measure devoted to topics suggested by the International Health Exhibition of that year. Wide as was the scope of that Exhibition, which dealt not only with the necessaries and comforts of life, and the promotion of bodily health in the feeding, clothing, and housing of all classes, but also with the all-important subjects of physical and mental training, the Exhibition of Inventions—which has just terminated a prosperous and, I believe, a very useful career—embraced a wealth of material for study which could bear comparison, as regards extent and interest, with that presented by any one of the great International Exhibitions of former years, the initiation of which we owe to that illustrious Prince whose memory the Society of Arts delights to honour.

I have resisted the temptation to devote this evening to a brief review of some of the chief matters of interest presented by the most prominent sections of the Exhibition, because I entertain a lively hope that a thorough examination of at any rate *many* of these will afford topics for important communications to this Society, and I consequently feel that it would be scarcely just to those who may consent to devote themselves to their preparation, were I to cull specially attractive matter from the mass of information opened up to the student by the achievements demonstrated at the Exhibition. I therefore propose to limit myself in this address to the treatment of some matters relating to only one branch of a division of the Exhibition, namely, the class which deals with machinery and appliances *used in mines*.

I venture to think that this class of subjects has claims to special interest, *because* the mining industry ranks among the most important sources of the wealth and cosmopolitan influence of the Empire; *because* its development and successful pursuit have involved the utilisation of the resources of many branches of applied science, and have taxed the talents and ingenuity of some of our greatest mechanics, and most accomplished physicists and chemists; and, though last, not least, *because* the pursuit entails the encountering of dangers and vicissitudes which will aptly bear comparison with those involved in the careers of the soldier and the sailor. Thrilling and harrowing accounts of great disasters in coal mines direct public attention from time to time to certain special dangers which the miner has to encounter, but the annual reports of H.M. Inspectors of Mines show that there are yet others to which miners in general are daily exposed, which, although they do not attract public attention (partly because of the very circumstance of their constant occurrence, and partly because the sufferers by them meet their deaths in most cases

[1] Address of Sir Frederick Abel, Chairman of Council of the Society of Arts, delivered at the opening meeting, Nov. 18, 1885.—(Abstract by the Author.)

singly), are nevertheless far more formidable in regard to the gross extent of the fatalities attending them, than are coal-mine explosions.

When the late Mr. MacDonald, M.P. for Stafford, made his remarkable speech in the House of Commons, in 1878, advocating the necessity for the more rigorous inspection of coal mines, and supported his arguments with the enumeration of an appalling list of disastrous colliery explosions, it was pointed out by Mr. Thomas Burt, and other members, that explosions did *not* constitute the chief element of danger which the miner had to encounter, and that, while out of 25,000 lives which had been lost in mines since 1851, over 6,000 deaths had been caused by explosions, there were more than 10,000 due to falls of stone and coal in the mine workings, which attracted little or no public attention. Mr. Cowen also pointed out that there was a still larger number of injuries, due to such causes as these, which were never heard of beyond the locality of the disasters, because they were not attended with fatal results at the time, although in the larger proportion of such cases the sufferers were either maimed for life, or died after more or less brief intervals. The Table below, which has been compiled from the annual reports of the Mine Inspectors for the past ten years, shows the total number of deaths annually due to accidents in mines, and the deaths due respectively to explosions, to the falls of roof or sides in mine workings, and to other miscellaneous causes; and it will be seen that even in those years when especially disastrous explosions had occured, the fatalities due to explosions were, with the exception of two years, considerably in the minority, compared with deaths from falls of roof and sides, while—comparing them with the deaths due to all other causes—the latter were invariably much in excess. It is not surprising, however, that the paralysing moral effect exercised upon small mining communities, and the heartrending local misery and suffering which suddenly and simultaneously fall upon many families, should cause coal-mine explosions to command special sympathy, and to call forth public expressions of regret and surprise that the resources of science and of legislative power should have failed utterly to prevent, or even very greatly diminish, such sad disasters, while, on the other hand, the daily occurrence of fatal accidents in the ordinary pursuit of the miner's vocation, attracts little public attention. It has been contended that the classes of constantly recurring accidents, which combine to cause a far more formidable

STATEMENT OF PROPORTION, AT COLUMN II., OF DEATHS FROM EXPLOSIONS IN COAL MINES, FROM FALLS OF ROOF AND SIDES, AND FROM OTHER MISCELLANEOUS CAUSES, TO TOTAL DEATHS IN MINES FROM ALL CAUSES DURING THE YEARS 1875–1884[1]

Year.	Total Number of Deaths from Accidents of all kinds.	No. of Deaths from Explosions of Fire-damp.	No. of Deaths from Roof and Sides falling.	No. of Deaths from Other causes.	Results of some of the more disastrous Explosions in each year.
1875	1244	288	459	497	Explosion at the Swaithe Main Colliery, near Barnsley ... ... 143 lives lost.
					,, Bunker's Hill Colliery, Stoke-on-Trent ... ... 43 ,,
					,, New Tredegar Colliery, Monmouthmouth ... ... 23 ,,
					,, Llan Colliery, near Cardiff ... ... 16 ,,
1876	933	95	449	389	,, South Wales Colliery, Abertillery ... ... 23 ,,
1877	1208	345	448	415	,, Blantyre Colliery ... ... 207 ,,
					,, Pemberton Colliery, near Wigan ... ... 36 ,,
1878	1413	586	469	358	,, Abercarn Colliery, Monmouthshire ... ... 268 ,,
					,, Wood Pit, Haydock ... ... 189 ,,
					,, Apedale Colliery ... ... 23 ,,
					,, Barwood Colliery, Kilsyth, near Glasgow... ... ... 17 ,,
1879	973	184	426	363	,, Dinas Colliery, Pontypridd ... ... 63 ,,
					,, Blantyre Colliery ... ... 28 ,,
					,, Stanley Colliery, near Wakefield ... ... 21 ,,
1880	1318	499	462	357	,, Seaham Colliery ... ... 164 ,,
					,, Risca Colliery ... ... 120 ,,
					,, Penygraig Colliery ... ... 101 ,,
					,, Leycett Colliery ... ... 62 ,,
1881	954	116	450	388	,, Abram Colliery, Wigan ... ... 48 ,,
					,, Whitfield Colliery, Tunstall ... ... 25 ,,
1882	1126	250	468	408	,, Trimdon Grange Colliery, Durham ... ... 74 ,,
					,, Tudhoe Colliery, Durham ... ... 37 ,,
					,, Clay Cross Colliery, Derbyshire ... ... 45 ,,
					,, Baddesley Colliery, Warwickshire ... ... 23 ,,
					,, West Stanley Colliery, Chester-le-Street ... ... 13 ,,
1883	1054	134	469	451	,, Altham Colliery, Lancashire ... ... 68 ,,
					,, Wharncliffe Carlton Colliery, near Barnsley ... ... 20 ,,
1884	942	65	482	395	,, Pochin Colliery, near Tredegar, Monmouthshire ... ... 14 ,,
					,, Naval Steam Coal Colliery, Penygraig ... ... 14 ,,

[1] The facts embodied in the above Table have been long accessible to all who care to inform themselves correctly, by reference to the published annual reports of H. M. Mine Inspectors; it is, therefore, somewhat surprising to find that the Manchester Correspondent of the *Times*, to whose views that journal appears to attach much weight, and whose evident acquaintance with high authorities in matters relating to coal mines, such as Mr. Ellis Lever, should have, at any rate, assisted him to a knowledge of the existence of those reports, is ignorant of the truth relating to a subject with which he deals in a fashion somewhat over-authoritative for the representative of "unenlightened earnestness," which is "impatient" to learn the reason for "hesitation" on the part of a Royal Commission on mine accidents in promulgating its conclusions, is "incredulous of the difficulty of speaking out," and indignantly regards "the delay as a national scandal." In support of this somewhat strong expression of sentiment, "unenlightened earnestness" inquires whether it has "really needed so long to dispel any doubt that shot-firing, for instance, is the commonest cause of the loss of life in coal mines."

total of deaths than even an unusual succession of serious explosions, are to a great extent made up of unavoidable sources of danger to which the miner must be exposed; and that, on the other hand, the causes which lead to explosions have been long known, and can be readily grappled with and removed by the colliery owner or manager. But as a matter of fact the nature of some of the chief and most prevalent conditions favourable to mine explosions is only now being thoroughly made clear, and the same may be said of the nature of measures and appliances by which explosions may be avoided or diminished in magnitude.

From the foregoing considerations, it is evident that very great interest and importance must attach to any decided improvements in systems of working, or in appliances connected with mining, and bearing directly upon the safety, facility, and degree of comfort, with which subterranean operations can be carried on. The members of the Society of Arts will, therefore, I feel sure, take a lively and sympathetic interest in the statements and observations which I have to offer in connection with the Mining Section of the late Exhibition, and, in reference to the labours, now fast drawing to a close, of a Commission, appointed by Her Majesty about six and a half years ago, to inquire and report whether the resources of science could furnish any practical expedients, not then in use, calculated to prevent the occurrence of accidents in mines, or to limit their disastrous consequences; a Royal Commission whose earnest and disinterested labours have been patiently, steadily, and faithfully pursued to successful issues, in spite of engrossing official public and professional duties, and undeterred by the public censure and abuse with which the persevering efforts of its members to complete, as far as practicable, the heavy task allotted to them, have as yet been alone encouraged.

The display at the recent Exhibition of implements and appliances connected with mining, was sufficiently comprehensive to be fairly representative of the nature of improvements which have of late been accomplished in almost all directions. Some of the exhibits demonstrated very important progress made since the Accidents in Mines Commissioners commenced their labours, and are traceable in several instances to certain results of those labours, which, though not formally communicated to the public, have become known to many engaged in the management and supervision of mines.

An examination of the evidence taken by the Commission, and published with their Preliminary Report, showed that there were several important subjects connected with the safe and efficient working of mines upon which large differences of opinion prevailed. This was especially the case with reference to the employment of naked lights in mines—the relative merits of well-known safety lamps—the uses of gunpowder or other explosives underground—and the possible influence of coal-dust in the development or extension of explosions. It was, therefore, especially in these directions that the Commissioners considered it their paramount duty to pursue experimental inquiries, and, as those investigations proceeded, their importance and the useful results likely to emanate from them became the more apparent, while each succeeding step demonstrated the necessity for proceeding further in the inquiries, so that, even up to this, the period fixed by them for the completion of their final Report, the Commissioners have found themselves still engrossed in experiment.

Without presuming to deal in anticipation with the conclusions arrived at by my colleagues and myself as the results of our protracted investigation, I may venture to indicate the nature of some of those results sufficiently to illustrate the progress made in certain matters most vitally affecting the safety of the miner.

The important advances which have of late been made in the methods of operation, and mechanical appliances, provided for exploring and for breaking ground, were illustrated in the Exhibition by some of the most recent improvements in boring and drilling machines, and in the construction of the more ordinary hand tools. Without dwelling upon the marked advance which has been made in the operations of deep-boring and of tunnel-driving, by combining the utilisation of steam or compressed air with the method of continuous flushing, special reference must be made to the great improvement effected in mining operations by the use of drills or perforators driven by compressed air, of which several varieties were shown at South Kensington.

So-called coal-cutting machines, for holing or undercutting coal, of which many forms have constituted prominent features in the mining sections of former Exhibitions, were only represented by one variety on the present occasion, and appear to have hitherto made little way, although their use would seem to be attended with some decided advantages. Hydraulic pressure has been applied with some degree of success in connection with drilling machines and with the forcing down of coal; thus, Messrs. Dubois and Francois have applied a very efficient hydraulic arrangement, called the *Bossoyeuse*, with considerable practical success, to the removal of rock or stone in mines where fire-damp exists. As regards the different methods of working seams of coal, and the variety of circumstances which determine their expediency or relative merits in different cases, I must limit myself to the statement that the so-called *long wall* system, which consists in the continuous excavation of the coal throughout or along a considerable distance of the breadth of the seam, the excavated part being filled up, as the work advances, with stone and slack, or with material brought from the surface, presents facilities for securing efficient ventilation, and other advantages in regard especially to the safety of the workmen, by which it recommends itself for choice wherever it is applicable, and which, supplemented by the employment of wedges, have been used successfully for bringing down coal or rock in some localities where fire-damp is prevalent.

Large as is the proportion which accidents arising from falls of roof and sides in mine-workings bear to casualties of all other descriptions, an examination of the Mine Inspectors' Casualty Returns happily shows that a considerable improvement has actually taken place in the death-rate from falls during the last twenty years. This is unquestionably owing to bestowal of increased care upon the proper support, by timbering or arching, of the roof and sides of many workings, or upon improvements in the system upon which this most important work is carried out. Cheering as these results are, it cannot be doubted that much remains to be accomplished in order to reduce the proportion of casualties from these causes to some approach towards what might be reasonably accepted as unavoidable at the present day.

One great safeguard to the miner against accidents from falls of stone and coal would obviously be the provision of efficient illumination of the ways and working places. A powerful excuse for the use of naked lights, even where risk of producing explosions was known to be incurred thereby, has been sought, and even sometimes admitted, in the necessity for more light in insecure places than that furnished by the Davy, the Geordie, or the Clanny lamp; the argument against enforcing the general adoption of safety lamps, most strongly urged by Mr. Burt and others in the debate of 1878, was the miserable insufficiency of the light afforded by them, and the consequent increase in the number of accidents due to causes other than explosions. Among improvements of late effected in the construction of safety lamps, has been the increase of their illuminating power; and this subject of underground illumination is, I may confidently say, ripe for very great amelioration.

The simple modes of underground transport of coal by manual or horse labour have now, to a very considerable extent, given place to its haulage, along tramways, by means of wire ropes or chains actuated either by steam hauling engines placed near the pit bottom, or by compressed air-engines stationed in different parts of the main roads. Some good illustrations of hauling machinery of these kinds were included in the Exhibition, and members of the Society of Arts cannot fail to remember with interest that our late lamented chairman, Sir William Siemens, was the pioneer in the introduction of electric hauling arrangements for mining work.

A fruitful source of disaster connected with mines has been the descent or ascent of the men by the shafts, and many contrivances have been devised, and more or less extensively applied, for preventing accidents resulting from the overwinding of the cages in which the men and the coal are brought to the surface, or from the fracture of the rope with which these cages are worked.

Really efficient and trustworthy appliances of this class cannot fail to be important safeguards, equally perhaps with those afforded by great improvements which have been effected in the construction and quality of the hauling- or pit-ropes. It is impossible to overrate the necessity for the bestowal of the highest skill and care upon the manufacture, testing, and periodical inspection of these all-important adjuncts to mining work, to which many thousands have daily, in blind confidence, to trust their lives.

The great improvements which have been effected in the steam brakes and reversing gear applied to the powerful wind-

ing-engines which, as monuments of mechanical skill, merit the careful inspection of all interested in mining industry, are most important additions to the safety appliances provided in the present day in connection with the pit work of our mines. To these must be added the improvements made in signalling arrangements from the surface and underground, in connection with which electricity has of late commenced to play an important part.

The great advance made in the *ventilation* of mines during the past half century is well known to all who have paid the least attention to these matters. Not only has the ventilating furnace been greatly improved in efficiency and power; the steam jet and compressed air have received important application within the last thirty-six years, and fans, and other mechanical ventilating agents of great power have come into extensive use during the past twenty-three years.

The proper distribution of the air which is drawn down into the pit, and the arrangements necessary for insuring the distribution of fresh air throughout the different roadways and workings in a mine, and its isolation from return- or foul air-currents which are passing to the upcast or exit shaft, are now carried out effectually in a large proportion of our coal mines.

Although we have long been familiar with the nature of fire-damp, and with the generally-accepted explanation of its origin in coal, considerable uncertainty and consequent diversity of opinion still prevail as to the condition in which the gas is pent up in coal, and in the associated strata. That the light carburetted hydrogen, which chiefly composes fire-damp, exists, with its associated gases, in a more or less condensed condition, in coal, even some time after removal from the pit; and, that the gradual escape of the condensed inflammable gas from coal has constituted a fruitful source of disaster to coal-laden ships, and to steam-vessels carrying a large provision of coal—such as our ships of war—are very well known facts; but, there are constantly-recurring phenomena connected with the escape of gas from coal, a really satisfactory explanation of which is still wanting, although patient inquiry has long been devoted to its discovery. Thus it has been demonstrated by experiment that, if cavities are bored into the coal and plugged, the gas will speedily accumulate so as to exercise a pressure of several hundred pounds upon the square inch, as indicated by pressure-gauges fixed into the cavities.

In some localities, the gas issues as a jet, or so-called "blower," and many of these furnish a continuous supply of gas under fairly uniform pressure, which may be conducted in a steady stream to the surface, and utilised for heating and even for illuminating purposes. Many explanations have been offered of the existence of these blowers, and of the maintenance and sudden cessation of the gas supply, but they have remained a mystery.

The systems of ventilation now in use in coal mines, and the powerful circulation of air maintained thereby, deal effectually with the removal of gas, as it exudes from *freshly-worked* coal even in very fiery mines, when it passes into the main ways and the workings which are actually in use; but, in *old workings*, recesses, or cavities, and in the so-called goaves, where the worked-out space has been filled up with stone and *débris*, the gas may lurk and lodge, and may at any time constitute a source of great danger, if special means are not adopted to favour its removal; and, even with the most efficient and searching ventilating arrangements, the almost unavoidable existence of some accumulations here and there in mines where fire-damp is prevalent, renders absolute freedom from it, of the air in the mine, practically unattainable in such cases, although the amount diffused through the atmosphere may seldom, under ordinary conditions, approach, even distantly, to the minimum proportion which, *per se*, might constitute a source of danger.

It is now generally admitted that variations of atmospheric pressure influence the tendency of fire-damp to escape from goaves or old workings in a mine where accumulations are liable to exist, and that when a reduction of pressure suddenly sets in, such an escape may take place even to some considerable extent before the barometer indicates the depression. Some even maintain that the emission of gas from the fresh face of coal is considerably promoted by such alterations of pressure; but although there are many undoubted instances of explosions having occurred during sudden and very considerable depressions of the barometer, different observers in this and other countries are by no means in accord as to the extent to which, in a properly-ventilated mine, the existence of fire-damp in the air is influenced by barometric changes.

There are some mines so free from fire-damp that naked lights may be used therein with perfect safety, and others where the use of safety lamps need apparently be only insisted upon in certain parts of the workings. There can be no doubt, on the other hand, that the adoption of even the most perfect ventilation cannot secure such absolute safety as to render the use of naked lights warrantable, where seams are worked in which fire-damp exists in any abundance,—because danger may there arise at any time, from some accidental stoppage or partial failure of the ventilating arrangements, from the effect of a reduction of atmospheric pressure in promoting the escape of gas from lurking places, or, from a liability to the sudden emission of gas in considerable quantity from coal. The very poor light furnished by the forms of safety lamp still chiefly in use, has afforded very strong temptation to the men to have recourse to naked lights, and to the managers of mines to regard such proceeding with indulgence, even where its danger is well recognised. Poor as the light is which the older forms of lamps furnish in a quiet atmosphere, it becomes even much worse when they are exposed to such currents as are now met with in properly ventilated mines.

Efficient lamps should therefore burn brightly and steadily even in strong currents of air, and they should be unable, under any circumstances at all likely to arise in coal mines, to ignite an inflammable mixture of fire-damp and air, even when this is passing at the highest velocities which can occur in any part of a mine.

The importance of determining how far modifications of existing lamps, or new kinds, fulfil these conditions, has led individuals specially interested in the subject, and associations of mining engineers, for many years past, to submit lamps to comparative experimental tests; and the first branch of inquiry which was taken up by the Royal Commission was the systematic comparison of the behaviour of different lamps under variously modified conditions in currents of explosive mixtures of gas and air, travelling at different and accurately-determined velocities.

As the experiments proceeded, and the results of tests applied to particular lamps became known to the makers, modifications in construction were introduced, or new arrangements devised. More than 200 lamps have been submitted to a variety of trials, and even up to the present day the Commission have continued to receive new lamps, with urgent requests that they should be included in the trials.

This investigation has also included a careful determination of the amount of light furnished, and of the burning qualities of all the more promising lamps, as well as an examination into their practical merits, in regard to construction, weight, and handiness.

The results of these extensive investigations will now very shortly be in the hands of the public: I must content myself with very briefly indicating their general nature.

Only three types of lamp were until recently in extensive use in this country: the original safety lamps, which the miners owe to the genius of Davy and of Stephenson, and a lamp not long afterwards devised by Dr. Clanny. When the safety lamp was first invented, the ventilating currents in mines were very moderate indeed, and under the then prevailing conditions these earliest lamps were fairly safe. But, at the present time, the air in the mine roadways often travels at a rate of 20 to 25 feet per second, and may even, in some special places, attain velocities of 30 to 35 feet. Under these conditions the Davy and Clanny lamps cease to afford any security in localities where fire-damp is prevalent. This had already been indicated by the results of previous experiments when the Commissioners commenced their work, but their own investigation so clearly established the great danger of these lamps, and the facts already known on the subject appeared to have received so little consideration, that the Commissioners regarded it as their imperative duty to direct the Home Secretary's attention officially and in strong terms to the fact, in the hope that most prominent publicity would be at once given to their warning.

After some delay, a circular embodying the substance of it was issued, but without any indication that it bore the authority of the Royal Commission. This action was taken not long after the appointment of the Commission, yet the Davy and Clanny lamps have continued in use in mines where the elements of danger insisted upon exist.

The Davy lamp had, some years back, been rendered much

less dangerous by the addition of a metal shield partially surrounding the gauze cylinder, or by the provision of an external glass cylinder extending up the gauze to various distances. The latter modification proved to be the most efficient safeguard of the two; but a much more important protection has been comparatively recently effected by inclosing the lamp in a case, which protects it to a great extent from the action of currents, though this considerably diminishes the already very meagre light afforded by this lamp.

A lamp of Belgian origin, termed the *Mueseler*, and which has for many years past been officially adopted in Belgian mines, presents important advantages over the lamps already referred to, which were, in part, recognised before the Commission existed, the lamp having since come into somewhat extensive use. Some experiments and certain results of practical experience had, however, already thrown doubt upon the wisdom of placing absolute reliance in the safety of this lamp; the Commissioners' experiments confirmed the validity of those doubts, and showed that, under particular conditions, the Mueseler lamp might cause an explosion when exposed to a current of fire-damp mixture of very moderate velocity. On the other hand, the *cased Davy* lamp was found perfectly safe, under much more severe conditions, and this important fact has led to the adaptation of cases in various ways to the old types of safety lamps—many so-called new safety lamps consisting, in fact, of the Davy and Clanny protected by inclosure from the direct action of the current.

The publication of the Commissioners' investigations will, I venture to affirm, convince even those who, although they have not cared to inform themselves of the character and extent of the work which was being done, have thought it right and just to publicly reproach the Commission with dilatoriness, that the curtailment of these researches would only have been detrimental to the conclusive, and therefore practically important, nature of the results arrived at. For, these have not only led to decisive conclusions regarding the defects of the best known types of lamps, and the degree of safety and other merits of a large variety of modifications of them, as well as of new forms of lamps, but they will also enable the Commissioners to indicate, with confidence, several lamps which combine a great degree of safety with other important merits, and to specify a few among these which, while ranking highest in point of safety, and leaving very little indeed to be desired in this respect, combine, with this first essential, the important adjuncts of simplicity of construction and fair illuminating power. It will, moreover, be possible to indicate some directions in which even these lamps are susceptible of improvement. It, therefore, only remains to be hoped that the results of the labour which the Commissioners have devoted to this branch of their inquiry will be accepted wtth the confidence they merit, and will be speedily utilised both by those who are responsible for the management of mines and by those who control the actions of the miner.

When the Commission's investigations were already considerably advanced, Mr. Ellis Lever publicly offered a premium of £500 for a miners' safety lamp, which, while being of convenient size for carrying about, would continue to give a useful amount of light for not less than twelve hours, *and which would not cause an explosion of gas under any circumstances at all likely to represent conditions which may occur in actual practice.* It was proposed that the judges to whom lamps submitted for competition were to be referred should include three scientists, nominated respectively by Mr. Lever, by the Royal Society, and by the Society of Arts. No less than 108 different lamps were sent in, and it need scarcely be said that the determination whether any among them fulfilled the prescribed conditions involved a very extensive series of experiments. The adjudicators who had to investigate the merits of the various lamps, included three scientists, and two were members of the Commission, who cheerfully consented to take upon themselves this very considerable addition to the voluntary labours already being carried on by them in the interests of the miners.

Only four electric lamps were submitted, and these altogether failed in fulfilling any one of the conditions laid down, excepting that of being self-contained lamps. Eventually, not one of the other lamps was found completely to fulfil the whole of the conditions under which the premium was offered, although several ranked very high as regards safety and efficiency; foremost among these being the lamp of M. Marsaut and that of Mr. N. Morgan, of Pontypridd, to whom gold medals have been awarded at the Inventions Exhibition, and whose lamps rank among those which the Commissioners are able to speak most highly of. But, the premium which Mr. Lever placed at the disposal of the adjudicators reverted to him, and those who have great experience of the behaviour of safety lamps of the various well-known and recently developed types, could scarcely have anticipated a different result. Mr. Lever has, since then, again offered a similar premium, this time for "the invention or discovery of an economical, efficient, and safe substitute for gunpowder and other dangerous explosives used in the getting of coal." The Council of the Society of Arts could not see their way to comply with the suggestions of Mr. Lever that they should award this premium, or appoint adjudicators for that purpose, as they did not feel themselves warranted in suggesting the great sacrifice of time, in the performance of the very laborious and exhaustive experiments indispensable in this case, to such as would be really competent to perform the work of adjudication, which Mr. Lever appears to think at least as lightly of as of the offer of these prizes. It borders upon the amusing to observe in the article by the Manchester Correspondent of the *Times*, to which such prominence was given on the 27th of last June, how the writer heralds offers of subscriptions and of premiums, as illustrating the way in which his hero "gallantly attacks the problem (of accidents in mines) at all points," while he has no encouraging word for the man of science whose disinterested devotion to very arduous work, for which his sole probable recognition would be hostile criticism, or worse, can alone give any point to the "gallant attacks" of philanthropists like Mr. Ellis Lever.

(To be continued.)

THE ROYAL SOCIETY[1]

AT the earliest opportunity after my return to England last spring I offered my very grateful acknowledgments to the Society for the kindness with which the Fellows had condoned my enforced absence from my post during the winter. And I should not venture to occupy your time by recurring to the subject, did not the return of St. Andrew's Day admonish me that duty and inclination alike require me to offer my especial thanks to the Treasurer for the cheerful readiness with which he took upon himself the burden of my duties, and the efficiency with which he discharged them on our last Anniversary.

On the last occasion on which I had the honour to address you, it was my painful duty to commence by lamenting the death of a very eminent member of the Society, who was, at the same time, one of my oldest and most intimate friends. I deeply regret to find myself once more in this position. The lamentable accident which has deprived the Society of one of its oldest and most distinguished Fellows, Dr. Carpenter, has robbed me of a friend, whose kindly sympathy and help were invaluable to me five-and-thirty years ago, and who has never failed me since.

You are all acquainted with Dr. Carpenter's great and long-continued services to science as an investigator and as an expositor of remarkable literary skill; and there must be many here who, having worked with him in the University of London, of which he was so long Registrar, are familiar with the high integrity, the energy, and the knowledge, which marked him as an administrator. He was a man of varied accomplishments outside the province of science, single-minded in aim, stainless in life, respected by all with whom he came in contact.

Within the last few days, Physics has lost an eminent representative in Dr. Thomas Andrews, of Belfast. Among the cultivators of Chemical Science we have to regret the decease of Mr. Field, who was one of the original members of the Chemical Society; of Mr. Weldon, and of Dr. Voelcker, whose names are well known in connexion with manufacturing and agricultural chemistry. In Biology, we have lost Dr. Davidson, whose elaborate monographs on the fossil Brachiopoda are remarkable examples of accurate malacological work combined with artistic skill; Dr. Gwyn Jeffries, the veteran explorer of our marine molluscous fauna, and a high authority on conchology; and Dr. Morrison Watson, whose early death has cut short the career of an anatomist of much promise. Mineralogy has suffered a similar loss by the premature death of Dr. Walter Flight. In Engineering Science, we have to lament the deaths of Mr. Barlow and Professor Fleeming Jenkin. I may be permitted to dwell for a moment upon the latter name, as that of a most genial and accomplished man and a valued personal

[1] Address of the President, Prof. T. H. Huxley, delivered at the Anniversary Meeting, November 30, 1885.