account of the notices that have appeared in NATURE (vol. xxi. pp. 330, 372, and vol. xxii. p. 77) and in *Comptes rendus* (xc. 622–26), this note would be needless, were it not that some may regard these ashes as of recent origin.

Microscopically the material (already described by Prof. Delesse) is seen to be decomposed to a considerable extent. The materials evidently filled an old crater, and have been subjected to secondary action, so that of the original constituents only the feldspar and augite are left. The other constituents are the results of the alteration of this andesitic (probably) *débris*. No trace of *recent* volcanic material could be found in that examined by me. In no sense can these ashes be called a recent product; they have simply been transferred from one place to another. The transfer is recent, but the ashes have for ages been at or near the surface of the earth. M. E. WADSWORTH

Museum of Comparative Zoology, Cambridge, Mass., U.S.A., June 30

Large Meteor

ON Friday evening last, July 9, at 9h. 45m., I saw a very fine meteor about equal in brightness to Venus at her maximum, moving very slowly from nearly west to south-west. I did not see its origin. It passed about 4° above *Spica*, and disappeared soon afterwards, as nearly as I could estimate, in altitude 16° and azimuth 50° west of S. Its apparent course was only slightly inclined to the horizon, approaching it at an angle of about 1 in 10.

Its apparent angular velocity was about 8° in a second, its light yellowish till the moment of extinction, when it became blue and fainter, and disappeared without any sign of explosion. Its course was somewhat wavy, and the trail it left behind it very evanescent. My latitude and longitude was 51° 25′ and 0° 14′ W. F. C. PENROSE

Coleby Field, Wimbledon, July 14

Ball Lightning

ON Saturday night, the 17th inst., an instance of this form of lightning came under my observation.

The day had been hot, the thermometer registering a temperature of about 71° F. in the shade during the middle of the day, which was bright and clear. In the evening, however, a curious haze or mist spread rapidly over the landscape, while the temperature had fallen to about 68° F. This haze was very much denser and more analogous to the smoke-fog of a town than I have ever observed in the country at this time of year, yet the air did not seem particularly damp or chill.

About 9 p.m. frequent flashes of sheet-lightning occurred, with rumblings of distant thunder at intervals, both of which continued more or less up to midnight, about which time, the mist having somewhat cleared off, I saw when returning home, apparently about a quarter of a mile ahead, a ball or globe of fire of considerable size descend slowly from the clouds, and when near to or touching the earth suddenly disappear, its disappearance being accompanied by two slight but quick concussions, which may have been an explosion and its echo. The fire-ball could not have been visible more than five or six seconds. I cannot ascertain that any damage was done by it.

As this somewhat rare and curious phenomenon seems to be manifesting itself at this period, accompanying the thunder-storms we are having (see NATURE, vol. xxii. p. 193), may I be permitted to suggest that those interested in electrical science should be on the alert to observe any repetition of the occurrence with its concomitant circumstances? W. F. SMITH

Sutton Valence, Kent

E. M. F. should read Prof. Ayrton's Sheffield lecture on "Electricity as a Motive Power" (see NATURE, vol. xx. p. 568); any decent text-book—Noad's, for example—will tell of the older attempts of Jacobi to propel boats by electricity.

THE RECENT EXPLOSIONS

ALTHOUGH it is difficult to say anything new on the subject, or give instructions more effective than such as have been given over and over again, still the recent remarkable and destructive explosions in London, Wolverhampton, and Monmouthshire seem to call for some remarks at our hands.

Two serious explosions of gas following close on each other, in the streets of large towns, announce to every one that the difficulties of supplying gas to large numbers of consumers have not been completely overcome.

The special feature in the London accident was the occurrence of a series of explosions, at first at nearly regular, and then at increasing intervals, along the gas main. The first explosion blew out the "cap" of the main with great violence; the rush of heated air, doubtless mingled with more or less gas, in the other direction seems to have carried the flame—probably by a rapidly occurring series of small explosions—to a point at which a mass of explosive gas was again reached and fired. The mass of gaseous mixture fired in the second explosion appears to have been about equal to that in the first, but towards the close of the series either the gas became much more diluted with air, or the air became much more charged with gas. It seems just possible that vibrations propagated by the first explosion passed rapidly through a gaseous medium, consisting of much air and little gas, until they came in contact with a mass of gas and air, which they threw into rapid vibration, and so caused to explode. But from the experiments of Abel and others one would scarcely expect this to occur under the conditions which—judging from the evidence given at the inquest—appear to have existed.

A second point, illustrated more markedly by the Wolverhampton explosion, is the apparent readiness with which a soil may be charged with coal-gas and retain this gas for long periods of time. The passage of such gas into drain-pipes, and perhaps even into unfilled gas-mains, seems to be of ready occurrence.

Experiments might well be instituted by the gas companies to determine the power of soils for absorbing and retaining coal gas, and secondly, the conditions of diffusion of mixtures of gas and air through the walls of pipes of different materials. If it can be shown with certainty that the valve at the junction of the main in which the explosion occurred with the Howland Street main was absolutely impervious to gas, then the explosion may almost be regarded as proving the permeability of the material of gas mains to mixtures of air and coal-gas.

The practical lesson of the explosions is that some means of certainly determining whether a gas main does or does not contain gas must be found at once, and that this means must *not* be the application of a light to an opening in the main. The foreman who applied the fatal match said that the pressure gauge showed the absence of gas in the main; but as the main contained a quantity of gaseous mixture at rest, and not flowing through the pipe, the gauge could not be expected to indicate the presence of this mixture.

It is almost amusing to read of the simple astonishment of the two foremen when the fact was announced to them that mixtures of coal-gas and air are explosive: twenty or twenty-five years' experience in gas-works had failed to teach them this fact. Yet the lives of the inhabitants in the neighbourhood of Tottenham Court Road were practically in these men's hands for the last three or four months.

With regard to the Risca disaster, of a different and unhappily more fatal kind than the former, clouds of smoke are said to have accompanied the explosion which devastated the pits soon after midnight on Thursday last (15th inst.), and we have it from the lips of a credible eye-witness that fused and coked coal-dust is found adhering to the timbers in those parts of the workings which have been already visited, though not so conspicuous as in some cases. In these respects therefore the recent explosion is only a repetition of similar events which have

taken place before, and we need not again go over the ground which we have already traversed several times in these pages, when we have endeavoured to point out their most probable origin and mode of propagation.

We propose, however, in this place to devote a few lines to the discussion of a question which we think has not as yet received the attention it deserves, namely: When is a mine in such a state that it may be termed *well-ventilated?* and our principal reason for doing so is that a statement has been already put forth to the effect that the ventilation of Risca Colliery was as perfect as it well could be, the total volume of air passing through it being considerably over 100,000 cubic feet per minute.

An air-current of given dimensions may be sufficient to thoroughly ventilate the workings of a fiery mine at one time, and it may be quite insufficient at another: for the degree of sufficiency is obviously wholly dependent on the amount of fire-damp given off per unit of time. Each unit of volume of coal contains a certain volume of fire-damp in a state of great compression—it may be in a liquid or solid condition—and this gas begins to be given off when the workings approach to within a certain distance of the space within which it is confined. The greater proportion of the fire-damp is probably given off immediately before the coal is laid bare, and at the instant it is being detached from the face; but some of it still continues in the coal long after it has left the mine.

If the workings of a fiery mine are stopped abruptly and allowed to remain unworked for a considerable time, we find that the amount of fire-damp given off gradually decreases, until in the course of a year or so it is not more than one-tenth of what it was when the mine was in full work. If, on the other hand, the output of a fiery mine is largely increased, we find that the workings soon lapse into a dangerous condition unless the ventilation has been largely in excess of its requirements in the first place. The character of the ventilation is thus dependent upon the output of coal for the time being as well as on the amount of air.

The daily output of Risca Colliery is stated to have been 1,000 tons, and supposing the amount of gas given off to have been 2,880 cubic feet per ton of coal, which is the actual amount we have found by observation and calculation in similar mines, then we know that, if the volume of the ventilating current had amounted to 30,000 cubic feet per minute, the whole of it would have been explosive as it returned from the workings; if it amounted to 50,000 cubic feet per minute it would show a cap half an inch high in the small oil-flame of a lamp, and when charged with coal-dust it would form a *highly explosive* mixture; if it amounted to 100,000 cubic feet per minute it would still show a small cap $\frac{1}{8}$ to $\frac{3}{16}$ inch, and it would still produce an explosion when mixed with coal-dust, and ignited.

It is notorious, however, that as a rule the volume of air which reaches and passes round the working faces is much less than that which descends the down-cast and ascends the up-cast shaft; and when we are told that the ventilation of a mine is represented by a certain number of cubic feet of air per minute, we are on the safe side if we estimate the useful volume to be little more than two-thirds of the stated one.

It is further notorious that the practical miner of almost every grade regards a small cap on the flame of the lamp, even if $\frac{1}{4}$ to $\frac{1}{2}$ inch high as a very trivial matter, so long as he finds little or no explosive gas in the mine; and he only begins to speak of the return air as being heavy or rather heavy when the size of the cap on the small oil-flame reaches or exceeds a height of $\frac{3}{4}$ of an inch; but still even in this case he is not much troubled with thoughts of immediate danger.

What then constitutes a well-ventilated mine?

We say in reply that no mine containing dry coal-dust is well-ventilated when the cap on the small oil-flame of a lamp is over $\frac{1}{8}$ or $\frac{3}{16}$ inch in height, that is to say, when the return air contains more than 2 per cent. of gas. Even with that amount, as we know, it will form an explosive mixture with coal-dust, and we should prefer to see a standard insisted upon in which not more than 1 per cent. was allowed.

This aspect of the question is well worthy of the attention of the Royal Commissioners on Accidents in Mines, and we hope they will not allow their present opportunity to pass without endeavouring to arrive at some definite settlement of such an important question.

NORTH AMERICAN GEOLOGY—IDAHO AND WYOMING[1]

IN spite of the revolution that was recently effected among the Government geological surveys of the American Union, provision has wisely been made for the completion of the Reports of the different corps which have been abolished. It is pleasant to welcome still another of the stout black volumes issued annually by the Geological and Geographical Survey of the Territories. On the completion of the Survey of Colorado in 1876 Dr. Hayden and his corps of active coadjutors moved northwards across the belt of country included in the Survey of the 40th Parallel under Mr. Clarence King, with the intention of mapping the territories of Idaho and Wyoming to the north and west. A number of reconnaissances had been made by various observers in these regions since the days of Bonneville and Fremont, some of the earlier work of Hayden's Survey having been accomplished there. But no general survey of the whole area had been attempted, and many parts of it had never been penetrated by white men. It was a vast territory, including within its borders the sources of the Green, Snake, and Yellowstone Rivers, and embracing the most varied forms of surface and the greatest diversities of geological structure. To survey this unknown domain and bring its geography, geology, mineralogy, ethnology, zoology, botany, and general economic capacity to the knowledge of the world was the aim with which Dr. Hayden and his staff started in the summer of 1877. During the season the primary triangulation was extended over an area of 28,000 square miles, from West Long. 107° to 112° and between North Lat. 41° 10′ and 43° 50′, and was connected with the stations made by the Survey of the 40th Parallel, and by the Boundary Survey of Wyoming. Topographical field-work was carried on by three parties, each having an area assigned to it of about 11,000 square miles. The total area thus surveyed amounted to about 29,000 square miles. The geological staff was likewise divided into three divisions, each being intrusted with a separate district, viz., the regions of the Sweetwater, Teton, and Upper Green River.

In the report of Dr. Endlich of the Sweetwater division, one of the most interesting features is his account of the structure of the Wind River Mountains. This important portion of the true Rocky Mountain range is formed of three parallel chains, of which the western, and chief, rises to heights of more than 13,000 feet and forms the watershed of the continent. Even now its huge snow-fields, which, through the clear summer air can be seen gleaming from a distance of more than 100 miles, suggest the presence of glaciers. When Dr. Endlich and his party traversed these mountains in 1877 they found, indeed, no recognisable glacier, but abundant freshly-grooved and polished rocks and moraine mounds, showing the comparatively recent existence of land-ice in these elevated regions. On the west side of the

[1] "Eleventh Annual Report (1877) of the United States Geological and Geographical Survey of the Territories, embracing Idaho and Wyoming." (Washington: F. V. Hayden, 1879.)