

But we have extended far beyond the allotted limits our consideration of the present work—a work tending, if aught could, to impair the deep veneration we feel for the man, the high honour in which we hold the poet; and why should Dr. Wordsworth have thus wantonly and injudiciously tampered with either? During his own life-time did the poet and the philosopher rear with blameless hands his enduring monument. His pen has forestalled and rendered vain the equivocal labours of the biographer. Nothing daunted by the merciless attacks of crabbed critic, undismayed by failure, yielding not a jot to the distempered taste of a public over-excited by the stimulating diet administered by a Scott, a Byron,

and others of the stirring school, Wordsworth took no counsel, save from the inspirations of his own sterling and observant spirit. The lowly yet upright in station found in him an earnest chronicler. Nature's High Priest, he laboured long and lovingly to kindle in other hearts the sacred fire that pervaded his own, as he gazed on those mighty works reared by no human architect; nor could aught have better rewarded his pious labours than the warm appreciation now so universally accorded them.

Erst hattest Du Deine Freude dran;
Nun haben sie andre Leute dran;
Das ist nun Deine Freude dran!

COAL MINE EXPLOSIONS.

THE recent terrible and destructive explosion at the Victoria coal-pit, Nitshill, near Glasgow, by which sixty-one lives were lost, has occupied much of the public attention, and occasions a few remarks from us on explosions in general. The lamentable ignorance which generally prevails on this entire subject leads us to attempt, within reasonable limits, a popular explanation (founded on strictly scientific investigations) of the causes of these dreadful catastrophes.

Coal-strata generally contain a varying quantity of explosive gases. Of these, light carburetted hydrogen is the chief, and perhaps the only inflammable, constituent. It is composed of two volumes of hydrogen and one volume of vapour of carbon. One hundred cubic inches of this gas weigh 17·4166,* and its specific gravity is 0·5594. One hundred parts contain by weight seventy-five carbon and twenty-five hydrogen. It is in many respects an important gas, therefore all its scientific characteristics are important. The few facts just mentioned are the result of much research and experiment. It is the confinement of this gas in mines which causes it to explode; for when free or unconfined it will not explode with violence any more than loose gunpowder. It becomes explosive, and therefore the cause of a mining accident, when a proportion of from seven to twenty-five per cent. of the gas is mixed with atmospheric air, which also at such times usually contains a small portion of carbonic acid gas and free nitrogen. When a greater quantity than twenty-five per cent. of the light carbon and hydrogen gas is mixed with the common air it will not explode; because air does not afford sufficient oxygen for combination with so large a proportion. When a less quantity than seven per cent. of the gas is mixed with common air it is too diluted and diffuse for explosion. The most explosive proportion has been found to be about twelve and a half per cent. of gas to the ordinary atmospheric air.

This gas is the *fire-damp* of the pitmen. It exists in very large quantities in some mines, and is thought to be pent up in the body of the coal in some state which admits of an easy passage into the aeriform condition. The common weight of the atmosphere keeps it down to a considerable extent, and we think that a pressure of four or five atmospheres, that is, of the common air increased in weight fourfold or fivefold, would altogether hinder its development in the gaseous state. Being only about one half the specific gravity of common air, it is always tending to rise into the same. It is said that, when pure, fifteen times its own bulk of atmospheric air will prevent its ascendibility.

Where a coal-mine is so situated that this gas largely exudes from it, it is called, in the language of the pitmen, "a fiery pit." The more bituminous the coal, the more *caking* it is in its burning, the more does it commonly contain of gas. Thus the mines on the Wear and the Tyne are much troubled with it; and this very Victoria Pit at Nitshill was so "fiery" that a single hour's interruption of the air-courses, or the ventilation, would suffer as much gas to accumulate as would, when exploded, shatter all the erections throughout the seventy acres area of the pit.

The great object of colliery-ventilation is to dissipate or dilute this constantly-exuding gas, to render it inexplorable by diffusion into a large quantity of air, and to carry it off from the mine by continual atmospheric currents. Pits were at first very clumsily ventilated, if at all; now the ventilation of coal-mines has become a study and a science. The Newcastle and Durham mines are generally well ventilated. We have ourselves descended several of them, and have been much gratified with their systematic ventilation. The plan adopted is to force a current of air through the passages of the mine by rarefaction. There are either two shafts sunk, or one shaft is divided into two compartments, by which this plan is carried out. At the bottom of one shaft, or one compartment, a large furnace is kindled, and this large

* Henry, in his "Chemistry," says 16·044.

body of fire rarefies the whole shaft at the base of which it burns. As an obvious consequence, the air which descends one shaft (called the "down-cast-shaft"), which is unrarefied, is immediately and forcibly drawn through the intervening passages, and ascends over the furnace up the other and heated shaft, which is called the "upcast-shaft." It is, then, clear that the cause of the ventilation of the pit thus arranged is the difference between the weights of two columns of air, one of which is at the natural temperature, and the other at that of the rarefying furnace. Nothing can be more beautifully simple in theory, for the theory is that of every parlour and domestic fire-place, where the draught from the door of the room is drawn by the fire over it and up the chimney; and yet few things are more difficult in practice than to ventilate thoroughly a large mine on this principle.

There are not always two shafts, and where one must be subdivided difficulty and risk occur. The sinking of shafts is sometimes a very expensive business; many thousands have been expended in sinking *one* shaft to the coal-beds. Of course, the expense depends on the depths and various obstacles, such as great bodies of springs, of shifting sands, and of rock. The depth of some of the Newcastle shafts is great. We descended shafts of 800, 1000, and 1,800 feet in depth. The last shaft is near Sunderland, and is nearly the deepest perpendicular shaft in the world. Perhaps the words 1,800 feet may not convey a very clear idea of the depth; but we may grasp the idea better by observing that this Sunderland shaft is nine times as deep as the Monument of London is high—that is, it equals in depth the Monument, if placed nine times upon itself! We well remember, and ever shall, our descent of this shaft, through darkness visible and smoke most palpable. Of course, the proprietors would not sink *two* such shafts; hence the one is divided into two compartments, one of which forms the upcast, or ventilating shaft; and down this long chimney—for such it really was—we were launched in a swinging basket, before breakfast, one fine summer's morning! All the ventilating air in such a mine must travel through the various passages, and then return to its starting-point, and ascend through its fiery chimney. But even where two shafts are sunk, there is often much difficulty in the ventilation, from the extent of the workings of the mine, and the great distance of the extreme points, or the impediments in the way of reaching them. To secure the life and health of the pitmen, air must be conducted to them as surely and as purely as their daily food. When they are labouring in the farthest passages, and in angular turnings, this is not always easy; but the various devices which have been adopted in the Northumbrian and Durham pits to secure this end are really ingenious, and commonly successful.

The system of working the mines there is such as to lay them out very much in the form of a large window placed flat upon the ground. Imagine one of your parlour windows taken out and laid upon the floor, and suppose the bars or frames contain-

ing each square of glass to be open passages, and the glass to be solid coal, and you will have a tolerable idea of a northern pit. It is, then, a kind of network system, the passages crossing each other nearly at right angles, and being multiplied by similar crossings as they proceed. Then the solid coal stands up in the shape of huge square solid pillars. The last working of all is to get out these pillars, after which the roof falls in, and the mine is abandoned, being closed up by the meeting of roof and floor. Sometimes portions of the pillars are worked away, and portions of the pit abandoned. These parts of the pit so deserted are termed *goaves* (we think from a Welsh word), and these *goaves* become so many gasometers, for their ruinous state liberates the gas from the coal, and causes it to ooze out upon the surrounding passages.

If a pit can be successfully ventilated, the miners seldom hesitate to employ naked candles at their work; if it cannot, they use the lamp invented by Sir Humphrey Davy. This lamp is well known, at least in name, as a signal triumph of practical science. In a few lines we will attempt to show the *rationale* of the Davy-lamp, deducing our explanation from Sir Humphrey's description.

Flame is a gaseous matter heated so intensely as to be luminous. When flame comes in contact with the sides of very minute apertures—as when, for example, wire-gauze is laid upon a burning jet of coal-gas, it is deprived of so much heat that its temperature instantly falls below the degree at which gaseous matter is luminous, and consequently the gas itself passes freely through the interstices of the wire without communicating ignition. Thus the light of the flame still continues without its explosive power, and this is always the case at any degree of heat which the encased flame can communicate to the surrounding wire, for the gauze of wire having a large extent of surface, and being, from its nature, a good conductor of heat, it loses heat with great rapidity, and thus exerts a cooling influence over the gas which may be burning inside the lamp, and reduces its heat below the point at which it will ignite and explode. Such is the scientific *rationale* of the lamp. Its construction is simple enough; for it merely consists of a small cylinder of wire-gauze, the apertures of the wire-gauze being extremely small, and at least 625 in number to the square inch of surface. Within this cylinder, which is protected by a covering at top and at bottom, a lamp-wick is placed, and fed with oil. When the wick is lighted, the lamp may be used safely in all parts of the mine. Although the fire-damp often passes through the gauze of wire and enlarges the flame, yet the flame never passes in return through the gauze, for the reasons above stated. We have often been startled with the sudden increase of the flame inside the lamp, when in some recess of a coal-pit; but, of course, the alarm was only that of a novice to the mines.

If these Davy-lamps were always used in mines there would be few accidents from explosions; but as they give a feebler light than candles, there is a great reluctance on the part of the men to

employ them. In the majority of mining explosions we find that the Davy-lamp was not in use. This is reported to be the case at the Victoria Pit, Nitshill. No accident had happened for four years previously; hence, perhaps, undue confidence was inspired in the efficiency of the ventilation; and hence, on that day when a sudden discharge of gas occurred, probably from a fall in the roof of the mine, the terrible accident took place which plunged sixty-one human beings into eternity!

An Act of Parliament has been recently passed to authorise the inspection of coal-mines by Government officers. In pursuance of this Act, four experienced gentlemen have been appointed to inspect the British coal-pits. At least four more ought to be appointed, and these should be gentlemen totally unbiassed by any kind of connexion with colliery-owners, and wholly unaddicted to any pre-conceived system or theory of ventilation and coal-mining; for a gentleman educated in and restricted to one district, will not be the very best inspector for another, where the system is different and the chief men look shy.

One of the present inspectors has been engaged in examining the Nitshill pit, and is reporting upon the circumstances of the catastrophe. It may be interesting to our readers if we conclude this paper with a brief description of the appearance of a pit and its neighbourhood after the occurrence of a similar and fatal explosion, some few years since. The description will be that of an eye-witness and actual visitor.

"As long as memory remains to us, we shall never forget the circumstances of our visit to the W— Pit, near Newcastle-on-Tyne, about ten years since, just after the occurrence of an explosion there. As we approached the locality no smoke was ascending from the tall engine-chimney. No shouts of men and calls of boys gave life to the surrounding desolation as before. We first called at the chief agent's house, and requested the favour of being permitted to descend the mine and observe for ourselves. This, with some difficulty, was obtained. Equipped, as usual, in mining dress, we accompanied the agent himself to the pit's mouth. What an assemblage of anxious faces was there at that little spot! The wives of men of whose safety there had yet been no tidings. *Wives* did we say?—rather, *widows* in almost assured anticipation. The pit was small, but the explosive force had been terrific; for it had shattered the timbers, and deranged the winding machinery. With difficulty, therefore, did we secure a safe descent in a wicker basket, together with the agent. As soon as we arrived at the bottom of the shaft, we lighted our Davy-lamps and began to grope through the main passage; but difficult as this is at all times to a novice, it was now ten times more so, since immense masses of stone, coal, and rubble were scattered confusedly all about. A hard concussion on our shin-bone soon brought us into a disagreeable acquaintance with one such mass. After this, we had to scramble over stone after stone, and heap of fragments after heap, in order to make any progress at all. At length the whole passage became nearly

blocked up. Men were engaged in tunnelling through the mixed mass, just as if they were forcing a drift-way for the first time. A stranger to such matters would have said that no human beings had ever trodden that course before; whereas, in fact, hundreds of men and boys, and hundreds of loaded coal-waggons, had made that very place a kind of highway but the day before. By the time that we had scrambled through holes and hollows barely larger than our own bodies, we came upon a company of three miners employed with pick-axes and other mining implements in searching for dead bodies. They had strong reason to think that some one or more of the men had been crushed down in that very spot. Nor were they wrong; for, about twenty minutes after we had arrived they came upon a battered can for water and a broken pick-axe, together with a rag or two of a bag that once held bread and meat. These were signs of death, if not of life. We were at the stretch of anxiety. In another minute they came upon a mass of soft coal, on which a jacket seemed to be fastened. The men uttered a low groan. They held up their mining-lamps. We held up ours, thinking this mass of soft coal would lead to a discovery of a dead body. The men stopped, and stood speechless. The three or four lamps were held up high as the roof. They cast an uncertain gleam of light on the rubbish below. We were a little surprised at this sudden stoppage just when there should have been redoubled zeal. One of the miners turned over the mass of soft coal, peered at it closely with his lamp, and exclaimed, 'Poor Will Coxon!' Reader, the apparent piece of soft coal was William Coxon's *dead body*; the can, the bag, the axe were his!

"The *turn*, as men say, which this gave us was not slight. We felt a sickness of heart and a parchedness of lip. We were willing—*anxious* to return; but the agent had to visit two other spots where digging was going forward, and we could not go back alone. Both these spots had been rendered remarkable by the previous exhumation of two or three bodies of the poor sacrificed men. One corpse was wrapped up, and laid on a board ready to be sent up to the surface. We then went, *on all-fours*, to a side-passage, where the damage had been considerable, and afterwards repaired to the *stables* of the pit.

"Every pit (at least in the north of England) has a very comfortable stable, where there are cribs and stalls for horses and ponies. Horses are let down the shafts by being inclosed in nets, and when once let down they may be said to have bid farewell to the sun, for they seldom come up again. In the stables below they are well looked after; and being, of course, mostly of a small size and ponies, they suffer little inconvenience. Indeed the equable temperature of the pit seems to agree even better with them than the variable and changeable climate above-ground; and they grow therefore, very sleek, glossy, and fat in their subterranean life. It is proved that they keep in excellent working condition; and, what might not be expected, their sight is nearly uninjured by being always in gloom. Of course, when an explosion

occurs, the horses share the fate and death of the men. The carcass of one poor old coal-waggon horse I stumbled over in my way to the stables. When I arrived at the stalls, singularly enough they had been little injured; and, to my surprise, in one stall, fast to his crib, stood, calmly enough, one sleek little pony munching his hay, as if nothing particular had happened. I was told that when first the exploring-party descended the pit after the accident, the earliest and only sign of life that came upon them was the shrill neigh of this little pony, expressing, after his fashion, the fact of his escape, and the urgency of his hunger! I patted the little animal with great regard, and would have wished to bestride him above-ground. He seemed to understand me; for he neighed again, and moved his little ears in double-quick time, to the accompaniment of a far-switching tail.

“From the confined workings and narrow limits of the pit, and the rapid expansion of the gas after ignition, the effects were extremely violent, and the devastation tremendous. We noticed, in groping our way back by another course, that masses of strong Memel timber had been driven before the fiery and gaseous blast, and shattered and forced into the coal. Coal-tubs, made of strong planking, and bound with iron, were broken into small pieces. Waggons had been forced off their wheels, and wheels had been made into masses of wood and iron. The explosion was distinctly felt at the surface by a sudden rush of wind and dust upwards against the current of air, the cage (or load) of coals then at the mouth of the pit being lifted several feet in height. An immense quantity of coal-dust was scattered all round; and many of the wooden props that supported the roof of the mine seem to have been charred, and, in some instances, to have been half reduced to charcoal. The effects of the explosion were distinctly felt at a distance of 700 yards from the place where it was supposed to have occurred. The coal near to the source of the calamity *took fire*, and demanded the utmost efforts and most anxious care of the miners to extinguish it. To effect this the pit was closed down, and a deluge of water was pumped down, and conducted to the supposed place of fire; had these efforts to extinguish the flames been unsuccessful, the consequences would have been yet

more fearful. Some mines which have been thus ignited have burned on for months, smoking, and charring, and smothering, and flaming up from every crevice to the daylight!

“When we had gained the surface again, the agent kindly sent a miner round with me to conduct me to the cottages where the corpses lay which had been up to that time exhumed. I had braced myself up to seeing *all*. I never looked at corpses before; but I was much excited by my adventure, and wanted to complete my mental picture of this mining woe. My guide led me into a poor cottage where darkness ruled. An old woman was moaning, a *new-made widow* was absorbed in grief, four children were weeping aloud. I entered a back room, a sheet was removed from a bed, and there I saw what I will not attempt to depict. It was a *black mummy*!—that is the nearest similitude. Five other cottages I visited, and saw five such spectacles. The last, indeed, was somewhat different. Its late owner had been killed by the *after-damp*. His features were in no way distorted, but calmly composed. His body was uncharred and unchanged. He merely looked as if he had been in a very deep sleep—but this was the sleep of death! Most of the corpses of those who are killed by the *after-damp* present this placid appearance. In all, *thirty-two* persons were destroyed by this explosion. I believe nearly all their bodies were exhumed from the mine to be inhumed in W— churchyard. On the following Sunday the little-green churchyard was the scene of a succession of funerals, or rather of one simultaneous funeral of many men and boys. Some twenty to thirty corpses are interred there of human beings who were called unto death at one moment's warning, and by one fiery blast. Such are the liabilities of a miner's life. The chimney of the pit smokes as before, the engine steams away, the men hew coal, the horses draw it, the boys drive them, the coal comes to market, perhaps to the very fire-grate of the reader of this article! Many an anxious day of thought has the writer of this article bestowed on this subject, in the hope that some preventives or palliatives for such catastrophes might be found and applied.”

IMPRESSIONS DE VOYAGE.

BY OUR OWN TOURIST.

London, May, 1851.

MY DEAR TAIT,—I have the audacity to flatter myself that you will not be sorry to see my handwriting once more, although it may strike you as being rather more shaky than in the days of old. It is not many weeks since the most fashionable M.D. of Damascus informed me, with a grave face and an impressive delivery, that, if it should please Allah to heal me of the ague under which I

was then labouring, I should find my recovery greatly promoted by the wonderful quinine medicines to be procured in the Crystal Bazaar of England, in the country of London, unto which all the Hawagées (literally shopkeepers, *alias* Franks) of the earth were gathered together. As this judicious advice happened to tally with the inclinations of the patient (a not unfrequent coincidence with fashionable physicians, whether