number of disasters have been greatly reduced during each succeeding decade. Explosions, however, still occur in the best-arranged collieries, showing that there are some phenomena not yet fully recognised and understood; and, with this fact as a justification, the author ventures to offer this paper to the members.

The author had the advantage of investigating the first and second recorded explosions in mines that yield no fire-damp—viz., the disasters at the Camerton and Timsbury collieries, Somersetshire, in November, 1893, and February, 1895, respectively. These disasters provided opportunities for observing the phenomena of two explosions not complicated by the presence of fire-damp. They exhibited the effects produced by an explosive agent, and therefore pronounced its identity, as every agent is identified by the phenomena it produces. The records have this value: They demonstrate that explosions are produced in mines by gases derived from coal-dust, and that the processes are originated under ordinary working conditions and operations; they also disclose the phenomena which identify explosions from this agent.

The effects of the disaster at the Camerton collieries were visible from the point of origin for 828 ft. towards the coal-faces, and for 3,714 ft. in the opposite direction, towards the downcast shaft. The phenomena were equally clear at the Timsbury collieries from the seat of origin to the upcast shaft, a distance of 2,900 ft., and into the several districts that branched off at intermediate points.

In the paths of the explosions there were occasional exhibitions of destruction, where men had been exposed to violent forces—trams of coal hurled off the rails, crumpled up, and their contents scattered abroad; empty trams broken, the roof ripped down in large falls, timber structures reduced to matchwood, and wrought- and cast-iron fittings and pipes torn or broken to pieces. These scenes of destruction were separated by intervals varying from 114 ft. to 1,030 ft. in length; and in the intervening spaces the men have suffered no violence, trams of coal were standing undisturbed, the empty trams were uninjured, the timber and fixtures were in their normal positions, and the iron fittings and pipes were not damaged or displaced. The phenomena of explosive violence at distinct points along the paths of the explosion, and the positive absence of such phenomena in the intervening spaces, demand for their explanation distinct modes of energy.

An examination of the local disturbances in parallel passages showed that the materials were displaced in opposite directions; and, where the destruction occurred at junctions, the wreckage was distributed in the entrance of each road. The positions occupied by the displaced materials indicated the exertion of explosive forces from a common centre, and exhibited the phenomena that must arise in a gaseous explosion, in which disruptive forces are necessarily exerted in radial lines, hurling movable objects in all directions around the gaseous body within a local area. The evidence in the disturbances and in the spaces between them left no room to question the occurrence of distinct local disruptions along the paths of the coal-dust.

Between the points of origin and the first disturbances there were considerable lengths of road in which the men were found who fired the originating shots, also their cotton food-bags, loaded and empty trams, and timbering. The men had suffered no violence, not a bone was broken, nor their clothing disturbed, the food-bags were still hanging from the roof by cotton tapes, the loaded and empty trams were alike undisturbed, and the timber standing in its ordinary position. Consequently, there could not have been either explosive violence or a rapid gaseous movement between the shots and the first disturbances; the distances were 408 ft., 420 ft., and 573 ft. respectively; and this undisturbed condition of road was repeated between every propagated explosion.

The author numbered the local explosions for facility of reference, and, referring to the disaster at the Camerton collieries, he observed six loaded trams of coal in the road between No. 5 and No. 6 explosions, which threw some light upon the gaseous movement in the interval of 492 ft. that separated these propagated explosions. The trams have an open end, in which lumps of coal are built up, and this wall of coal in the last tram faced the emergent gases of No. 5 explosion. About 60 lb. of this exposed coal, in lumps of $\frac{1}{4}$ lb. to 4 lb. or 5 lb. each, had disappeared. If the coal had been removed by mechanical force the lumps, or their fragments, must have been present somewhere in the road, but the author could not discover any trace of them. He, however, observed heavy deposits of coked coal along the opposing faces of two rods or collars (6 ft. long each) fixed next to the roof, almost immediately over the tram referred to. This coke and some fine carbon were the only visible remains of the missing coal, which had evidently been reduced to globules of coke by gases at an exalted temperature. Had there been a great velocity in the horizontal movement of the gaseous body that attacked the coal the particles of coke must have been swept along as they were produced, but they ascended almost vertically to the faces of the overhanging timber, and were deposited there, indicating a comparatively slow onward movement of the gaseous body, and showing that the disruptive forces of No. 5 explosion were expended in the immediate vicinity of their production—about 120 ft. from the tram of coal.

In a stall at the Timsbury collieries, about 210 ft. from No. 6 explosion, a tram of coal was found undisturbed upon the rails, the blocks of coal standing from 15 in. to 18 in. above the woodwork, the top surface reaching a height of 4 ft. above the floor. The hard faces of these blocks of coal all round the tram had been made to burst out into globules of bituminous matter, which underwent further destructive distillation, leaving residues of comminuted coke. Some globules remained attached to the faces of coal in different stages of production, and every ledge of coal, the edges of the woodwork of the tram, and the buffers were loaded with accumulated particles of coke resembling small shot or coarse sand. These particles of coke did not ascend to the roof, but gravitated down to the resting-places where they were found, showing an inadequate horizontal movement in the gaseous body that attacked the coal to carry the particles forward; and that the disruptive forces in No. 6 explosion, which were necessarily of an enormous velocity, were also expended in the immediate vicinity of their production.