MINISTRY OF POWER

EXPLOSION AT HAPTON VALLEY COLLIERY, LANCASHIRE

REPORT

On the causes of, and circumstances attending, the Explosion which occurred at Hapton Valley Colliery, Lancashire, on 22nd March, 1962

by

H. S. STEPHENSON, B.Sc., M.I.Min.E.

H.M. Chief Inspector of Mines and Quarries

Presented to Parliament by the Minister of Power by Command of Her Majesty November, 1962

LONDON

HER MAJESTY'S STATIONERY OFFICE

FIVE SHILLINGS NET

Cmnd. 1845

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REPORT ON THE CAUSES OF, AND CIRCUMSTANCES ATTENDING, THE EXPLOSION WHICH OCCURRED AT HAPTON VALLEY COLLIERY, LANCASHIRE, ON 22ND MARCH, 1962

24th September, 1962

The Right Honourable Richard Wood, M.P.,
Minister of Power.

Sir,

In accordance with your direction, I held a public inquiry with respect to the accident which occurred at Hapton Valley Colliery in the County of Lancaster on 22nd March, 1962, in which sixteen persons were killed, three died in hospital from injuries received, and thirteen persons were seriously injured. The names, ages and occupations of the killed and injured are given in Appendix I.

2. I opened the inquiry in the Borough Police Headquarters, Burnley, on 18th June, 1962; it lasted for five days during which sixty-one persons gave evidence. Their names and occupations are given in Appendix II.

3. The representation of the interested parties was as follows:—

The Ministry of Power, by Mr. R. H. Clough, O.B.E., H.M. Divisional Inspector of Mines and Quarries, North Western Division, with Dr. E. M. Guénault, Deputy Director of the Safety in Mines Research Establishment.

The National Coal Board, by Dr. H. L. Willett, Deputy Director-General of Production (Safety and Techniques) with Mr. E. J. Kimmins, Production Director, North Western Division, and Mr. R. Lowe, lately Area General Manager, Burnley Area.

The National Union of Mineworkers, by Mr. J. Gormley, J.P., General Secretary of the Lancashire Area, with Mr. L. K. Crossley, President of the Lancashire Area, Mr. K. Saunders, Mining Adviser to the Union, and Mr. T. Sharples, Secretary, Hapton Valley Branch.

The National Association of Colliery Overmen, Deputies and Shotfirers, by Mr. L. C. A. Benson, O.B.E., Mining Engineer, with Mr. J. Crawford, General Secretary, Mr. W. Grundy, General Secretary, North Western Area and Mr. J. Ashurst, Treasurer, North Western Area.

The National Association of Colliery Managers and the British Association of Colliery Management, by Sir Andrew Bryan, D.Sc., LL.D., F.R.S.E., Mining Engineer, with Mr. W. Oldroyd, Manager of Huncoat and Scaitcliffe Collieries, and Mr. J. M. Broadie-Griffiths, LL.B., Secretary, North Western Branch, British Association of Colliery Management.

4. I find that the casualties resulted from an explosion which occurred at about 9.45 a.m. in the No. 2 District of the Union Seam. Although coal dust played some part, the explosion was predominantly one of firedamp and affected about 680 yards of roadway and face. The evidence suggests that the explosion

originated either in the return gate stable, as a result of shotfiring, or at a point in the return gate between 180 to 280 yards outbye of the face ripping, from a flash produced by friction involving metallic foil (a thermite reaction). I am, however, unable to say which of those alternatives was the more probable. Equally inconclusive was the evidence as to the source of the firedamp involved.

GENERAL DESCRIPTION

The Colliery

5. Hapton Valley Colliery is in the National Coal Board's North Western Division and is situated on the boundary of the County Borough of Burnley. The line of management was R. Lowe, Area General Manager; J. Whittaker, Area Production Manager; W. E. Rawstron, Group Manager; A. L. Weir, Manager; and R. O'Hara, Under-manager. On the day of the explosion, B. Kennedy, a certificated colliery manager, was exercising supervision in the absence of Mr. Weir. The colliery, which employed 386 men below ground and 67 on the surface, had a daily output of about 700 tons of saleable coal, all got from two faces, Nos. 2 and 5, in the Union Seam. The general layout of the underground workings and the ventilation system are shown on Plan No. 1.

6. The colliery has three shafts: No. 3, the downcast, used for winding men, coal and materials; No. 4, the upcast, used for winding men only; No. 2 was used for pumping only but, although it was downcasting, it did not contribute to the ventilation of the mine workings. No. 4 shaft was equipped with an electrically driven exhausting fan producing 112,000 cubic feet of air per minute at 4·3 inches of water gauge. Following its completion in January, 1962, a surface drift, 1,260 yards long and dipping at a gradient of 1 in 4·16, was brought into use as a second intake. Before this drift connected with the mine workings, the ventilation of the mine had been assisted by a booster fan situated in the main return airway about half a mile from the bottom of the upcast shaft. Because it no longer made any significant contribution to the ventilation of the mine, the booster fan was taken out of commission and put on a care and maintenance basis in March, 1962.

7. The colliery has always been a safety lamp mine and, in addition to electric cap lamps in general use, flame safety lamps were issued to officials and selected workmen as firedamp detectors; those carried by the former were of the internal relighter type.

The Union Seam

8. The Union Seam which is 171 yards deep at the shafts and the only one worked at the colliery, is from 3 feet 4 inches to 3 feet 9 inches thick with a hard fireclay floor and an immediate roof of medium strong shale. As a result of faulting, the cover at the face of No. 2 District was 242 yards. The seam is gassy and in the recent past there have been three ignitions of firedamp at the colliery. On No. 1 face, now discontinued, there was an ignition during shotfiring on 23rd June, 1960, and another in the undercut, attributed to frictional sparking, on 28th July, 1960. The third ignition, also ascribed to frictional sparking in the undercut, occurred in No. 2 return gate stable on 4th April, 1961. To reduce the risk of ignition in the undercut, the management installed cutting jibs with

internal water feed. The cutting machine on the main face line was also fitted with a compressed air/water ejector for ventilating the undercut, but this additional safeguard could not be applied to the machines undercutting in the stables.

No. 2 District

General

9. Plan No. 2 shows, with other information, the face and inbye sections of the ventilating roads of No. 2 District. No. 2 face, 155 yards long, was nearly $1\frac{1}{2}$ miles from the pit bottom and was advancing southwards, in the solid, on a rising gradient of 1 in 6·25 with a very slight rise from the intake gate to the return gate. Started in September, 1960, the face had advanced 765 yards at a rate of about 10 yards per week. No. 5 face, advancing in the same direction, was 400 yards behind and 33 yards to the east of No. 2 face.

10. After infusion by water, the face was cut about 1 foot above floor level by an electrically driven machine mounted on an armoured flexible conveyor. Until 3rd February, 1962, the depth of cut was 6 feet 6 inches, but on that day the jib was changed and the depth of cut increased to 7 feet 6 inches. Coal in the stables was cut at floor level by shortwall machines. After cutting, all the coal was won by an Eq.S. explosive and compressed air picks. The same type of explosive was used in taking down the gate rippings which were kept well up to the face. The normal cycle of face operations was as follows:—

- (*a*) Afternoon shift: advance the face conveyor; drill shotholes in the face; withdraw supports from the waste; drill and cut the stables; rip the intake gate;
- (*b*) Night shift: rip the return gate; cut the face line; commence filling; and
- (*c*) Day shift: complete filling.

I refer later to shotfiring procedure in relation to these operations.

11. The roof at the face was supported by friction type yielding props set to corrugated steel bars 8 feet long. Additional friction props were set as breakers at the edge of the waste which was completely caved between the 6 yards wide intake gate pack and the 8 yards wide return gate pack. The intake gate, 14 feet wide and 10 feet high, and the return gate, 10 feet wide and 8 feet high, were supported by arched steel girders which were stilted and backed with fire-resistant wood boards.

12. Coal from the face conveyor was transferred to a belt conveyor in the intake gate, the first stage of a trunk belt conveyor system to the shaft bottom. Some supplies reached the face by the surface drift and the intake gate, using the tub track provided in that gate. Other supplies came down No. 3 shaft and along the main intake airway in tubs to the Cut-back. There the tubs passed through separation doors into the main return airway, where they were taken by an endless rope haulage to a point in the return some 300 yards outbye of the face ripping; the tubs were then hauled inbye by an electrically driven direct rope engine situated near the face ripping.

Ventilation

13. Statutory records show that for some months before the explosion the quantity of air, as measured at a point in the intake gate 10 yards outbye from

the face, was slightly in excess of 20,000 cubic feet per minute. The records also show that during the three months before the explosion the firedamp content of samples of air collected at a point in the return gate 10 yards from the face varied between 0·4 and 0·7 per cent., but occasionally it was outside these limits.

14. Firedamp was drained by holes, 120 feet long, bored from the return gate into the shale above the waste, at intervals of 35 yards. The holes were connected to a pipe range 6 inches in diameter, which was increased to 8 inches in the main return to the bottom of No. 2 shaft, and to 12 inches in the shaft. The firedamp was drawn from the boreholes and discharged to atmosphere by an exhauster situated on the surface. The quantity of gas drained averaged over 100 cubic feet per minute, which represented about 55 per cent. of the make of firedamp on the face.

Shotfiring

15. The practice was to fire shots in the intake gate stable, and also in some of the top coal on the face, during the night shift to facilitate the start of filling operations. The return gate stable was fired either at the end of the night shift or at the commencement of the day shift, according to how work had progressed. The remainder of the top coal followed by the bottom coal was fired during the day shift. The intake gate ripping was fired on the afternoon shift and the return gate ripping on the night shift. In addition to the deputies, who were not authorised to fire more than ten shots per shift, there were shotfirers available on the day and night shifts and they each carried 40 detonators. In order to ensure that all demands for shotfiring were met, some of the shotfirers' shifts were " staggered " with the main working shifts. As a result, there were frequently three shotfirers available at the beginning of the day shift.

Precautions against coal dust

16. The volatile content of the coal was 32 per cent., but the management had not formally declared this figure to H.M. Inspectors, and were thus required by law to ensure that a minimum of 75 per cent. incombustible material was always present on the roof, sides and floor of the roadways. At the last statutory sampling before the explosion, the incombustible content of most of the road dust samples was well in excess of the minimum required; the lowest recorded was 76·2 per cent.

17. A Polish type stone dust barrier consisting of 17 heavy shelves and 8 light shelves, covering about 50 yards of roadway, was sited in the intake gate about 300 yards from the ripping. One hundred yards farther inbye there was a similar barrier composed of 12 light shelves.

Automatic firedamp detectors

18. Automatic firedamp alarms were not in use at the time of the explosion, a matter to which I will refer later.

General experience

19. With the exception of the ignition in the undercut, to which I have referred earlier, the working of the district appears to have progressed without any untoward incident. The general impression created by witnesses was that the

ventilation of the district had always been good, and that men working on the face were obliged to wear coats or woollen garments to keep warm. There were no reports of firedamp having been detected other than occasionally in the return gate stable.

THE DAY BEFORE THE EXPLOSION

The Afternoon Shift of 21st March

20. On the afternoon shift, the face conveyor was moved over, the waste drawn off, the face and stables drilled, the coal in both stables cut, and the intake gate ripped. J. McKillop, deputy in charge of the district, fired the ripping. In his report for the shift, he noted that there was broken roof in the intake gate stable and his recollection was that the waste behaved quite normally in that, as the supports were withdrawn, it hung for the first 10 yards and then started to cave progressively throughout its full length.

The Night Shift of 21st-22nd March

21. On the night shift, the district was in charge of R. Jackson, a deputy, and the main operations in progress were the cutting and firing of the coal on the main face line and the ripping of the return gate. Work proceeded normally and, in spite of a late start, cutting was completed before the end of the shift, the jib of the machine drawn out of the cut, and the electric cable detached and taken into the return gate. Jackson, who examined the district twice during the shift, observed nothing unusual, but did notice a slight roof break of about 2 to 3 inches throughout most of the face. He last visited the return gate stable soon after 6.30 a.m. and, although the stable had been cut on the previous shift, he found no firedamp there. In his opinion, the ventilation was very strong. He travelled the return gate twice and, on both occasions, observed three empty tubs and two bogies near to the direct rope hauler and attached to the rope. There were a few small roof cavities in this gate, apparently caused by the deterioration of the backing boards, which had allowed roof dirt to fall through.

22. Two shotfirers, R. Latham and R. Hutchinson, started at normal shift time, and a third, R. Ridge, came on an intermediate shift starting after midnight. Each fired 40 shots distributed between the intake gate stable and the main face line; no shots were fired in the return gate stable, although nine holes had already been drilled there. None of the shotfirers found any firedamp during the shift. In addition to the shots in the coal, the deputy himself fired a few in the return gate ripping.

23. To facilitate packing the material from the return gate ripping, G. Rimaldi, who was in charge of the rippers, took down a brattice sheet which had been erected to deflect air into the return gate stable. This sheet was not re-erected because Rimaldi and his team failed to complete the building of the pack. The unpacked ripping debris was retained in the highly inclined gate behind a wooden barrier about 3 feet high. It is worthy of note that Rimaldi confirmed the deputy's statement that there were three or four empty tubs at the head of the return gate.

24. At about 10.15 p.m., J. Feltell, attendant, started up the booster fan and ran it for about an hour. This had no significance in relation to the ventilation of the district; it was merely part of the care and maintenance routine of the fan.

25. Jackson left the return end of the face just after 7.0 a.m. and at about 7.30 a.m. he met J. Halstead, one of the oncoming day shift shotfirers, at the junction of No. 2 return with old No. 1 return. He told Halstead about the holes which were drilled and ready for firing in the return gate stable. At the Deputies Meeting Station at the Cut-back, Jackson discussed the condition of the district with S. Bullen, the oncoming day shift deputy.

The Day Shift of 22nd March

26. The workmen on the day shift reached the face at about 8.0 a.m., some by the return and others by the intake gate. With one exception, none of those who went on to the face from the return gate recalled seeing a brattice sheet in position near the return gate stable. In addition to the deputy in charge of the district, there were on the face two shotfirers, J. Halstead at the return end and K. Clarkson at the intake end; 19 fillers with J. Murray as captain; two conveyor attendants, T. Isherwood at the return end and P. Ince at the intake end; a conveyor maintenance man, J. Allen; and a mechanic of the mine, G. Hartley. In the intake gate, J. Pollard, W. Bradshaw and T. Chapman were working at a floor dinting about 500 yards from the face ripping.

27. Two men, D. Rushton and R. Dunston, were completing the building of the return gate waste side pack with ripping debris left by the previous shift. In the return gate was D. McGoogan, a mechanic, who had been instructed to make an extension piece for the rope of the direct electric hauler. This machine had recently been moved nearer the face and the existing rope was not long enough to reach the return wheel of the endless haulage. Also in the gate were four electricians, G. Pickles, R. Howarth, and P. Tinsley, who were engaged in hanging a new length of armoured cable and extending the signalling system for the newly positioned electric hauler, and J. Barritt, who was responsible for supervising their work and for the routine maintenance of the electrical equipment in the district. According to J. Holden, driver of the endless rope haulage engine, three supplies lads, R. Taylor, J. Cummings and J. Forrest, left the Cut-back early in the shift to collect empty tubs which had been left up No. 2 return gate.

28. The evidence suggests that conditions on the face in the early part of the shift were quite normal. There was no evidence of roof weighting, of floor movement, or of broken coal other than that consistent with the firing of shots on the previous shift. The fillers who gave evidence said that on the face line the ventilation was normal and, indeed, many were wearing jackets and pullovers. With the exception of J. Madden and A. Fisk, to whose evidence I will refer later, none of the fillers heard any shots fired that morning.

29. The colliery records show that flame safety lamps, of the relighter type, had been issued to the deputy and two shotfirers and, of the non-relighter type, to Murray and Fisk. Automatic firedamp detectors had been provided and used at the colliery but were not available on the day of the explosion because some had become defective and all had been sent from the colliery for repair or overhaul.

30. When the day shift overman, H. Lister, reached the intake end of the face at about 9.0 a.m., he found that there had been difficulties with the running of the face conveyor. Apart from a visit to the return gate ripping, where he tested for firedamp, he appears to have been entirely preoccupied with these difficulties. While at the return end of the face, Lister spoke to Halstead, the shotfirer, who, in the course of some jocular conversation, said that he had already made a start by firing three shots. Lister did not go over the conveyor to the face of the stable, but he gained the impression that some of the coal was down because he saw it being turned back into the stable by men who were working there. He left the return end just before 9.45 a.m. to travel down the face.

31. Madden, who was the last filler at the return end of the face line, said that he was told by Rushton and Dunston, as they were passing props to him over the conveyor, that shots were about to be fired and that they were going down the return gate to take shelter. Madden assumed that he was expected to act as sentry and, regarding himself as being in a safe position, continued to pull down some coal. Fisk, who was working with J. Robinson in the return gate stable, said that he did not find firedamp when he tested there at the beginning of the shift. He helped Halstead to stem 'nine or ten shotholes' in the stable and thought that the shotfirer coupled up the leads from two shotholes in series to the shotfiring cable. Fisk went about 50 yards down the return gate to what he regarded as a safe place and he believed Halstead stopped some 10 yards short of this point.

THE EXPLOSION

32. When the explosion occurred, Murray was filling coal at a point on the face about 30 yards along from the intake gate stable. He thought it was about 9.40 a.m. when he heard a sound like the bursting of a compressed air line. The air reversed, but the normal direction of the current was quickly restored, and although there was a considerable amount of dust in the air, he did not see any flame. The fillers along the face described in their own ways their experiences of the blast and the reversal of ventilation. Madden said he was flung over the conveyor and enveloped in 'swirling soot' which came rushing on to the face from the return end. He felt certain that the noise he heard was that of a shot being fired; although he had never before experienced a firedamp explosion, he thought that it would have produced a 'far louder bang'. Fisk, sheltering in the return gate, also thought the sound he heard was that of a shot being fired. He said that he heard the shotfirer turning the key in the exploder immediately before and he naturally associated this with the event. So far as he could be expected to remember what happened in such circumstances, Fisk seems to have retained an impression that the blast came towards him from the face.

33. Pollard, working on the floor dinting in the intake gate, had just looked at his watch at 9.45 a.m., when he heard what he described as a thud and he and his mates, Bradshaw and Chapman, were enveloped in dust. The air reversed but its normal direction was resumed very quickly. Pollard, whose evidence about the time of the explosion is confirmed by the recordings on the methane drainage chart, realised that something serious had occurred. After Bradshaw had telephoned the surface, the three men went up the intake gate on to the face. After going about 60 yards along the face Pollard, recognising that there had been an explosion, immediately went back to a telephone and informed someone

on the surface, probably B. Kennedy, the acting manager. He rejoined his mates and together they made their way along the face and into the return gate, doing all they could to comfort the survivors, while stretchers and first aid equipment were being brought. Although, in the course of his search for survivors, Pollard was obliged to move some bodies, he distinctly recollects it was not necessary to move that of Halstead, the shotfirer, who was found, face downwards with his head outbye, lying on the debris in the vicinity of the ripping.

34. J. Holden, the engine driver at the Cut-back, said that at about 9.40 a.m. he attempted to 'inch' the haulage rope, but after moving very slightly, it held fast. Some five minutes afterwards, he was enveloped in dust and both doors in the Cut-back were blown open. R. McKenna, who was working in the Cut-back at the time, was sure the doors were blown open twice within a short interval. About the same time, D. Whitehead, who had been a deputy for many years and was now engaged on the supervision of fire-fighting equipment and stone dust barriers, was at a point in the main intake some 200 yards outbye of James Bradley's Junction when he felt a reversal of air. He went to the Cut-back where he was told on the telephone that something had happened in No. 2 District. On going through the separation doors into the return, he tested for firedamp and estimated four per cent. in the general body of the air. He then went up the intake, along No. 2 face and into the return gate, giving what assistance he could.

35. The Boothstown Rescue Station's No. 1 Team, practising at the nearby Huncoat Colliery, were summoned at 10.15 a.m. and arrived at Hapton Valley Colliery 10 minutes later. The Station's No. 2 Team arrived from the Rescue Station some 25 miles away at 11.10 a.m.

36. The No. 1 Team, captained by L. Wheeldin and accompanied by W. Rawstron, Group Manager, went into the pit by the surface drift at 10.35 a.m. They entered the main return airway at James Bradley's Junction where they found 0·006 per cent. carbon monoxide, but no firedamp, in the general body of the air; the ventilation was good and although there was no smoke or haze, there was a slight smell resembling that found after a fire. The team proceeded towards No. 2 face by the return gate.

37. The No. 2 Team, captained by W. Sturgeon and accompanied by L. Hampson, Rescue Station Instructor, and E. Whatmore, manager of Bank Hall Colliery, went underground by the surface drift at 11.15 a.m. They travelled the main intake airway, where they passed a number of stretcher parties, along the face and a short distance down the return gate. Sturgeon reported, among other matters, that he had seen a shotfiring exploder on top of the retained debris near the return gate ripping. A shotfiring cable, which ran through into the right-hand side of the return gate stable, was fastened to the exploder, but he was not clear whether or not it was connected to the terminals.

38. Because of the relatively slight disturbance by violence, the absence of fire, and the rapid dispersal of the afterdamp, the affected area was re-entered very soon after the explosion. True to the traditions of the industry, many willing helpers were immediately available to give first aid treatment, including the administration of morphia, to the injured. Very soon afterwards all the survivors were examined underground and further treatment given where necessary by the nursing sister and the Group Medical Officer. The positions of those who died in the pit were determined by the rescue teams and are shown on Plan No. 2.

THE INVESTIGATION

General

39. Immediately the recovery operations had been completed, H.M. Inspectors of Mines and Quarries, accompanied by representatives of management and workmen, carried out a preliminary inspection of the greater part of the mine, including the explosion area. Shortly afterwards, H.M. Inspectors and scientists of the Safety in Mines Research Establishment (S.M.R.E.) made another inspection of the explosion area only. Neither inspection revealed any obvious point of ignition, igniting agent, or source of the firedamp. Thereupon H.M. Inspectors and scientists, with every possible assistance from the representatives of the interested parties, commenced an extremely detailed investigation, which lasted two months.

The Extent of Flame and Blast

The intake gate

40. Specimens of fibrous material collected in the intake gate were examined microscopically and did not show signs of having been subjected to heat. Although there was a thin layer of explosion dust on the gate conveyor, the dry stone dust on the barriers had not been disturbed.

The face and the stables

41. There were no signs of burning in the intake gate stable, but microscopic examination of specimens collected at points along the face indicated that flame had travelled down the face to within about 30 yards of that stable. On much of that part of the face affected by flame, there were unmistakable signs of coking on the intake sides of the props, an indication that flame had come from the return side. Detonator leads coming from charged shotholes in the return gate stable showed obvious signs of having been exposed to heat. There was little or no sign of violence in either of the stables or on the first 20 yards of the face from the intake; but farther along the face there were signs of some violence, although roof supports had not been disturbed.

The return gate

42. Microscopic examination of fibrous specimens collected from an area between the face ripping and a point 550 yards outbye showed obvious signs of exposure to flame. Beyond this point to the junction with No. 5 District return, specimens had been subject to some heat but had not been carbonised. There were signs of blast near the ripping, but evidence as to direction in this area was not positive. In the length of gate between points 28 yards and 180 yards outbye of the ripping, there were unmistakable signs of blast in the direction of the face. Outbye of this area, although there were a number of small roof cavities and the floor was strewn with fallen stone, backing boards and other debris, there were no indications of blast up to a point about 280 yards from the ripping. There an electric section switch had been moved outbye, presumably by blast. In the next 40 yards of roadway, the damage from blast was the most severe in the whole of the affected area. In this length, a number of badly damaged tubs and bogies were found derailed and smashed near the return wheel of the endless rope

haulage. The wheel, the carrying frame and the arch girder supporting it had all been displaced in an outbye direction, but there was no sign of abrasion on the return wheel or its framework. Plates I and II show the damage in this area. For a further 200 yards outbye, signs of damage were much less in evidence, but there had evidently been strong blast some 650 yards from the ripping where a tank had been displaced. From there to the junction with No. 5 District return there were signs of only slight blast.

Summary

43. Nowhere in the area was there any indication of a slow burning of a rich firedamp/air mixture. The results of the examination suggest that blast had affected, in varying degree, nearly 1,000 yards of face and roadway, of which 680 yards had been exposed to flame. These indications are shown graphically on Plan No. 3.

Ventilation

44. Ventilation measurements made shortly after the explosion indicated that the quantity of air leaving the district varied from 14,200 to 15,000 cubic feet per minute. The firedamp content of this air, as measured by a methanometer, was between 0·6 and 0·8 per cent. The colliery records show that before the explosion the quantity of air passing was higher and the percentage of firedamp lower, but the actual make of firedamp was about the same. Excluding that being drawn off by the drainage system, this was about 100 cubic feet per minute.

45. Discarded firedamp drainage holes were sometimes sealed by the insertion of wooden plugs but some had been left unsealed. Six of the unsealed holes in a length of from 321 to 709 yards from the face ripping, were examined for firedamp issuing from them. By using a methanometer and probe, firedamp was found in five of these holes but only one, at 472 yards from the ripping, gave any indication of continuing flow. This was small in quantity but up to 30 per cent. was detected at the mouth of the hole. Relatively high concentrations of firedamp were found in a number of small cavities in the roof of the return gate, but it was estimated that the total volume of pure firedamp in these cavities could not have been more than 50 cubic feet.

46. On 24th March, one of H.M. Inspectors made a ventilation survey in the return gate stable without a brattice sheet in position. By using artificially produced vapour clouds as a tracer medium, he found that only a small proportion of the air leaving the face entered the stable. Here there was very marked recirculation. Using a methanometer with a probe attachment, the inspector found high concentrations of firedamp at a number of points between the roof and the top of the fallen coal, but the total quantity involved was very small. On the same occasion, the inspector, using the same equipment, made determinations of the firedamp content of air in the waste, some of them from points 7 to 8 feet above the seam roof level. In no case was the concentration higher than that in the general body of the air on the face.

47. Although the quantity of air leaving the district immediately after the explosion was found to be substantially less than that recorded from the last statutory measurements made before the explosion, later measurements showed that the quantity had increased to between 16,000 to 17,000 cubic feet per minute, with a firedamp content of 0·4 per cent.

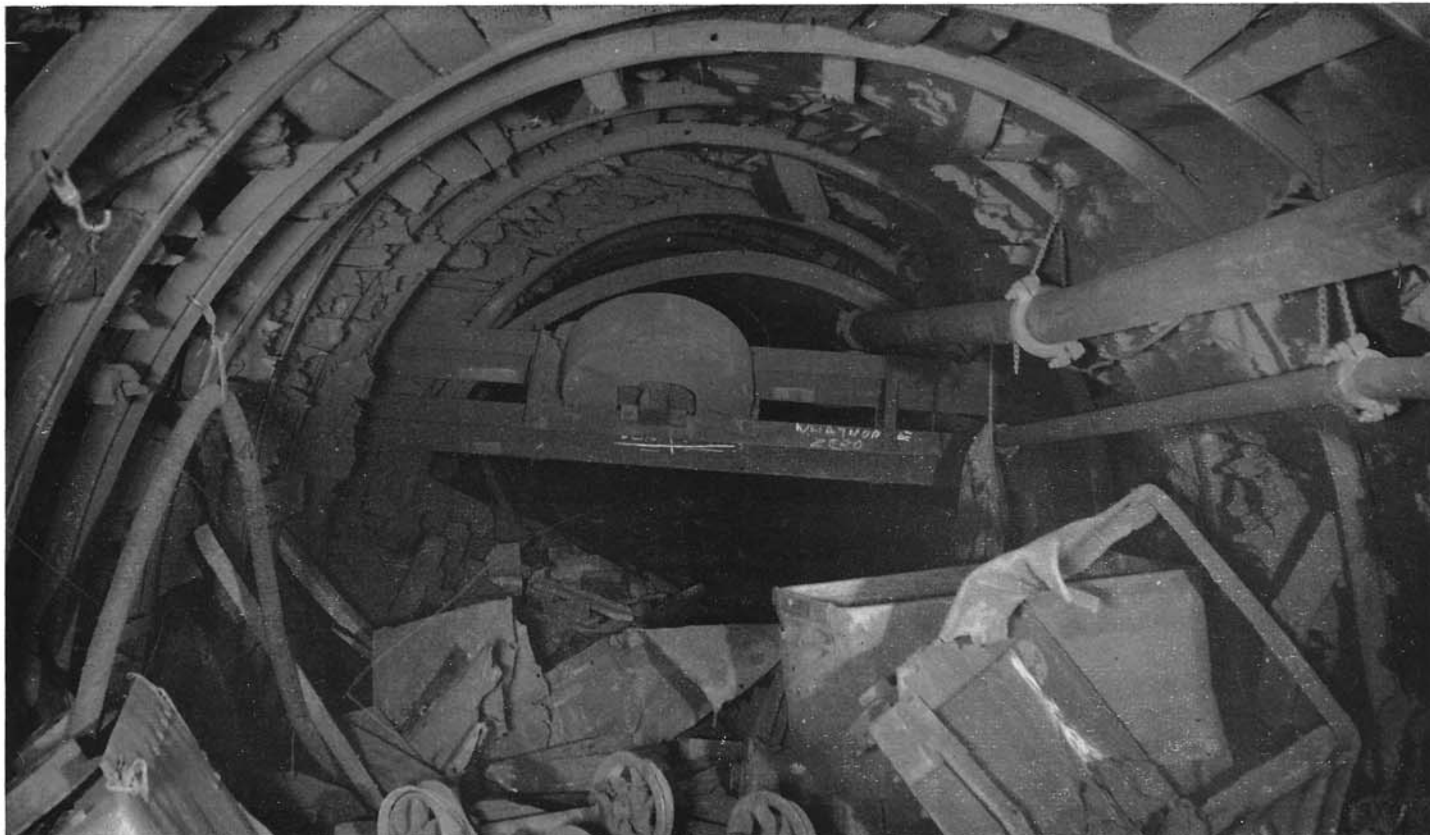

PLATE I. Wrecked tubs and bogies in return gate inbye of haulage return wheel.

Plate II. Return gate immediately outbye of haulage return wheel.

PLATE III (*a*). Hole in aluminium foil wrapping showing fusion of surrounding foil: as found among floor rubble in return gate 302 yards from ripping.

PLATE III (*b*). Hole in same specimen showing no fusion at edges.

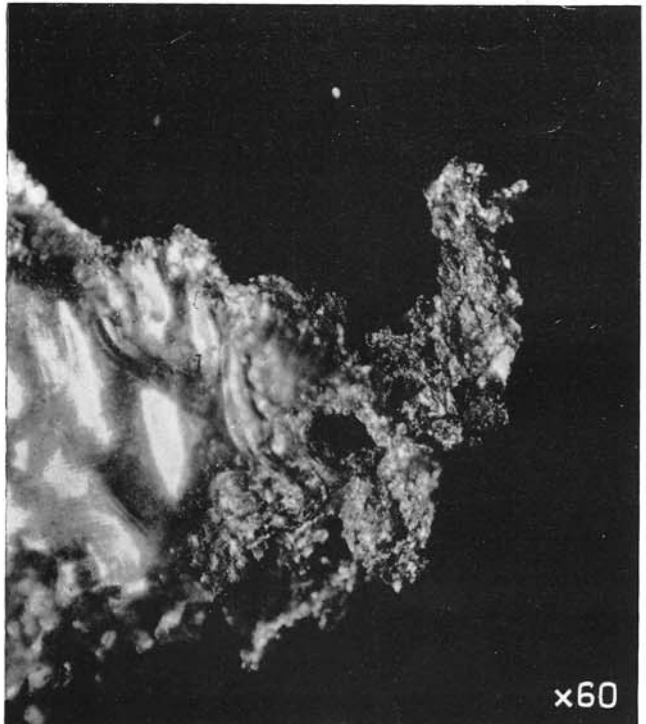

PLATE IV (*a*). Specimen of foil found in return gate: fusion at edge of foil after an ignition of firedamp in test with hard blow on foil in contact with rusted steel.

PLATE IV (*b*). No fusion with same specimen after a non-ignition with foil in contact with carborundum surface.

48. Because of the frequency with which men and materials were known to pass through the doors at the Cut-back, and men through the doors at James Bradley's Junction, it was decided to measure the effect of opening these doors on the ventilation of the district. Two tests were carried out, one with the doors at James Bradley's Junction fully open, and the other with the doors at the Cut-back partially open. In the first test, the normal quantity of air reaching the face was reduced by 6,000 cubic feet per minute and, in the second, by 5,000 cubic feet per minute.

Explosives

49. In the course of the investigation, two hessian sacks were found, each containing the same type of Eq.S. explosive in cartridge form. One, near the intake gate ripping, contained 12 pounds and the other, near the return gate ripping, 56 pounds.

50. Along the first 14 yards of the face from the intake gate stable, 10 shotholes had been drilled in the bottom coal. Nine of these had been charged and stemmed, and a single-shot exploder with connected cable was lying between the ninth and tenth holes.

51. In the return gate stable, seven shotholes had been drilled and six of them charged and stemmed. The charged shotholes were disposed in two groups, two near the ribside and four to the left side of the stable. In the short length between the two groups there was a heap of broken coal lying against the face. It was clear from the evidence in the roof and face that at least two shots had been fired in this vicinity. Of the group of four shotholes, the one immediately next to the broken coal and about 12 feet from the face buttock invited particular attention. It was observed that the coal on the loose side of this hole was fractured by innumerable fine cracks. When this coal was removed by hand, a plug of stemming at the front of the hole and three cartridges of Eq.S. explosive were revealed. The latter were impacted together as though they had been subjected to pressure from the back of the hole, and the inner end of the last cartridge was covered by a coating of coal dust $\frac{1}{8}$ of an inch thick. The shothole was subsequently found to extend about 12 inches beyond the last cartridge, but this section was empty. A primer cartridge was not found and there was no evidence to suggest that the shot had blown out laterally. Two detonator wires were found in the hole; one reached only as far as the stemming, but the other extended to the inner end of the recovered part of the charge. Nothing unusual was observed in the condition of the remaining five charged holes and they were subsequently fired without incident under the supervision of H.M. Inspectors.

52. A shotfiring cable, without detonator leads attached, extended from the face side of the conveyor, over a roof bar, under the return gate ripping, on to the ripping debris, where the remainder was tied in a hank with one of the leads connected to a single-shot exploder. A shotfiring exploder key was later found in the clothing of Halstead, the shotfirer, whose body was recovered from nearby.

53. A case, subsequently found to contain 31 detonators, was also found in Halstead's clothing. Some of these, with others taken from the colliery magazine, 25 in all, were sent to the Armament Research and Development Establishment, Woolwich, for X-ray examination and test. They were found to be normal in all respects.

54. Explosive from the pit and from the colliery magazine, when tested for behaviour and composition, proved to be normal. Tests for sensitivity to initiation of detonation on some of the explosive referred to in paragraph 51 showed that it had not deteriorated.

Safety Lamps

55. The five flame safety lamps and 53 electric cap lamps (some incomplete) recovered from the district, were sent to S.M.R.E. for test. The flame lamps and 28 of the electric cap lamps were found to be in approved condition, securely locked and in working order. The remainder of the electric cap lamps had each sustained some damage but this was considered to have been caused by the explosion.

Contraband

56. Smoking materials were not found either during the underground investigation or when the effects of the victims were examined on the surface.

Road Dust Samples

57. After the explosion, samples of roadway dust were collected from the roof, sides and floor at six places in the intake gate and 13 in the return gate. Analysis showed that, of the samples taken from the roof and sides in the intake gate, all contained from 80 to 98 per cent. incombustible material, with the exception of one, taken near the face ripping, which contained 59 per cent. The floor samples from the intake gate contained 62 to 97 per cent. incombustible material, except one, again taken near the face ripping, which contained 43 per cent. The samples from the roof and sides in the return gate varied from 69 to 86 per cent. incombustible material and those from the floor 62 to 95 per cent.

Electrical Apparatus

58. H.M. Electrical Inspector made a visual examination *in situ* of all the electrical apparatus in the district. As this failed to reveal any electrical defect, he had certain of the apparatus removed from the mine for more detailed examination and test. At the surface, the main supply cable and joint boxes were subjected to high voltage insulation tests; the joint boxes were also stripped, but no defects were found. The main switchgear and other items of electrical equipment were examined at the S.M.R.E. but there was no evidence of heavy arcing from electrical fault within any of the enclosures. A section switch, five gate-end panels and a drilling machine were twice subjected to the standard flameproof test and proved to be in safe working order.

59. The S.M.R.E. also tested, for intrinsic safety, a signalling transformer, six signalling bells and one magneto telephone, all of which conformed to their approval specifications. Two single-shot exploders, although showing signs of long use, were proved to be in good condition and their shotfiring efficiency unimpaired; they also satisfied intrinsic safety tests. Two twin core, plastic covered tinned copper wire cables, associated in use with the exploders, were found to be in good condition.

Mechanical Apparatus

60. H.M. Inspector of Mechanical Engineering examined all mechanical apparatus in the district. He paid particular attention to the return end drive of

the face conveyor but found nothing to suggest that frictional heating had occurred. During his examination of the direct rope haulage system in the return gate, the inspector observed that the rope had been run out to within 35 yards of the endless haulage return wheel. The rope was attached to the first link of a three-link chain. A second length of rope some 50 feet long was threaded through the last link of the chain, tied with two half hitches which appeared to have been subjected to strain, and laid out along the road as an extension of the first rope. At the outbye end of the extension rope was a capel not completely fixed. The only vehicles seen in the return gate were damaged tubs and bogies near the return wheel.

Frictional Heat

61. The Union Seam contains intrusions of rock roughly spherical in shape, in which there are inclusions of iron pyrites, sometimes associated with quartz. They are known locally as 'bobbers' and ignitions of firedamp in the undercut at the colliery have been attributed to coal cutter picks striking them. Because of this, a number of those found cast aside in the return gate were subjected by S.M.R.E. to rubbing and impact tests in an atmosphere containing 7 per cent. of methane, but no ignition occurred. The shale overlying the seam was recognised as being too soft to produce incendive sparking.

62. Because it was known that smears left by contact of aluminium alloys with rusty steel could, from subsequent blows, produce a thermite type reaction giving rise to a flash capable of igniting firedamp, S.M.R.E. tested a portable electric drilling machine and a fire hose nozzle both made from light alloy, and recovered from the return gate near the face. It was found that, while both items were capable of producing dangerous smears, there was no evidence that they had in fact done so. A search was made for such smears in the return gate but none was found.

63. In a length of the return gate from 192 to 307 yards outbye of the ripping, 18 metal foil wrappings of a type used for confectionery and chewing tobacco were found. Nearly all the specimens were damaged by what appeared to be normal usage but two had holes, the edges of which, when examined microscopically, were found to be thin and torn, with the appearance of having been fused (*see* Plate III). When pieces from each of the specimens were submitted to glancing blows with the foil resting on rusty steel in an explosive firedamp/air mixture, ignitions were obtained with all but two of the specimens, one of which was too small to handle (*see* Plate IV). These foil wrappings, which are generally of aluminium, usually have paper backing, sometimes waxed; where this backing was retained ignition could not be obtained.

64. The two specimens which had signs of fusion when picked up, were found at points 302 yards and 307 yards, respectively, from the return gate ripping. The signs of fusion on these specimens were very similar to the signs on the pieces of foil which had given incendive flashes when tested.

Strata Control

65. Strata control in the district was good and none of the features observed before or after the explosion was indicative of unusual roof movement. The roof breaks observed at the face by the afternoon and night shift deputies were not accompanied by marked displacement, and were not unusual. The deputies

described the wastes as behaving normally. Both intake and return gate rippings contained some bed separation, but firedamp was not found to be coming from these points after the explosion. The small cavities in both gates were attributed either to normal deterioration of the backing boards before the explosion or, in the case of the return gate, to explosion violence.

THE CAUSE OF THE EXPLOSION

Point of Ignition and Spread of Explosion

66. At the inquiry, F. J. Hartwell, a Senior Principal Scientific Officer in charge of the S.M.R.E. investigation into the explosion, summarised the conclusions he had reached about the point of ignition and the spread of the explosion. These were based on three facts. Firstly, none of the fibrous specimens examined had been exposed to flame for more than a very short time. Secondly, at no point in the explosion area was there evidence of slow burning of rich firedamp. Thirdly, there had been a rapidly moving flame accompanied by considerable violence, although not so great as would be expected from the most explosive mixture of firedamp and air, with a relatively 'quiet zone' between 180 yards and 280 yards outbye of the return gate ripping. These three facts and his experience of other explosions, led Hartwell to take the view that the explosion could have originated in this 'quiet zone'. The signs were that flame had travelled outbye from this area with some violence to a point about 550 yards from the face ripping, and possibly with less violence inbye, to the return gate stable. Here it was probable that there had been additional firedamp which would have added to the violence sufficiently to raise some coal dust along the face, contributing to the spread of flame and blast in that direction.

67. He added, however, that alternatively, but equally possible, firedamp might have been present and ignited in the return gate stable and that flame from such an ignition could have blown out on to the face, causing a minor coal dust explosion there. If this did occur, flame from the stable could have been propagated down the return gate in a 'trail' of firedamp along the roof to a body of firedamp which would have exploded with flame and blast in both directions.

68. Either possibility would have required the presence in the return gate of a reasonably well mixed volume of firedamp and air. The violence observed was consistent with the explosion of about an 8 per cent. firedamp/air mixture. Assuming that a mixture of this order had been involved, Hartwell estimated that at least 2,000 cubic feet of pure firedamp must have been present. To have remained apparently undispersed in the relatively large volume of air passing through the district, this quantity must have been emitted quite quickly.

Source of the Firedamp

69. Hartwell said that he had not found any scientific evidence to indicate a possible source of the firedamp, but he thought probable places might be half-way along the face or the return gate stable. Dr. Willett, for the National Coal Board, thought the firedamp came 'either from the solid coal in the vicinity of the top stable or from the waste'. Mr. Clough, H.M. Divisional Inspector of Mines and Quarries, on the other hand, was firmly of the opinion that the firedamp could have come only from the waste because neither on the face nor in the return gate stable were there strata breaks or displaced coal, the more common signs of rapid emission. Sir Andrew Bryan, for the National Association of Colliery Managers and for the British Association of Colliery Management, considered that the evidence regarding the source of the firedamp was inconclusive.

Means of Ignition

70. All of the representatives were of the opinion that, of the possible causes of ignition, only explosives and frictional heat need be considered.

Frictional heat

71. Mr. Crawford, for the National Association of Colliery Overmen, Deputies and Shotfirers, suggested that firedamp had been ignited by either frictional sparking or thermite reaction as a result of vehicles running uncontrolled down the return gate. No other form of frictional heat was considered by the representatives as a possible source of ignition.

Explosives

72. Mr. Gormley, for the National Union of Mineworkers, and Mr. Clough were both of the opinion that a shot fired in the return stable was the igniting agent in the explosion. Because of the finding of charged shotholes and indications of others having been fired, it was clear that shotfiring operations were in progress at the time of the explosion. Some of the men who died in the explosion were found grouped together some little way down the return gate, as if sheltering from shotfiring, and both Madden and Fisk, the only two survivors of those known to be in or near the return gate stable at the time of the explosion, thought that the explosion followed the firing of a shot. However, if a shot was fired immediately before the explosion, the shotfirer, Halstead, must have had time to return the shotfiring key to his pocket, where it was found afterwards. Mr. Clough thought that an ignition in the stable would have been of firedamp from the broken coal already produced by other shots and that this flame, in turn, ignited gas passing from the face into the return gate after being emitted from the waste. In these circumstances, he concluded that Halstead would have had time to return the firing key to his pocket and to begin returning to the shotholes before he realised that gas was burning in the stable.

CONCLUSIONS

73. Although I have given long and earnest consideration to the mass of evidence produced and to the submissions made to me at the inquiry, I have not been able to find an entirely satisfactory explanation either of the source of the firedamp or of the means by which it was ignited.

74. I accept Hartwell's view that this was not an explosion of maximum violence and that not less than 2,000 cubic feet of pure firedamp was present in the return gate in a fairly well mixed body of gas and air. In considering the ways in which such a condition might arise, I dismiss the possibility that it resulted from an interruption of the normal ventilating current. The average firedamp content of air leaving the district was little more than ½ per cent. in a quantity of about 20,000 cubic feet of air per minute and, in order to produce the quantity of firedamp estimated to have taken part in the explosion, the ventilation would have had to be completely stopped for about 20 minutes. There is no evidence that this occurred.

75. In considering the possibility of a rapid emission of firedamp in the return gate stable, one must bear in mind that the volume of the stable was about 700 cubic feet, and that it was not being positively ventilated. An emission of the

order of at least 2,700 cubic feet would have been required to account for 2,000 cubic feet being rapidly displaced into the return gate, and that remaining in the stable, about 700 cubic feet, would have dispersed only very slowly. With some 2,000 cubic feet of firedamp moving very rapidly into the main ventilation current, it is possible that the required explosive mixture could have been formed in the return gate. On ignition, the blast ahead of the flame travelling up the return gate could have so dispersed any rich firedamp remaining in the stable as to cause it to inflame and to continue the explosion, with the help of coal dust, along the face. This depends entirely on not less than 2,700 cubic feet of firedamp being emitted very rapidly in the stable, and there was no evidence that this had occurred.

76. Had the firedamp come from the waste immediately behind the working face, it would have been emitted fairly rapidly as a solid plug, mixing with air taking place principally in the roadhead area, but some of the rich firedamp being diverted into the stable. This also could have produced the condition visualised by Hartwell of an explosive mixture some distance down the return gate and a local accumulation in the stable.

77. Firedamp from a high level in the waste could have been pushed out on to the face but this, I feel, would have required a heavy strata movement which one would expect to be audible, but no evidence as to this was produced. An emission from the waste could, however, have taken place quietly had the firedamp been hanging close to the edge of the waste, but after the explosion efforts to establish the location of the firedamp were unsuccessful even though probes were pushed up into the waste to a distance of 7 to 8 feet above the seam roof level.

78. Though they were not put forward at the inquiry, I cannot disregard two other possible sources of the firedamp. The first is the return gate ribside. A sudden emission of the amount postulated would normally be accompanied by breaks in the coal and surrounding strata. The fact that no such breaks were found after the explosion is not, however, conclusive proof that they did not exist. They could have been present near the ribside but concealed by packed material. The second possible source is unplugged methane drainage holes. There were five such holes in the return gate between 200 to 350 yards outbye from the face. Separation of the upper beds resulting from the working of No. 5 face could have made rich firedamp available to these holes. Relatively high pressures would have been needed to emit the firedamp, but not in my opinion higher than might have occurred.

79. In common with the representatives who made submissions at the inquiry, I accept that, on the evidence, all possible causes of ignition other than explosives and frictional heat can be dismissed.

80. The use of explosives has long been recognised as a possible cause of ignition of firedamp and there is ample evidence that shotfiring was in progress in the return gate stable at the time of the explosion. It is clear that shots in the stable were fired from a point immediately outbye the ripping debris. The position in which the body of the shotfirer was found, that is on top of the debris, face downwards with head pointing outbye and with the shotfiring key in his pocket, suggests that, after firing a shot, he was either going towards or returning from the stable when the explosion occurred. Fisk, who at the time was sheltering in the return gate outbye of the ripping, said in evidence that 'the blast came at me from the stable hole'. I am satisfied that the rate of emission of the firedamp involved in the explosion could have been such as to create adverse

conditions in the vicinity of the stable between the shotfirer's examinations and the firing of any shots.

81. Had shotfiring in fact been the cause of an initial explosion, it would have required the flame from firedamp ignited in the stable to communicate with and explode a mixture farther down the gate. That the blast pattern showed marked signs of movement towards the face does not rule out this possibility, as blast from a minor explosion in the return gate stable would have been masked by the effects of a much larger explosion down the gate. This, of course, presupposes two explosions and is supported by a witness who gave evidence that the doors at the Cut-back opened and closed twice.

82. A great many pieces of foil of the type commonly used in the wrapping of confectionery and chewing tobacco were found in the return gate, including some in the 'quiet zone' referred to by Hartwell. The S.M.R.E. have shown that, if this material is laid on rusty steel and struck a glancing blow by a hammer, a thermite reaction capable of igniting firedamp may result. Two pieces of foil found immediately on the outbye side of the 'quiet zone' showed signs of fusion which, I am advised, would result from the thermite reaction to which I have referred. No pieces showing signs of fusion were found in the 'quiet zone' but this is no proof that none was present. Even the most meticulous search could not be expected to reveal all the pieces. I cannot, however, find any evidence of movement in this zone which would have produced the kind of blow required to cause a thermite reaction.

83. In considering whether the firedamp was ignited by frictional heat, it must be remembered that, at the beginning of the shift there were empty tubs at the top end of the return gate waiting to be taken down to the return wheel, and that these were found after the explosion piled up near the return wheel. But there is evidence that three supplies lads had been sent early in the shift to collect the tubs and that the rope itself, which was to be lengthened, was found after the explosion almost fully extended. The rope would not, in my opinion, have been drawn by hand down the gate solely for recapping by the mechanic. I consider it more likely that the supplies lads used it to lower the tubs as far as possible and, in this event, the tubs would then have been at a point not more than a few yards from the outbye fringe of the 'quiet zone'. Had the tubs run uncontrolled from this point and ignited firedamp either by running over aluminium foil or by violent impact with any other material, the resulting ignition would not, in my opinion, have produced the flame and blast pattern described by Hartwell.

84. I am led to the conclusion, therefore, that there was either one explosion, predominantly of firedamp in which coal dust played little part, initiated at a point from 180 to 280 yards outbye of the face by thermite flash from aluminium foil, or two explosions, a minor one of firedamp and coal dust initiated by shotfiring in the return gate stable, followed almost immediately by a major explosion of a large body of firedamp/air mixture in the return gate.

GENERAL REMARKS

Firedamp Drainage and Caving

85. The effectiveness of drainage in retracting the firedamp fringe from the face edges of strip packed wastes has been generally demonstrated, but the effect where complete caving is practised is by no means clear. When firedamp drainage

was first applied to the No. 2 face, the strata boreholes were driven from the return gate over the waste and angled towards the face. The mixture drained was, however, consistently low in methane, and to improve this the direction of the boreholes was changed to 90 degrees to the line of the roadway, and the elevation reduced from 45 degrees to 40 degrees to the horizontal. This increased the methane content of the mixture, but the reason for this is not known.

86. The object of drainage by boreholes is to remove firedamp from the strata and so by reducing accumulations in the waste, prevent the possibility of emissions of firedamp into the general air stream. It is assumed that substantial separation can occur in the uncaved beds and more needs to be known of the effect of strata borehole drainage on gas in the cavities so produced. The effect is obviously a function of borehole angles in relation to bedding planes and seam inclination and it may be that, in some cases of complete caving, two series of firedamp drainage holes may be needed—one aimed at the extraction of a mixture of high firedamp content from the relaxed strata and the other for removing relatively low firedamp content mixtures from the cavity immediately above the fallen material.

87. A useful additional feature of observations on the effects of firedamp drainage would be the continuous monitoring of the firedamp content in return airways to ensure the detection of any sudden emission from the waste into the ventilating current.

Stables

88. I was disturbed by the casual attitude of both management and officials to the coursing of the ventilation into No. 2 return stable. In evidence, the manager agreed that the decision whether or not to use a brattice sheet for this purpose was left entirely to his subordinate officials. The officials who gave evidence appear to have given little thought to the ventilation of the stable; rather they seem to have assumed that, as the ventilation on the face was brisk, sufficient air would enter the stable. One man, working on the return gate ripping the night before the explosion, took down the brattice sheet used to divert air into the stable because he thought it would interfere with the building of the waste side pack. The deputy on this shift agreed, however, that the sheet could have been maintained in position without interfering with the work of ripping and packing.

89. Stable holes are now a common feature of modern mining practice and, to fulfil their purpose of accommodating power loading machinery, they must be advanced rapidly by the use of machines and explosives. Where high rates of advance are achieved, the stables at some stage in the cycle of work are taking on the characteristics of short headings driven in advance of the face line and as such demand a positive system of ventilation.

Automatic Firedamp Alarms

90. The automatic firedamp alarms in use at the colliery had not functioned reliably, and they had been withdrawn for servicing some seven weeks before the explosion. The efficient performance of the various types of automatic firedamp alarms available to the industry demands a high standard of mainten-

ance, but the unreliable behaviour of these over the past years has created a generally unfavourable impression of the degree of protection they offer. They were, however, originally designed and introduced to give warning of the sudden appearance of abnormal amounts of firedamp such as I envisage might have occurred at Hapton Valley Colliery.

91. The circumstances of the explosion clearly indicate the need for an improved type of automatic firedamp alarm, preferably one giving a strident audible warning.

The Use of Explosives

92. During the investigation, a number of irregularities in the use of explosives came to light. Large quantities of explosives had been taken below ground in hessian bags instead of in proper containers; this can only have been done with the connivance of the shotfirers, probably as an aid to the rapid charging of shots, but I find it difficult to accept that the practice escaped the notice of officials. Another irregularity was the charging together of a number of shotholes intended to be fired singly. With this practice, the firing of any one shot may so affect the burden of successive shots that they become either dangerously over-burdened or overcharged. Not infrequently groups of two shots were fired in coal with a single shot exploder, with the consequent risk, not only of misfires, but of undetected misfires.

93. It was the usual practice at the colliery for shotholes to be bored in the coal before undercutting, so that the operation of boring could be more conveniently fitted into the cycle of operations at the face. However convenient this may have been, the practice was undesirable. When a face is bored first, the subsequent machine undercutting may either shatter a hole and make it useless or leave it in a dangerous condition by producing breaks across it. Although breaks should be discovered by using a break detector, it is wrong to follow a method of working which might create a danger that could escape detection. In this connection I am not satisfied that break detectors were either conscientiously or regularly used at the colliery.

94. It is clear that, to complete the stripping of the deep cuts, the speed with which shots could be fired would have been an important factor; this, in itself, must have been an invitation to indulge in bad practices. The conditions under which shotfirers work should not be such that they are encouraged to disregard the requirements of regulations or neglect to carry out the proper methods of work which they have been taught during their training.

95. Although there were only two production units at the colliery, and these quite close together, it nevertheless had a full management structure and an ample complement of officials. It was all the more disappointing to me that irregularities such as those to which I have referred should have gone uncorrected.

96. I was also disappointed to learn that the workmen at the colliery had failed to take full advantage of the right conferred on them by Section 123 of the Mines and Quarries Act, 1954, to inspect the colliery. Persons had been nominated for this purpose and there was an inspection of No. 2 District as recently as 22nd February, 1962, but the records show that such inspections averaged no more than one a year.

Aluminium Alloys and Wrapping Foil

97. The danger of incendive sparking from aluminium alloys has been known for some ten years now. Steps have already been taken by the National Coal Board to limit, so far as possible, the use of equipment made from these alloys to situations underground where the danger of inflammable gas is remote. In fact, the National Coal Board's Production Instruction on this matter had been revised shortly before the explosion. In view of the evidence from this disaster, I feel that another revision should be made of this Instruction with particular reference to aluminium equipment which may still be used in face workings and subsidiary roads, especially return airways. Portable drills should certainly be considered since I understand that manufacturers can now produce them constructed of steel or brass. At the same time, I see no reason why fire fighting equipment should not be constructed of material other than aluminium alloy. There may be other items in the construction of which the use of these alloys cannot be justified.

98. The position in regard to the use of metallic foil in wrapping confectionery and chewing tobacco is not so clearly within the control of the National Coal Board or other mine owners. This is a matter not confined to mining communities but in general use. Dr. Willett, in his submission, suggested that the various associations and organisations in the industry should jointly consider the steps which might be taken to prevent aluminium foil wrappings from being taken underground. I agree with this suggestion which I am pleased to say is, at the time of writing, being actively considered by the Safety and Health Committee of the Coal Industry National Consultative Council.

RECOMMENDATIONS

99. I recommend that:—

(1) the National Coal Board should undertake further investigation into the effect of borehole drainage on the movement of firedamp where total caving is practised, including the possibility of using lower inclination boreholes aimed at exhausting from waste cavitation in addition to boreholes into relaxed strata, and the continuous monitoring of the firedamp content in return airways from such faces;

(2) managers of collieries should ensure that stables are always positively ventilated;

(3) managers of collieries where shotfiring forms one of the principal face operations should review current shotfiring practice and ensure that not only are explosives used efficiently but that the circumstances are such that the shotfirers are not tempted to disregard the requirements of safety;

(4) every effort should be made to hasten the development of a robust automatic firedamp detector which is easily maintained and gives a strident audible alarm;

(5) the National Coal Board should further revise the restrictions imposed on the use of aluminium based alloys so as to exclude them from face workings, from return roadways and from within 300 yards of the face in all other roadways; and

(6) the several associations and organisations in the industry should consider ways and means of preventing aluminium foil wrappings from being taken below ground in permitted light mines.

ACKNOWLEDGMENTS

100. I should like to record my thanks to the Town Clerk and other officials of the County Borough of Burnley for the facilities they afforded me in making the arrangements for the inquiry; to Mr. Massey, the Chief Constable of Burnley, for placing the Lecture Hall in the Borough Police Headquarters at my disposal for the inquiry and to his officers for their continual service during the proceedings; to the representatives of the interested parties for their courtesy and co-operation; to all those concerned in the investigation—National Coal Board staff, representatives of mining officials and workmen, members of the Safety in Mines Research Establishment and H.M. Inspectorate—for sparing no effort in seeking the cause of the explosion; and to Mr. Edge, National Coal Board Area Planning Engineer and his staff for the excellent plans displayed at the inquiry. I am particularly indebted to Mr. A. R. D. Murray of the Ministry of Power for his invaluable assistance at the inquiry and in the preparation of this report.

I have the honour to be, Sir,

Your obedient Servant,

H. S. STEPHENSON.

APPENDIX I

Names of Casualties

Name	*Age*	*Occupation*
Killed		
Christopher William Brown	55	Driller
Samson Henry Bullen	44	Deputy
James Cummings	19	Supplies Man
Robert Dunston	26	Ripper
Stanley Faulkes	41	Filler
John William Halstead	53	Deputy/Shotfirer
George Hartley	32	Mechanic
Raymond Ernest Howarth	20	Electrician
Tom Isherwood	49	Face Scraper Operator
Donald Stewart McGoogan	28	Mechanic
Garry Pickles	22	Electrician
John Robinson	24	Filler
Donald Rushton	33	Ripper
Robert Shuttleworth	33	Filler
Ronnie Anthony Taylor	16	Supplies Man
Benjamin Walsh	25	Filler
Died from injuries		
John Greig Barritt	23	Electrician
Joseph Forrest	17	Supplies Man
Peter Tinsley	16	Apprentice Electrician
Seriously injured		
James Allen	48	Conveyor Maintenance Man
Neville Edward Barker	24	Filler
Brian Bullen	23	Filler
George Dyson	34	Filler
Alan Fisk	24	Filler
Brian Greenwood	23	Filler
John Heywood	24	Filler
Joseph Madden	46	Filler
Jack Myers	35	Filler
John Pinder	28	Filler
Robert Pinder	25	Filler
Henry Dransfield Walker	39	Filler
George Walsh	21	Filler

APPENDIX II

Names of Witnesses

Name	*Occupation*
Allen, J.	Conveyor Maintenance Man
Almond, C.	Overman
Ashton, W.	Driller
Barker, N. E.	Filler
Behr, Dr. G.	Consultant Pathologist
Bonell, J. N.	Police Constable
Bullen, B.	Filler
Carver, J.	H.M. Senior District Inspector of Mines and Quarries
Clarkson, K.	Shotfirer
Cowley, V.	Ventilation Officer, Bank Hall Colliery
Dyson, G.	Filler
Edge, F. H.	Area Planning Engineer
Edwards, L. L.	H.M. Senior District Inspector of Mines and Quarries
Faulds, H.	H.M. Inspector of Mechanical Engineering
Feltell, J. H.	Booster Fan Attendant
Fisk, A.	Filler
Greenwood, B.	Filler
Hacking, R.	Machine Man
Haken, J. S.	Group Ventilation Officer
Hartwell, F. J.	Senior Principal Scientific Officer, S.M.R.E.
Heffernan, Dr. C. K.	Consultant Pathologist
Heywood, J.	Filler
Holden, J. I.	Haulage Engine Driver
Holland, S.	Unit Mechanical Engineer
Hope, T.	Machine Man
Hutchinson, R. H.	Shotfirer
Ince, P.	Conveyor Attendant
Jackson, R.	Deputy
Kendall, T.	Filler
Lane, J.	H.M. Senior District Inspector of Mines and Quarries
Latham, R.	Shotfirer
Lister, H.	Overman

Name	*Occupation*
Madden, J.	Filler
MacDonald, B.	Filler
McKenna, R.	Supplies Man
McKillop, J. P.	Deputy
Meldrum, C.	Mechanic
Morgan, T.	Unit Electrical Engineer
Murray, J.	Filler
Myers, J.	Filler
O'Hara, J. B.	Ripper
O'Hara, R. A.	Under-manager
Parry, G.	Group Surveyor
Pinder, J.	Filler
Pinder, R.	Filler
Platts, E. J.	H.M. Electrical Inspector of Mines and Quarries
Pollard, J.	Ripper
Ridge, R.	Shotfirer
Rimaldi, G.	Ripper
Sagar, R.	Safety Officer
Sharples, T.	Repairer
Spencer, J.	Deputy
Stanton, C.	Ventilation Officer
Sturgeon, W.	Rescue Team Captain
Wade, J.	Booster Fan Attendant
Walker, H. D.	Filler
Walsh, G.	Filler
Weir, A. L.	Manager
Wheeldin, L.	Rescue Team Captain
Whitehead, D.	Deputy
Widdicks, A.	Police Constable

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