

Report on Explosion

No. 3 Shaft
Providence Mining Company
Providence, Kentucky

November 25, 1910

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Report written by R. Y. Williams, Mining Engineer

Preliminary Statement.

On the afternoon of November 25th, 1910, an explosion occurred in the No. 3 shaft of the Providence Mining Company at Providence, Kentucky. Ten (10) lives were lost, the headframe of the tippie was demolished, and every stopping and door in the mine was wrecked. The following report outlines the rescue tactics used in locating and recovering the bodies, describes the conditions that were found at the working "faces" and along the entries, and suggests the probable origin and travel of the explosion.

Introduction.

The town of Providence is situated in Webster County, Kentucky, on branch lines of the Louisville & Nashville and the Illinois Central railroads. The mines of this vicinity are classified as forming a part of the Western Kentucky Coal Field. The principle coal seam developed near Providence, and the one in which the explosion occurred, is known as the No. 9 seam according to the Kentucky State Geological Survey, or the No. 5 seam of Indiana and Illinois. This seam at Providence averages 4 feet 10 inches in thickness, lies under a strong black slate roof, and has a hard, smooth, clay pavement. A sample of this coal, taken by Mr. George S. Rice, April 1909, in the Providence Mining Company's mine No. 1 (The entries of which mine are only 400 feet from the No. 3 shaft) gave the following proximate analysis:-

Moisture.....	1.61%
Vol. Combust. Matter...	37.28%
Fixed Carbon.....	51.85%
Ash.....	<u>9.26%</u>
Total.....	100.00%
Sulphur,	3.32%

The NO. 3 shaft of the Providence Mining Company had but one opening which was a shaft 103 feet in depth. This shaft contained two hoisting compartments (which served also as the upcast for the air) and a third compartment half of which was used as a pipeway and as the downcast for the ventilation, the other half serving as an escapeway for the men. The air compartment was separated from the hoisting compartments by 4" timbers and from the escapeway by 1" board brattices. As the 4" timbers did not exactly fit, lagging was placed on the hoisting compartment side of the partition to prevent the leakage of air. A 12-foot Cole centrifugal force fan, located 10 feet north of the shaft, furnished 30,000 cubic feet of air per minute, this air being split at the foot of the shaft in order to send half to the west side and half to the east side of the mine.

The mine was developed on the room-and-pillar system, the main entries running east and west on the three-entry plan. This was a comparatively new mine, the first shipment of coal having

been made in October 1909; and a glance at the map shows that the mine was still in the development stage, the most distant workings being but 500 feet from the shaft.

The method of mining adopted at this shaft was known as "shooting off the solid", the miners drilling, ~~and~~ tamping and firing their own shots. The explosive used was FF black powder, the yield being about 15 tons of coal per 25-lb keg of powder. The size of the augur bit was 2 inches, and slack was used for tamping. The company required the miners to fire their charges with squibs, hoping in this way to lessen the number of heavy shots. The men were allowed to shoot twice a day i.e., at noon and after four o'clock in the afternoon ---- the miner on the last of the air shooting first. This mine was subject to many windy shots; and in order to render the mine safer the company was in the act of installing electric chain machines when the explosion occurred.

The Explosion.

At 3:53 p m, Nov 25th, 1910, while eight miners, one driver, one trackman and three mules were in the mine, an explosion occurred that snuffed out every life underground and totally wrecked the mine. The violence was so great that a mule was blown from the mine all the way up the shaft and through the sheave wheels, the body landing at a point on the surface 60 feet south of the shaft. Assistant State Inspector, Mr. Thomas O. Long at Harlington, Ky., was immediately

notified of the disaster and four hours later arrived on the scene to take charge of the work of rescue.

The Work of Rescue.

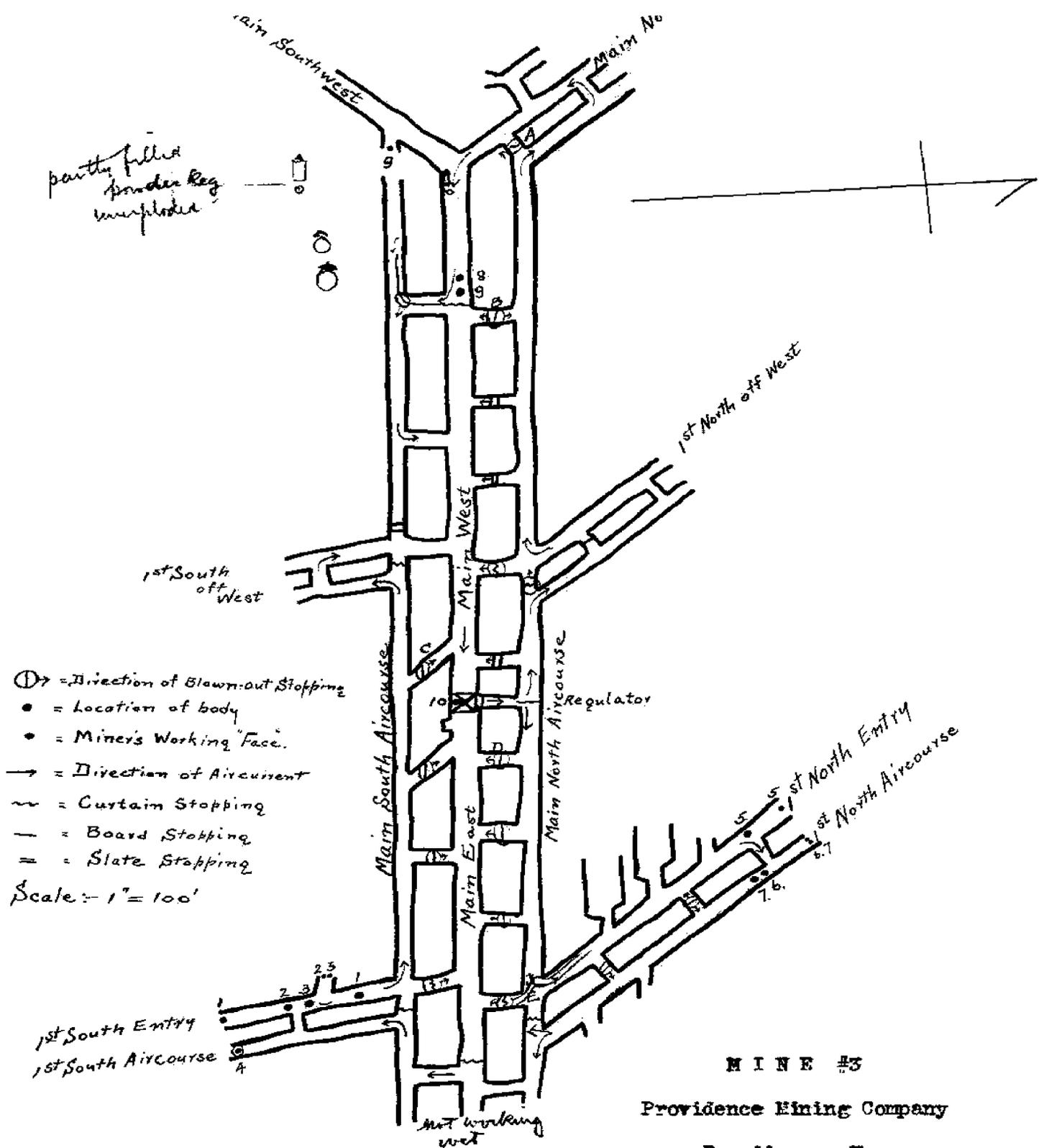
The first steps undertaken were the reestablishment of the ventilation and the installation of some means of hoisting and lowering men. The demolished air-conduit, leading from the fan to the air-compartment of the shaft was quickly rebuilt with heavy canvas brattice cloth. An inch-and-a-quarter manila rope was passed through a single block pulley hung over the north hoisting compartment of the shaft, a board seat (2" x 10" - 3') was attached securely to one end of the rope, and the other end was wrapped three times about the four-inch drum of a hand windlass. With the aid of this temporary hoist, and in the presence of fresh air, men then began the work of lining with roofing-paper the partition between the air-compartment and the cageway, the lagging of which had been destroyed. The next morning at five o'clock this task was completed, the result being that ventilation was established from the surface to the foot of the shaft.

One hour and forty minutes later, or 6:40 a m November 26th, U. S. Bureau of Mines Rescue Car #3 arrived at the illfated mine. This car at the time of the explosion was at Linton, Indiana, training miners in helmet work; but as soon as word of the dis-

aster was received, arrangements were made for the transportation of the car to Providence. Three railroads assisted in this movement ---- the Southern Indiana, the Evansville & Terre Haute, and the Louisville & Nashville ---- the total distance covered being 210 miles.

The rescue car brought with it four (4) sets of 1910 Draeger apparatus, which were ready for immediate use. Inspector Long had his two (2) sets of apparatus with him; but he had not unpacked them because he was not familiar with the 1910 model and because he had been requested not to open the shipment until the arrival of the Draeger agent who would test them and explain their mechanism. The men on the rescue car, however, at Mr. Long's suggestion, opened his equipment and tested and refilled his machines. Forty (40) minutes after the arrival of the car the mine was entered, for the first time after the explosion, by three men wearing oxygen helmets, three additional men remaining with helmets in reserve on the surface.

The men who entered were Thomas O. Long, Assistant Mine Inspector of Kentucky, A. G. Spillman, Assistant Manager of the St. Bernard Mining Company at Earlington, Ky., and A. A. Sams, Foreman of Mine Rescue Car #3. With the aid of the helmets, and carrying both electric and wolf safety lamps, they thoroughly inspected the main east entries and the first south entry and



partly filled powder keg unexploded

- ⊙ → = Direction of Blown-out Stopping
- = Location of body
- = Miner's Working "Face"
- = Direction of Aircurrent
- ~ = Curtain Stopping
- = Board Stopping
- = = Slate Stopping

Scale: - 1" = 100'

MINE #3
 Providence Mining Company
 Providence, Ky.

aircourse on the east side of the shaft. This was the dip side and would be the first to free itself of damps. Four bodies were located, two of which were delivered by the helmetmen to the foot of the shaft. The object of the helmet-inspection was to advance ahead of the air to find if possible any live miners, to locate the bodies of those already dead, to search for any fire that might have been left by the explosion, and to test for poisonous gases at the working faces. This inspection revealed the fact that there was no hope of recovering alive any of the ten entombed miners, that there was no fire in the mine, and that the condition of the mine atmosphere was such that men could advance without helmets. Answering the call for volunteers, eleven men then stepped forward and were lowered singly or two at a time down the temporary hoist. The first pair of these volunteers entered at 8:47 a m.

After the recovery of the four bodies on the first south entries, a careful examination of the first north entry and air-course resulted in the location of three additional bodies which were sent to the surface. Then a cautious advance was made up the main west entry; and two bodies were found which were immediately sent out of the mine. To recover the tenth and last body, which had been discovered about 20 feet up the south hoisting compartment of the shaft, a man was lowered from the surface on

a 5/8" manila rope (part of the equipment of the rescue car).
 The location of the ten bodies is shown on PLATE I, the bodies
 being numbered in the order in which they reached the surface.
 The time at which each body was sent out of the mine is given
 in the following list.

First body reached the surface,	8:41 a m.
Second " " " "	9:15 "
Third " " " "	9:34 "
Fourth " " " "	9:58 "
Fifth " " " "	10:35 "
Sixth " " " "	10:55 "
Seventh " " " "	11:45 "
Eighth " " " "	12:25 p m.
Ninth " " " "	12:38 "
Tenth " " " "	2:19 "

A word should be said about the methodical manner in which
 the work of rescue was accomplished. Each step was carefully
 thought out and then quietly executed, the result being that there
 was no confusion of orders, and there was a complete absence of
 the excitement that usually attends such disasters. Even the
 crowd of 3,000 people that surrounded the shaft waited quietly
 while the work was in progress, realizing that everything was
 being done in the quickest possible manner. Each volunteer

before entering the mine gave his full name and address to the man in charge on the surface. The time at which he entered was noted in a book. When he reached the foot of the shaft, he reported to the man in charge underground who issued all orders. There was no haphazard wandering about the mine, each man trying to act on his own responsibility, with the attendant danger to the rescue party; instead, the squad was held together in a unit and was strictly instructed to follow the leader. Upon the return to the surface, each man was checked off the list. At frequent intervals a bucket of hot black coffee was lowered to the men underground showing them that they were being cared for by those on top.

Because of the damage the explosion did to the mine and tibble, it was impossible to make a careful examination into the origin of the disaster. Inspector Long therefore gave orders to repair the tibble, shaft and underground stoppings, cautioning the company to leave things as they found them in the mine in order not to destroy any evidence that might throw light on the cause of the explosion. Arrangements were then made to attach Rescue Car #3 to the Louisville & Nashville train leaving Providence at 4:15 p m, en route to Evansville, Indiana.

The Examination of the Mine

On January 7th, 1911, at the invitation of Inspector Long, the following party of mining men visited the #3 mine at Providence to investigate the results of the explosion and to discover if possible the origin.

Thomas O. Long, Assistant Mine Inspector of Kentucky.

Maynard Nance, of the Providence Mining Company.

A. L. Donan, " " " " "

Claude Wynn, " " " " "

J. M. Cardwell, " " " " "

J. W. Lamb, " " " " "

E. P. Robinson, of the Ruckman Coal Company

Thomas Longstaff, of the St. Bernard Mining Company.

Edward Carroll, of the Sunset Coal Company.

R. Y. Williams, of the U. S. Bureau of Mines.

On February 7th, Inspector Long, A. G. Spillman, A. A. Sams and R. Y. Williams returned to Providence to complete the inspection of the mine a portion of which could not be entered on the previous date because of the accumulation of considerable water. The following data set forth the results of the writer's examination on these two visits.

The only miner who was at work on the west side of the shaft on the day of the explosion fired two shots in the advancing east face of the south main west aircourse . The diagram on PLATE II shows these shots to have been heavy, the coal having been hurled 32 feet to the far rib of the main south-west entry. The body of the miner (colored) who had fired these shots was found on the main west entry at the point indicated by #9 on PLATE I. The body marked #8 on the map was that of the tracklayer (white). The dinner-buckets of these men were found considerably nearer the shaft, seeming to indicate that these men were on their way out of the mine when the explosion occurred and that they had fled inbye to escape a violence which was approaching them from the east. This is further substantiated by the fact that they were lying on their faces, their bodies parallel with the entry, their heads to the west, and the negro holding fast to the heels of the whiteman. There were slight indications of coke and considerable soot on all "faces" in the aircourse where the two shots had been fired. The same was true in the main southwest entry. No difference in the amount of the cokings could be noted in these two entries, and the coke effects were the same right at the boreholes of the fired shots as everywhere else.

From the head of the main west entry 100 feet toward the shaft, very heavy coke crusts were noted on the west (inbye) side of all

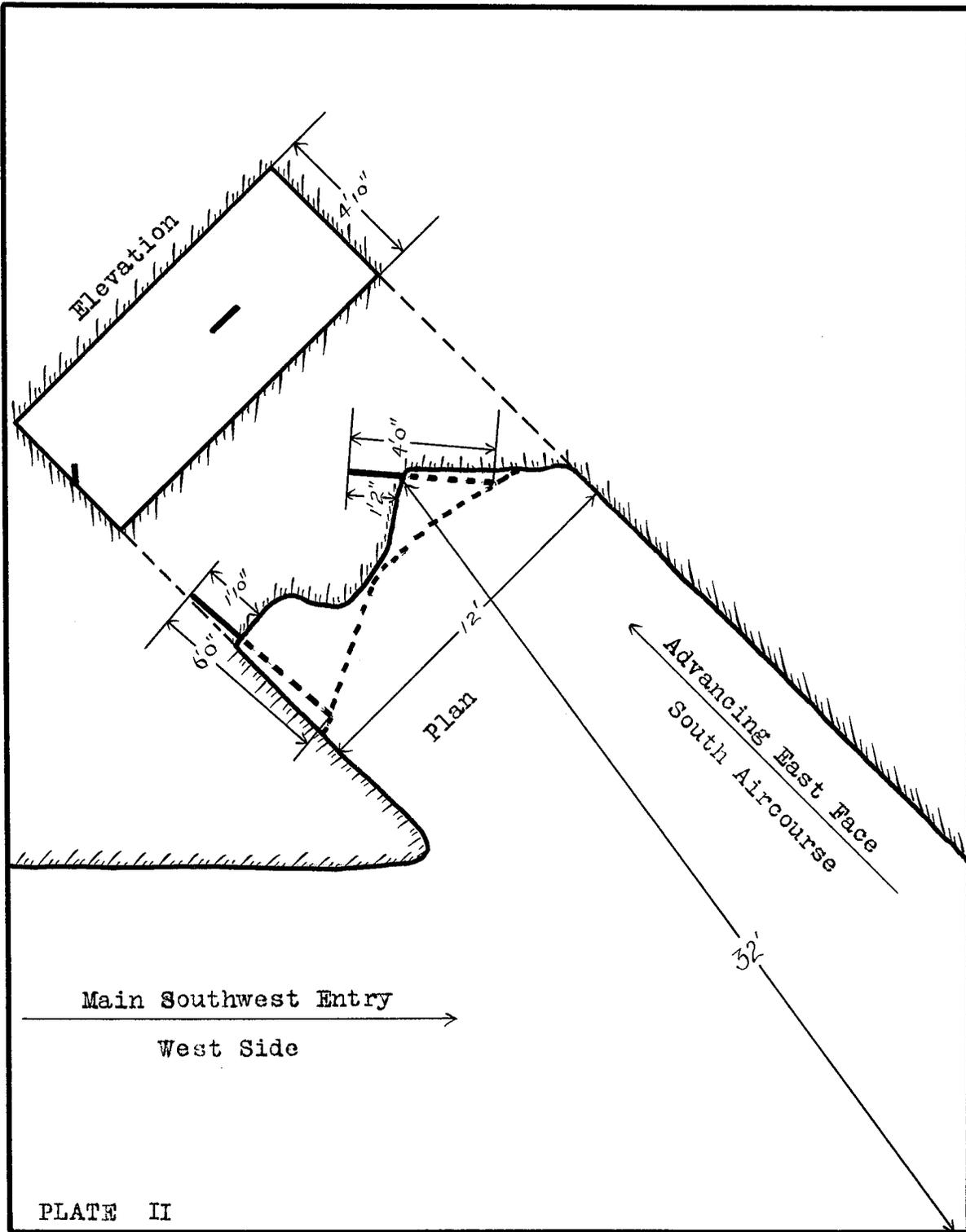


PLATE II

props. A sample of the coke from four of these posts was submitted to the Bureau of Mines Laboratory at Pittsburg, Pa., for analysis, in can #20621-R.Y.W.-102(c). A second sample of this coke crust was taken from a wooden powder box and placed in can #20674-R.Y.W.-102(a). This powder box was 2' x 2' - 4' and was located on the south side of the main west entry at the junction of that entry with the main southwest. This box showed a 1/2 inch deposit of coke crusts on the west end, slight but similar cokings on the east end, and a heavy soot deposit on the rib side. A sample of this soot was sent to Pittsburg in can #20651-R.Y.W.-102(b). The results of these analyses will be attached to this report. The above powder-box was closed and in it was a full 25 lb. keg of F F black powder. On the outside of the box close to the east end of it there was a keg containing a quart of powder, the can being closed with a paper stopper. Neither can exploded, nor was the paper stopper charred.

The stopping in the first crosscut between the main northwest entry and aircourse, shown by "A" on PLATE I, consisted of a curtain 5' in width and a board brattice 9' in width. The curtain was entirely consumed by fire and the bottom of the northwest post of the board brattice was shoved 12" southwest. From this point to the "faces" of the northwest workings the cokings

were weak and quite similar to those described above to the southwest. But from this stopping at "A" to a point 100' east, the cokings were heavy crusts and on the west side of ~~exp~~ exposed surfaces.

The evidence thus far obtained seemed to indicate that the origin of the explosion must have been east of this section of the mine, and that the cokings were deposited by a sheet of flame which traveled into this field and was fed by the large quantity of coal dust here obtainable. The absence of any violence either to the mine or to the bodies of the men leads to the belief that right here there was an inflammation of the dust as the force approached a tight end, the result for this particular place being not an explosion but a rapid burning.

The stopping marked "B" on the map showed the result of some violence, the boards of which it was built having been blown partly to the north and partly to the south. With this single exception, all the stoppings on the west side of the shaft were blown toward the center entry ----- and the nearer the shaft the greater the violence. In the case of the gob stoppings, only about a foot at the top was blown away.

At the stopping marked "C" the crosscut was swept clean, the debris being carried to the wreckage in the sump at the foot of the shaft. A mule, tied to a post in this crosscut, was

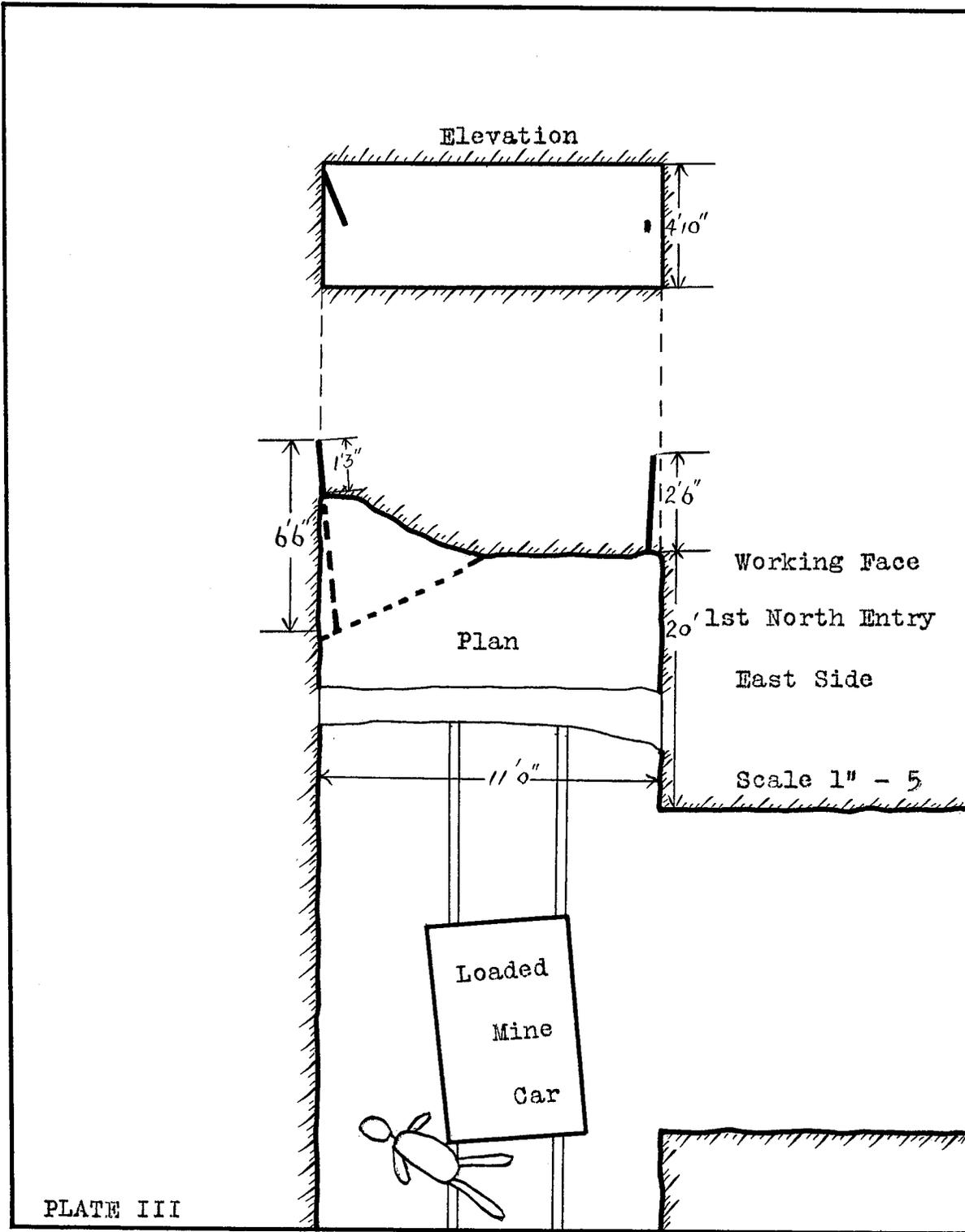


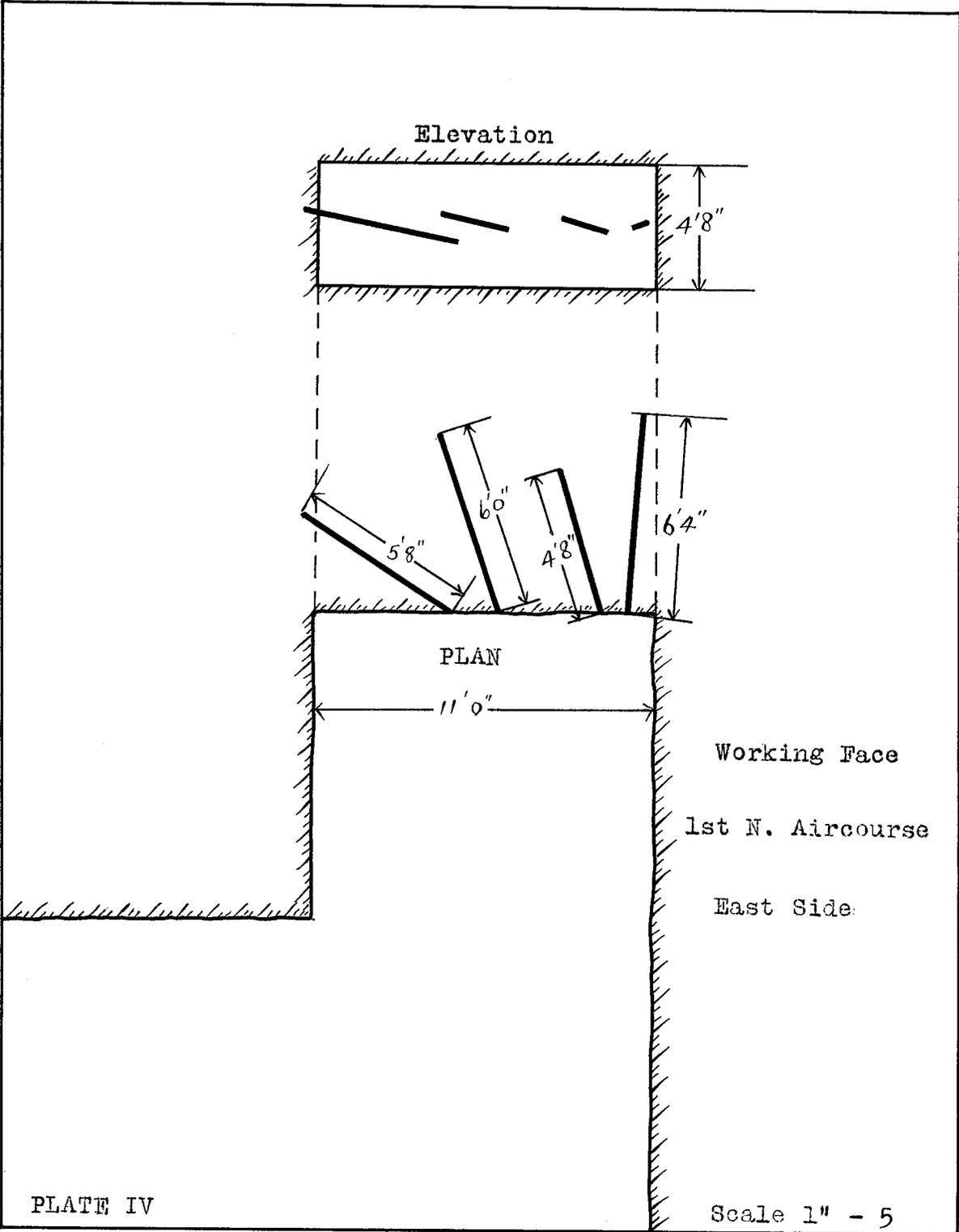
PLATE III

blown poste and all out to the center entry and toward the shaft. Five or six sets of bottom timbers immediately west of the cage-way were blown into the wreckage in the sump.

Between ~~this~~ crosscut "B" and the shaft, the cokings on the ribs were noticeably less than in the section of the mine west of "B". Our deductions were to the effect that the explosion must have originated on the east side of the shaft, and must have crossed to the west side via the two main aircourses.

On the east side of the shaft the violence was much greater, and all the main entry stoppings were blown into the center entry and toward the shaft. A pump, weighing approximately 800 lbs, and located in the center of the crosscut marked "D", was picked up and deposited in the wreckage at the shaft. This pump carried with it a tail of 60 feet of 4" pipe which had been broken loose at an elbo^o at the next inside crosscut.

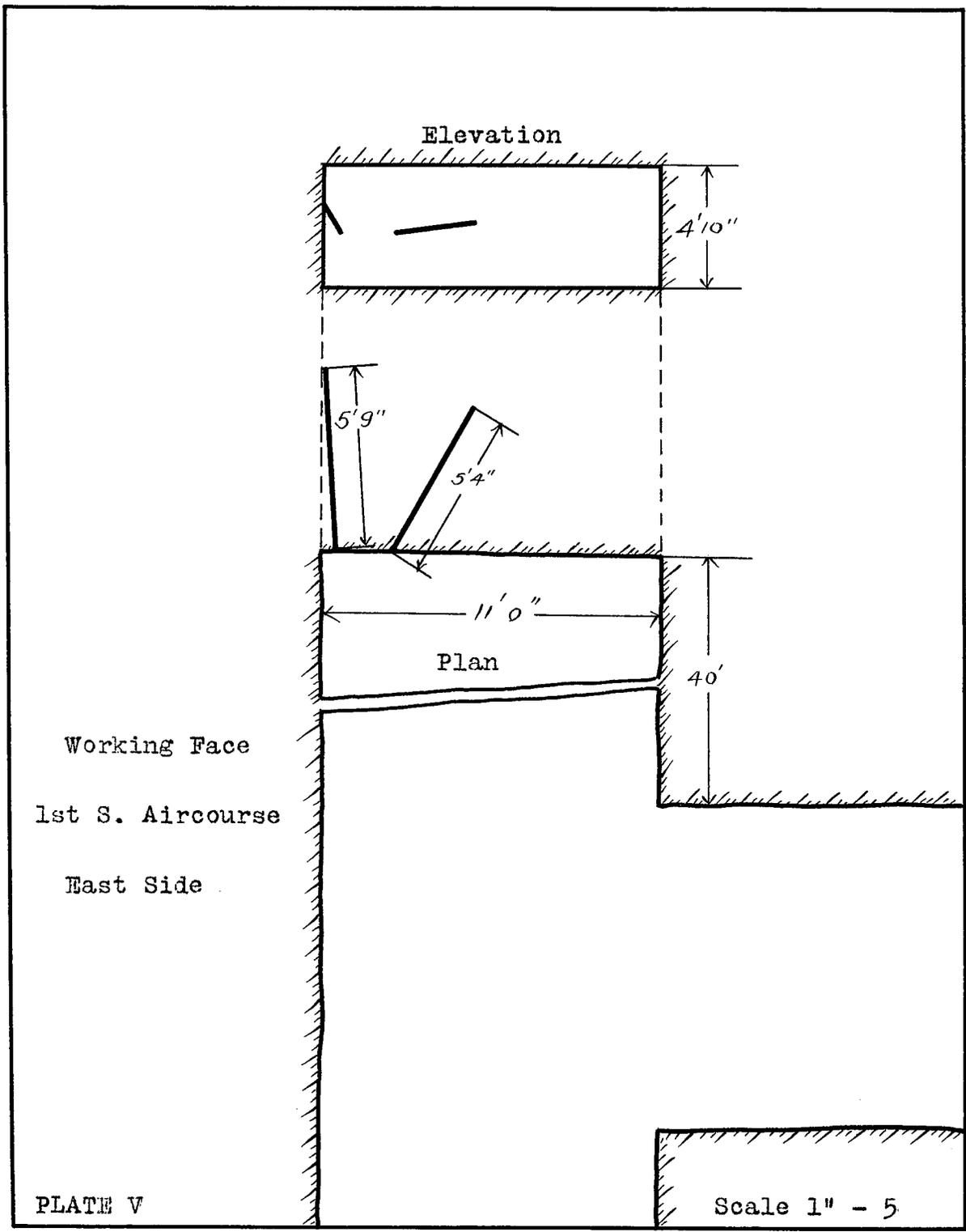
At the face of the first north entry the indications were that the miner had shot his coal at noon; and the conditions of his working place are explained by PLATE III. A car that he had completed loading stood 20 feet from the face and opposite the last open crosscut. The wheels nearer the face were off the track to the west. The miner when found was lying on his back between the west rib and the car: he was not burned nor mutilated.



At the face of the first north aircourse, the conditions were as described in PLATE IV. The shots had none of them been fired, not even tamped, the post drill being still in place. The two miners were found lying on their faces 60 feet from the "face" of the aircourse. They were somewhat singed but not badly burned; nor were they mutilated. They showed frothing at the mouth, indicating that they had been suffocated.

The track in the first north entry, which was built of 16# iron, was intact from the face to the second room-neck; but an examination of the turnouts to the first and second rooms showed that the whole track had been pulled or forced toward the main entry to such an extent that a car would not clear the rib in entering either room. At the point where this track crossed the north aircourse of the main East entry, at the point "E" on the map, the track was bowed 10 feet out of line to the west. In the first north aircourse the track, which was of 2-1/2" x 4" wood, was crooked at all joints and lifted out of bed ^{its} over a distance of 120 feet. The switches to the first and second rooms were forced against the outside ribs. At the point "E", the switch which led via the main aircourse to this first north aircourse was blown into a pile of wreckage on the south rib of the center entry.

There was no evidence that at the time of the explosion any shots had been fired on either the first north entry or aircourse;



but two wrecked powder cans were found some distance from the "face" on the first north entry. The main east entry and the two parallel aircourses did not work the week of the explosion and contained considerable water.

At the face of the first south aircourse the conditions were as shown on PLATE V. The two holes had been bored but not tamped or fired. The miner was found lying face down on his pick right at the face of his working place. He was considerably burned but not mutilated. The track in this aircourse was intact.

The only room-neck turned on the first south entry showed the conditions at the "face" as sketched on PLATE VI. The rib shots had been fired the day before the explosion, the left rib shot having destroyed the entry track. This track had been repaired the morning of the disaster. The bodies of the miner and his boy who worked in this place were found on the first south entry, the boy twenty feet and the miner ~~5~~ five feet south of this room-neck. The clothing of both men was completely consumed and the bodies charred but not mutilated. A mine-car, the main part of which was found directly opposite the room-neck, was completely wrecked, small board pieces of which were lying against the "face" in the room-neck.

At the face of the first south entry, the conditions were as shown on PLATE VII. The body of the mine~~E~~ who was working here was found between the first room-neck and the main aircourse. His

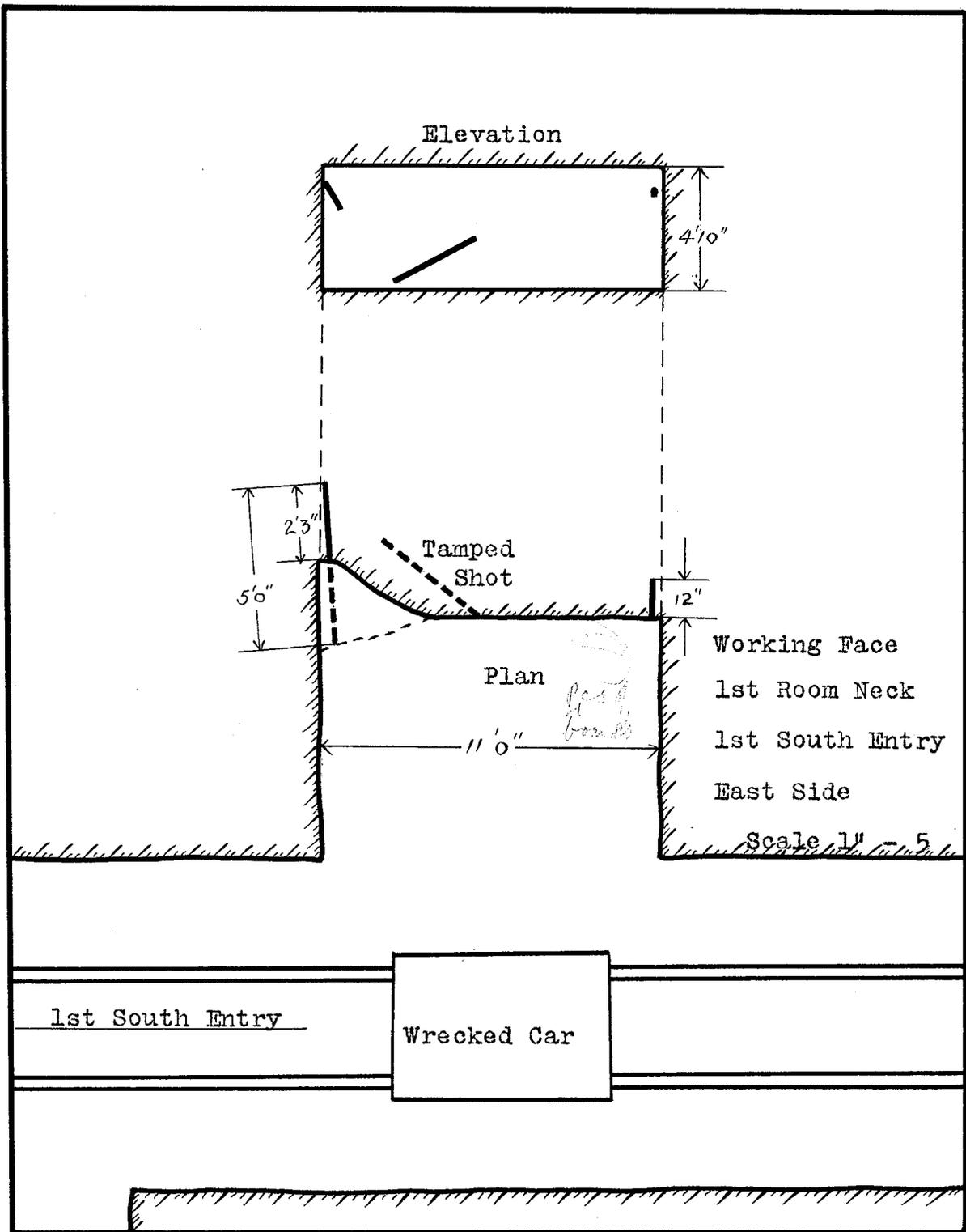


PLATE VI

clothing was badly burned and his body horribly mutilated-----his intestines having been torn out. This miner, who was working "butties" with the miner in the first south aircourse, had checked sixteen (16) cars (a ton and a quarter each) of coal the day of the disaster. The car of coal on the cage when the mine ~~lx~~ blew up contained his check. The miners tools were plied near the rib on several very large lumps of coal, and the indications were that the miner was preparing to do his firing.

Ordinarilly one would suppose, judging from the haphazard method of shooting as described on the several plates accompanying this report, that the miner would have loaded all three shots at one time. Two reasons may be given why in this particular case all three were not loaded before the first was fired.

(a) As it here happened, the twelve inch point of a previous shot, as shown on the sketch, had cracked the "face" to a very considerable extent; and we are free to assume that the miner realized that if the 7-ft hole brought the coal the second shot (5'7") would require only a small amount of powder; whereas, if the 7-ft shot did not bring the coal, but merely kicked back through the borehole bringing only a part of the heel, then a very heavy charge would be required in the second shot. (b) The firing of this shot may have been a premature blast. The miner's tamping bar was entirely of steel and was found on the right rib twenty feet from the "face". It was not, however, twisted or bent. This view of the accidental firing of this shot makes it less difficult

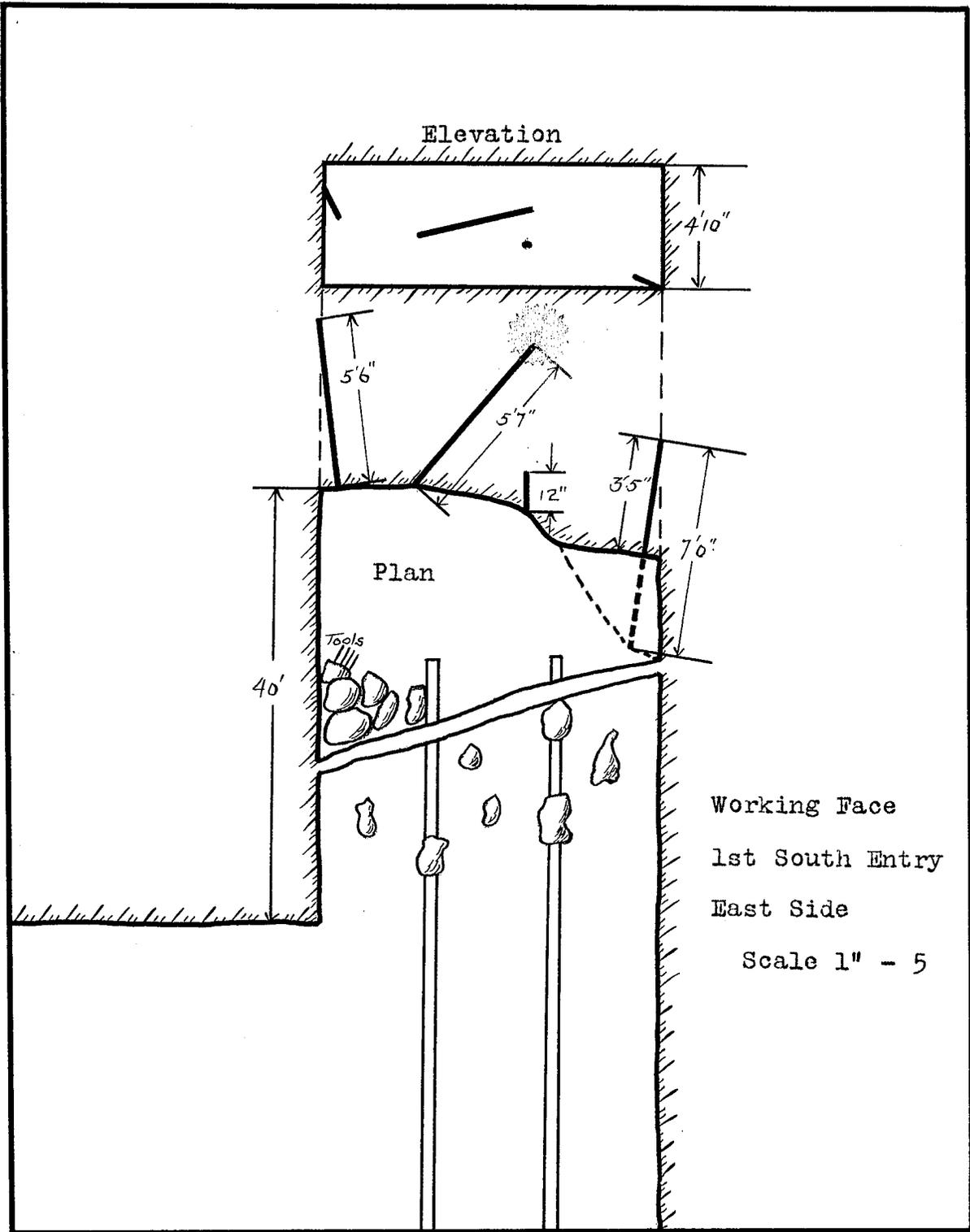


PLATE VII

to explain why the men in the room-neck (who were working on the last of the air) had not previously fired their shot which was already tamped.

The sketch is correct in showing that only a small amount of coal at the heel of the 7-ft sumping shot was kicked out; but this coal was thrown between 30 and 40 feet from the "face", the working place itself being swept clean. Several lumps, approximately 25 pounds each, were lying directly on the wooden track over which a loaded car had recently passed on the way to the shaft.. Forty-one inches of the point of this shot remained ---- like a rifle bore, except that it was longer than any rifle in the United States.

The coking effects on the ribs in the first south entry and aircourse were very much lighter than elsewhere in the mine. It seemed as though the coke either had not been plastic enough at the time of deposition to adhere to the ribs or that the depression caused by the explosive wave had had so much violence that the coke globules had been swept off the ribs. A sample of this road and rib dust (somewhat coked) was taken from the first south entry between the room-neck and the crosscut and sent to Pittsburg for analysis in can #20649-R.Y.W.-102(d).

Point of Origin and Travel of the Explosion.

It is the opinion of the writer that the explosion originated from the premature firing of the 7-ft sumping shot at the face of the first south entry. This entry was dry throughout and contained plenty of dust to propagate the explosion. There was only one crosscut between this entry and the parallel aircourse, so that there was only a small area for the expansion of the gases; and as a result extreme violence gained immediate headway. The explosive wave carried the miner with it from the point of origin and threw him violently against the mine car standing in front of the room-neck, disembowelling the miner and wrecking the car. The two miners at work in the room-neck were able to get to the entry (the total distance from their "face" to the ~~xxx~~ entry being but eight feet) and were there caught by the return wave which carried them a short distance toward the head of the south entry, the boy being carried the farther.

When the outrushing violence reached the main south aircourse the velocity was augmented by the explosion of at least two kegs containing the powder of the four miners on this first south entry and aircourse, all of this powder being set off during the progress of the explosion. At this point a considerable amount of the force was spent toward the shaft, passing west along the main south

aircourse and the main east entry. A wave of some violence and much flame, however, passed up the first north entry, exploding two full kegs of FF black powder. This entry was dry, and it is the opinion of the writer that a secondary explosion occurred here occasioned by the flame and pressure of the original explosion, the fifty pounds of powder and the presence of the coal dust. This new wave increased in violence outbye until it reached the first crosscut east of the shaft where it picked up the pump and landed it in the sump.

Because of the small area of the crosscut leading from the main north aircourse directly to the shaft bottom, part of the violence of the explosion passed to the west side of the mine which was toward the rise and very dusty. This force was sufficient to throw the dust into suspension; and the accompanying flame, feeding on this dust, passed through the most westerly workings. As the pressure recoiled, the force once again traveled toward the shaft, depositing the burning coal dust as coke crusts on the props.

Conclusion:-

From the above report, the following practices are dangerous:-

1. Shooting off the Solid.
2. The use of steel tamping bars.
3. The use of coal dust for tamping.
4. The use of black powder in high volatile coals.
5. The accumulation of dry coal dust.
6. The lack of humidification during the winter.
7. The carelessness of miners.