

C. J. D. Smith  
(16)

UNITED STATES  
DEPARTMENT OF THE INTERIOR  
BUREAU OF MINES

Health and Safety  
District C

Mount Hope, West Virginia  
May 16, 1961

Memorandum

To: W. R. Park, District Supervisor

From: J. L. Gilley, Mining Health and Safety Engineer

Subject: Report on investigation of minor coal-mine bump, No. 2 mine,  
Chafin Coal Company, Rita, Logan County, West Virginia,  
March 29, 1961

A coal-mine bump which resulted in minor abrasions and bruises to 4 employees occurred at 2:00 a.m., March 29, 1961, in the 5 north section of No. 2 mine, Chafin Coal Company. After receiving first aid underground, the 4 men were taken to a hospital in Logan, West Virginia, for further treatment and observation. The injuries were determined to be of a minor nature and the men were released from the hospital; however, 2 of the men lost one day each from work because of soreness from bruises received in the bump.

The author was informed about the coal-mine bump by W. R. Park, Supervisor of District C, and an investigation was started on the date of the occurrence and completed the following day. Federal Coal-Mine Inspectors James T. Whalen and William M. Cordray visited the scene of the bump on the morning of the occurrence and accompanied the author underground the following day for further observations. An investigation was also made by representatives of the West Virginia Department of Mines.

The No. 2 mine is at Don, approximately 3 miles west of Rita, Logan County, West Virginia, and operates in the upper Cedar Grove coal bed through drift openings. The average height of the coal bed in the section involved is 44 inches, but measured 40-42 inches in the immediate vicinity of the coal outburst. The coal is high-volatile in rank, black and shiny in appearance, and possesses a fairly high degree of hardness although it is brittle. The coal shatters or breaks somewhat readily under stress or a blow. Pulverization of the coal by abnormal stress upon the coal pillars in this mine

Copy to: W. A. Chafin, Vice President (2)  
Woodrow Marcum, Superintendent (1)  
McCoy Engineering Mining & Construction Company (2)  
Mr. Westfield (3)  
Mr. Ferguson, UMWA (2)  
Mr. Thomas (2) ✓  
Mr. Gilley (4)  
Mr. Whalen (1)  
Mr. Keith (1)  
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produces the characteristically dark brown color of bituminous coal. Face-and-butt cleavage planes in the coal are not pronounced. One of the important characteristics of the upper Cedar Grove coal bed on this property, especially in areas where the mine floor is firm and the cover is comparatively thick, is that considerable amounts of latent energy can be developed in comparatively small coal pillars.

A total of 58 men, 49 underground and 9 on the surface, was employed on 3 shifts a day, 5 days a week, and produced a daily average of 1,400 tons of coal, all loaded by mobile loading machines into shuttle cars. Coal is transported from the sections by a rubber-conveyor belt, thence to the surface by rail haulage.

Development and pillar extraction was by a room-and-pillar method. Main entries were projected 5 abreast on 60-foot centers. The 5 north room-panel entries were projected 7 abreast on 60-foot centers, but previously, all room entries were projected 5 abreast on 50-foot centers at intervals of 460 feet off the main entries. Rooms were on 50-foot centers, and the interval between crosscut centers (room and entry) ranged from 60 to 80 feet; however, entry and room crosscuts were on 75- and 70-foot centers, respectively, in 5 north section. Projections for entries, rooms and crosscuts in 5 north specified that the respective widths not exceed 22 feet; however, this minimum requirement was exceeded at several locations.

It will be noted from Sketch C that the proposed procedure for extracting pillars in 5 north was by the split-and-fender method with the splits driven 30 feet in width leaving 9-foot-thick fenders to be recovered open-ended. A flat pillar line is employed and pillaring begins as soon as a panel of entries is driven to the boundary line or the desired distance. Rooms, it will be noted, are projected to the left off the 5 north panel entries toward the previously mined-out 4 north panel entry. The above procedure for extracting the pillars was not being followed during this investigation.

The irregular crests of the mountain ranges on this property attain a maximum elevation of 2,093 feet, and logs of drill holes indicate that the maximum cover is about 846 feet. The maximum cover over the 5 north territory perhaps ranges from 500 to 750 feet in thickness. The immediate roof, as determined by observation of the structure in caved areas and from logs of drill holes, comprises firm, thinly laminated gray sandy shale ranging from 17 to 46 inches in thickness overlain by comparatively thick-bedded, thinly laminated strata of firm shales with defined bedding planes. Logs of 3 drill holes indicated that the overlying shale formations ranged from about 17 inches to 49-1/2 feet in thickness at some locations and that the several overlying strata of sandstone range from a few feet to as much as 89 feet in thickness.

Normally, the mine floor comprises about 60 inches of shale, the first few inches of which heaves very readily under pressure and is affected by excessive water. The immediate floor (the first 6 to 8 inches) in 5

north generally contained a layer of impurity (bone and coal), known locally as "false bottom", which heaves very readily near the line of extraction and especially at areas where pillar dimensions were decidedly unequal. The immediate floor is underlain, generally by a bed of sandstone ranging up to about 35 feet in thickness. The floor, insofar as could be determined, was not affected at the immediate location of the bump, but the floor was heaved along the roadways apparently from pressure in the outby crosscut, along the back side (No. 1 entry side) of the coal pillar involved, and in the roadways of the 2 adjacent rooms (Nos. 16 and 17.)

The timbering system adopted required one row of posts to be set on 4-foot centers along each side of the 14-foot roadways in entries, rooms and crosscuts, and a minimum of 2 safety posts set at each working face. Breaker and turn timbers were required at the entrance to pillar lifts in addition to one or more rows of posts set on 4-foot centers next to the gob area during mining of pillar lifts. Sufficient timbers as required were not set in some instances, particularly breaker posts during mining of the final portions (push-outs of the pillars) during this investigation.

The mining system used, the extent of development and extraction, and the comparative dimensions of the coal pillars in the 5 north section at the time of the coal-mine bump, are illustrated in Sketch A. The location of the workmen and equipment at the time of the bump and the extent of the area affected, are shown in Sketch B. The proposed mining procedure for the extraction of individual pillars in 5 north is shown in Sketch C.

The outburst occurred along a coal pillar rib between Nos. 1 and 2 entries of 5 north. The third shift crew, comprised of 9 men, entered the mine at midnight and arrived on the section about 12:20 a.m., on the date of the outburst. After receiving their instructions, the workmen proceeded with their assignments of delivering supplies, timbering and moving the loading equipment to the working face. The loading machine (81AH Jeffrey) was trammed into No. 2 entry, and coal-loading was started from the No. 2 entry side of the chain pillar between the Nos. 1 and 2 entries (see Sketch A.) This particular chain pillar was 61 feet in length and 36 feet in thickness and slightly larger in dimensions than the immediate adjacent pillars. The cutting-machine crew on the previous shift had undercut the coal after several shuttle cars of coal had been loaded from along the No. 2 entry side of the pillar, to a depth of about 6 feet and for a distance of about 45 feet. This was the first undercut made in this pillar; the coal was not blasted after it was undercut. Blasting after undercutting pillars is seldom done in this mine, because much of the coal falls or is dislodged during cutting operations. However, after the loose coal is loaded, the practice is for the loading machine operators to continue to dig coal from the face or ribs of the pillars with the loading machines as long as the pillars continue to "work" or can be made to "bump" by the stresses from percussion created by the loading arms of the loading machines penetrating or striking the coal pillars. This was the procedure being followed in attempting to mine the pillar

involved immediately prior to the outburst. About 40 tons of coal had been loaded in the place when it was decided that the coal was too hard to dig "from the solid". Preparation was in progress to move the loading machine and tools to the adjacent No. 3 entry chain pillar when the outburst occurred. Plans were to cut the place after the loading machine had been trammed to No. 3 entry.

Five men, including the section foreman, loading-machine operator, cutting-machine operator, timberman, and driller, were in the place and were just starting to leave when the bump occurred. The stress wave, created by the release of pressure from within the pillar, and flying particles of coal resulted in minor bruises and/or abrasions to the section foreman, loading-machine operator, cutting-machine operator, and driller.

The outburst was accompanied by sufficient force to move the front end of the loading machine several inches away from its position near the coal rib of the pillar. About 2 tons of coal were expelled from the pillar face or rib and a dense cloud of dust was thrown into suspension. Coal was shaken down but not expelled with force from the other 3 sides of the pillar. The floor and roof at the immediate location of the outburst, insofar as could be determined, were not affected, and none of the timbers were broken in the immediate vicinity of the outburst. Equipment was not damaged.

From interrogation of witnesses and from statements by officials and workmen employed on the other shifts in the 5 north section, it was learned that light bumps frequently occurred while coal was being mined with loading machines from the "solid" faces or ribs of pillars and occasionally during cutting operations.

It will be recalled that on September 30, 1960, a coal-mine outburst of considerable magnitude occurred under somewhat similar circumstances in the 4 north section (now mined-out) a distance of about 900 feet from the location of this bump in 5 north.

From Sketch A, it will be noted that the 5 north development entries had been extended to the boundary line, a distance of approximately 2,535 feet from the main entries and that retreat mining (pillar recovery) was 800 feet outby the boundary line. Pillar extraction for approximately 350 feet outby the boundary line was very successful with an ultimate recovery reportedly at about 94 percent, and apparently the roof had caved extensively. However, for the next 150 feet outby, adverse mining conditions, including low coal, a steep grade, and excessive water, were encountered. Consequently, several pillar remnants of various dimensions (some were practically full-size pillars) were left unmined in that area. These unmined pillars and pillar remnants undoubtedly delayed and/or prevented the thick overlying roof strata from caving as soon as desired. This condition likely accentuated the bending movements in the roof with the resultant imposition of unequal stresses upon the outby entry and room pillars.

From Sketch B, it will be noted that the room and entry pillars in 5 north were of different dimensions. This situation in combination with other factors, including excessive widths of several of the openings, could have possibly created a differential in the load-carrying capacity of several of the pillars, as indicated by the difference in the degree of convergence in the vicinity of the extraction areas of rooms and entries.

The immediate roof stratum had caved in by the extraction line prior to the outburst. However, at the time of the investigation, the main roof, which could be seen at some locations extending seemingly intact for considerable distances in by the active area, was "working" at high elevations above the coal bed, thus indicating an impending "pillar fall". Occasional audible sounds emanating from some of these coal pillars flanking the extraction line indicated additional stressing. An extensive "pillar fall" did occur in the mined-out area about 12 hours after the outburst.

From Sketch B, it will be noted that the method of extracting the individual pillars at the time of the outburst was by slabbing and/or by driving a wide pocket through the pillar, then recovering part of the triangular stumps formed at the corners of the pillars. It will be further noted that the pillars in Nos. 16 and 17 rooms, the 2 rooms opposite the entry pillar in the process of being mined at the time of the outburst, were not mined. Reportedly, the reason for not mining these pillars in line with the entry pillars was because of adverse roof and floor conditions.

It is the opinion of the author that this coal-mine outburst was the result of an accumulative process from a combination of the several factors discussed above, and recommendations which are thought will minimize coal-mine outbursts in this mine, and which were discussed with the management during this investigation include:

1. A system of mining should be adopted that will produce the least number of critical areas during retreat mining. Critical areas are produced by pillar line points, pillars not developed sufficiently in advance, improper sequence in development and extraction.
2. The mining system should require that coal pillars be developed as nearly uniform in shape and size as practicable. Consideration should be given to increasing centers of entries and rooms to a minimum of not less than 60 feet.
3. Complete extraction should be striven for and pillar remnants should not be left. If it is not possible to recover such pillar remnants, their load-carrying capacity should be destroyed.
4. Pillars should be recovered in a straight line. Irregular pillar lines result in excessive pressures on the pillar line points. (Those jutting into the gobs.) Experience has shown, however, that the lead end (top end) of a pillar line can be kept slightly in advance.

5. Widths of roadways in rooms and entries, including crosscut openings, should be kept to the minimum required by the approved mining plan (entries - 20 feet, rooms - 20 to 22 feet). The adopted mining plans and practices should be complied with at all times.

6. Inducer shooting has proven beneficial in the mining of stressed pillars under controlled conditions and the method should be considered.

7. Loading (digging) coal with a loading machine from the ribs of stressed pillars, where conditions are favorable for bumps, should be discontinued.

8. The pillars should be recovered by the open-end lift method. The lifts should be driven so that each lift and adjacent consecutive lifts will be mined along the gob sides of the pillars. Preferably, only one lift should be mined in a pillar at a time and this lift should not be driven more than 22 feet in width.

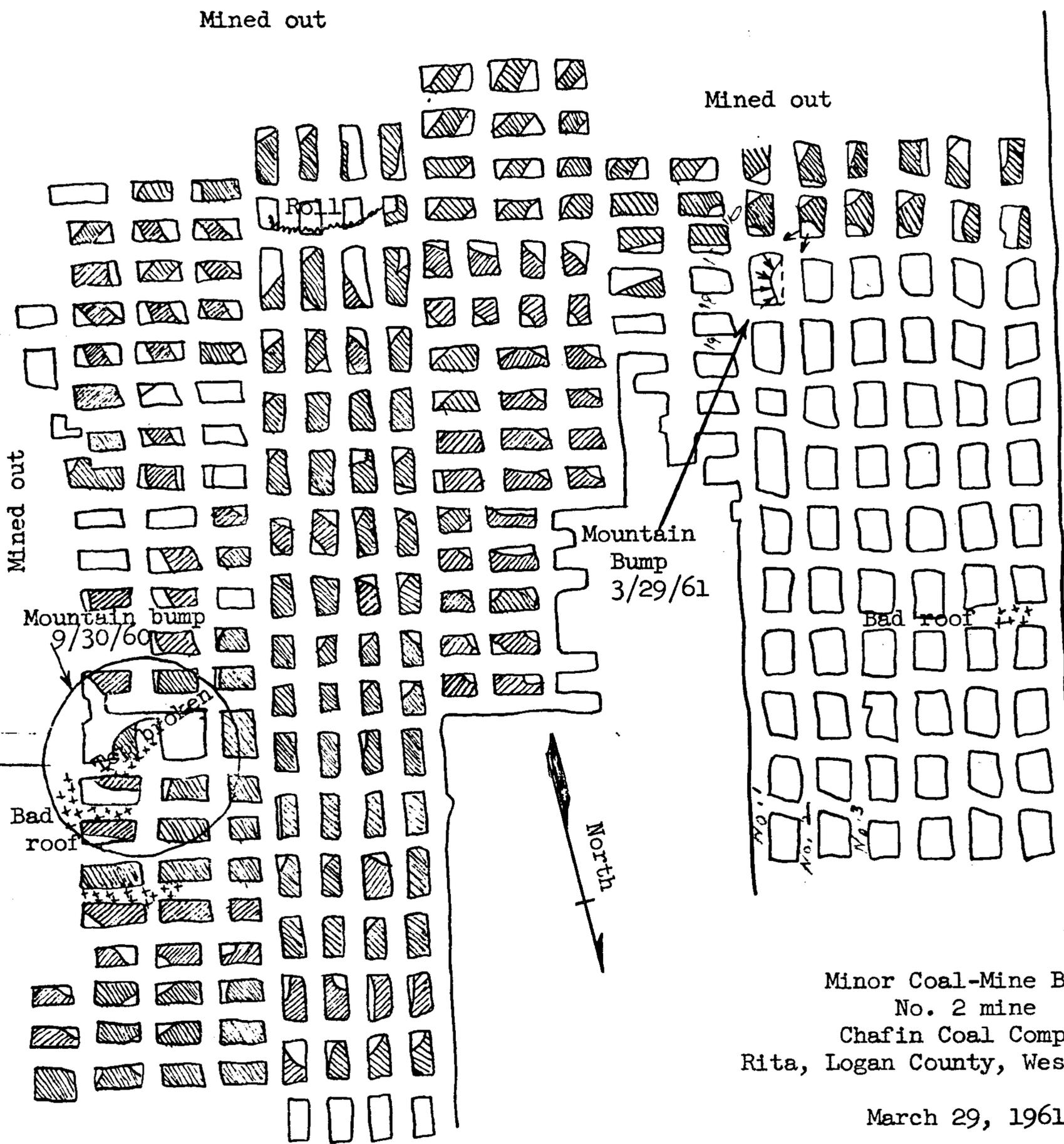
The author gratefully acknowledges the courtesy and cooperation of the employees, mine officials, and State and Federal inspectors during this investigation.

Respectfully submitted,

/s/ J. L. Gilley

J. L. Gilley  
Mining Health and Safety Engineer

Cedar Grove coal bed  
thickness 44"



Minor Coal-Mine Bump  
No. 2 mine  
Chafin Coal Company  
Rita, Logan County, West Virginia

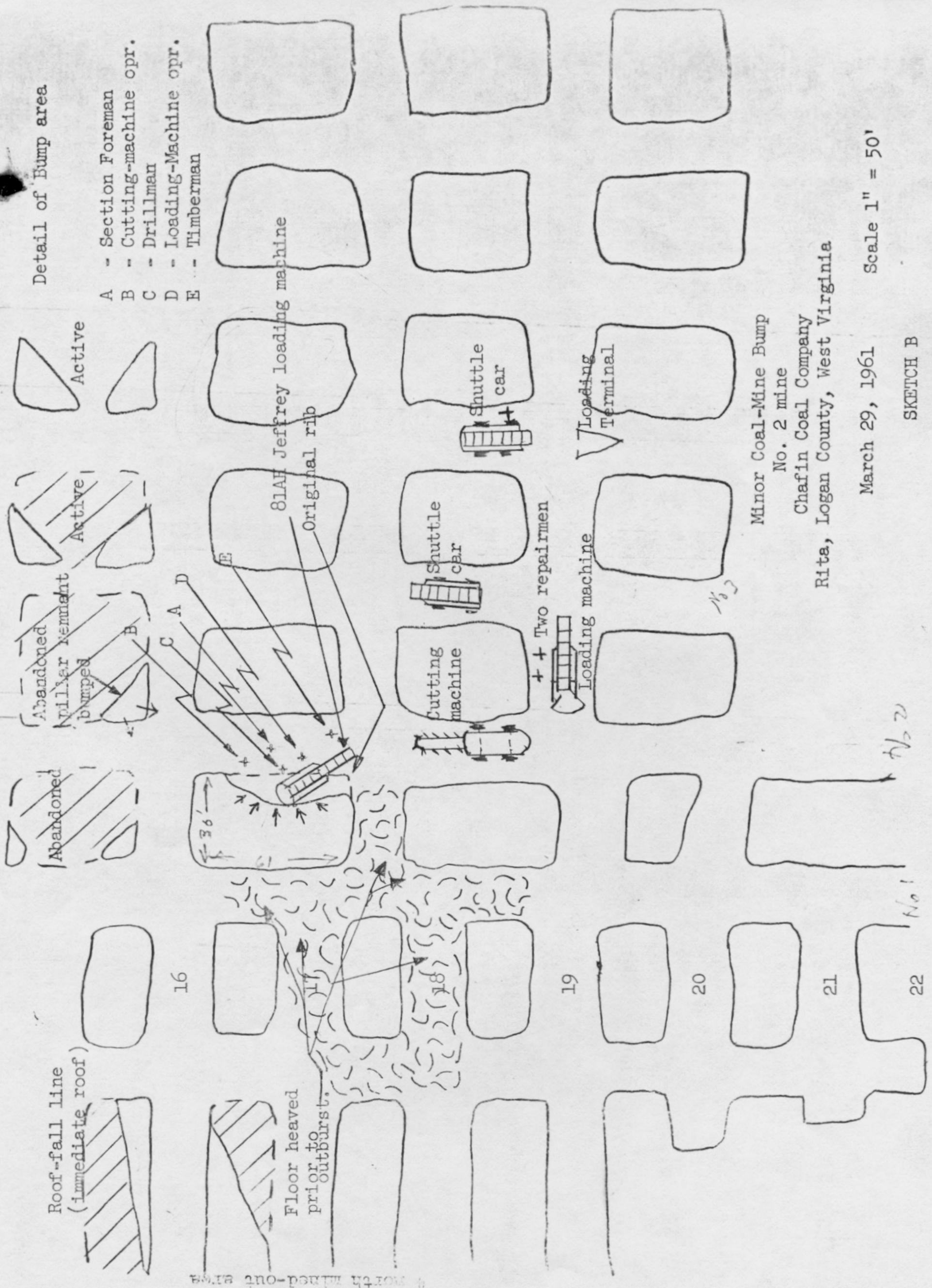
March 29, 1961

Scale 1" = 200'

SKETCH A

Detail of Bump area

- A - Section Foreman
- B - Cutting-machine opr.
- C - Drillman
- D - Loading-Machine opr.
- E - Timberman



Abandoned  
Pillar remnant  
bumped

Abandoned  
Pillar remnant  
bumped

Abandoned  
Pillar remnant  
bumped

Active

Roof-fall line  
(immediate roof)

Floor heaved  
prior to  
outburst.

81AH Jeffrey loading machine  
Original rib

Cutting machine

Shuttle car

++ Two repairmen

Loading machine

Loading Terminal

Minor Coal-Mine Bump  
No. 2 mine  
Chafin Coal Company  
Rita, Logan County, West Virginia

March 29, 1961  
Scale 1" = 50'

SKETCH B

16

18

19

20

21

22

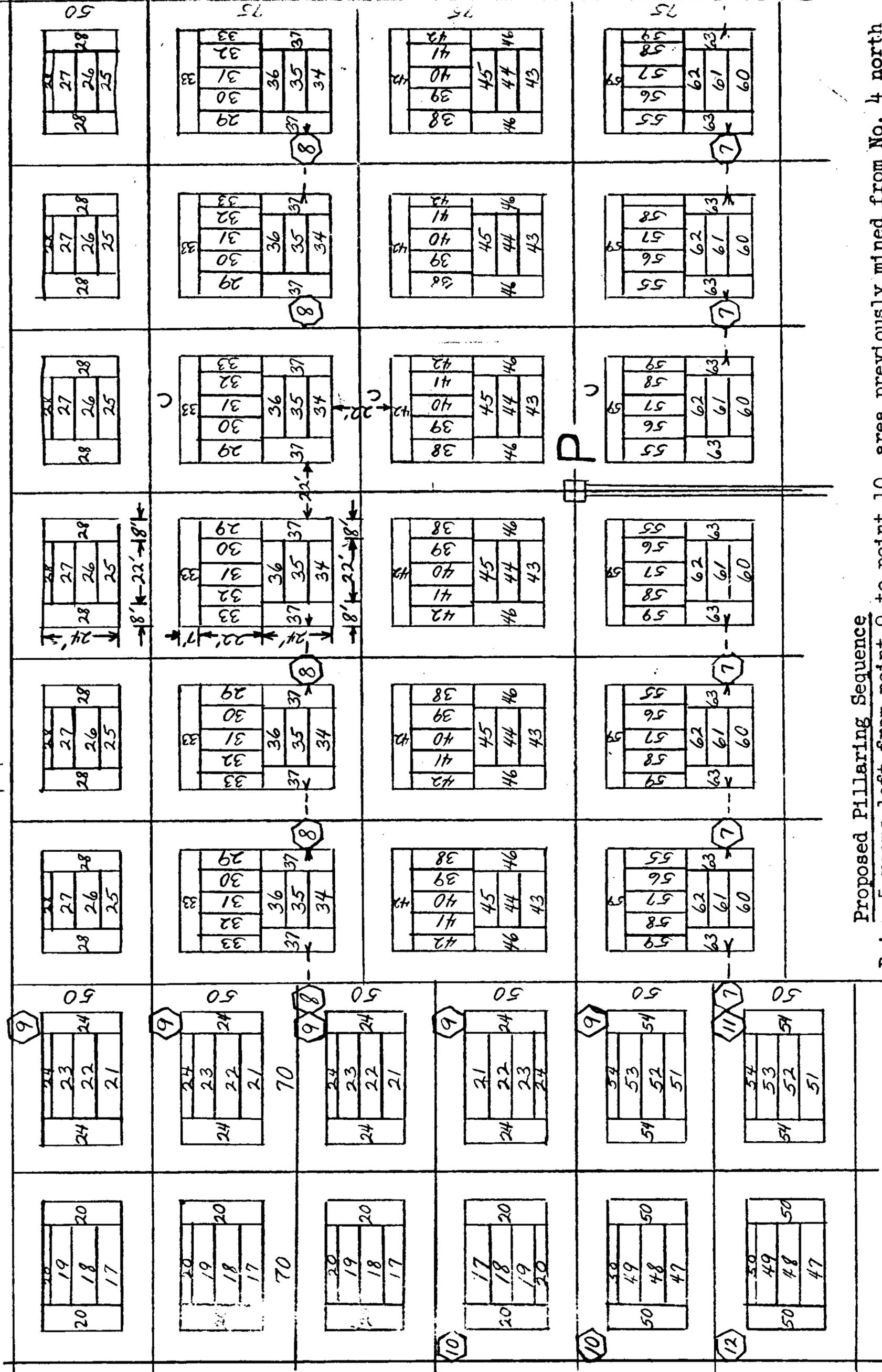
North mined-out area

No 2

No 1

SKETCH C

MINING LIMIT



Proposed Pillaring Sequence

Drive 5 rooms left from point 9 to point 10, area previously mined from No. 4 north butt entries, and load coal at P.

Mine room pillars (cuts 9 to 24, incl.) and load coal at P.

Retreat - Entry Chain Pillars

Mine entry chain pillars (cuts 25 to 33, incl.) and load coal at P - remove belt conveyor from P to O.  
 Mine entry chain pillars (cuts 34 to 46, incl.) and load coal at O.