PROCEEDINGS

of the

ILLINOIS MINING INSTITUTE

FOUNDED FEBRUARY, 1892

Sixty-fifth Year

1957

Annual Meeting

SPRINGFIELD, ILLINOIS

October 18, 1957

Paul Halbersleben
President, 1957

In Loving Remembrance

WILLIAM ORTMAN, Feb. 22, 1931
S. W. FARNHAM, March 12, 1931
H. C. PERRY, April 13, 1931
A. J. SAYERS, Oct. 11, 1931
C. E. KARSTROM, March 24, 1932
JOSEPH D. ZOOK, May 28, 1932
EDWARD CAHILL, Aug. 4, 1932
JOSEPH VIANO, Dec. 12, 1932
JOHN ROLLO, Feb. 6, 1933
DAVID I. ROCK, Aug. 2, 1933
WM. HUTTON, Aug. 18, 1934
FRED K. CLARK, Oct. 24, 1934
ERWIN CHINN, April 16, 1935
ADAM CURRIE, June 12, 1935
W. H. SLINGLUFF, Sept. 10, 1935
CHAS. B. SPICER, Oct. 26, 1935
NELSON P. MORRIS, Sept. 3, 1936
DON WILLIS, Dec. 9, 1936
T. E. COULEHAN, Jan. 11, 1937
ALBERT WEBB, March 5, 1937
H. B. COOLEY, March 23, 1937
C. W. SWANSON, July, 1937
JOSEPH McFADDEN, Sept. 15, 1937
E. G. LEWIS, Sept. 21, 1937
E. L. STEVENS, Sept. 28, 1937
W. C. ARGUST, Dec. 17, 1937
H. H. TAYLOR, SR., Dec. 28, 1937
E. L. BERGER, May 27, 1938
J. I. THOMPSON, June 24, 1938
P. W. MacMURDO, July 11, 1938
J. A. EDE, July 26, 1938
M. C. MITCHELL, Sept. 11, 1938
C. F. HAMILTON, Sept. 22, 1938
H. C. LONGSTAFF, Oct. 12, 1938
JOHN JOHNSON, Jan. 2, 1939
C. A. BLOMQUIST, Jan. 9, 1939
JOHN WHITE, April 15, 1939
CHARLES HAFFTER, May 21, 1939
BRUNO F. MEYER, July 21, 1939
JOHN A. GARCIA, Aug. 11, 1939
A. J. MOORSHEAD, Oct. 16, 1939
HARVEY E. SMITH, Nov. 6, 1939
C. W. McREAKEN, Nov. 30, 1939
C. C. HUBBART, March 4, 1940
SAMUEL HANTMAN, Sept. 13, 1940
SIMON A. BOEDEKER, Oct. 12, 1940
JOHN H. DAVIS, Oct. 21, 1940
S. J. WILLS, Oct. 22, 1940
HARRY HANTMAN, Nov. 5, 1940
J. W. GLENWRIGHT, Nov. 27, 1940
J. C. WILSON, Dec. 18, 1940
NICHOLAS CHRISTENSEN, Dec. 26, 1940
JOHN W. POLING, Jan. 31, 1941
JOHN T. RYAN, Feb. 20, 1941
M. F. PELTIER, April 2, 1941
F. M. BEAN, April 30, 1941
C. J. SANDOE, Aug. 29, 1941
F. M. SCHULL, Aug. 20, 1941
F. F. SCHLINK, March 15, 1942
FRED F. GERMANN, March 31, 1942
JOHN MENTLER, April 28, 1942
HUGH MURRAY, June 5, 1942
G. D. COWIN, June 14, 1942
JAMES M. ROLLO, June 15, 1942
SYDNEY A. HALE, Aug. 12, 1942
BYRON BROWN, Sept. 17, 1942
J. E. SEYMOUR, Nov. 21, 1942
OTTO AWE, Dec. 6, 1942
A. F. ALLARD, Dec. 29, 1942
THOMAS R. STOCKETT, Feb. 15, 1943
A. R. JOYCE, April 7, 1943
W. S. BURRIS, April 9, 1943
A. H. MALSBERGER, May 7, 1943
J. B. FLEMING, May 19, 1943
H. T. MORGAN, May 29, 1943
E. W. HASENJAEGER, July 29, 1943
C. W. WATERMAN, Aug. 7, 1943
J. R. HURLBURT, Sept. 6, 1943
JAMES S. ANDERSON, Sept., 1943
F. F. JORGENSEN, Nov., 1943
E. W. BEARD, Jan. 5, 1944
W. M. ELDERS, Jan. 22, 1944
THOMAS ENGLISH, April 3, 1944
FRANK TIRRE, May 22, 1944
*J. K. CHILDS, June 10, 1944
W. S. STINTON, Dec. 6, 1944
E. W. HAWLEY, Jan. 29, 1945
J. C. ANDERSON, July 7, 1945
F. A. FLASKAMP, Aug. 12, 1945
JOHN M. DILLAVOU, Aug. 19, 1945
STANLEY A. TRENGOVE, Dec. 28, 1945
H. A. ZELLER, Jan. 22, 1946
H. E. MABRY, Nov. 8, 1946
M. K. HERRINGTON, May 11, 1946
L. W. BALDWIN, May 14, 1946
C. P. HOY, May 30, 1946
STUYVESANT PEABODY, June 7, 1946
PETER A. CASSADY, June 18, 1946
JOHN F. GOALBY, June 7, 1946
OSCAR WINTER, Sept. 21, 1946
GEORGE HOOK, Sept. 29, 1946
E. J. KRAUSE, Sept. 30, 1946
J. R. PEARCE, Dec. 10, 1946
E. R. ARMSTRONG, Feb. 17, 1947
JOS. P. LENZINI, Feb. 20, 1947
JOHN H. BAUER, March 12, 1947

* Killed in Action

In Loving Remembrance

ARTHUR PHILLIPS, June 27, 1947
LEE HASKINS, Sept. 19, 1947
C. H. BURKHALTER, Oct. 18, 1947
JETT J. WEST, Nov. 11, 1947
THOMAS MOSES, Feb. 20, 1948
W. H. HUBELI, April 3, 1948
G. E. LYMAN, April 27, 1948
WALTER M. DAKE, May 13, 1948
ARLEN "ZACK" JENNINGS, July 30, 1948
ERNEST L. STEPPAN, Aug. 7, 1948
KENNETH DONALDSON, Aug. 18, 1948
PAT HEAP, Sept. 23, 1948
F. E. FINCH, Nov. 2, 1948
J. E. BARLOW, Nov. 5, 1948
J. W. STARKS, Feb. 3, 1949
D. W. MARSHALL, March, 1949
JAMES WHITE, March 17, 1949
W. W. PAAPE, March 18, 1949
JAMES W. BRISTOW, April 14, 1949
GEORGE F. CAMPBELL, June 18, 1949
E. J. BURNELL, July 22, 1949
LOUIS W. HUBER, Aug. 7, 1949
JOHN RODENBUSH, Nov. 1, 1949
R. G. LAWRY, Dec. 24, 1949
WALTER A. BLEDSOE, March 1, 1950
A. S. KNOIZEN, April 29, 1950
H. C. FREDERICKS, Aug. 16, 1950
JOSEPH E. HITT, Sept. 21, 1950
ARTHUR C. GREEN, Oct. 31, 1950
A. P. TITUS, Nov. 9, 1950
A. W. DUNCAN, Nov. 20, 1950
GILBERT W. BUTLER, Nov. 26, 1950
FRED W. RICHART, Dec. 10, 1950
CHARLES L. BOWMAN, Jan. 30, 1951
B. P. MELTON, February 22, 1951
A. F. KEENAN, March 18, 1951
GEORGE M. LOTT, April 12, 1951
D. F. McELHATTAN, April 12, 1951
M. J. CHOLLET, April 20, 1951
WILLIAM BURNETT, JR., June 14, 1951
E. J. COFFEY, July 20, 1951
A C. CALLEN, July 30, 1951
F. E. WEISSENBORN, August 7, 1951
R. A. BARTLETT, November 26, 1951
D. D. WILCOX, November 30, 1951
A. D. BUSCH, January 1, 1952
F. H. SEYMOUR, February 20, 1952
C. M. O'BRIEN, April 16, 1952
JOHN L. CLARKSON, June 9, 1952
HARRY VOGELPOHL, June 15, 1952
HECTOR HALL, August 21, 1952
J. J. RUTLEDGE, September 11, 1952
NORMAN PRUDENT, September 18, 1952
WALTER WHITING, September 25, 1952
D. W. JONES, November 26, 1952
G. H. BERGSTROM, December 11, 1952
E. J. STERBA, December 31, 1952
W. J. JENKINS, January 12, 1953
FRED J. BAILEY, January 16, 1953
A. C. BASS, Feb. 10, 1953
A. R. JAMISON, Feb. 25, 1953
ANDREW JUNELL, March 4, 1953
HARVEY CARTWRIGHT, June 4, 1953
L. A. DUNBAR, July 30, 1953
R. W. WEBSTER, August 10, 1953
L. A. TROVILLION, Sept. 4, 1953
H. A. REID, October 20, 1953
GEORGE MEAGHER, November 6, 1953
WILLIAM J. McDOWELL, Dec. 12, 1953
L. E. YOUNG, Dec. 27, 1953
O. V. SIMPSON, March 25, 1954
CASPER D. MEALS, April 27, 1954
T. W. PEARSON, May 11, 1954
HARRISON H. JOHNSON Jr., July 20, 1954
BEN H. FIRTH, October 21, 1954
JACK BULLINGTON, October 29, 1954
LOWELL T. MALAN, December 29, 1954
H. KENNETH VOGEL, January 4, 1955
CHARLES H. DUESING, January 8, 1955
JOHN LAND, June 5, 1955
C. W. BROOKS, September 21, 1955
JOE LITTLEFAIR, September 27, 1955
O. J. PLESCHNER, December 10, 1955
GLENN A. SHAFER
HENRY M. MOSES, April 1, 1956
CAPT. W. H. LEYHE, July 4, 1956
J. A. JEFFERIS, July 14, 1956
JOHN A. EMRICK, July 27, 1956
J. M. VANSTON, August, 1956
ROBERT M. MEDILL, January 27, 1957
JAMES W. MORGAN, February 1, 1957
W. E. VAUGHN, February, 1957
JOSEPH F. JOY, February 19, 1957
FRANK H. REED, April 27, 1957
JOHN E. JONES, July 1, 1957
L. C. STRAWSER, July 23, 1957
F. A. CHAPMAN, October 6, 1957
N. C. McFADDEN, October 17, 1957
GEORGE C. McFADDEN, Dec. 1, 1957

OFFICERS 1957

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Paul Halbersleben
Harrisburg, Illinois

VICE-PRESIDENT

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MURRELL REAK**
JOSEPH SCHONTHAL**
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R. H. SWALLOW***

* Term expires 1958
** Term expires 1959
*** Term expires 1960

PAST PRESIDENTS OF ILLINOIS MINING INSTITUTE

FOUNDED FEBRUARY, 1892

1892-93 James C. Simpson, Gen. Mgr., Consolidated Coal Co., St. Louis, Mo.
1893-94 James C. Simpson, Gen. Mgr., Consolidated Coal Co., St. Louis, Mo.
1894-95 Walton Rutledge, State Mine Inspector, Alton, Ill.
1895-1911 Institute inactive.
1912-13 John P. Reese, Gen. Supt., Superior Coal Co., Gillespie, Ill.
1913-14 Thomas Moses, Supt., Bunsen Coal Co., Georgetown, Ill.
1914-15 J. W. Starks, State Mine Inspector, Georgetown, Ill.
1915-16 William Burton, V. P., Illinois Miners, Springfield, Ill.
1916-17 Fred Pfahler, Gen. Supt., Superior Coal Co., Gillespie, Ill.
1917-18 Patrick Hogan, State Mine Inspector, Carbon, Ill.
1918-19 William Hall, Miners Examining Board, Springfield, Ill.
1919-20 William Hall, Miners Examining Board, Springfield, Ill.
1920-21 Frank F. Tirre, Supt., North Breese Coal & Mining Co., Breese, Ill.
1921-22 Prof. H. H. Stoek, Mining Dept., University of Illinois.
1922-23 John G. Millhouse, State Mine Inspector, Litchfiield, Ill.
1923-24 D. D. Wilcox, C. E., Superior Coal Co., Gillespie, Ill.
1924-25 H. E. Smith, Gen. Supt., Union Fuel Co., Springfield, Ill.
1925-26 E. G. Lewis, Supt., Chicago-Sandoval Coal Co., Sandoval, Ill.
1926-27 Wm. E. Kidd, State Mine Inspector, Peoria, Ill.
1927-28 James S. Anderson, Supt., Madison Coal Corp., Glen Carbon, Ill.
1928-29 John E. Jones, Safety Engineer, Old Ben Coal Corp., West Frankfort, Ill.
1929-30 Prof. A. C. Callen, University of Illinois, Urbana, Ill.
1930-31 Joseph D. Zook, Pres., Illinois Coal Operators Assn., Chicago, Ill.
1931-32 Geo. C. McFadden, Asst. Vice-Pres., Peabody Coal Co., Chicago, Ill.
1932-33 Chas. F. Hamilton, Vice-Pres., Pyramid Coal Co., Chicago, Ill.
1933-34 Harry A. Treadwell, Gen. Supt., C. W. & F. Coal Co., Benton, Ill.
1934-35 C. J. Sandoe, Vice-Pres., West Virginia Coal Co., St. Louis, Mo.
1935-36 T. J. Thomas, Pres., Valier Coal Co., Chicago, Ill.
1936-37 W. J. Jenkins, Pres., Consolidated Coal Co., St. Louis, Mo.
1937-38 H. H. Taylor, Jr., Franklin County Coal Corp., Chicago, Ill.
1938-39 Paul Weir, Consulting Mining Engineer, Chicago, Ill.
1939-40 Roy L. Adams, Old Ben Coal Corp., West Frankfort, Ill.
1940-41 Dr. M. M. Leighton, State Geological Survey, Urbana, Ill.
1941-42 J. A. Jefferis, Illinois Terminal Railroad Co., St. Louis, Mo.
1942-43 Carl T. Hayden, Sahara Coal Co., Chicago, Ill.
1943-44 Ben H. Schull, Binkley Mining Co., Chicago, Ill.
1944-45 George F. Campbell, Old Ben Coal Corp., Chicago, Ill.
1945-46 Joseph E. Hitt, Walter Bledsoe Co., St. Louis, Mo.
1946-47 Robert M. Medill, Dept. Mines & Minerals, Springfield, Ill.
1947-48 Harry M. Moses, H. C. Frick Coal Co., Pittsburgh, Pa.
1948-49 J. Roy Browning, Illinois Coal Operators Assn., Chicago, Ill.
1949-50 T. G. Gerow, Truax-Traer Coal Co., Chicago, Ill.
1950-51 G. S. Jenkins, Consolidated Coal Co., St. Louis, Mo.
1951-52 Clayton G. Ball, Paul Weir Co., Chicago, Ill.
1952-53 William W. Bolt, Pawnee, Ill.
1953-54 Harold L. Walker, M. & N Engineering Company, Alton, Ill.
1954-55 J. W. MacDonald, Old Ben Coal Corp., Benton, Ill.
1955-56 Earl Snarr, Freeman Coal Mining Corp., Hinsdale, Ill.
1956-57 Paul Halbersleben, Sahara Coal Co., Harrisburg, Ill.

1957

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1957

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Reprint from *Economic Geology*

Reprints from *Mining Congress Journal*

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PROCEEDINGS OF ILLINOIS MINING INSTITUTE
SIXTY-FIFTH ANNUAL MEETING

Held in Springfield, Illinois

FRIDAY, OCTOBER 18, 1957

MORNING SESSION

The Sixty-fifth Annual Meeting of the Illinois Mining Institute, held at the Hotel Abraham Lincoln, Springfield, Illinois, convened at 10:00 a.m., President Paul Halbersleben presiding.

President Paul Halbersleben: This is the Sixty-fifth Annual Meeting of the Illinois Mining Institute and, as President of that organization, I welcome you to this meeting.

I have not checked on the registration, but George will probably give you some figures on that when he speaks. All of you have received copies of the *Proceedings* and so we will dispense with the reading of the minutes of the meeting because they have been published.

I want to call on George Wilson, Secretary-Treasurer, at this time, to discuss certain business matters. George.

REPORT OF THE SECRETARY

George M. Wilson (Secretary-Treasurer of Illinois Mining Institute): During the past year, your Institute had 807 paid members. As of 9:45 this morning, there are about 396 paid members plus some life members in attendance. At the banquet tonight, we will give total registration as of today.

The cash balance is $2,005.06; and we have $19,000.00 in government bonds as well as a $1,000.00 railroad bond. The *Proceedings* for 1957 are being compiled for our advertisers. We have about one hundred pages of ads.

The Advertising Committee extends a vote of thanks to you manufacturers and suppliers for your cooperation. We wish to thank the officers and members of the Executive Committee for their wholehearted cooperation during the last year, and to the honorary Secretary-Treasurer, Mr. Schonthal, I wish to express my own thanks for continued wise and valued counsel. Thank you. (Applause)

President Halbersleben: Thank you, Mr. Wilson. Gentlemen, you have heard the report of the Secretary-Treasurer, what is your pleasure in this matter?

B. E. Schonthal (Honorary Secretary-Treasurer): I move for its acceptance, Mr. President.

C. C. Conway (National Mine Supply Company, Nashville, Illinois): I second the motion.

President Halbersleben: It has been moved, seconded, and carried. Now we will have the report of Mr. B. E. Schonthal, Nominating Committee.

NOMINATING COMMITTEE REPORT

B. E. Schonthal: Mr. President and members of the Illinois Mining Institute, your Nominating Committee has met and made the following nominations for officers for the ensuing year:

OFFICERS

President: H. C. Livingston, Truax-Traer Coal Company, Chicago, Illinois.

Vice-President: A. G. Gossard, Snow Hill Coal Corporation, Terre Haute, Indiana.

Secretary-Treasurer: George M. Wilson, 102 Natural Resources Bldg., Urbana, Illinois.

EXECUTIVE BOARD

For the Executive Board to serve three years:

J. A. Bottomley, Sahara Coal Company, Harrisburg, Illinois.

A. P. Massman, Peabody Coal Company, St. Louis, Missouri.

J. W. Broadway, Bell & Zoller Coal Co., Chicago, Illinois.

R. H. Swallow, Fairview Collieries Corp., Indianapolis, Indiana.

Respectfully submitted by B. E. Schonthal, Chairman, T. G. Gerow, and F. E. Snarr.

President Halbersleben: You have heard the report of the Nominating Committee. What is your pleasure on their recommendations?

Sam Caplan: I move the nominations be accepted.

Ellis J. O'Brien (Heyl and Patterson): I second the motion.

President Halbersleben: No further nominations are to be made from the floor. . . . All those in favor signify by saying "Aye"; opposed, "No." It is passed unanimously.

Now, if I get off the beam here this morning, it is because I am following Earl Snarr's tracks of last year, so you can blame him. (Laughter) They have this microphone set so that it will fit George here, and the fellow put a tilt spring on that nut so I have to teeter a little bit to be able to use it.

From the floor: As long as you do not totter. (Laughter)

President Halbersleben: Dr. Thomas A. Read, Professor of Metallurgical Engineering, University of Illinois, will make a report on our scholarships at Illinois. (Applause)

SCHOLARSHIP REPORT

Dr. Thomas A. Read (Professor of Metallurgical Engineering, University of Illinois): Mr. President, members of the Illinois Mining Institute and guests: You will recall that at last year's annual meeting of the Institute, the new program of the Institute supported mining engineering scholarships. George has given me the privilege of announcing that the Institute has further increased their generosity this year, increasing, effective next year, the amount of the scholarship awards from $400.00 a year to $500.00 a year.

In addition to this, I have the pleasure of reporting the additional scholarship programs which have just been started. The Old Ben Coal Company has just this year started a scholarship program which will provide a $500.00 a year scholarship to a student who comes to study mining engineering at the University of Illinois and each succeeding year, up to a total of 4, an additional scholarship will be awarded.

Then, finally, the Sahara Coal Company has also set up a new scholarship program with an award of $500.00 a year and the first of these will be awarded next year. I think we have your President to thank for this new scholarship.

We at the University, of course, appreciate very much this support of our educational program by the coal mining industry, and we also feel that it is an excellent way to supply some of our most talented youth along engineering lines to the mining industry. Not only do the awards make possible technical education for students who otherwise would not have sufficient means, but also it helps to impress on prospective engineering students the importance and dignity of the mining industry.

I would like to announce the names of this year's scholarship holders, two of whom are here at this meeting. First, the two recipients of the Illinois Mining Institute's scholarships: Mr. Paul Stuber – unfortunately, Mr. Stuber is one of those people who had a little trouble with the flu, I understand, so he is not here this morning; but the second Mining Institute scholarship holder is John Harris, and he is present. Will you rise, please. (Applause)

The first recipient of an Old Ben scholarship is Mr. Louis Wozniak. Louis, please. (Applause)

Finally, the Sahara Coal Company scholarship holder is Mr. Thomas Brown, who, unfortunately, could not attend this meeting.

I would like to make a report on the mining engineering enrollment. This year we have 44 undergraduate students, which represents an increase from 30 last year. This, of course, is a substantial increase percentagewise.

The University enrollment, as a whole, has not undergone any such increase this year over last.

In closing, I would like to express again our thanks to the Illinois Mining Institute, the Old Ben Coal Company, and the Sahara Coal Company for continuing their vigorous support of our educational program. Thank you. (Applause)

* * *

President Halbersleben: Thank you, Dr. Read. You heard what he said about me, but all of you know that he is really talking about Henry Woods, who is the Chairman of the Sahara Coal Company. (Applause)

I have asked Dr. George Clark, Chairman of the Department of Mining Engineering, Missouri School of Mines, to speak for just a minute. (Applause)

Dr. George Clark (Chairman, Department of Mining Engineering, Missouri School of Mines): Mr. President and members of the Illinois Mining Institute: First of all, let me express my own personal pleasure at being at another one of the annual meetings of the Illinois Mining Institute. I believe I have missed only two of these within a period of thirteen years and it is always a pleasure to come back, I assure you.

With regard to all scholarship programs, we have a number of mining scholarships at the Missouri School of Mines, but the one of primary interest to this group is the one that is furnished by the Illinois Mining Institute. The recipient of the scholarship was unable to be here today because of family difficulties, but he asked me to convey his sincere thanks to the Institute for the assistance he has received through the scholarship.

I, too, would like to convey the sincere gratitude of the Missouri School of Mines for the generosity you have shown in furnishing a scholarship to one of our students.

With respect to enrollment figures in mining engineering, we had a slight increase again this year percentagewise, which is a good, healthy sign. Total enrollment is 130 students, about 30 of whom come from the State of Illinois. Thus, we feel that, although we are outside of the geographical boundaries of the sovereign State of Illinois, we actually are a part of it.

With respect to educational research programs, we are doing very well on a graduate level with the support from the National Science Foundation and from industry, but we are lacking somewhat in support on the undergraduate level. The results of our graduate research do filter down to the undergraduate students and are of extreme benefit to them, but we need more financial help, and I am sure this is true of almost every school in the country.

To obtain this, we are going to need the help of not only the school administration and the State legislature, but also of industry itself. Industry can furnish moral support, but this is not enough. They can furnish real support to the schools by taking a real interest in what the schools are doing in the way of research and teaching programs. They can also help in a financial way by making direct contributions or by assisting the schools with their research programs. Other industries are doing this extensively and it is helping the schools in the other engineering professions and setting them out ahead of where they are at present.

I leave this as a word of suggestion to you: We are attempting to go a little more aggressively after some financial support from the mining industry in our own area and this support possibility appears very promising.

Again, let me express my own sincere pleasure at being here and for being able to say these few words to you. Thank you, very much. (Applause)

* * *

President Halbersleben: We have Dean William L. Everitt, University of Illinois, with us this morning and at this time I have asked him to come to the platfrom. (Applause)

Dean William L. Everitt (University of Illinois): It is a real pleasure to be here again. I am particularly impressed with the program which has been made in terms of support for scholarships, which I think I mentioned here two years ago as being very important.

All of the various areas of engineering in recent years have been competing for students and there is a real problem of communication to students on the part of the various industries so that they can each, in turn, get their share of the available supply. Sometimes, of course, communications fall down because of misinterpretation of data.

There are various ways of reaching the students. One of the ways is through the scholarship program, which I hope will continue to expand. George Clark mentioned another area that I think is very important, namely, the field of electrical engineering, the technical field in which I have been particularly active. When I was a younger man, electrical engineering emphasized the power field and had very little on communication, or what we call the electronic field. For a variety of reasons, there has been a great deal more support for research in the field of electronics than there has been in the field of power, and the result is that the new university students see a lot going on in this field of electronics but they have not seen as much going on in the field of power because it has not been very well supported. Therefore, there have not been as many graduate students and/or professors working in this field. This has been one of the things that has caused a major shift in emphasis so that now the power companies are worried that they cannot get electrical engineers to come into their field.

The mining atmosphere around the campus that is maintained by research programs, I think, has a good deal to do with this changing emphasis. I think you are all aware that it is somewhat more difficult to get funds for research programs in mining than it is in some other areas of engineering: partly because of the difficulty in obtaining funds from the Department of Defense, which is one of the major sources nowadays, and partly because of the difficulty in obtaining support from industry itself.

I would like to use that as my theme today in terms of suggesting an area to which I think we might begin to give more serious consideration, as you have in undergraduate scholarships, through the support of research programs at the University.

It has been a great deal of pleasure to be here and I will be glad to meet more of you as the day goes on. I hope I can come back in future years. Thank you. (Applause)

* * *

President Halbersleben: Thank you, Dean Everitt.

I see Ben Schull, the Director of the Department of Mines and Minerals of the State of Illinois, back in the audience and I am going to ask Ben to come forward and talk to us for just a minute or two. (Applause)

Ben H. Schull (Director, Department of Mines and Minerals, State of Illinois): Thank you, Mr. Halbersleben, for the opportunity of coming up and telling you about the coal business – what little we know.

We are minus 0.032 percent or 1,100,000 tons for nine months, comparing 1956 and 1957 production figures in the State of Illinois.

Our non-fatal accidents are down to 139, comparing the nine months or on a tonnage basis. We had one lost-time accident in 1956 for 46,000 tons, and for 1957, it was 55,000 tons. Now, if I quit right there, it would sound better. Our fatalities for the first nine months of 1956 were 15 and the first nine months of 1957, there were 20 – a plus 5. Our tonnage in 1956 was 2,300,000 for each fatality and for 1957, the figure is 1,700,000.

I think that if a man talked for a week on that, he would only get weaker. I think all of you know what the situation is. I think that your reports show you what they are. Our department would certainly appreciate your cooperation in helping to stop these roof, rib and face falls which are our main killers in mining today.

I do not think that, with the cooperation of the mining industry, they will continue. Your cooperation will certainly be appreciated by us. I thank you. (Applause)

* * *

President Halbersleben: Thank you for those facts, Ben. I am sure that you know that all of us are digging in and following out these suggestions to the fullest extent in attempting to get away from these accidents.

I believe that that constitutes all the extraneous matters that we have ahead of this program. At this time, I would like to turn the mike over to Howard Stelzriede of the Freeman Coal Mining Corporation, who will act as chairman.

. . . Mr. Howard R. Stelzriede assumed the chair . . .

Chairman Howard R. Stelzriede (Freeman Coal Mining Corporation, Waltonville, Illinois): Thank you. I see from the program that we have two papers on the technical session of this morning's meeting. The first one is "The Effect of Weather Conditions on Explosive Elements in Coal Mines," by Professor C. B. McIntosh.

Professor McIntosh has done quite a lot of work on this subject. He did his first work, I understand, while working on his degree of Ph.D. at the University of Nebraska, and I think that, for some of the particular data he accumulated, he should have hailed from Nebraska to Illinois under some special conditions, but he can tell you about that. Since that time, he has taught at the University of New Zealand and at the University of Texas. He is now Associate Professor of Geography at Eastern Illinois State College, Charleston, Illinois. You will note that it is now officially Eastern Illinois University. At this time, we will have Professor McIntosh. (Applause)

EFFECT OF WEATHER CONDITIONS ON EXPLOSIVE ELEMENTS IN COAL MINES

CHARLES BARRON MCINTOSH
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The purpose of the research here presented was to determine what, if any, possible relationship there might be between weather, explosive elements in coal mines, and coal-mine explosions.

This summary paper presents information obtained in field research from two Illinois coal mines. In addition, a few patterns and observations resulting from a study of more than 400 coal-mine explosions and the weather conditions associated with 365 of them are presented (McIntosh, 1957a, 1957b, and 1958? References are given at end of article).

I wish to acknowledge the cooperation of the Peabody Coal Company in the research on methane and coal mine dust. Their No. 14 mine east of Du Quoin was used as the research mine from which all of the methane samples were taken, and their No. 17 mine at Pana was used for the major part of the coal-dust investigation. Both union and company men were helpful with ideas, instructions, and with some of the work involved in the study.

The first step in the field study involved a determination of the relationship between methane content of mine atmosphere and atmospheric pressure. The idea that miners thought such a relationship could exist was first presented to the author by David Stanhouse shortly after the West Frankfort explosion in December 1951. Air samples were taken from the main return entry of the mine. The air samples were obtained with standard sampling bottles during the passage of low pressure cells.

The results of this initial investigation are pictured in figure 1. The passage of seven cyclones and the associated changes in methane are shown. The seasons represented are summer, autumn, and winter. Number 1 graph in figure 1 represents the passage of a typical summer cool front.

A cold front is a line of discontinuity separating a warm body of air from a cold air mass. Such a line generally occupies a trough of low pressure extending southwestward from a low pressure center and moves in such a direction that

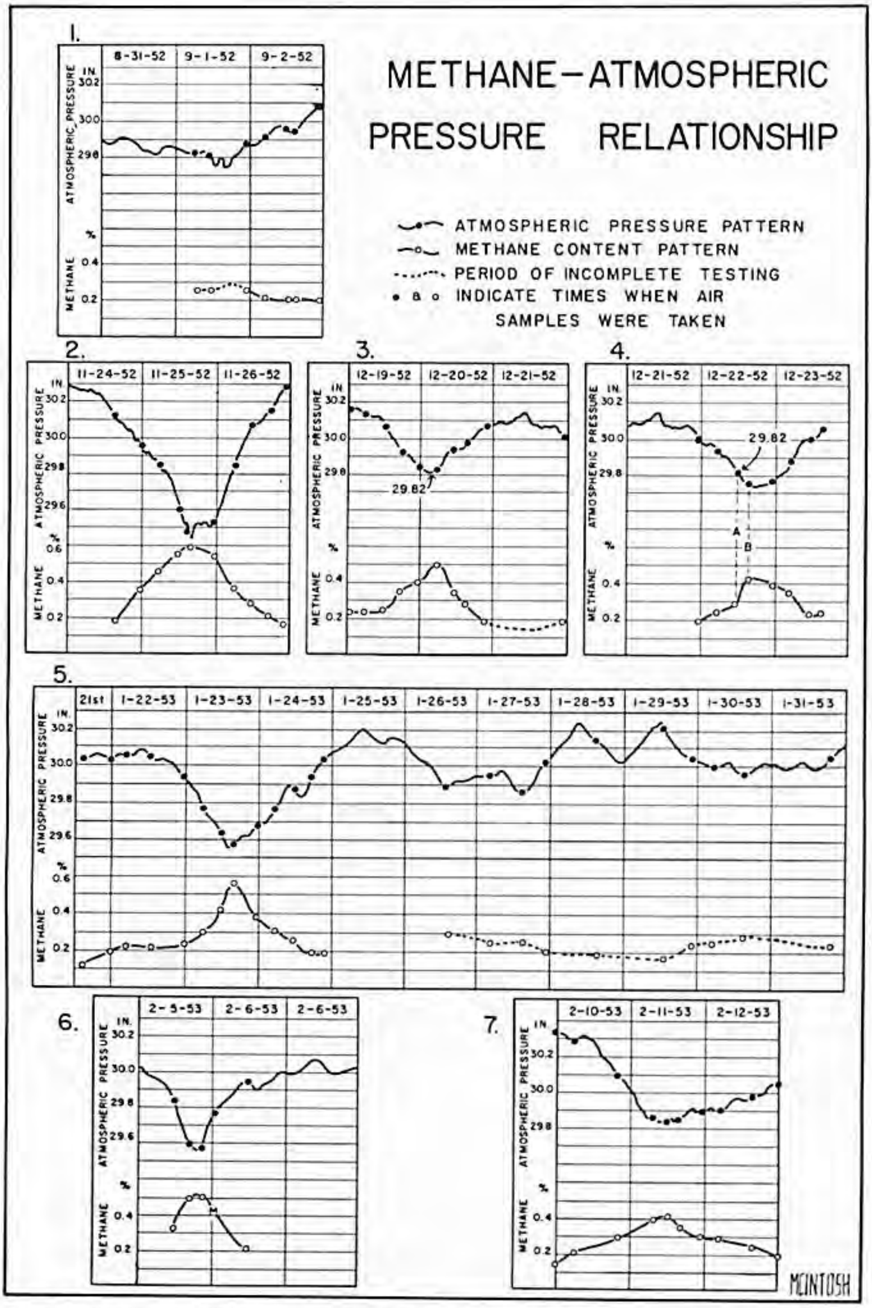

Fig. 1 — Methane-atmospheric pressure relationship as shown in a Southern Illinois mine.

the cold air advances, replacing warm air on the surface. A cold front is often referred to as a *cool front* during the summer season.

Methane testing was not complete during the time of lowest pressure because the first two days shown were Sunday and Labor Day, when access to the mine was limited. The few samples obtained indicate a slight drop in methane content after the typical weak summer front had passed. This suggests that a slight increase in methane occurred during the time of lowest atmospheric pressure.

The autumn sampling, represented in Number 2 graph, shows a well defined relationship between a drop in atmospheric pressure and a rise of methane content in mine atmosphere.

The remaining graphs picture relationships found in winter sampling. Whenever there was a marked depression in atmospheric pressure there was a correlated increase in methane. The period from January 26 to January 31 was used as a check period when relatively high pressures prevailed. Where no definite depression in the barogram occurred there was no outstanding increase in methane.

When two cyclones follow each other closely the methane content associated with the second low pressure cell may vary from the normal pattern. For instance, No. 3 and No. 4 in figure 1 are separated by only one day. The lowest pressure in No. 3 is 29.82 inches. The pressure at the time of observation "A" in No. 4 is 29.82 inches. The amount of methane in the methane-storage cavities must have been depleted during the drop in pressure associated with No. 3 cyclone. A slower than normal rise in methane is observed in No. 4 until after the pressure falls below 29.82 inches. A rapid rise in methane content is noted between observations "A" and "B" after the pressure has dropped below the lowest pressure of the previous low. Such a feature should be kept in mind for forecasting procedures.

Investigation of mining literature revealed attempts at correlation between low atmospheric pressure and coal-mine explosions. The results of one of the earliest such investigations (Darton, 1915) might be noted here:

> Sir Frederic Able has shown this opinion [that explosions are most frequent at times of low pressure] to be largely erroneous. He gave a list of explosions during the years 1875 to 1885, involving the loss of 2,229 lives, and by reference to weather records showed that only 17.4 per cent of the mortality was at a time when the barometric pressure was below the average and that half of the explosions occurred when the pressure was increasing. If the frequent small accidents due to various causes could be excluded, three out of four of the explosions were at times of high pressure or anti-cyclonic conditions.

Able's observations led him to one conclusion: coal-mine explosions were not related to low atmospheric pressure.

More recently, C. L. Hosler (1948) made an investigation of 41 coal-mine explosions that occurred from 1936 to 1948, eight of which were in anthracite mines and thirty-three in bituminous coal mines. Hosler's paper indicated a close relationship between anthracite-mine explosions and a sharp fall in atmospheric pressure. Barograms associated with the anthracite-mine explosions show the average pressure reaching its lowest point on the explosion day. The low pressure on explosion day should have indicated more methane in the mines at explosion time.

Averaged barograms representing the weather accompanying the bituminous coal-mine explosions, however, revealed the low barometric reading to be on the day before the explosion day. The averaged barograms indicated a rising pressure during explosion day. A similar rising pressure pattern at the time of the explosions had been noted by Able more than 50 years earlier. Methane patterns shown in figure 1 established the fact that a rising barometer lowers the methane content in a mine.

Hosler (1915) concludes that his ". . . investigation strongly indicates a relationship between the occurrence of coal-mine explosions and the pressure changes accompanying certain synoptic situations." This conclusion undoubtedly applies to the averaged barometric conditions associated with the anthracite-mine explosions. However, the fact that the pressure rise was more common than a falling pressure on explosion day (in the case of the bituminous coal-mine explosions) must cause one to question the validity of the conclusion in its application to a majority of coal-mine explosions.

One important fact was not considered in either of the above-mentioned investigations. *There are coal-dust explosions as well as methane explosions.* Anthracite coal dust does not explode and it is assumed that only methane explosions take place in anthracite mines. This fact, taken in connection with Hosler's study, gives a plausible explanation as to why there is a close relation between the time of explosion and the time of low pressure in the anthracite mines. For, with only methane explosions active in anthracite mines, the law of probability would dictate the occurrence of a greater number of explosions when the methane content was greatest in those mines.

Sir Able found atmospheric pressure rising on 50 percent or more of the days when bituminous explosions occurred, and Hosler's averaged pressures indicated a rising barometer for his 33 bituminous explosions. Thus, if a relationship does exist between barometric pressure and bituminous explosions, the association relates explosions to a rising pressure and decreasing methane content rather than to a falling barometer producing an increase in the mine's methane content.

A rising barometer is indicative of post-cyclonic or post-frontal weather conditions and their effect upon coal-dust moisture. The passage of a cyclone or cold front is generally accompanied by a change in the type of air mass from warm, moist air to colder and drier air. It was assumed that lower temperature and less water vapor should tend to reduce the moisture content of the mine atmosphere and in turn reduce the moisture content of coal dust in the mines. Dust of uniform mesh was exposed in an air passage one mile from the air intake. Samples of the exposed dust were obtained as four different cold fronts approached and passed over the mine. The moisture content of the samples was obtained and plotted on the graph shown in figure 2. In all cases the moisture content of the coal dust increased under the influence of the warm, moist air preceding the cold front. After the cold front passed (the time of cold front passage is indicated by '0' on the horizontal grid)

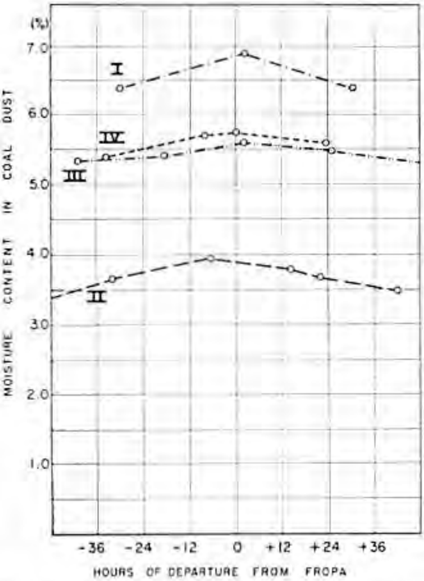

Fig. 2—Variation in coal-dust moisture content associated with changes from warm, moist air masses to cold, dry air masses. FROPA (frontal passage) is at 0-hour.

the drier air removed moisture from the coal dust. The moisture loss approximated 7 percent in a 24 to 32 hour period after the invasion of cold, dry air, and in one case amounted to a loss of 11 percent within 42 hours.

Comparison of Seasonal and Short-Period Drying

Seasonal differences in moisture content of coal dust has long been recognized. Recognition of brief, fast-drying periods, described above, has not yet been accepted among those most intimately connected with coal-mine operation.

Winter drying in mines is great enough that a printed note "Seasonal Warning" was sent out by the United States Bureau of Mines early in 1952. The following is quoted from the warning:

> Experience over the years has indicated that the fall and winter months are the most dangerous from the standpoint of coal dust explosions. A logical explanation for this is that during the fall and winter months the outside temperature of the air is lower than the mine temperature. Any fine coal in the mine gradually dries out and hence becomes easier to disburse into a dust cloud and more readily ignitable.
>
> The effect of the fall and winter season on the increased possibility of mine disasters can be offset by increased diligence in maintaining adequate ventilation in the face regions and by application and maintenance of rock dust close to the faces.

Because the seasonal change in coal-dust moisture was considered worthy of a warning, a comparison was made between the effect of seasonal changes and the effect of short-period air mass changes upon the moisture conditions in a mine.

Average humidity and temperature conditions were obtained for intake air and the return air in a mine for July and January. Table 1 shows the calculated loss of moisture from the mine in January and deposition of moisture in July. The loss and gain of moisture in the mine were then computed for conditions associated with the cold, dry (cP = Polar Continental) air mass that followed the front over the mine and the warm, moist (mT = Tropical Maritime) air mass preceding a front that passed over the mine in April 1954. A uniform amount of air was assumed to pass through the mine for all four check periods. (For a more detailed discussion, see McIntosh, 1955.) The statistics for the tropical maritime air and polar continental air represent a time separation of only 34 hours compared to six months for the seasonal time span.

TABLE I

COMPARISON OF SEASONAL AND AIR MASS MOISTURE VARIATIONS *

Type of air	Temperature ° F.	Relative Humidity %	Aqueous vapor in grains per cu. ft. of air	Gain or loss to mine in grains per cu. ft.	Gain or loss to mine in gallons per day
cP air mass	32.6	75	1.621	—4.250	—10,468
January average	29.5	73	1.382	—4.489	—11,059
mT air mass	71.6	82	6.887	+1.016	+ 2,506
July average	77.5	66	6.678	+0.807	+ 1,987

* From "Danger Period in Coal Mines Following a Low-Pressure Passage," Mining Engineering, Oct., 1957.

The last column in Table I reveals that the amount of moisture deposited in the mine during one day in July differs little from the amount of moisture that would have been deposited in one day under the warm, moist conditions observed ahead of the front. Likewise, the amount of moisture drawn from the mine during one day in January differs little from the amount of moisture that would have been lost from the mine in one day under the cP air mass conditions observed following the April cold front. Thus, practically the same changes in moisture conditions in the mine may be observed within a few hours that is evidenced by the average seasonal change from summer to winter.

Coal Mine Explosions and Weather

The weather conditions associated with 365 coal-mine explosions were analyzed in light of the observations revealed in the field work. A high frequency of explosions centered close to the time when fronts passed the mines. Another time of higher explosion-frequency was spaced about 24 hours after the time the front passed. These two peaks could possibly represent explosion association with methane at time of low pressure and with coal dust 24 hours later after cold, dry air would have removed considerable moisture from the mines. A fatality count was used as a check on the validity of

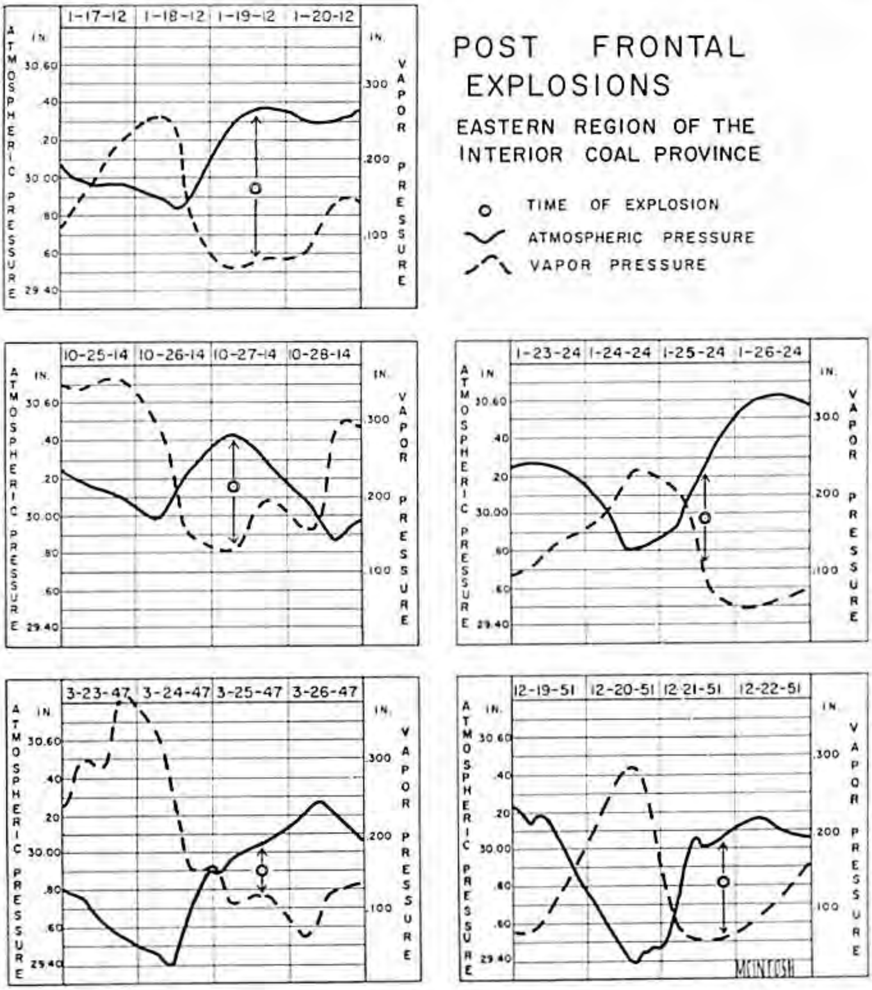

Fig. 3—Post-frontal explosions that have occurred in the Eastern Region of the Interior Coal Province.

such an association. Methane explosions are more localized than coal-dust explosions. It was assumed that the loss of life would be less in methane explosions than in coal-dust explosions. The low-pressure explosions, assumed to be methane explosions, averaged between 17 and 25 fatalities, whereas the post-frontal explosion period, assumed to be coal dust or including coal-dust explosions, averaged twice the number of deaths that were observed in the explosions occurring near the time of frontal passage.

A historical study of explosion-weather association and the appearance of several explosion series have led the author to assume the possibility that weather influences both methane and coal-dust so that a greater number of explosions will occur during periods of maximum methane content and during periods when coal dust is most dry.

I have chosen to present here some weather patterns associated with post-frontal explosions. Weather conditions shown in figure 3 are those associated with five post-frontal explosions recorded from the Eastern Region of the Interior Coal Province. All of these explosions occurred during the day following a cold front passage. The period between the time of cold front passage and the time of mine explosion is marked in all cases by (1) a rise in atmospheric pressure and (2) a sharp fall in vapor pressure. These conditions would indicate a cold, dry air mass over the mine. Polar continental air, we have already noted, takes moisture from the coal dust. The two lower graphs represent weather conditions for the two most recent major explosions in Illinois—the Centralia and West Frankfort explosions. The weather conditions associated with these two explosions, in modern mines, are remarkably similar. Coal dust was an important factor in both explosions; dry air had been forced through the mines for more than 25 hours prior to both explosions; lowest pressures at time of the frontal passage were approximately the same; the rise in pressures were similar; there was a decided drop in vapor pressure in both cases; and the explosion results were also similar.

The weather data associated with the recent explosion that occurred near Marianna, Pennsylvania, are shown in figure 4. The weather maps show the cold front moved over southwestern Pennsylvania on September 22. The mine, during the post-frontal period, was under the influence of a cold Polar Continental air mass. This 14-hour period was one of marked decrease in atmospheric moisture. This latter condition is revealed by the sharp drop in vapor pressure between the time of cP air mass invasion and the explosion time. A comparison of the weather phenomenon associated with the Marianna explosion and those shown in figure 3 reveals a marked similarity.

Forecasting Dangerous Conditions

It is possible to forecast times of high methane content and periods when the air will be exceptionally dry.

Graphs may be produced by plotting the methane content from air samples taken during the passage of several low pressure cells. The chart in figure 5 plots methane content on the Y axis and time on the X axis, with zero representing the time of lowest pressure. The methane content for this particular point in the mine went above the gassy classification from 6 to 20 hours before the time of lowest pressure and stayed above the .25 to .30 of one percent for a like period after the time of lowest pressure. The total time in gassy classification ranged most often from 20 to 30 hours.

The solid line M in figure 6 is the line of regression determined from the pressure and methane statistics for the methane amounts not-

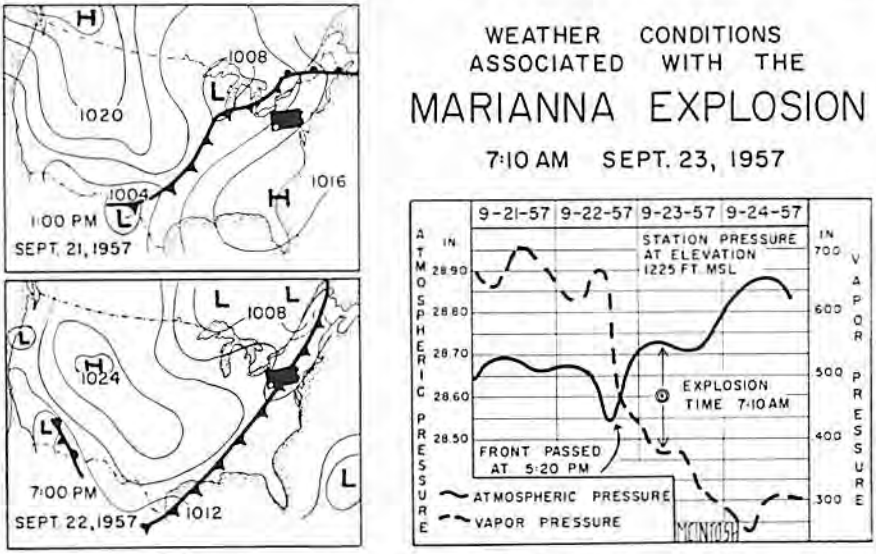

Fig. 4—Weather conditions associated with the Marianna explosion.

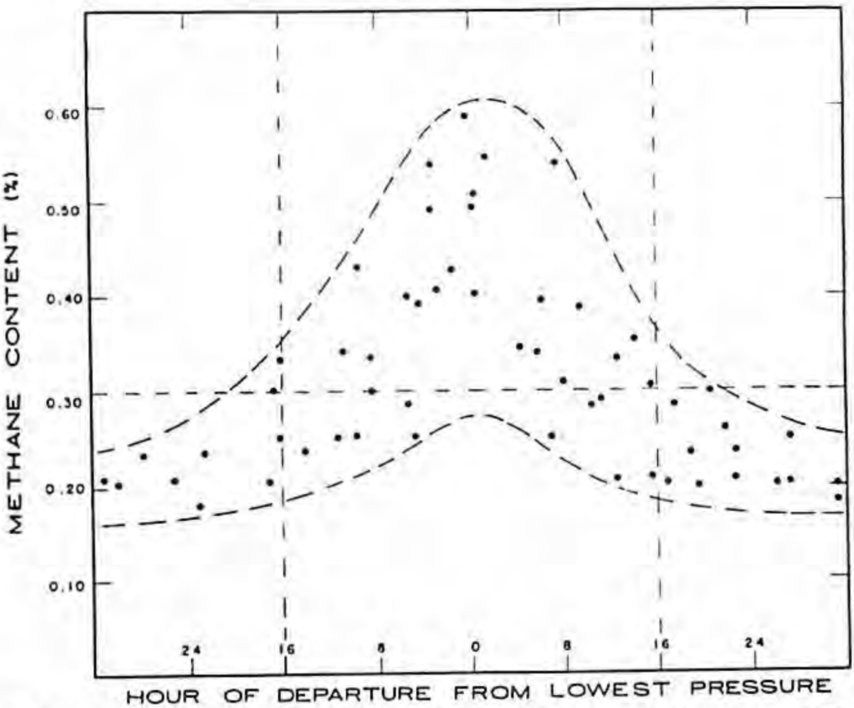

Fig. 5—Chart used to estimate length of time mine air will have a methane content exceeding the gassy classification.

(Figs. 5 and 6 were used in "Forecasting Explosion Conditions in Coal Mines," Illinois State Academy of Science Transactions, Vol. 50.)

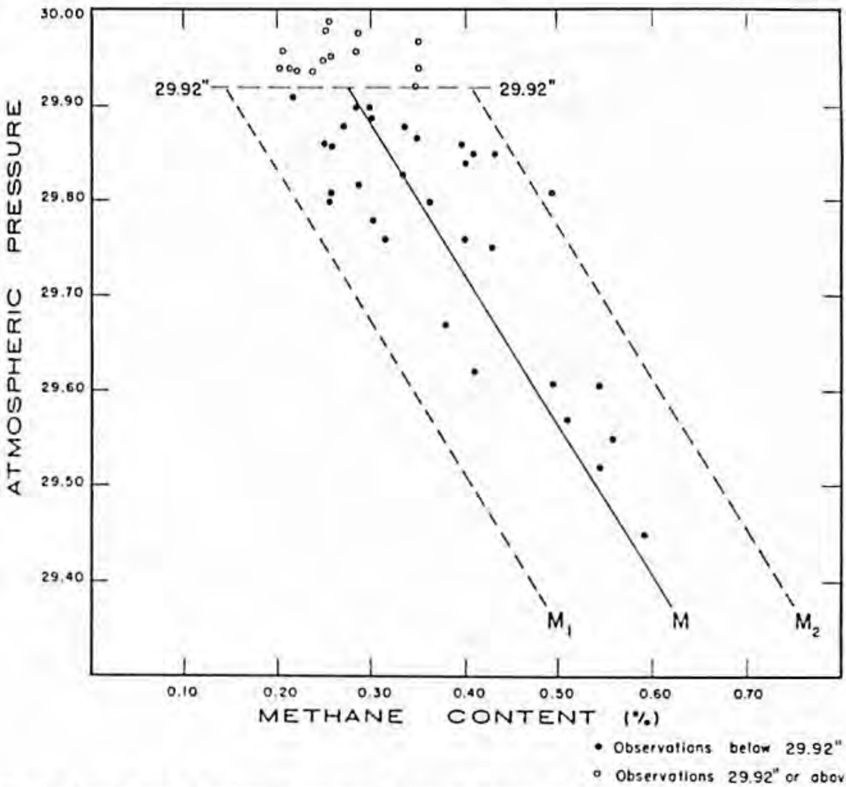

Fig. 6—Graph used to estimate maximum methane content at time of lowest pressure. Graph depicted would be valid only for the mine and point in the mine where the air samples were obtained.

ed below a pivotal pressure of 29.92 inches. Given a forecast of low pressure, the best estimate of methane content may be obtained by crossing line M with a line drawn from the forecast pressure and dropping from that point to the estimated methane content on the X axis. The dashed lines M_1 and M_2 have been determined by the standard error-of-estimate formula so that the amount of methane for any given pressure will fall between M_1 and M_2 95 per-cent of the time. Another attempt at forecasting methane content has been admirably presented by Durst (1956).

Another factor to be considered in forecasting for methane in the autumn period is worthy of some consideration. The average pressure for the study area of Illinois approximates 1017-18 mb. (30.05 in.) in September, 1019 mb. (30.09 in.) in October, and 1021 mb. (30. 15 inches) in November. Thus, there is a slight but definite increase in average pressure during this particular season. With a gradual increase in pressure there will be less chance for methane to escape from the methane storage cavities. Such a situation should result in a gradual build-up of methane in the cavities. The first deep low over the area in fall or early winter should result in a greater release of methane than might be expected from a similar low later in the season. The first deep autumn cyclone should receive special consideration in forecasting plans.

The time of maximum drying in the mine would accompany the invasion of a cold air mass following the passage of a cold front. Any measures used in a mine to counteract dust dispersion or to make the dust non-combustible could receive special emphasis during this post-frontal period.

One further point could well be emphasized. The previously mentioned "Seasonal Warning" states "The effect of the fall and winter season on the increased possibility of mine disasters can be offset by increased diligence in maintaining adequate ventilation in the face regions. . . ." The face area is often the first part of the operating area in a mine to receive the fresh air. The first part of the operating area to receive cold, dry air will be the area where the greatest amount of moisture would theoretically be removed from the coal dust. Thus, although fresh air is essential to safe operation, the writer questions the effectiveness of the fresh air in alleviating the danger of coal dust explosions. Rather mining engineers face the paradoxical situation in which the measures taken to minimize methane-explosion danger tend to increase the drying of coal dust and hence increase the possibility of coal-dust explosions. (Applause)

References

Darton, N. H., 1915, Occurrence of explosive gases in coal mines: U. S. Bureau of Mines Bull. 72, p. 82.

Durst, C. S., 1956, Barometric changes and the efflux of gas in mines: Meteorological Office Professional Notes No. 117, London (Her Majesty's Stationery Office), p. 15.

Hosler, Charles L., 1948, Atmospheric surface pressure related to coal mine explosions: Trans. American Geophysical Union, v. XXIX, p. 607-612.

McIntosh, C. B., 1955, Weather and coal mine explosions: Univ. of Nebraska, unpublished dissertation, p. 60-76.

McIntosh, C. B., 1957a, Atmospheric conditions and explosions in coal mines: Geographical Review, April, p. 155-174.

McIntosh, C. B., 1957b, Danger period in coal mines following a low-pressure passage: Mining Engineering, October, p. 1152.

McIntosh, C. B., 1958?, Forecasting explosion conditions in coal mines: presented at 1957 meeting of the Illinois State Acad. Sci., scheduled for publications in Trans. Illinois Acad. Sci., v. 50, 1958.

U. S. Weather Bureau, 1946, Normal Weather maps, northern hemisphere, sea level pressure: U. S. Dept. of Commerce Weather Bureau, p. 14.

Chairman Stelzriede: Thank you, Professor McIntosh. Are there any remarks or questions you would like to ask Dr. McIntosh?

You seem to have answered their questions, Dr. McIntosh. Thank you.

The second paper on the program will differ slightly from that printed in the announcement. The title is "Roof Bolt Recovery in the Middle West" by Leon W. Kelly, Roof Control Specialist, District E, U. S. Bureau of Mines, Vincennes, Indiana. Mr. Kelly has been a famous face in here for so long that I am going to turn it over to him. I think you all know him. Mr. Kelly. (Applause)

ROOF BOLT RECOVERY IN THE MIDDLE WEST

LEON W. KELLY

Roof Control Specialist, District E

United States Bureau of Mines

Vincennes, Indiana

Mr. Chairman and gentlemen of the Illinois Mining Institute: Eight years ago this month I appeared before the Illinois Mining Institute in an effort to interest every operator in Illinois in experimenting with roof bolts. At that time, there were only three or four Illinois mines, with the exception of Consolidated No. 7, that were using any roof bolts at all, and the number installed was probably less than 1,000. On June 30, 1957, it was estimated that 9,852,179 roof bolts had been used in Illinois mines in the intervening eight years. In those eight years with all those roof bolts, there were only three men killed. That is a wonderful set of figures, and it is comparable to figures for the rest of the country. The significant thing about that to me is that I do not think justice has ever quite been done to the people that originated roof bolting.

There were two men who had the courage and the vision to go into the Lake mines of Missouri, see the possibilities, bring them back to Illinois, put them in a coal mine and work with them. From that mine, it spread all over the world.

Those two men, I think, should receive some acknowledgement. They are both Illinois men and both members of the Institute. Their names are C. C. Conway and Dave Neal. They are the gentlemen that deserve all of the credit, in my book, for the spread of roof bolting. (Applause)

The problem that confronted you eight years ago was the problem of putting the bolts in. You have solved that problem successfully and now it is a question of getting the bolts out successfully and safely. Inasmuch as the time limit for this paper is 20 minutes, the method of recovering roof bolts will be described in only two mines. In one the bolts are recovered by hand methods and in the other by means of a roof-bolt recovery machine.

As far as is known, roof bolt recovery was begun in February, 1951, in a mine in western Kentucky. Inasmuch as the recovery of bolts in the early years of roof bolting was not publicized to any extent by anyone, it is possible that bolts were being recovered in some Illinois mines prior to February, 1951. However, that is not an established fact.

The first mine to be discussed is operated in a coal bed very similar to the Illinois No. 6 bed. The coal averages 72 inches in thickness and has a maximum cover of 240 feet. The roof is bad. In general, it consists of soft shale or "gob" overlain by limestone. The policy of the company is to seat all of the roof bolts in limestone, and as the thickness of the "gob" varies from area to area, bolts ranging from 18 inches to 72 inches in length are required. The bolts are ¾-inch mild steel, and are used with expansion shells, 4" by 4" x ¼" steel plates and 2" by 8" by 18" wooden blocks. Three bolts are installed in a set and the sets are spaced five feet apart. The bolts are recovered only in the rooms and the rooms are 22 feet wide.

Some things in their procedure you may not believe are true, but they are true; I was there and spent two days with these men.

Two men are used to recover the bolts. When they enter a room, they first examine the roof carefully from the room neck to the face. This gives them an idea of the condition of the roof and determines how many and which bolts they can recover. There is no inflexible rule as to the number they must recover and the judgment of these two men determines which ones will be recovered. They are under instructions to recover only those bolts that can be recovered without injury to themselves.

Their first operation is to set two No. 9 screw jacks under the set of bolts nearest the face and two more under the next outby set. A 15-inch crescent wrench is used to loosen the nut. They do it, because I saw it. A short wrench is used because it is believed that if a bolt is so tight it cannot be loosened with a short wrench, the load may be resting on the bolt and recovery would be dangerous.

When about six turns are made on the nut, the bolt is struck sharply with a hammer to drive the expansion plug up, freeing the shell. The bolt is then screwed out of the nut and recovered. A special hook is then inserted into the hole, and the shell withdrawn. When the bolts are recovered in the first set, the two jacks are moved back to the third set from the face and the same procedure is repeated until all of the bolts that can be recovered safely have been removed. When a jack is removed, the practice is to loosen it a little and listen. If the men do not hear anything, they remove the jack.

The men who do this recovery work have been doing it for more than six years. I know them both well. They have had no accidents of any kind and the precautions that they take are reflected in the fact that they recover only approximately 60 percent of the bolts.

Two men recover approximately 290 bolts, 290 plates, 290 wooden blocks and 260 expansion shells in a shift. Approximately 10 percent of the shells are not recovered. The value of one roof bolt assembly that they recover is as follows. I chose a 30" bolt. The value of it may have changed in the meantime. This is the price I have and it is the price I read.

1, 30" by ¾" steel bolt	$0.35
1, 4" by 4" by ¼" steel plate	0.11
1, expansion shell and plug	0.22
1, 2" by 8" by 18" wooden block	0.10
Total	$0.78

Thus, if two men at $20.04 a shift recover 290 bolt assemblies and 260 expansion shells in one shift, a saving of $179.52 is indicated for one day's work.

The second mine to be discussed is one in which a roof-bolt recovery machine is used. All of the roof-bolt recovery machines are fundamentally the same as the original one that was designed and constructed by Mr. James Martin, Superintendent of the Truax-Traer Coal Company in 1952. It consists of an electric drill mounted on a two-wheeled, rubber-tired truck and so constructed that the men operating it are always under the protection of roof bolts. It can be constructed easily in the mine shop at a nominal cost, and when I say nominal, I mean less than one hundred dollars, if discretion is used in assembling the parts.

The machine is operated by two men, but in many mines a third man is employed on a shuttle car or other form of mobile truck for the purpose of gathering the bolts and transporting them to the room necks or the shop. The two men push the machine up to the bolts, engage the chuck in the nut, and by means of a thumb switch on the handle, spin the bolt out. One of the operators drags the recovered bolt back by means of a long-handled hook. The bolts can be used several times, and the usual cause of discarding a bolt is the fact that the heads become rounded as the result of the wear by the chuck. Here is a point. It costs a little money, but it is a good point. It has been found that by using the universal joint (No. A25429) from an 11-BU Joy loader, this wear can be virtually eliminated.

An investigation of the results obtained by using the roof bolting machine disclosed the fact that the results obtained varied widely. The amount saved in a day ranged from $159.88 to $617.86. This discrepancy is due principally to the difference in value between a 24-inch bolt assembly and a 60-inch bolt assembly. Approximately the same number can be recovered in a shift, but the values vary widely.

An Illinois mine was taken as representing the average performance of the recovery machine. This mine is opened by two slopes into the No. 6 coal bed which averages 7 feet in thickness and has a maximum cover of 200 feet. The immediate roof consists of approximately 36 inches of black shale overlain by limestone. At places, the shale is replaced by limestone. All places are roof-bolted with ¾-inch bolts 5 feet long. They are installed 4 feet apart laterally and longitudinally and are kept within 18 inches of the faces.

About 90 percent of the bolts are recovered and the recovery machine is used exclusively for this work. Two men, equipped with a shuttle car, recover the bolts and they average 350 in a day. Their record is 704 in one shift. No effort is made to recover the shells. The value of one set is as follows:

1, Bolt ¾" by 60"	$0.71
1, Washer (used instead of a plate)	0.00¼
1, Block, 3" x 6" x 18" wood	0.12
Total value of 1 set	$0.83¼

The value of 350 sets is $291.37. From this must be subtracted the wages of two men ($44.08), which indicates a saving of $247.29 for two men's work for one day. That is conservative.

The roof-bolt recovery machine has been in use since 1952, with a steady increase in the number each year. There have been no lost-time injuries connected with its use in five years, as far as can be learned. Consequently, in the absence of any evidence to the contrary, it must be assumed that its operation is not one that could be considered particularly hazardous.

The areas from which roof bolts have been recovered are usually sealed; however, sometimes they are barricaded and marked with a "Danger—Keep Out" sign. In some instances, these areas cave quickly and at times they are not barricaded or marked with a "Danger" board.

Regardless of the safety record that has been made in the past in the recovery of roof bolts, there are always the chances that something may go wrong and an accident may occur. Consequently, the following suggestions and recommendations are presented. Some of them may seem to be elementary, but nevertheless they are all founded on experience.

1. When starting roof-bolt recovery, assign practical and experienced men to the job. Do not hire some new boys and have them come in and you find you have no place for them.

2. Once the recovery crews are established, do not change them.

3. Use a long hook to pull the extracted bolt back under the supported roof.

4. Do not try to recover the expansion plugs and shells when the recovery machine is used.

5. Have each recovered bolt cleaned with a wire brush, oiled, and examined.

6. If the threads are worn on the end, discard the bolt or saw off the burred threads.

7. If the heads of the bolts are being rounded, use the socket that has been described previously in this paper.

8. Recover the bolts as quickly as possible after the place has been driven up.

9. Do not recover bolts in a section where mining is being carried on nearby, as the noise incidental to mining operations may make it difficult for the recovery men to hear roof movements where they are working.

10. The recovery crew should consist of a minimum of two men.

11. When possible, the bolts should be recovered on an odd shift or an idle day when everything is quiet and the recovery men can hear all noises distinctly.

12. The recovery men should be instructed to use their own judgment and if there is the slightest doubt in their minds as to the safety of recovering a bolt or group of bolts, to leave them in place.

13. Unsealed areas from which roof bolts have been recovered should be barricaded and marked plainly with "Danger—Keep Out" signs.

This is the end of my paper. I have to ad lib just a little bit more. It will only take me two or three minutes.

Sixteen years ago, I came to Illinois from Utah, a stranger. I knew no one. When I came to Benton, a hand of friendship was extended to me. Very few of those people are here today. In a month, I belonged to the Rotary Club and the Country Club and I knew the people. They were good people. I moved away from there. I am going to quit in four months, so I have no ax to grind. I am going to quit in four months and go to Florida.

I was put on a roof-bolting job and I had an opportunity to travel all over the state and, with one exception, every place where I went I was greeted as a friend by good people. I look you right in the eye and tell you good people that I will always remember you. It has been a privilege for me to live in Illinois. Thank you. (Applause)

* * *

Chairman Stelzriede: Are there any comments?

William R. Chedsey (University of Illinois): Mr. Chairman, the speaker described very nicely the two men removing bolts by hand. I missed something, or perhaps he did not say it. He said that after they had put the jacks in place, they removed the bolts, loosened the jacks and then they listened. He said if they did not hear anything, they removed the jacks. But, I do not know what happened if they did hear something.

L. W. Kelly: Put a post there and lift a jack up.

William R. Chedsey: That would reduce the profit from the recovery of the bolt. I wondered if they ever used a jack that could be clamped.

L. W. Kelly: Not in this mine. I was just talking about this one mine. It is not done there.

Chairman Stelzriede: Is there anyone else? We have time, gentlemen. Don't be bashful.

Returning to the first paper on the program, in talking with Professor McIntosh before the meeting, I found out that Tom Garwood described to him a machine that he had recently received. One of the details on this machine is a change alarm. Would you describe that, Tom, for the meeting?

Thomas L. Garwood (Orient Mine No. 2, Chicago, Wilmington & Franklin Coal Company, West Frankfort, Illinois): The Weather Bureau has instituted a program of giving warning of approaching cyclones and tornadoes. To build a machine that was relatively simple to give an alarm, they have set up a design that they have passed out, I believe, to the Civil Defense officials.

They use a 55-gallon drum. There is attached a small capilary tube, which allows a slow leaking of the pressure within the drum. If the pressure rises quickly, then that capilary tube will not pass sufficient air for the use of the diaphragm and the micro-switch and an alarm will be given. That is, theoretically, what is called a "jump indicator."

In other words, it is to indicate the quick rise or quick fall of the barometer. It is rather bulky. They recommend that it be held in an area of temperature change which is held to a minimum and where it is not subject to pressure changes.

I think that the instrument might be designed so that it would be more compact and maybe more sensitive, but apparently this fits the demands of the Weather Bureau and the machines are being installed. Thank you. (Applause)

Chairman Stelzriede: Is there anything else, gentlemen?

If not, the morning technical session is finished.

. . . President Halbersleben resumed the chair . . .

President Halbersleben: Thank you, Howard. I want to especially thank these two speakers, Professor McIntosh and Mr. Kelly. This is the first time I have met Professor McIntosh. The other gentleman has been a frequent visitor and he has always been a helpful one. We are going to miss him when he is gone from the Federal Department.

We stand adjourned, gentlemen, to meet again at 2:00 o'clock.

. . . The morning session thereupon recessed for lunch at 11:40 a.m. . . .

AFTERNOON SESSION

October 18, 1957

The meeting reconvened at 2:15 p.m., President Halbersleben presiding.

President Halbersleben: Gentlemen of the Mining Institute, I am going to turn this meeting over to Mr. Ellis O'Brien of Heyl and Patterson, who will act as your moderator for this afternoon.

. . . Mr. Ellis J. O'Brien assumed the chair . . .

Chairman Ellis J. O'Brien (Heyl and Patterson, Inc., Pittsburgh, Pennsylvania): Thank you, Mr. President. This afternoon, gentlemen, we are privileged to hear three men, who I feel are well qualified to speak to you on their related subjects.

Our first speaker is Mr. R. F. Knobloch, Midwest Belt Engineer, U. S. Rubber Company. Mr. Knobloch is married and the father of one child. He is a graduate of Norwich University in Northfield, Vermont. His degree is in chemistry. Since 1954 up until the present time, he has been with U. S. Rubber. He started in the factory in Passaic, New Jersey, and since then has been assigned to sales and service engineering.

Copies of his address are available in a limited quantity, but anyone who wishes may have it by simply asking and it will be sent to you. I take pleasure in presenting Mr. Knobloch.

SAFETY FEATURES IN BELT CONVEYOR OPERATIONS

R. F. KNOBLOCH
Midwest Belt Engineer
U. S. Rubber Company
Chicago, Illinois

Thank you, Mr. O'Brien. Members and guests of the Illinois Mining Institute: It gives me great pleasure to talk to you this afternoon, after the fine papers which were submitted this morning. My topic this afternoon is "Safety Features in Belt Conveyor Operations."

From the past to the present, conveyor belt fabrics have expanded from all cotton to the varying types and combinations of synthetic fabrics to meet the needs of the coal industry. In the past, cotton fabric was used for all types of installations, regardless of the physical, chemical, or other important characteristics of the fabric. Today, such fabrics as cotton-nylon, rayon or cotton-rayon are used to realize the necessary standards and productions required by the expanding economy of the coal industry.

Regardless of all these advances which the conveyor industry has made from its past, choice of the best belt for the job is only the first step in realizing your belt investment. Belts first of all must be properly installed, maintained, and inspected to get a long life and the smooth, safe operation that you expect.

The industry's great strides in different types of belt conveyors offer you the opportunity to reduce underground haulage accidents. However, in 1956 haulage accidents, listed as the second common cause of mine fatalities, accounted for 77 deaths.

Such things as inadequate clearance and operation of haulage equipment account for a major portion of the accidents. It must be noted that replacement of so-called other types of haulage methods with belts cannot guarantee an accident-free operation.

A sound fire-prevention policy is one of the basic factors in implementing an accident-free type of program. Any program of this type to minimize conveyor belt fires should be separated into three main divisions:

1. Accelerated use of fire-resistant belting.
2. Fire prevention.
3. Fire protection.

On November 9, 1955, the U. S. Bureau of Mines approved Schedule No. 28 which set forth certain requirements covering the usage of fire resistant belting and its related equipment. In order for a conveyor belt to be considered adequate for use as a fire-resistant means of haulage, it must pass a rigid proof test set down by this schedule.

Basically, in the industry as we know it today, there are two types of fire-resistant belts in use, both of which meet the existing standard set down by the U. S. Bureau of Mines. The first type is constructed of Neoprene compound and the basic belting fabrics I spoke of formerly. These fabrics, when used in a fire resistant type belt, are impregnated with a fire resistant material which, like the Neoprene itself, will not support combustion.

The second type of fire-resistant belting is constructed of Polyvinyl Chloride or PVC. Although we do have PVC in this country, PVC belting is primarily in use in England, basically due to the English availability of manufactured PVC. Both the Neoprene and PVC exhibit the necessary fire resistant qualities as required by the U. S. Bureau of Mines. Both Polyvinyl Chloride and Neoprene have good abrasion resistance. PVC has fairly good tensile strength, whereas Neoprene has a very high tensile strength. Neoprene, however, has a higher coefficient which eliminates the necessity of high tension as in the case of PVC belts.

I have talked a little bit about fire-resistant belts. How about fire prevention?

An active fire prevention program must be implemented and rigidly enforced in order to properly assure a complete and safe fire prevention policy. Perhaps some of the most important factors in effecting a good, rounded fire prevention program are:

1. Good housekeeping. Coal lumps, fines, or dust must not be permitted to accumulate around the belt conveyor. Spillage should be removed frequently. Excessive spillage of lubricants must be avoided and consideration given to the use of higher flash point and higher combustion point greases and lubricants. Frozen idlers and their possible failure to turn—because they are frozen—with the movement of the belt can cause heat through friction which could ignite the lubricants utilized thereby.

2. Prompt repair of conveyor belts preventing the exposure of the carcass should be exercised. Any unrepaired cover tears or gouges will definitely lower the belt's fire-resistant qualities. In other words, fabrics themselves will lose that impregnation and, therefore, you will lose the advantage of a fire-resistant belt as such.

3. Pulley lagging should be constructed of fire resistant compounds. Worn lagging should be replaced immediately. If you are going to put in a fire resistant system, your pulley line should be of fire resistant compounds.

4. When flexible or impact rubber idler rolls are used, they should be made of fire resistant compounds, again to insure over-all protection against mishaps.

5. Centrifugal switches should be installed. These switches will shut down the power on the entire belt system when the belt falls be-

low its normal speed. This prevents material build-up because feeders do not continue to load a stationary belt.

6. Proper ventilation should be provided in all places where feasible in underground mining. This is very important, I feel, and a lot of the underground mining men have done a very good job on proper ventilation.

7. Proper installation of electrical equipment should be protected against overloads by overload relays. Power circuit should be protected by current interrupting devices such as circuit breakers and fuses. Power lines must be large enough to carry a normal load with enough reserve to accommodate reasonable overloads. There is no point in a power line that is just going to handle the load you have. If something should happen and a current should go through the line, your equipment might not be able to take it and there is the cause of the fire. Power lines should be on insulators and kept free of combustible material. Insulation on wire and cables must be made of fire resistant compounds.

8. Conveyor structures, skirt boards, loading and discharge transfer devices should be made of fire resistant material.

9. One of the most important things to remember is that, regardless of all the prevention you put into a system, you have to inspect it. Periodic inspections regularly conducted are important. All deficiencies disclosed should be promptly corrected because there again, you lose a certain amount of protection without the inspection of it. Belts should not be permitted to come in contact with the conveyor structures or obstacles along the belt line. Proper alignment and belt training can go a long way to prevent a fire by friction.

10. A good communication system that provides contact along the main points on the conveyor system and other parts of the mines is an aid to both fire prevention and fire protection. It is rather fascinating to see some of the communication systems that the underground mines use, but your good communication system provides contact along the main points in the conveyor system and they help in a big way to prevent fire. If something should happen, you have a communication system so that the man down at the end can tell the mine superintendent that you have trouble down there and he can go down and fix it.

11. Installation of roof-fall cutout switches and emergency cords running the length of the conveyor should be made. They go a long way in helping to prevent accidents and fires.

What if a fire should occur despite all the preventive measures outlined above? Then of prime importance is the saving of the lives of the men that are in your mine and the reduction of property damage. For example, in an all-belt mine, the main and gathering conveyors should be provided with water lines, hydrants or hose taps, fire hose, nozzles or a sprinkler system in accordance with the N.F.P.A. specifications. When a fire resistant belt is used, however, substitutes for water line and sprinkler systems may be made in accordance with suggestions in the U. S. Bureau of Mines Circular 7662.

Such things as hand-type fire extinguishers should be located at each point of possible electrical fires, such as drive motors and circuit breakers. The only sure way to ensure that fire-fighting equipment will be properly maintained is for mine management to institute a regular detailed inspection schedule. Instances where fire fighting equipment was available but unoperative or unsuitable are numerous and sometimes have resulted in tragedy.

Fire fighting equipment should be inspected at least every three months by qualified persons who thoroughly understand every device or material provided for fire protection. Any defects or shortages that may have developed since the previous inspection should be recorded and corrected immediately.

Every hand-type fire extinguisher should carry a tag indicating when it was inspected and the inspector's name or initials. Similar tagging of all truck-mounted facilities, hose stations, and miscellaneous fire fighting items is recommended also.

In setting up good fire-protection measures, keep the following three points in mind:

1. Make sure you have easy accessibility to fire-fighting equipment. It is very frustrating to a man to know that it is in the corner but he has to go over a big piece of equipment to get at the fire extinguishers.

2. Provide more than two openings to ensure an escape route.

3. Proper ventilation. Too much air disperses the fine coal; too little will permit concentrations of noxious and explosive gases that can hinder fire fighting.

In conclusion, remember fire resistant belts are only the first step toward preventing fires. With the utilization of a good prevention and protection program as well as a fire resistant belt, a sound accident-free program can be achieved. (Applause)

* * *

Chairman O'Brien: Are there any questions? Well, if not, we will proceed to the second subject, which is "Fine Coal Cleaning." The paper was prepared by two gentlemen, Myron W. Mellor of McNally-Pittsburg Manufacturing Corporation, and Thomas P. Rhodes of Peabody Coal Company.

Mr. Mellor is presently Consulting Engineer for McNally-Pittsburg Manufacturing Corporation and he has spent the past 21 years of his life with them.

He is a graduate of the University of Utah and his thesis was on "Low Temperature Composition of Coal." You can see that at that very early age, he had coal in his blood. Mr. Mellor travels 125,000 miles a year for McNally-Pittsburg, so he really gets around. His present capacity is between engineering and sales.

The paper will be delivered by Mr. Thomas P. Rhodes, Preparation Engineer, Illinois Division, Peabody Coal Company. Mr. Rhodes formerly was with Sinclair Company. I take great pleasure in introducing Mr. Rhodes. (Applause)

FINE COAL CLEANING

MYRON W. MELLOR
McNally-Pittsburg Manufacturing Corp.
Pittsburg, Kansas

THOMAS P. RHODES
Preparation Engineer
Peabody Coal Company
Freeburg, Illinois

Fine coal treatment in any preparation plant is usually the most difficult problem that the operator has to cope with. This applies to all phases of handling, including cleaning, screening, dewatering, drying, water clarification, dust control, maintenance, first cost, and many others. For this reason, it is extremely important that anyone contemplating the installation of a preparation plant should examine the problem very carefully from all angles. It is not only important that the basic cleaning unit be capable of delivering a saleable product with a minimum loss to refuse but the auxiliary equipment and operating problems must be reduced to the least possible minimum.

Some of the equipment in a plant is necessary, of course, regardless of the type of cleaning unit selected, however, several portions of the circuit and its operation are directly affected. The purpose of this article is to present some background history and describe a washer not available in the United States until recently, which is now being offered by the McNally Pittsburg Manufacturing Corporation. It alleviates or overcomes many of the difficulties connected with the problem of handling fine coal. The name Feldspar Jig has been used for this washer in Europe, presumably because feldspar is quite often used as the "bedding" material.

The so-called Feldspar Jig is not a recent development, it has been used extensively in Europe for several years. It is now being installed in a majority of cleaning plants throughout many of the foreign countries. Some typical large foreign manufacturers are Preparation Industrielle des Combustibles (P.I.C.) of France, Schutermann & Kremer-Baum (SKB) of Germany, Coppee of Belgium. Most installations are for coal no larger than 3/8" or 1/4" x 0 with tonnages ranging from 15 to 150 tons per hour in a single unit. Quite a wide variation exists as to the types of automatic controls in use, impulse application, refuse removal, and other features.

A primitive form of the machine was used in the United States years ago but it was a small tonnage unit that required close supervision. Very few improvements were made so the potentialities were never exploited. Three years ago McNally Pittsburg constructed a commercial size unit and installed it in their research laboratory at Pittsburg, Kansas. Design was based on a study of various European methods.

The laboratory circuit was set up to duplicate as nearly as possible actual plant operating conditions on United States coals. Research continued for two years, during which time many alterations were made to improve operating characteristics and general design. Approximately one year ago, the Northern Pacific Railway Company installed a unit in their preparation plant at Roslyn, Washington, to treat 40 TPH 1/4" x 0 raw coal with a reject varying between 10 percent and 50 percent of the feed. A considerable amount of research was done in the field on this machine under actual operating conditions to determine what further improvements could be made. It has been performing very satisfactorily under difficult operating conditions. The automatic controls enable the washer to deliver a product with a consistent ash even though the ash percentage in the feed varies over a wide range. There is also considerable variation in feed tonnage, yet no attendant is required to make compensating setting changes. Approximately 40 TPH is the maximum tonnage being treated in a washing compartment three feet wide.

The U. S. Bureau of Mines, under the direction of Dr. H. F. Yancey, Chief of Fuels Technology Division, Seattle, Washington, has made exhaustive and detailed studies of the Roslyn fine coal washer operation. The results will be published by the Bureau of Mines. A typical example of the washer's operation taken from test data collected by McNally Pittsburg showed 97 percent over-all efficiency for 1/4 x 48 mesh with feed ash 29 percent, washed coal ash 11 percent, refuse ash 69 percent, amount of reject 31 percent. At the time of the test, the washer was receiving 40 TPH raw coal feed. Near gravity accumulation (±0.10) was 11 percent at the separating gravity of 1.55.

At the last Mining Congress general session, Mr. Earl R. McMillan, General Manager of Coal Operations for the Northern Pacific Railway Company, presented a report on this washer. Mr. C. A. Vissac, Consulting Engineer, presented an article for the AIME titled "Coal Preparation with the Modern Feldspar Jig," which was published in Mining Engineering, July, 1955. This paper included a detailed description of the operating theory. Several other foreign publications are available, therefore, this report is not meant to be of a highly technical nature. However, a brief description of the operating principles would appear to be in order.

Basically, the so-called Feldspar Jig is an adaptation of the well-known Baum principle with special features necessary for treating fine coal. The particular machine referred to here has three washing cells in line. Approximately two feet below the water level a screen plate with 1″ round perforations supports a feldspar or ceramic tile bed; thickness of the permanent bed is about four inches and consists of pieces 2″ x 1½″ x ¾″ and smaller but large enough to remain on the plate. Each of the cells is independently sealed below the screen plate level with separate air lifts to dispose of the refuse or recirculate middlings being hutched through the bed. No division is made above the screen plate. As the coal progresses through the washing compartment it is stratified gravimetrically by a successive series of jigging impulses.

Air intermittently forces water up through the screen plate opening up the feldspar bed and lifting the coal and water in the washing compartment, then as the air pressure is released, stratified refuse at the bottom is hutched through the bed until it settles into a locking position. Intensity of the impulse, and consequently the amount of hutching accomplished, is automatically controlled in each cell by a device that senses the concentration of heavy material at the bottom of the bed. Clean coal overflows a weir at the end of the last cell with the water. Obviously the stratification of fine coal must be accomplished under closely controlled conditions that will prevent eddies, violent impulses, and undue disturbance of any kind which is the reason for the application of special design features not found on the conventional Baum Jig.

At the present time McNally Pittsburg is erecting a plant for Badger Coal Company at Philippi, West Virginia, to treat 75 TPH 3/16″ x 0 raw coal. This plant will be in operation in the near future and should provide some interesting information concerning the washers operation in the West Virginia field. (Applause)

* * *

Mr. Thomas P. Rhodes: Mr. Mellor will be available for further discussion or for any questions that you may have on this particular machine. (Applause)

Chairman O'Brien: Thank you, very much, Mr. Rhodes. I hope there are some questions, gentlemen. This certainly must bring to mind several questions on comparisons of this machine with equipment with which you are familiar.

I hope that you will give Mr. Mellor something to do. Are there any questions? He has spent a lot of time on this, gentlemen, and he is anxious to convey some of the information he has.

Mr. Mellor, I will ask one question then: What is the lowest size particle that you feel can be adequately washed in your washer?

Myron Mellor: Well, it is a jig and the lowest size particle that we feel can be handled really efficiently is about 40-mesh. There is some washing done to 100-mesh, but how much is hard to say. It depends on different coals.

William Chedsey: Don't the characteristics of the sink material influence the size at which you can recover? Some of the sink materials will break up like clay and make a separation almost impossible, but others, like sand or limestone rock, might be much more sinkable.

Myron Mellor: Yes, that is entirely true and it is important that the water be clarified. When you build up a medium, it is too viscous to really handle the fine coal.

William Chedsey: Do you have any figures as to how many gallons per minute or hour you can get from a ton?

Myron Mellor: Yes, its capabilities were checked at the Roslyn plant and I would say it is about 800 gallons a minute or 40 tons an hour. That is the entire research on that one.

Chairman O'Brien: Are there any questions over here?

Thomas Davis (Vice President, Nelson L. Davis Company, McHenry, Illinois): I was wondering about this possibility: Have you tried removing part of the fines that you mentioned you cleaned down to 48-mesh or even down to 100-mesh?

Myron Mellor: Yes.

R. A. Mullins (Preparation Manager, Enos Coal Mining Company, Oakland City, Indiana): Did that increase the tonnage that could be put through the box? In other words, with this 100-mesh material going into the water, could that increase the tonnage that you could put through the box?

Myron Mellor: Yes, sir, because of the fact that you do have a less viscous medium and you can handle more tonnage.

S. A. Stone (Deister Concentrator Company, Fort Wayne, Indiana): What do you consider the top size that you can effectively handle in a +48-mesh bracket?

Myron Mellor: Oh, up to three-eighths of an inch. Perhaps it could go higher than that, but then anything larger than that would not be quite effectively cleaned. Nearly all of the installations on coal have a top size of three-eighths to a quarter-inch.

Chairman O'Brien: Are there any other questions? I would like to have Mr. Mellor tell us a little bit about the control system which, from what he has told me, certainly seems worthy of your consideration. Would you mind telling us a little bit about that, Mr. Mellor?

Myron Mellor: In that connection, a lot of our experimentations in the laboratory were with controls. For the handling of the fine coal, you must have the controls very sensitive. Intensity of the impulse is automatically controlled in each cell by a device that senses the concentration of heavy material at the bottom of the bed.

Chairman O'Brien: Are there any other questions?

Thank you, very much, Mr. Mellor, for your time and for your answers to these many interesting questions.

Our next paper is by F. W. Parrott, Manager of the Technical Service Section, E. I. Du Pont de Nemours and Company.

Mr. Parrott is a graduate Chemical Engineer from the University of Wisconsin. I take great pleasure in presenting Mr. Parrott. (Applause)

USE OF AMMONIUM NITRATE BLASTING AGENTS IN STRIP MINE OPERATIONS

F. W. PARROTT

Manager, Technical Services Section, Explosive Division

E. I. DuPont de Nemours and Company

Wilmington, Delaware

Mr. Chairman and members of the Illinois Mining Institute: I certainly appreciate being here today. This is my first attendance at this meeting. I found it very enjoyable and very informative, including my introduction to the Lake Club last night. (Laughter)

And now to Ammonium Nitrate Blasting Agents in Strip Mine Operation.

The use of ammonium nitrate as a source of explosives energy is not new. It was well known, as far back as fifty years ago, that ammonium nitrate, although insensitive to detonation itself, could be sensitized and under proper conditions made to explode and perform useful work. The first dynamite, which was invented by Nobel of Sweden in 1866, consisted of nitroglycerin mixed with various absorbents to make an explosive which could be handled with at least so ne degree of safety. During the next forty years a number of improvements were made to the original crude type of dynamite, but the only real explosive ingredient remained the highly sensitive nitroglycerin.

Shortly after the turn of the century ammonium nitrate was introduced as a dynamite ingredient and since that time its use in commercial explosives has expanded until today there are very few commercial explosives that do not contain substantial percentages of this material.

Ammonium nitrate has the disadvantage that it is only about 70 percent as strong as nitroglycerin, and is hyrogroscopic. However, it is much less sensitive and less expensive than nitroglycerin. Gradually it has replaced nitroglycerin in dynamite in percentages which maintain the rated strength of the explosives. Various means have been devised to impart sufficient water resistance to these dynamites to make them practical for most types of blasting. The use of increasing proportions of ammonium nitrate has resulted in dynamites that are less hazardous to manufacture, handle, and use, and that are of lower cost per unit of energy.

During and after the First World War, the quest for cheaper and safer explosives went on at an accelerated rate, and with it came the development of many new types of explosives and blasting agents. The trend in dynamite was toward less and less nitroglycerin, until finally it was acting mainly as a sensitizer for the ammonium nitrate which made up almost the entire remainder of the composition.

This trend culminated in the development of the blasting agent, "Nitramon," which contains no nitroglycerin whatever and which was introduced by the Du Pont Company in 1935 after many years of research along this line. This product, which is packed in tightly sealed metal cans, is not classified as a high explosive since it cannot be detonated by commercial blasting caps, friction, or the impact of heavy steel weights. Special "Nitramon" primers, also packed in metal cans, likewise contain no nitroglycerin and hence are much safer than dynamite.

The history of "Nitramon," or at least most of its features, is probably familiar to all of you. "Nitramon," together with "Nitramex," the stronger high density canned product which was subsequently developed, were soon recognized as the ultimate in safety for large-hole blasting. Because they were equal to or better than nitroglycerin explosives in most properties, particularly in loading density and water resistance, they were widely adopted for quarry and open pit blasting throughout the country.

The next development of importance involving ammonium nitrate occurred only a few years ago with the invention of "Akremite," named for its co-inventor, Bob Akre of Maumee Collieries. Industry in general first learned about "Akremite" late in 1954, although it had been used experimentally before that date for several years at the various Maumee stripping operations. As all of you probably know, "Akremite" consists simply of fertilizer grade ammonium nitrate combined with a small percentage of fuel material, either solid carbon in some form, or fuel oil. It is packed in cylindrical bags made of an expansible material, usually a plastic known as polyethylene. For best results, it is mixed in a mixer of some type to insure thorough incorporation of the two ingredients.

"Akremite" is covered by a patent which embodies the method of use and the pertinent feature is the expansible plastic bag which allows it to expand to fill the borehole, completely or nearly so, when loaded by dropping. This results in elimination of most of the air space in the hole, and the resulting high degree of confinement is important both from the standpoint of complete detonation and blasting efficiency. This product, the only one properly designated as "Akremite," is now supplied by explosives manufacturers and is also being made on the job by a number of large users.

Since "Akremite" appeared on the market, there have been a number of further modifications of this type of blasting agent. All of these consist of ammonium nitrate, usually in the prilled form, containing a small percentage of combustible material to provide sensitivity and produce maximum strength.

Before going further into the details of the use of prilled ammonium nitrate for blasting, we would like to explain briefly the developments in the manufacture of this chemical that have resulted in its economical and successful use in field-mixed blasting agents. Prior to World War II ammonium nitrate, although recognized as an excellent source of nitrogen for fertilizer, was not widely used for this purpose. Production facilities in the United States were small as compared to those at the present time, and the cost of this chemical was considerably higher than at present.

During and after the last war, facilities for the production of synthetic ammonia and nitric acid, the chemical intermediates from which ammonium nitrate is made, were expanded tremendously since these same intermediates are used in the production of practically all military as well as commercial explosives. With the large increase in production facilities, together with improvements in the chemical processes, fertilizer grade ammonium nitrate has been greatly reduced in cost. Most ammonium nitrate prills are now manufactured in privately owned plants, a number of which were built by the federal government during the war. Low investment and tremendous production, only a small portion of which is used for blasting agents, have resulted in a very low cost for this chemical.

The original "Akremite" was made with a solid combustible material, carbon black, as a fuel, but solid fuels have now largely been replaced by oil for several reasons, chiefly economy, convenience, and availability. Also, the compositions are being packaged in various containers such as multi-wall paper bags or cylindrical burlap bags for direct loading into the hole. Some type of moisture barrier is built into all these containers for moisture protection in storage.

Although many stripping operators seem to prefer a prepared and packaged product for convenience in handling and use, the ultimate in simplicity is the actual preparation of the mixture at the hole. The prills are poured from their original containers into the borehole and the fuel oil is added with or following the prills. In some instances the proper amount of oil is added to each bag of prills prior to loading and a short waiting period allowed for the oil to percolate through the contents. The oil coated prills are then poured into the hole. Compositions mixed on the job in this manner are not chemically balanced and will not develop the theoretical strength and other properties equal to the carefully pre-mixed compositions. However, they are being used with very satisfactory results on a number of stripping operations.

The success of ammonium nitrate prill and fuel mixtures may be credited mainly to two factors:

(1) These mixtures result in a product which has low density, generally on the order of about 0.8. This is important because such mixtures become less sensitive as the density is increased. High density results in reduced sensitivity and, when densities comparable to those of conventional high explosives normally used for stripping work are reached, detonation of the material is difficult and unreliable even with large primers.

(2) Confinement is also all important in the successful use of a composition of this type. In general, prill-fuel mixtures do not shoot reliably when unconfined, even with large primers. However, when confined in a borehole with essentially no free space in the hole, they detonate and explode

with maximum velocity when properly stemmed and primed. For this reason, compositions packed in any sort of container for direct loading into the hole are generally not as effective as pouring the free-flowing prill-fuel mixture down the hole. In addition to ideal confinement, pouring provides a better loading density which, in some instances at least, approaches that obtainable with the denser dynamites or blasting agents.

These two factors, density and confinement, along with proper priming, should be kept in mind since attempts to increase density and to load without complete confinement will probably lead to difficulty.

Now we would like to cover some of the points that have been pretty well established from actual testing and from accumulated field experience over the last several years.

Several trials have been made using ammonium nitrate prills alone, but it has been established without question that some sort of carbonaceous material is necessary for satisfactory performance and sensitivity. Ammonium nitrate is an oxidizing agent and thus contains excess oxygen. The excess oxygen burns up the fuel material which adds considerably to the volume of gas and energy of the explosion. The cheapest and easiest fuel material to add to prills is some sort of oil. In general, this can be almost any type, either lubricating or fuel oil, but No. 2 fuel oil is being used most widely because it is cheap and readily available. Although there are several special types of oil which are better from several standpoints, they are generally more viscous and require a mixer to produce a uniform product.

The proper amount of oil to be added to produce a good oxygen-balanced mix is about 6 percent by weight, although slight variations are not critical. By fortunate circumstance, prilled ammonium nitrate will absorb and hold just about the correct amount. Essentially the oil coats the surface of the prills, although some may be absorbed into the particles themselves.

When mixing on the job it is generally desirable to add an excess of oil to be sure that all of the material is covered. The standard proportion is usually one gallon of oil for an 80-pound bag of prills, or five pints for a 50-pound bag. Too great an excess can be harmful, since it tends to desensitize dynamite primers, and possibly the prill-oil mixture as well, causing loss of blasting efficiency.

Prill-fuel mixtures of this type, when properly primed and confined in large holes, provide a blasting agent of medium strength. Although strength figures on this type of material cannot be established by laboratory tests, due to the fact that it cannot be evaluated in small quantities which laboratory methods require, we do have calculated figures which have been confirmed by field measurements. On a theoretical weight basis these mixtures produce energy equivalent to 50 percent to 60 percent dynamites.

Likewise, we do not have velocity figures obtained by normal laboratory methods. Actual measurements have been taken in large boreholes, however, and although these figures cannot be compared with our standard dynamite velocities, they are quite interesting. The velocity of plant-mixed prill-carbon black mixture in 10⅝-inch holes has been measured at approximately 12,000 feet per second. That of the prill-oil composition is approximately 13,000 feet per second in the same diameter. These velocity measurements were taken using various sizes and types of primers and have been shown to be constant, irrespective of the primer, as long as the primer was above a certain minimum size and strength. The only difference found in 6-inch holes was 800 to 1,000 feet lower velocity.

When very small primers were tried in this same series of tests, it was found that in some instances there were complete failures, whereas in others detonations were of a very low order, with velocities about one-fifth those just mentioned. This is, of course, an indication of incomplete or partial detonation resulting from the borderline priming.

From this it can be seen that to obtain satisfactory results with ammonium nitrate-fuel mixtures, proper priming is of considerable importance. It has been recommended that with dynamite primers, the primer should be at least 40 percent strength and on the order of 10 pounds in weight. In general, the high-velocity, high-strength dynamites are better primers than those of medium or low strength and velocity. Under favorable conditions such individual primers should be spaced at least every 20 feet in the column load. In ground where the holes tend to cave or where confinement is not good, additional primers spaced at closer intervals are necessary and should be used for best results.

Under some conditions it is possible to shoot these mixtures with somewhat less primer material, but to assure over-all dependable results, a factor of safety is needed. A number of large consumers of prills have found by experience that, although visible results appear to be good, machine production is considerably better if a fairly high percentage of primer is used. In some instances operators have adopted a ratio as high as 10 or 15 percent, after having had considerable experience with smaller amounts. This is, of course, particularly true where fairly hard shooting material is encountered.

While on the subject of primers, we would like to spend a moment on the safety aspects. The combination of materials loaded into the hole is only as safe as its most hazardous unit. Since primacord initiation is almost always used in stripping work, this danger point is usually the primer, if dynamite is used. With dynamite primers on the job, the loading operations are subject to almost the same degree of hazard as when the complete load is dynamite. There is also the possibility of digging into a misfired hole. Several accidents from this cause have been reported. Such mishaps are very unlikely with non-nitroglycerin primers since none has ever occurred with "Nitramon" or "Nitramite" primers during the many years these products have been used. Consequently, it is strongly recommended that "Akremite" and compositions of the prill-oil type be detonated with non-nitroglycerin primers. The Du Pont Company markets several different types and sizes.

"Nitramon" primers have established themselves as being very satisfactory over the years, and are excellent for the prill-oil blasting agents. The smaller and more economical "Nitramite" primers are now available in two sizes. In addition, other non-nitroglycerin primers packed in polyethylene bags of various diameters and weights are being used with excellent results. While in some instances the non-nitroglycerin primers are slightly higher in cost, the added safety is well worth while.

Ammonium nitrate is a very soluble material and various means have been tried to provide a degree of water resistance for ammonium nitrate-fuel mixtures. Various types of packages are in use—the polyethylene tubes in which "Akremite" is supplied, or paper or burlap containers which have some sort of waterproof barrier. All of these packages may provide a measure of water resistance for damp holes. However, most of them provide no real water resistance for water-filled boreholes.

Metal cans have also been tried, and although these are essentially water-tight under the normal pressures encountered, the container cost and labor in preparing such a package essentially rule out this method of obtaining water resistance in favor of some of the standard low cost water resistant explosives and blasting agents which are available today. In addition, the low density of such a package introduces loading difficulties because the unit is likely to float in water-filled holes. Poor loading density per foot of borehole, plus lack of confinement, which is so necessary with this type of material, can only result in unreliable performance.

Success has been reported in the use of prill-oil compositions in horizontal holes. However, this method of blasting is considerably more critical than with vertical holes, due mainly to the fact that the required degree of confinement is difficult to obtain. In general, best results have been achieved in large horizontal holes by using considerably heavier priming. The mixture must, of course, be packed in some sort of container for convenience in handling and loading. Prill-oil compositions, being slightly more sensitive than prills mixed with solid fuel, are preferred. From all of this, it is obvious that the conditions inherent in horizontal shooting, particularly lack of confinement and difficulties in assuring a solid column load, make it necessary to use more care in preparation of the mixture, in loading, and in selection and placement of the primer.

We in the explosives industry are frequently asked about the hazards involved in the use of either pre-mixed or borehole-mixed prill-oil blasting agents. The fertilizer grade ammonium nitrate is classified as an oxidizing material and is transported, stored, and used for fertilizer throughout the country in great quantities. We will not discuss here the regulations and recommendations covering the handling and storage of this commodity since there is readily available literature on the subject.

Simple ammonium nitrate prill and fuel oil mixtures are very insensitive to friction, abrasion, or shock. The greatest hazard in mixing or use is fire, and this is dependent upon the degree of inflammability of the oil used. We believe that the same safety precautions should be taken as are recommended for the handling of the fuel oil. You all remember the Texas City disaster. Failure to observe normal precautions in this regard should not be condoned.

We have had reports of field attempts to make the simple prill-fuel oil combinations cap sensitive by means of various additives. As we have stated previously, No. 2 fuel oil has been established as a satisfactory, cheap, and readily available fuel material for mixing with ammonium nitrate prills to produce field compounded blasting agents.

A number of other chemical materials could be used as a sensitizer and fuel, but some of them would result in cap sensitive compositions with varying degrees of sensitivity which could be extremely hazardous to mix, handle, or use.

Likewise, mixing of high explosives into prill-oil compositions is very dangerous. In the interest of safety, we in the explosives industry believe it is our duty to warn those who choose to field mix their own blasting agents that experimenting with such additives and other chemicals requires highly specialized equipment, knowledge, and experience. Without these, and the manufacturing safety precautions common to our industry, attempts along these lines are sooner or later almost certainly doomed to disaster.

The usual prill-fuel oil mixture, due to its composition and properties, falls into the classification of nitro-carbo-nitrate blasting agents. Although such compositions are considerably safer than dynamite, the Institute of Makers of Explosives recommends that nitro-carbonitrates be stored in magazines which comply in all respects with the safety requirements for the storage of high explosives.

The development of simple ammonium nitrate-fuel blasting agents has been a notable step in the history of ammonium nitrate as a source of explosives energy. This composition has established itself as a satisfactory blasting agent for the materials and conditions for which it is adapted—particularly in shooting of soft to medium overburden here in the Middle West. When properly used, either alone or as a top load in conjunction with denser and stronger high explosives and blasting agents, it has in many instances been a factor in reducing blasting costs, and hence over-all costs of removing overburden.

This contribution, along with improvements in equipment and methods, has already permitted and will continue to allow the recovery of coal by stripping methods from greater depths than were ever before feasible—and this can only be good for all of us. (Applause)

* * *

Chairman O'Brien: Thank you, Mr. Parrott, for a well written review of your subject. Are there any questions?

I am afraid, Mr. Parrott, that if there were more chemical engineers here you would be plagued with questions, but most of the coal preparation men simply know how to use your product.

If there are no other questions, gentlemen, I will turn the meeting back to our President.

. . . President Halbersleben resumed the chair . . .

President Halbersleben: Thank you, Mr. O'Brien. We have gone through these papers rather rapidly without as many questions as usual, but I am sure you will find places to stay this afternoon so we will stand adjourned at this time.

. . . The meeting thereupon adjourned at 3:10 p.m. . .

FRIDAY EVENING SESSION

October 18, 1957

The Friday evening session convened at 7:40 o'clock p.m. in the Banquet Hall, Hotel Abraham Lincoln, Springfield, Illinois, President Halbersleben presiding.

President Halbersleben: I will address my remarks to the lady and gentlemen who are gathered here this evening. I am going to proceed to introduce these guests.

On my right, Dr. Tom Read of the University of Illinois, who is in charge of the Mining Department there. (Applause)

Dr. George Clark, Missouri School of Mines in Rolla. (Applause)

John C. Frye, Chief of the State Geological Survey. (Applause)

"Just Plain" Dave Neal on the end there, the man Kelly so ably eulogized as a roof bolter and veteran of roof bolters. (Applause)

On my left is B. Schonthal. Stand up now B. E. (Applause) We do have his grandson, Spike Jones, all the way over there. I think Spike is the youngest and newest member of the Illinois Mining Institute.

E. Gammeter of the Paul Weir Company. (Applause)

Art Bottomley, another Sahara Coal Company product. (Applause)

Any of you that read the *Proceedings* of the Illinois Mining Institute may wonder where this fellow, J. W. MacDonald, came from. They promised to correct that in the next issue and put him where he belongs. (Laughter)

Joe Schonthal. (Applause)

You may wonder why we have Byron Somers up here tonight. He is going to tell you why Harry Livingston is not here tonight. Byron. (Applause)

Mr. Byron Somers (Truax-Traer Coal Company, Fiatt, Illinois): I am going to tell you about the quarter horse that is going to win this grand championship in Chicago. Harry Livingston is in Chicago having a quarter horse show tonight. He has a horse that won the Governor's Cup here at the Springfield Fair and he has that horse and three others in Chicago. He would not miss that for the Mining Institute. (Laughter)

He will do a good job as the President of the Institute. He said he was very sorry he could not be here but, he also said that he just could not miss competing with those three horses. (Applause)

President Halbersleben: A. G. Gossard is on his immediate left. (Applause)

Your able Secretary-Treasurer, George Wilson. (Applause)

A. Flowers of the Coal Age. (Applause)

George Sall, American Mining Congress Journal. (Applause)

That gets me down to the main part of the evening. Your speaker for this evening is a gentleman who has been officiating at Big Ten football games for the past fifteen years. He has been the Athletic Director of the Hyde Park High School in Chicago—I almost said Harrisburg there (laughter)—for 29 years. He has just returned from a trip of the Harlem Globe Trotters, in which he represented Mayor Kelly and Ike Eisenhower. They were in South America for six weeks and in Europe for eight weeks and are inviting these Pan-Americans and these Europeans to some kind of a Pan-American Congress that we may have over here. Anyway, we have with us tonight, Elliott E. Hasan, who is going to speak to us on "Football—As an Official Sees (?) It." (Applause)

Mr. Elliott E. Hasan (Athletic Director, Hyde Park High School, Chicago, Illinois): Thank you, Paul. You know, this Harry Livingston of your organization was smart. He sent a horse up to Chicago and they sent me down here. (laughter) I think that that is a pretty good trade. I brought a movie with me—The Highlights of the Big Ten Season. This is for last year. The movie runs about 25 minutes. I thought that inasmuch as this Institute winds up in a football party at the University of Illinois tomorrow, in order to put you in the swing of the football game, we would show you the movie first. At the conclusion of the movie, perhaps I can entertain you for a few minutes.

Who always sees it the wrong way because he calls it against your team? (Laughter) I will have more to say about that after the movie. May we have the lights turned out and the movie started, please?

Incidentally, gentlemen, before we show the movies, let me tell you that the movies that they take of football games are the bane of the officials' existence. Here the movies are taken Saturday afternoon, developed Saturday night, the coaching staff meets Sunday morning at 8:00 o'clock and runs through the movies, particularly if the game has been lost by a touchdown. They run the movies and study them for an hour or so and then decide it was not clipping and the penalty for that clipping foul put that ball in position where the other team scored and sometimes we feel that we would like to have just about that much time to decide whether a foul was or was not. (Laughter)

When you see these movies and the gentlemen in the black and white shirts, distract your attention from them and watch the ballplayers, will you?

And now the movies.

. . . The movies were thereupon shown, entitled "Sports TV" with subtitles as follows:

Indiana University, Bloomington, Indiana
University of Wisconsin, Madison, Wisconsin
Purdue University, Lafayette, Indiana
University of Illinois, Urbana, Illinois
Northwestern University, Evanston, Illinois
University of Minnesota, Minneapolis, Minnesota
Michigan State University, East Lansing, Michigan
Ohio State University, Columbus, Ohio
University of Michigan, Ann Arbor, Michigan
University of Iowa, Iowa City, Iowa
(Applause)

Reprinted from Illinois Engineer, Vol. XXXIII, No. 4, April, 1957, pages 3-8.

SOME BASIC INDUSTRIAL TRENDS AND THEIR ECONOMIC INFLUENCE ON THE BITUMINOUS COAL INDUSTRY *

HUBERT E. RISSER †

That the bituminous coal industry is far from being the dying industry that many believe it to be is attested by a detailed examination of trends within the industry. Today, coal is in a position to share more fully in America's industrial growth than it has been for many years. In the immediate future its hope lies in further industrial expansion and in increased consumption of coal in its traditional uses. In the more distant future large quantities of coal will probably be converted to other products and consumed as liquid or gaseous fuels, and to some extent as chemicals.

The ultimate consumer buys directly only a relatively small portion of total coal production, but indirectly he buys millions of tons in the form of automobiles, concrete highways, electrical power, and the many other products of modern industry. Any study of the economic aspects of the coal industry must therefore turn to trends within that wide variety of industries and other groups that are the major consumers of coal.

Growth of Population and Industry

The promising position that the coal industry now occupies is the result of a number of basic trends, most of which are related closely to the increasing consumption of goods by our growing population, and to the expansion of plants and facilities to provide these goods. Both the population and the production of goods and services within the nation have shown phenomenal increases within the last 20 years.

Population, instead of stabilizing at a level of about 150 million, as had been anticipated by some population authorities, has continued to rise at an increasing rate. Census

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* Presented at annual meeting of the American Institute of Mining, Metallurgical, and Petroleum Engineers, New Orleans, February 26, 1957.

† Member of AIME, assistant professor of mining engineering at the University of Kansas, and mineral economist for the Kansas Geological Survey, now mineral economist, Illinois State Geological Survey, Urbana, Ill.

figures showed the U. S. population in 1950 to be 150.7 million persons, and by 1956 it had increased to an estimated 168 million. This population growth of about 17 million persons in six years was equal to the total increase over the preceding twenty years. Current predictions foresee a population of 178 million in 1960 and in excess of 190 million by 1965.

The expansion in population has been accompanied by a marked increase in the so-called Gross National Product, or GNP, which the annual dollar value of all goods and services produced. The GNP has shown a six-fold increase since 1933, and now exceeds 400 billion dollars per year. During the same period, personal consumption expenditures rose to $2\frac{1}{4}$ times the 1933 level, and the Federal Reserve Board index of industrial production showed a four-fold increase.

Although consumer expenditures and GNP have increased much more rapidly than population, not all of this difference reflects a higher standard of living, since much of it is the result of increased prices. Likewise, the index of industrial production reflects not only an increase in goods available for consumer use, but also the production of capital goods and of goods for government use. Regardless of the use of the product, however, increased activity affects the consumption of coal and other materials in the process.

Increased production of goods has required a parallel increase in the consumption of energy and materials, so that the fuel and raw materials industries have been directly affected. Some such industries have expanded as much as or more than their customers, but others, like coal, have barely held their own. Had the use of coal increased at the same rate as industrial production, coal production would have risen from 310 million tons in 1933 to about a billion tons per year in 1956. Instead, only about one-half billion tons were produced.

Although the coal industry's expansion failed to equal the general industrial growth of the nation, coal nevertheless has been strongly affected by the trend. In non-competitive uses of coal, industrial expansion caused direct increases in coal consumption. In competitive uses where coal has enjoyed special advantages, its use has also fairly closely paralleled the expansion. In competitive uses, where coal has lost large markets, the losses undoubtedly would have been even greater had not the consumer industries been expanding.

Expanded use of competitive fuels has been one major cause for coal's failure to parallel the nation's growth. Present consumption of fuel oil for heating and industrial purposes is almost four times that of twenty years ago, and there has been an almost equal increase in the use of natural gas for the same purposes. In some competitive uses oil and gas have supplanted coal because of convenience or cleanliness in their use; in other uses cost has been the determining factor.

A second reason for the decline in the consumption of coal is increased efficiency in its use. Most efficient use of coal is obtained in large units where close combustion control is possible, and where operations can be mechanized. Large utility plants provide a good example. Consumption of coal in such plants has dropped from an average of 1.46 pounds per kilowatt hour produced in 1933 to only 0.95 pounds today. New plants are using 0.75 pounds or less. Improved efficiency has in some instances reduced the amount of coal required to perform a given service, and has undoubtedly retained for coal some markets which otherwise would have been lost.

Some Basic Trends

The pattern of consumption of coal has shown many changes over recent years. In some uses gas and oil have largely supplanted coal as fuel. This is especially true in railroads, and in domestic and commercial heating, which once constituted the major markets for coal. Fortunately for coal, the decline in these uses has now been offset by increased consumption in other uses, resulting from the general expansion of our economy. Trends in the general activity and the use of coal by major consuming groups give an insight into what is happening to the coal industry.

Railroads

One of the traditional consumers of coal has been the railroad industry. Twenty years ago it consumed about 20 percent of total coal production; today it consumes about 2 percent. This is the result of trends in railroad activity as well as in the use of the fuels.

The railroads of the nation have failed to share proportionately in the expansion that has occurred in general industrial activity through recent decades, due primarily to competition from other forms of transportation. With more than a four-fold increase in industrial activity, railroad activity, as measured by freight carloadings, is only slightly more than 50 percent above the 1933 level.

Railroads have reduced drastically their consumption of coal. In 1933, Class I railroads used 73 million tons of coal; the current rate is about 12 million. During World War II the greatly increased activ-

TABLE I. FUEL CONSUMPTION BY RAILROADS*

Year	Tons of coal (Thousands)	Barrels of fuel oil (Thousands)	Gallons of diesel fuel (Millions)
1940	90,726	65,198	81
1945	124,220	111,966	454
1950	65,855	60,386	1,979
1955	15,913	14,873	3,535
1956	12,921	10,713	3,706

* Source: Interstate Commerce Commission.

ity of the railroads caused a large increase in the consumption of coal. From a peak of 132 million tons in 1944, consumption fell steadily and rapidly to its present level.

Most of the reduction in the use of coal has been due to a rapid change-over from steam to diesel locomotives. The figures in Table 1 on fuel consumption illustrate the rapidity with which this change has taken place.

Further dieselization will very likely take place and probably will reduce railroad consumption of coal to a still lower level. However, with such use now constituting only 2 percent of total coal consumption, the over-all effect on the coal industry will be small. Furthermore, it may be that the perfection of a coal-fired gas-turbine locomotive now under tests will enable coal to regain some of the lost railroad markets.

Retail Consumption

A second category in which coal consumption has been declining is in what is classified as "Retail Deliveries." This category includes domestic consumption and consumption by commercial concerns. Presumably, the amount of fuel in retail use would be governed largely by the size of the population.

From 123 million persons in 1930, our population has increased to an estimated 168 million. Despite this one-third increase in population, retail deliveries of coal declined from 80 million tons in 1933 to less than 50 million tons in 1956, roughly a 40 percent drop, reflecting the increasing inroads made by gas and fuel oil.

A further increase in population can be anticipated and this will mean a steady increase in the consumption of fuel for domestic heating. I believe, however, that it will be some time before this increase has any appreciable effect on the retail consumption of coal.

Natural gas, because of its convenience and cleanliness, is highly preferred for domestic and commercial heating. Consequently, it can command a premium price for these uses as compared to ordinary industrial uses, and there is the trend toward diverting gas from industrial to retail uses wher ever possible. This is being accomplished by underground storage of natural gas near centers of population so that it will be available when needed.

Steel

Exclusive of coking coal, the steel industry also uses moderate quantities of coal for other purposes, primarily for the generation of gas and steam. A gradual transition to oil and natural gas has reduced the consumption of coal for these uses.

Although steel production has been rising, coal consumption by the steel industry (exclusive of coking coal) has been gradually decreasing. In 1933, the steel industry produced 15.6 million tons of ingots for steel and castings, and consumed 10 million tons of coal. In 1956, steel production was approximately 115 million tons and the consumption of coal was about 5 million tons.

It appears that even the large expansion in steel capacity now planned will probably be insufficient to offset this downward trend. However, since the use of coal by the steel industry accounts for only one percent of total production, a further decline will have but little effect on the over-all picture.

ELECTRIC POWER

Twenty years ago electric power utilities ranked fifth among the seven major classes of coal consumers. Today it ranks first, and accounts for more than one-third of all the coal consumed within the United States.

The growth of electric power has exceeded that of nearly all other major segments of the economy. From 81.7 billion kilowatt hours in 1933, electric utility output rose to 546.4 billion in 1955 and an estimated 600 billion in 1956. This amounts to more than a seven-fold increase in 23 years. Comparison of this increase with a four-fold expansion in industrial activity, and a one-third increase in population during the same period provides some concept of the growth of the industry.

The steady growth in electric power generation has required increasing amounts of coal. While power production increased to seven times its 1933 rate, coal consumption by utilities increased six times. From 27.1 million tons in 1933, coal consumption by this industry has grown until, in 1956, it reached an estimated 155 million tons. That the expansion in coal use did not parallel that of electric power output even more closely can be attributed to improved efficiency in coal combustion, to some increased production of hydro-electric power, and to increased use of oil and natural gas. In areas where natural gas is readily available, its use for utility and industrial use has expanded rapidly through application of the industrial-interruptible type of contract. With further development of underground storage, the availability of gas for such uses will probably disappear.

Current estimates predict an increase in power production from the current rate of 600 billion kilowatt hours to an annual rate of 754.5 billion in 1960, and 956.5 billion in 1965. Such an output as that suggested for 1960 would probably require more than 190 million tons of coal.

What impact the use of nuclear energy for the generation of electric power will have on the coal industry cannot be predicted with any assurance at present. Although most authorities agree that the use of such power is still some years off, there is no complete accord on how long it actually will be before its effects are felt by coal producers. The general estimate is that it will be at least 20 years before it becomes significant, at least in the United States. In other countries where ordinary fuels are less plentiful and more expensive, progress may be at a somewhat faster rate. A report published late in 1956 indicated that power units now planned in the U. S. for completion by 1960 will have a total capacity of 556,000 KW, and those to be completed by 1962 will have an aggregate capacity of 1,126,500 KW

COKE

Coke plants currently are the second largest consumers of coal. Because a large portion of the coke manufactured each year is used to produce pig iron, activity in the coke industry closely parallels that in the iron and steel industry.

Pig iron and steel production in 1956 were approximately five times their 1933 level. Coal used to produce coke rose from 40 million in 1933 to about 105 million tons in 1956—somewhat less than a three-fold increase. Coke production would have paralleled pig iron production even more closely had there not been a decline in the use of coke for other purposes. About one-third of the coke produced in 1933 went for other uses; in 1956 it was about one-fifth.

The present capacity of the steel industry is about 128 million tons per year, and new construction now planned will increase the capacity to about 143 million tons by 1959. Such an increase, if fully utilized, can increase consumption of coal by millions of tons. However, certain factors may tend to offset the increase to some extent. For one thing, the ratio of scrap iron to pig iron used in the furnace charge can be varied. An increase in the proportion of scrap will reduce the amount of pig iron required and in turn the amount of coke needed. Secondly, the amount of coke consumed in producing a ton of pig iron is being gradually reduced. Other possible methods of reducing the amount of coke used to produce steel would be extensive use of high top pressures, or of the low-temperature direct reduction of iron ore.

Cement

The tremendous expansion in private and public construction since World War II is well known. Directly related to this is the steady and rapid growth of the cement industry. Cement production increased from 64 million barrels in 1933 to about 350 million barrels in 1956, or 5½ times the earlier figure. Coal consumption by the industry meanwhile has increased more than three-fold and is currently about 9.3 million tons per year. This amounts to slightly less

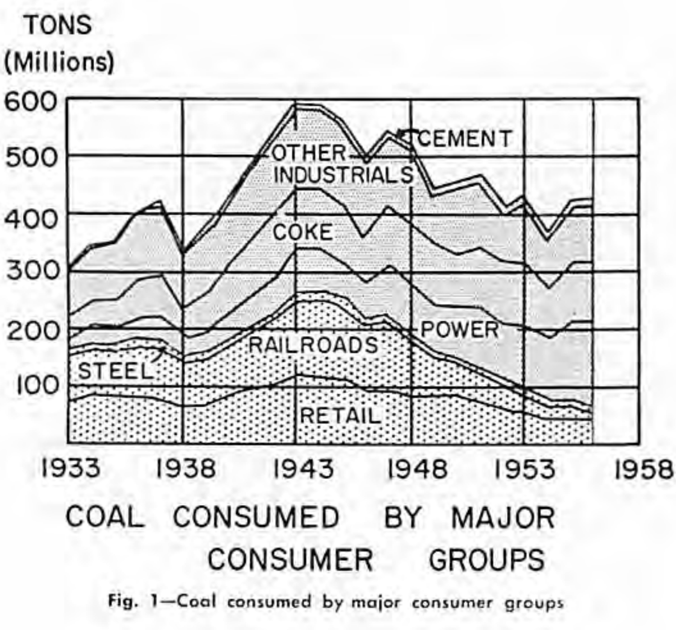
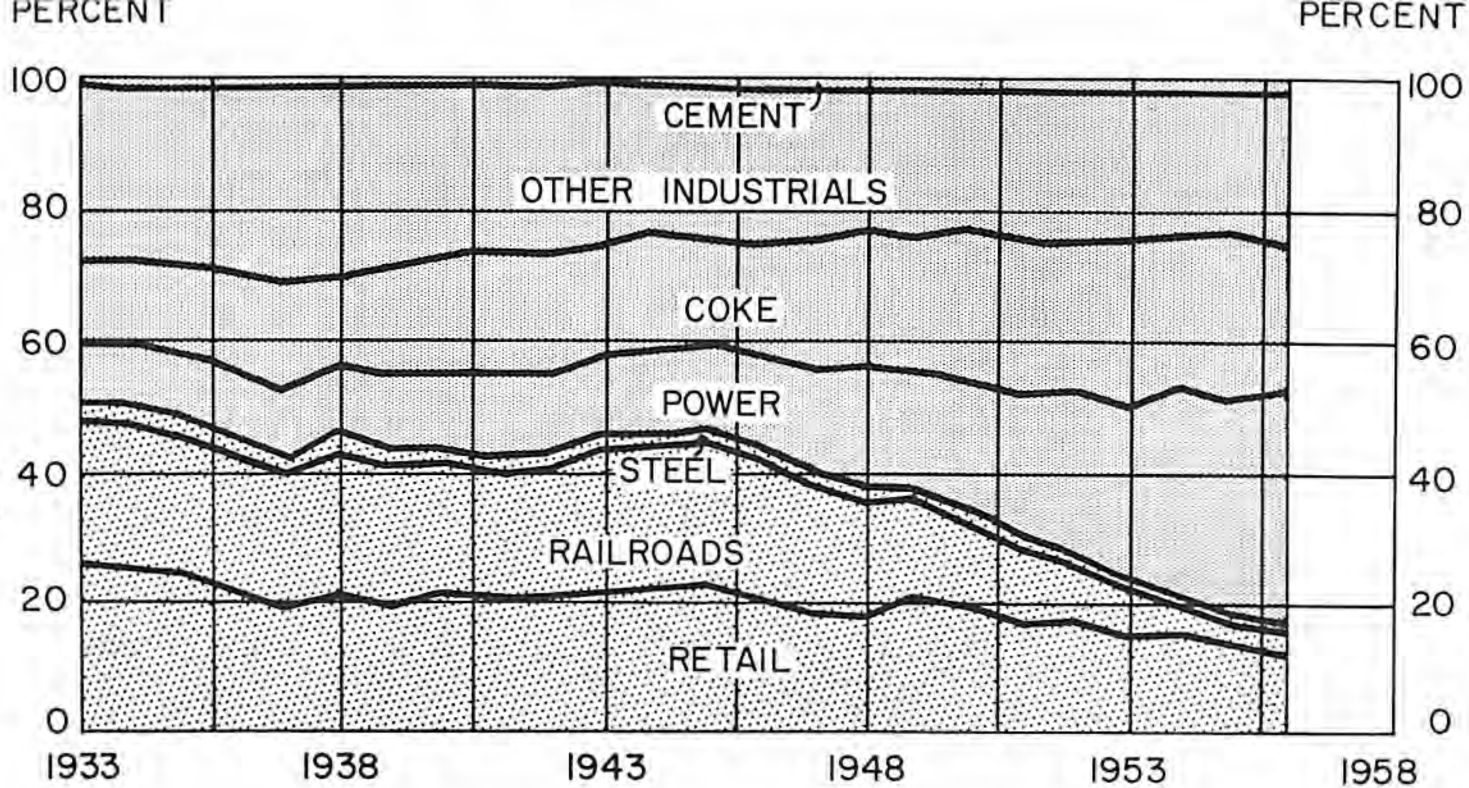


Fig. 1—Coal consumed by major consumer groups



PERCENT OF TOTAL COAL CONSUMED BY MAJOR CONSUMER GROUPS

Fig. 2

than 2 percent of total coal production. The expansion of the industry currently planned will bring some increase in the use of coal.

Other Industrials

Industries other than the specific industries discussed above are grouped within a consumer class designated as "Other Industrials." The general index of industrial production should rather closely parallel activity within the group. Industrial production in 1956 as shown by the index was four times that of 1933. Coal consumption by this group increased only 15 percent during this period. As a matter of fact, comparison of present consumption with more recent years shows a considerable decline rather than any increase. This has been caused by a steady replacement of coal by other fuels.

There may be some further decline in the use of coal by other industrials, but the trend seems to be leveling off. It appears that some of the natural gas now going to such industries will before long probably be diverted to retail consumers through use of the underground storage facilities being developed.

Net Effect of the Trend

To a large extent changes in consumption by the seven major consumer classes discussed previously have tended to counteract each other (Fig. 1). While consumption of coal in railroads, steel, and re

TABLE 2. TRENDS IN COAL CONSUMPTION

Industry	Coal consumption (percentage)	
	1933	1956
(Those of declining consumption)		
Railroads	23.0	2.9
Retail	25.5	11.5
Steel	3.2	1.2
	51.7	15.6
(Those of increasing consumption)		
Power	8.6	35.7
Coke	12.4	24.4
Cement	0.9	2.2
Other Industrials*	26.4	22.1
	48.3	84.4

* It should be noted that the *percentage* represented by "Other Industrials" declined, but the *actual tonnage* in 1956 showed an increase over 1933.

tail uses has been declining, its consumption in coke, cement, electric power, and other industrials has been growing. The magnitude of the gains during World War II, and losses since then, tend to obscure the fact that aggregate consumption by the seven classes has been trending upward over the long run, and that there has been a 35 percent gain since 1933.

Among the most important outcomes of the trends have been the changes in relative importance of the different classes, as consumers of coal (Fig. 2). These changes are shown in Table 2.

The three classes which consumed 51.7 percent of the total in 1933 had declined to 15.6 percent in 1956. Over the same period the other four classes, consuming 48.3 percent in 1933 had increased to 84.4 percent in 1956. In 1956, three classes accounted for 82 percent of the total.

With these industrial classes accounting for so large a percentage of coal consumption, the coal industry is in an extremely favorable position to gain by any further expansion of our economy. Conversely, it must be added that the coal industry is in an extremely vulnerable position should any decline, or even a leveling off of industrial activity, take place. From this standpoint, I believe the trends of the next twelve to eighteen months may be especially significant, and should be carefully watched by the coal industry.

Foreign Trends

Since the conclusion of World War II there has been a vast rebuilding and expansion of Europe's industrial production, requiring large quantities of coal. British and European coal mines have not been able to supply this coal in adequate quantities at suitable prices. Consequently, United States coal is being shipped abroad in increasing quantities.

Foreign exports of coal in 1956 amounted to 48 million tons. Current predictions are for an increase to about 56 million tons in 1957, and a steady growth in coal exports for some years to come. However the unsettled conditions prevailing throughout the world make the future of export trade very uncertain. Future estimates under such conditions can be hardly more than guesses.

On this side of the Atlantic, the growth of the Canadian steel industry may further increase our shipment of coal to that country.

Long-Term Trends

A comment was made earlier about the long-range future for coal. The promise for the distant future lies in the predicted need for energy sources of all forms. In a recent study made jointly by the U. S. Bureau of Mines and Bituminous Coal Research, Incorporated, the following projections of energy use were given:

Year	Energy equivalent in millions of tons of coal
1960	1,779
1965	1,990
1970	2,238
1975	2,530
1980	2,863

No prediction is made as to how much of the total energy will be provided by coal or by any other particular fuel.

Should bituminous coal retain its present share of 30 percent of the total energy produced, projected consumption of coal would be:

Year	Millions of tons of coal
1960	533
1965	597
1970	671
1975	759
1980	859

The largest U. S. consumption on record was the 593 million tons used in 1943. According to the foregoing estimates, this peak should be reached again in less than ten years—and this time without a war effort as its cause.

If the projected expansion in energy does occur, it appears likely that the proportion supplied by coal will steadily increase. However, in the years to come it is likely that the greatest expansion in coal use will be in its conversion to liquid and gaseous fuels. The oil and gas industries have built up a tremendous demand for their products – a demand which some day must be at least partially satisfied by synthetic liquid and gaseous fuels produced from coal, oil shale, and bituminous or oil sands. The higher costs of processing coal to provide these products will be offset at least to some extent by the fact that coal occurs near the major markets, whereas the products of oil shale must be shipped from Colorado or other western locations. Many factors will enter into the determination of when such conversion will be economically feasible. It has been predicted, however, that within 15 or 20 years inadequate supplies of other liquid and gaseous fuels will force us to it. To supply only 5 percent of the 1952 demand for natural gas and natural petroleum would have required more than 100 million tons of coal.

Another potential use for important quantities of coal is the manufacture of chemicals. In the past, coal chemicals have been almost entirely by-products of coke production and, therefore, were directly tied to coke requirements. New plants now are in operation for the purpose of producing chemicals directly from coal. At least one of these plants operates in close connection with a large fuel-burning installation which can make use of the char which is formed.

The prospects of such an industry depend almost entirely upon the extent to which markets for the products exist or can be developed, and upon how well coal can compete with other producers.

Summary

In summary, competitive fuels have replaced coal to such an extent in some of its traditional uses that present consumption in these industries is only a small fraction of its former volume. Meanwhile, expanded use in other fields, due to the nation's industrial growth, has reached a point where it has more than offset the declines. With use in declining markets, constituting only a very minor part of total consumption, coal is in an excellent position to benefit from further industrial expansion of the nation.

With the present consumption pattern, coal's future is tied more closely to industrial activity than ever before. This puts it in a position to share more fully in future growth of industry, but at the same time makes it more vulnerable in case of an economic recession. Present trends indicate a continued growth both in population and industrial activity, and to provide a portion of the energy for this growth, coal production will expand.

For the immediate future coal will be used in the traditional manner and in its natural form. To supply an increasing share of energy demand in the more distant future, coal will be converted to liquid and gaseous fuels. Some will also be converted to chemicals to fulfill a growing need for such products.

There will, no doubt, be interruptions in coal's progress and very likely some periods of decline, but if we are to assume that our nation will continue to grow and advance, that our population will increase, and that our standard of living will improve, then, I believe we are justified today in saying that coal's future has never looked brighter.

About the Author

Dr. Risser joined the staff of the Illinois Geological Survey as Mineral Economist on July 1, 1957. Before coming to the Survey, he was a member of the faculty of the University of Kansas for seven years, where he taught mining engineering. He holds a degree of Engineer of Mines, an M.S. in mining engineering, and a Ph.D. in economics.

Prior to his teaching assignment, Dr. Risser served as mining engineer and mine superintendent for the Alabama By-Products Corporation, and as engineer for the Coal Mining Section of the National Safety Council.

During World War II he was a major in the Army Corps of Engineers. He is currently active in the Army Reserve Corps in which he is assigned to the Civil Affairs, Military Government Branch.

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COAL GEOLOGY AND THE COAL INDUSTRY *

GILBERT H. CADY

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I assume that the Society has honored me with election to my present office mainly as a representative of that relatively small but virile group of the Society designated as coal geologists or coal geochemists. Although this group may be small, it represents the geological phase of one of the most important of our mineral industries. It is appropriate to emphasize the great importance of this resource, not only in contributing to our physical comfort and well-being, but also in supporting many of the activities of modern civilization that provide occasion for the services of a much larger group of economic geologists concerned with the discovery, mapping, and development of metallic and industrial minerals.

From time to time, therefore, some statement is desirable in explanation of the relationship and importance of coal geology to the coal industry, since coal geologists do not appear to have such an opportunity more than about once in a decade. It was nearly 10 years ago that Dr. Ashley presented the last presidential address of a coal geologist.

Such a statement may also serve to provide the membership with a somewhat better understanding of the nature and scope of coal geology and to strengthen any wavering confidence in the wisdom of the selection of such a branch of geology, which seems so little esteemed in the academic field, for life-time professional activity. Coal geologists are rarely, if ever, the direct product of academic training. The decision to enter this field of geology is usually the result of chance experience during the first years of field training. Why this decision is ever made is considerable of a mystery, but that it sometimes happens we have tangible evidence. Certainly there is no well laid out path into the profession. To the individual who has made this decision, may I take occasion to point to the Coal Group (GSA), a child of our own Society, as an organization that will offer encouragement and support for those entering this branch of geological science.

In the ensuing discussion I will

* Presidential address given at the annual meeting of the Society of Economic Geologists, November 6, 1957.

first point out the general nature of the important changes that have taken place in the American bituminous coal industry during the past fifty years, as indicated by statistical data obtained from the government publications and a booklet published by the National Coal Association (NCA) in 1956 entitled "Bituminous Coal Trends." I do this because the nature of these changes has a direct bearing on the importance of coal geology and the nature of its applications particularly for the future.

This statement will be followed by a consideration of the character of the research activities whereby the changes have been achieved and the general position of geological research among these activities. This relates particularly to the two fields of coal resources investigations and coal petrology, which are of most immediate importance to the coal industry.

Changes in the Bituminous Coal Industry Since 1905

The production of bituminous coal and lignite in the United States has increased from about 315 million tons in 1905 to 464 million tons in 1955, or about 50 percent above the 1905 production, with a maximum annual production in 1947 of over 630 million tons. Anthracite during the same fifty years declined from 78 to 44 million tons.

There have been many other important changes: The average price of bituminous coal has risen, but discontinuously, from $1.06 in 1905 to $4.49 in 1955, that is over $3.00 per ton. This is about twice the general increase in commodity prices since 1905, but only partly reflects the increase in miners' wages, which have increased in the order of four times.

The man-power required to produce the coal, however, has declined from 460,909 employees in 1905 to 225,093 in 1955. Most of this decline has taken place since 1950, when there were still 415,000 employees. Thus the number of employees has declined nearly 50 percent in the last 5 years.

There was essentially no mechanical mining before as late as 1923 (0.3 percent), since which time it has increased until now 85.5 percent of the coal is machine mined. Strip mining, which started in 1915 with 0.6 percent of the total coal mined, has increased to about 25 percent by 1955. The effect of this and other mechanization has been an increase in per day production of the individual miner from 3.4 tons per man day in 1905 to three times that amount (9.84 tons) by 1955.

Parallel changes have taken place in the markets. In 1905 bituminous coal and lignite represented 70.1 percent of the energy produced from fuels plus water power (NCA, p. 26); anthracite 18.4 percent; petroleum 4.7 percent; gas 3.2 percent; and water power 3.2 percent. In 1955 the corresponding figures were bituminous coal and lignite 31.6 percent; anthracite 1.7 percent; petroleum 37 percent; natural gas 26 percent; and water power 3.7 percent.

The change in the pattern of coal utilization has been equally remarkable, as may be seen by comparing figures for as late as 1933 with those for 1955 (NCA). The use of coal by the electric power utilities has increased from 27 to nearly 113 million tons, in spite of the fact that a ton of coal in 1955 produced more than 3 times the electric energy as the same weight in 1920 (3 pounds per KWH in 1920, —0.99 pound per KWH in 1954). The use of bituminous coal by the railroads has declined from a high of 132 million tons in 1945 to only 27 million tons in 1955 (NCA, p. 39); the use of bituminous coal in by-product coke ovens has increased from 38 to more than 104 million tons during the same period. Retail deliveries declined from a maximum of 125 million tons (1944) to less than half that amount (61 million tons) in 1955. These data represent the greatest changes and the largest classes of users in the market. The railroads and domestic markets have suffered the greatest declines because of the increase in the use of fuel oil by the railroads and of fuel oil and natural gas by the householder.

Industrial utilization has not changed a great deal, so that the chief reliance of the coal mining industry rests upon the utilities and general industrial utilization, particularly the steel industry. This change in the character of the market has been accompanied and, to a large extent been made possible by, and been responsible for, important changes in coal mining and coal preparation procedures. Thus nearly five times as much coal was crushed to fine size, or originally produced in fine sizes, in 1955 as in 1940 (161 as compared with 35 million tons). Furthermore, a good deal of the coal crushed at the mines is further reduced in size at the place of utilization.

This increase in the use and production of coal in fine sizes has been accompanied by a number of parallel changes in mining and preparation operations. Thus only 5.3 percent of the coal produced in 1927 was mechanically cleaned; this percentage had increased to 58.7 percent in 1955. Largely because of the decrease in the importance of railroad and domestic coal, together with the increase in the use of stokers in various types of installations, the production of lump coal has largely ceased.

Likewise, there has been a great expansion in the use of mechanical methods of mining. For the present purpose it is unimportant which was cause and which effect, but certainly unless combustion engineers had demonstrated the advantages of burning coal in powdered form, the modern types of mining machines could scarcely have acquired their present importance.

Since 1905 the amount of coal cut by machines has increased from 32.8 to 88.1 percent, and that mechanically loaded from 0.3 percent in 1923 to 85.4 percent in 1955. The "continuous miners" were introduced between 1945 and 1950. By 1950 there were 3,143 such machines reported in operation, and by 1955 11,830 such machines produced about 8 percent of the bituminous coal (7,460,204 tons). Augur mining has also become feasible with the increased demand for fine coal, and more than 6 million tons of coal were produced by this method in 1955.

Summarizing these data and adding a few other points the following outstanding trends of the coal industry during the past fifty years are apparent: A great decline in the number of mines and mining companies; a great decrease in the number of employees; a large increase in the production per man-day; a considerable increase in the amount of bituminous coal and lignite produced; extensive mechanization of the mining operations both above and below ground; great advances in the means and methods of transportation of the coal from the face to the preparation plant; and a great increase in the production of fine coal which is usually accompanied by an increase in the mineral matter content of the mechanically produced coal, making necessary a large increase in the amount of coal mechanically cleaned.

Thus the bituminous coal industry, like many other industries, particularly within the past 10 years has placed increasing emphasis upon mechanization, automation, and management. The trend has been stimulated by the competitive necessity of keeping the price of coal down where it can successfully compete with other sources of energy, in spite of the constantly increasing cost of labor and equipment. The general result has been to eliminate mining practiced as an art and to establish it as an engineering and mechanical process. The outstanding change has been the reduction in the size of the coal as prepared for sale and use.

Research Activities

These changes in the methods of mining, preparation, and utilization of coal have not been spontaneous, or simply a matter of growth. They are inter-related, and the particular type of change that has taken place and the equipment and processes that have been adopted have resulted from changes in the utilization practices, from exploratory and experimental testing, conventional promotion, and from experience gained by trial and error. Thus the loss of markets for lump coal and the parallel enlargement of the small coal market was a fortuitous but more or less unforeseen combination of circumstances greatly to the advantage of automatic mining, loading, and transportation machinery that handled small size coal most advantageously, and made necessary greater dependence upon cleaning process for the production of low ash and low sulphur coal.

All such exploratory and testing operations in mining, preparation, and various forms of utilization fall into the category of research in the eyes of management as represented by such groups as the National Coal Association, various operators' associations and Coal Mining Institutes scattered throughout the country.

The coal mining industry has, of course, been most acutely conscious of the problems which concern coal production and coal utilization, yet it has not been unaware of the importance of an understanding of the fundamental facts in regard to coal occurrence and availability and in regard to the physical and chemical nature of the coal itself.

The coal industry is well aware of the fact that it is an extractive industry and that it must be ready to substitute new supplies of coal for those being lost by mining, with the hope that the quality and availability of the new supplies will be as good or better than those lost by extraction. Likewise, although the interest is more or less incidental, there is an undercurrent of interest in the fundamental character and composition of coal because of a realization of its complexity and its inherent capacity of springing surprises upon the industry in the way of methods of utilization.

The general character of coal research as it is viewed by the National Coal Association, which is management, is indicated by the information contained in the accompanying summary table (NCA, p. 139).

This and other information provided by the National Coal Association show that the main research emphasis (64.2 percent) is in the field of utilization, that is carbonization, gasification, combustion, and hydrogenation. Carbonization concerns about one-quarter of the cost of the projects upon which the tabulation is based, and nearly 30 percent of the personnel. Furthermore, it is the only field in which federal, state, university agencies,

TABLE I. SUMMARY OF COAL RESEARCH BY TYPE OF STUDY – 1955 *

	Expenditure		Manpower	
	Dollars	Percent	Number	Percent
Coal resources	1,478,600	8.5	187	19.8
Mining	3,038,700	17.5	140	14.8
Preparation	606,400	3.4	45	4.8
Storage and transportation	97,900	0.6	5	0.5
Combustion	1,121,800	6.4	42	4.5
Coke and chemicals	5,435,400	31.3	273	28.9
Gasification of coal	2,517,900	14.5	91	9.7
Coal hydrogenation	2,080,100	12.0	93	9.8
Physical and chemical properties	1,005,600	5.8	68	7.2
	17,382,400	100.0	944	100.0

Contributed by:	Dollars
Federal agencies	4,863,737
State agencies	579,727
Commercial coal	2,452,284
Captive coal	1,206,888
Equipment manufacturers	3,220,810
Other industrial	4,954,954
University and unidentified	104,000

* Bituminous coal trends: National Coal Association 1956, p. 139.

and research institutions have all been engaged.

In the field of mining and transportation the research and testing activities represent about 21.5 percent of the total outlay for research. The projects in this field have been largely the concern of research institutions and industry, although the universities are working on problems of continuous mining and roof control and the federal government is making a study of augur mining.

Only two of the nine classes of research listed appear to be related to coal geology, namely the two designated Coal resources and Physical and chemical properties. The last item, however, refers mainly to activities concerned with sampling and analysis, much probably of a routine character. It is possible that the carbonization studies (Coke and chemicals) may include certain studies involving the relation of coal petrology to carbonization underway in the Coal Research Section of the College of Mineral Resources, the Pennsylvania State University, under the direction of William Spackman, Jr., in part supported by industry. In general, however, we are chiefly concerned with investigations of geological character that represent an expenditure of nearly $1½ million and the activities of 187 professional individuals representing 8.5 percent of the funds and 19.8 percent of the manpower devoted to all coal research.

Since the National Coal Association, in its classification of coal research activities, specifically differentiates coal resources studies from the several categories of applied research dealing with mining and utilization, it becomes pertinent to inquire into the nature of these activities, as their character is not immediately apparent.

Coal Geology as an Aspect of Coal Research

The geological investigations which are included under the heading of Coal Resources in Table 1 consist of two fields of geological activity: coal resources investigations and investigations in the field of "coal petrology, geology, and other earth sciences as applied to resources" (NCA, p. 45). This subdivision is a natural one, and is in accordance with the general practice in geological surveys under state or federal jurisdiction. One field has to do with the discovery, mapping, distribution, thickness, and mineability of the coal beds, and the quality of the coal contained therein, as determined by the conventional methods of face sampling and chemical analysis. The other branch is concerned with the coal material itself, rather than as a coal bed, that is with its origin, physical constitution and structure.

Coal Resource Studies. A little more than $1 million was used in 1955 by federal and state governments, universities and research institutions in coal resources studies, including an unspecified amount used in the study of trace elements of various kinds found in coal beds. Probably the greater number of the individuals counted are employees of federal and state geological surveys who are mapping the outcrops and structure of coal beds and making determinations of coal reserves.

The emphasis placed upon this type of geological work is understandable, for there is increasing need for the best possible knowledge concerning the location, quality, and availability of our bituminous coal resources. Coal geology of this kind absorbs much the larger proportion of the funds assigned to the general field of coal geology. Unfortunately, it seems to be the general idea that this type of work does not require a great deal of special training or instruction. Accordingly, there are commonly assigned to work in this field young men recently from college with little or no special training other than in the field of general geology. It is usually the case that after a little field experience and with good supervision in a short time they may become competent to map easily recognizable sedimentary horizons, coal beds or otherwise, and to work out structural features presenting no unusual difficulties. Not uncommonly, such a young geologist is more troubled with problems of field transportation and maintenance than with mapping or description of the coal bed itself. Lacking suitable instruction, too frequently the nature of variations to which the coal bed is subject are little understood and inadequately or entirely unrecorded. Variations in roof and floor and the significance of stratigraphic variations affecting the associated rocks, which may mean much in their effect upon ease of recovery of the coal, may be entirely overlooked. Particularly it is often the case that an understanding of the structural or constitional make-up is lacking, upon which knowledge alone a suitable description of a coal bed can be based, to say nothing of the ability to use the fossil plant components of the coal as a means of solving problems of stratigraphic correlation.

This idea that experience in coal geology is sort of an initiating procedure in geological training is due for a change. The long prevailing idea of the relative unimportance of the mapping of coal resources to the coal industry, which can possibly be largely ascribed to the supposed inexhaustibility and ready availability of supplies of good coal no longer holds true. From the experiences of the coal industry, public utilities, steel and aluminum companies and others in locating large bodies of workable coal as reserve supplies, it is being realized that such coal must be geographically well located and possess desirable geological and chemical characteristics. With the increasing specificity of requirements for each particular type of utilization and installation, the search for suitable bodies of coal is becoming increasingly rigorous. I believe that schools and colleges, particularly those located in or adjacent to the bituminous coal fields should consider this situation in planning curricula. It seems doubtful whether the conventional courses in economic geology in most cases provide the necessary instruction about coal and coal beds to equip an individual with training and knowledge necessary for the correct evaluation of a particular coal deposit.

Coal Petrology. We may now turn to a consideration of the other phase of coal geology which is somewhat more adventurous in character because of its relative novelty and the general lack of undertsanding of its significance in the field of applied or economic geology.

The science of Coal Petrology is like that type of construction to which writers have more or less frequently referred with two teams of architects, one team building from the roof down and the other from the ground upward. The two schools of coal science, that is the architectural teams, to which reference is made, are the American school of Coal Microscopists, which follows the system of description and nomenclature marked out by Reinhardt Thiessen, and the European school of Coal Petrologists that recognizes Marie Stopes as its leader. The first, or American, group is building on a foundation of painstaking study of the coalified fossil plant material present in coal. The main elements of construction are the microscopically identifiable constituents anthraxylon, translucent and opaque attritus and the uniquely coalified substance fusain, and the numerous plant organs, secretions and derivatives sometimes called phyterals, such as bark, wood, spores, cuticles, resin bodies, etc., identifiable as plant fossils.

The European group of coal petrologists, on the other hand, prefer basic subdivisions of coal materials as such, which are readily recognizable with the unaided eye in bituminous coals as the four banded ingredients now called lithotypes or rock types, vitrain, clarain, durain and fusain. It is from this over-riding subdivision of coal material that the coal petrologists have extended downward a science structure that reaches toward but does not quite match with that being built upward by the coal microscopists. Fusain seems to be the one construction beam which both systems have in common, and it does not provide much leverage for the good correlation of the two systems of construction.

One of the reasons for the more or less independent development of these two schools of coal petrology and coal microscopy resides in the prevailing use by the American coal microscopists of thin sections of coal viewed in transmitted light, and the predominant use by European coal petrologists of polished surfaces of coal viewed in reflected light. General substitution by European coal technologists of the polished surface for the thin section method may at least in part be ascribed by the discovery that the use of oil immersion objectives effected resolution of the reflected image to a degree that made unnecessary the preparation of thin sections for most of the practical applications of coal petrology.

Microscopic resolution of the four lithotypes or rock types of coal recognized by the European school into constituent parts was, of course, inevitable. This resolution resulted, however, not so much in the recognition of fossil plant forms, organs, and secretions but of varieties of coal or macerals. The macerals compose the lithotypes in a manner similar to minerals in inorganic rocks. Thus the emphasis was on the designation of the maceral as a particular variety of coal material rather than as a fossil entity.

To make provision for the various proportions of the macerals composing the different varieties of bituminous coal, a fairly complicated system of classification and nomenclature has been devised. In order to simplify the classification and description, particularly in the field of applied petrology, there has developed a simplified system attained by combining certain macerals of similar general characteristics into groups. Thus, in the last few years three groups of macerals or group macerals are regarded as representing in general the three varieties of material composing bituminous coal. These are the humic type of maceral represented by vitrinite and constituting that part of coal derived from woody substances; the bituminous type of coal material or exinite consisting of that part of the coal composed of waxy and resinous substances; and finally the macerals of high carbon content represented by fusain and other opaque or nearly opaque material and designated by a variety of names such as micrinite, inertinite, and carbinite. This system of group maceral clasification and nomenclature has been put into use in many foreign countries as a means of describing and classifying coal material for practical purposes. It has several advantages in its favor: It is relatively simple, the varieties of coal material are grouped into three categories of more or less distinctive properties; and the composition of a coal in terms of the group macerals can be readily indicated on a ternary chart. There is nothing strictly comparable to such an arrangement in the American system of coal microscopy. There still remains some question, however, whether the simplicity of classification imposed by the group maceral system adequately represents the complete range of possible variability.

The European coal petrologists have been striving to internationalize the language of coal petrology, particularly with respect to the applied aspects of the science and to provide a glossary of coal description of an international character. This activity has been underway since the formation of the International Committee on Coal Petrology at the last Conference on Carboniferous Stratigraphy at Heerlen in 1953, in which committee American representatives have had some part. These efforts will presumably soon bear fruit in the publication of the first edition of the glossary, consisting of about 40 terms, during the coming winter. This achievement will, however, not resolve all the difficulties in terminology and definition in terminology, definition, and concepts separating the European coal petrology and American coal microscopy in the construction of a unified science of coal petrology.

Application of Coal Petrology to the Coal Industry

The lack of complete agreement accompanied by some misunderstanding and confusion existing between the American and European groups of coal microscopists and petrologists should not distract our attention from and discourage recognition of the practical importance of the state of physical heterogeneity existing in coal, whatever the components or constituents are called. The fact of this heterogeneity exists, whether it is expressed in terms of plant parts of phyterals, or in terms of coal components or macerals. For about forty years the literature of coal geology has contained many references to the physical heterogeneity of coal, until now the idea is generally accepted.

The part this knowledge may play in the operation of the American bituminous coal industry is at least indicated by the application of coal microscopy to the selection and blending of coal in the manufacture of metallurgical coke, particularly in European countries. Similar applications are now under investigation in several coal petrology and coal geology laboratories in this country and Canada.

The possibility of still further application is to my mind strongly suggested by the situation in which the bituminous coal industry finds itself in the field of coal preparation, the tendencies in which have already been indicated. The increase in the production of fine coal together with the mechanization of mining operations has enhanced the importance of cleaning processes in order to produce coal of low ash content. Eventually, I believe, this trend will reach a limit of practical achievement in the improvement of such fine coal in terms of ash content. However, in the fineness of the coal and in the heterogeneity of its petrographic composition there exists further possibilities of modification and in the preparation of coals of specific type.

Within the past two or three years the possibilty of separating coals of high and medium volatile rank into three predominant types of coal material, vitrinite, exinite, and micrinite, when finely pulverized, seems to have been successfully demonstrated in several laboratories in Europe, particularly at Aachen and Essen in Germany, and in Geleen in the Netherlands. Concentrations demonstrated by microscopic examination to be above 90 percent have been achieved for each type of material in quantities adequate to provide material for chemical and physical tests. Although it was found that differences among the maceral groups tend to fade out in the higher rank coals, they are very real in the medium and particularly in the high volatile coals such as those that form the greater part of the production of bituminous coal from American mines. In view of what appears to be a steady trend toward an increase in the production of fine sizes of coal, the lesson of coal petrology points to the eventual utilization of this science in the production of special types of coal by existing or more refined methods of preparation, but prepared under petrographic laboratory control.

To believe that the possibility of this sort of change in the nature of the preparation of coal resides by nature in the coal industry would reveal a lack of understanding of the manner in which changes take place in this industry. In most cases they are in response to changes in the market. Hence in this case likewise, the market probably must be modified into forms that emphasize the importance in utilization practices of variations in coal type owing to the specific concentrations or reductions in the petrographic components. This eventuality, if realized, must wait demonstration supplied initially by academic and other fundamentally scientific laboratories sufficiently interested to explore the possibilities of the field not only along lines being followed by our colleagues overseas, but with a true spirit of exploration and research.

"If there is a way to do it better, find it."—Edison

Reprinted from Mining Congress Journal, January, 1957

CONTINUOUS MINING WITH EXTENSIBLE BELTS

MICHAEL YONKO
General Manager
The Powhatan Mining Co.
Dilles Bottom, Ohio

Since 1951 the yearly tonnage mined by continuous miner-extensible belt units has more than tripled. Here is one mine's experience with this new transportation method that cuts labor and operating costs.

From the very beginning, we must admit that the coal industry was not conceived, planned and blue printed by scientific supermen fully equipped to visualize and engineer perfect mining techniques for all variations in conditions. The coal industry, like other mineral industries, has evolved through the efforts of practical men as the uses for coal have been learned and the demand for it has grown. Men with initiative and vision have prospected for coal, developed mines which employ many thousands of men and have continually sought better methods of mining through the application of the best available mechanical equipment.

Over 65 years have passed since the inception of the first undercutting machines. Punch type cutting units were first developed; then the breast and shortwall machines evolved. In the early years all the coal was hand-loaded. Later shearing machines and mechanical loading units were developed and introduced into the coal fields. This created the need for new and different face haulage facilities, resulting in the development of chain conveyors and shuttle car haulage equipment.

During the last five years the coal industry has been applying on a large scale continuous mining machines that literally tear the coal from the earth without undercutting, drilling or blasting. As experienced in earlier years, a change in mechanical mining methods at the face requires a new and different type of haulage to utilize the full capacity of the face equipment. The latest innovation is the extensible belt which permits a continuous flow of coal without interruption.

Introduces New Problems

With the advent of continuous mining in eastern Ohio, many prob-

The extensible belt in operation provides an intermediate haulage system as near to continuous haulage as is possible with present day mechanical equipment

lems evolved that were not present with conventional mining. Our first problem was the resistance to accept new machinery and try new ideas on the part of the personnel. This resistance is found to some extent at all operating levels. The general attitude of the employee to accept new machinery is, and may well continue to be, one of reserve and skepticism. It is noteworthy therefore that the introduction of continuous mining has not meant that all of our problems have been solved. We have found that it is necessary that our thinking be changed to permit new methods of mining to be introduced, as well as new methods of transporting the coal, so that we can have a continuous flow of coal at all times. We have found that the attitude of different levels of management must be such that they inspire the employee to the point that efficiency in continuous mining is brought about by teamwork and a realization that no machine is more efficient than the crew that operates it.

The ensuing discussion of continuous mining and extensible belts will be limited to operational experience obtained at the No. 3 mine of The Powhatan Mining Co., located at Dilles Bottom, Ohio, in the Pittsburgh No. 8 seam.

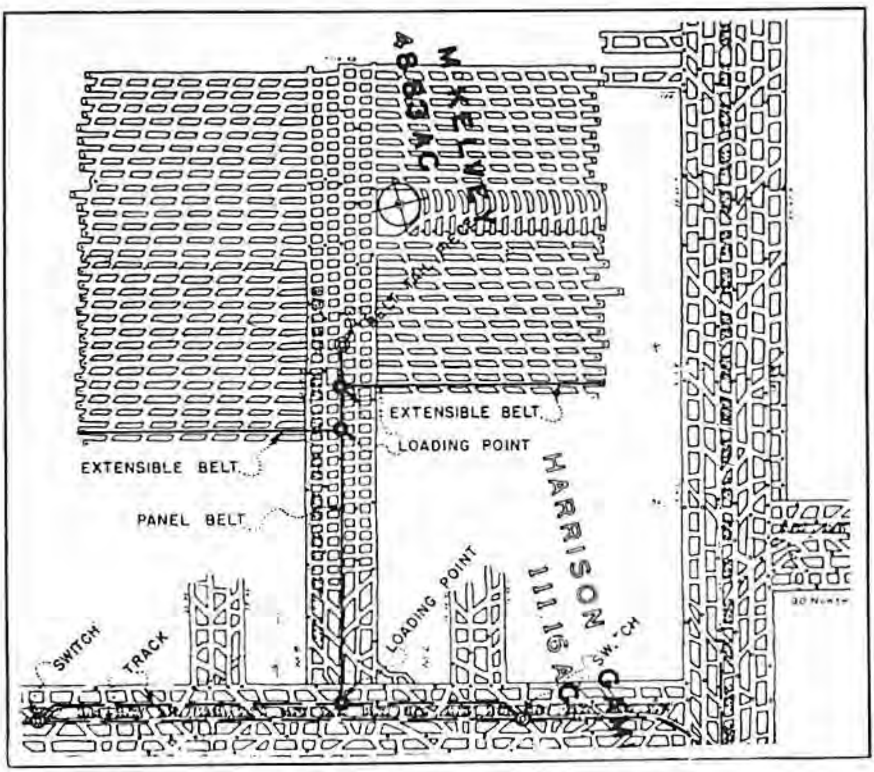
In the fall of 1953, two 3-JCM continuous miners were installed. Seam conditions at this mine do not lend themselves to good continuous mining. The coal is hard and dusty with three separate bands of sulphur which break out easily unless they are in the sumping range.

The seam is approximately 63 in. high and is overlain with drawslate that varies in thickness from 1 to 48 in. with numerous hidden slips and rolls. It is not an unusual condition to find one in. of drawslate on one rib and 48 in. on the opposite side. Immediately over the stone, the roof coal varies from 1 to 30 in. in thickness. Because of the hidden slips and varying thickness of the drawslate and roof coal, it became necessary to apply an approved minimum timbering plan. Presently we are using 4-in. "H" beams, 12 ft. long, on 3-ft. centers in room work.

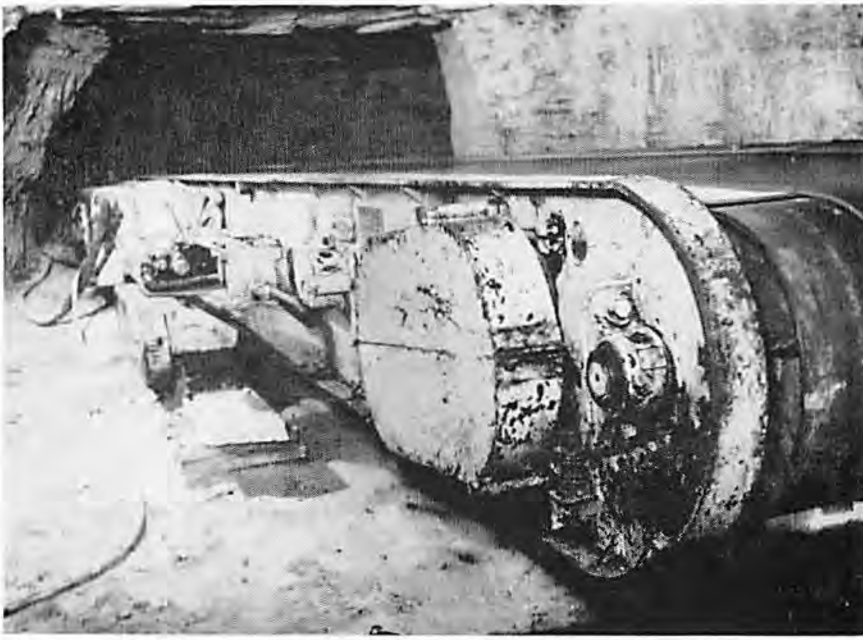
Trial and Error Methods

The room and pillar method of mining is presently used with two continuous miners working in rooms on one set of butt entries. The butt entries are developed by conventional mining equipment and all entries and crosscuts are roof bolted. The projection calls for entries to be driven in sets of five on 40-ft. centers for a distance of 1700 ft., and crosscuts are turned opposite room necks to accommodate the extensible belt unit setup on 32-ft. center.

Trial and error methods predominated in the first continuous min-



Butt entry with panel belt and two extensible belts



The drive unit contains storage space for 100 ft. of belting and is mounted on hydraulically operated cats

ing operations at No. 3 mine. By the use of shuttle cars and surge cars, much experience was gained with this type of haulage. An excessive amount of spillage, however, was had with this method and the transportation car was never fully loaded. Later a conventional loading machine was used behind the continuous miner with the floor as a surge bin. The coal that piled up not only obstructed ventilation but complicated the delivery of supplies to the face. This method also required constant shoveling of coal from behind the two rows of posts along each rib.

In an effort to get a perfected continuous flow of coal from the continuous mining equipment, a panel belt and two extensible belts were purchased. In August 1955 this installation was made and the transition from buggies to extensible belts began. This new system eliminated six surge car and six shuttle car operators since these two units work on a three-shift basis. It has also been found that many mechanical and electrical delays that were previously encountered in transporting coal with shuttle cars, as well as many shuttle car hazards when hauling under steel timbers, have been completely eliminated. As an example of this last effect, the use of extensible belts has completely eliminated the dangers from posts being knocked out by shuttle cars.

With shuttle car mining, the air was constantly being disrupted by the cars going through swinging doors to the discharge point; however, with the extensible belt, this no longer presents a problem.

Extensible Belt Overcomes Haulage Difficulty

Operation of a continuous miner and an extensible belt entails driving only one place at a time and it has been found possible to provide closer supervision at the working face. Because of rapid advancement, closer supervision is a necessity since careful attention must be given to roof control, supply and recovery work and providing adequate ventilation at the working face.

The working place must be kept properly rock-dusted and sufficient water pressure must be maintained to effectively allay the dust at the face. We have every reason to believe and our records show that accidents on continuous miner-extensible belt units are less frequent than in conventional units, due primarily to concentration of working equipment and closer supervision.

Continuous mining – the steady flow of coal from the face—has been a dream of mining men for many years. With the development of the extensible belt in the past few years, this dream is now a near reality. For this reason, Powhatan is actively and energetically engaged in a program of perfecting the best mining system for utilizing the continuous miner-extensible belt combination. Both units in a panel discharge onto a 30-in. panel belt, which in turn, loads the coal into

A 16-ft. bridge conveyor serves to tie the continuous miner to the extensible conveyor six-ton mine cars on the face entry. One miner works on each side of the panel belt in rooms which are driven 640 ft. deep on 32-ft. centers with crosscuts at 50-ft. intervals. Moving to a new room is done between shifts. As the crews gained experience, moving time has dropped from 90 to an average of 60 minutes per move and set-up.

The extensible belt in operation provides an intermediate haulage system as near to continuous haulage as is possible with present day mechanical equipment. Granting that there are "bugs" to be eliminated, they will be reduced as more extensible belts are put into use and mine service representatives have an opportunity to add their improvements and make refinements.

Description of Operation

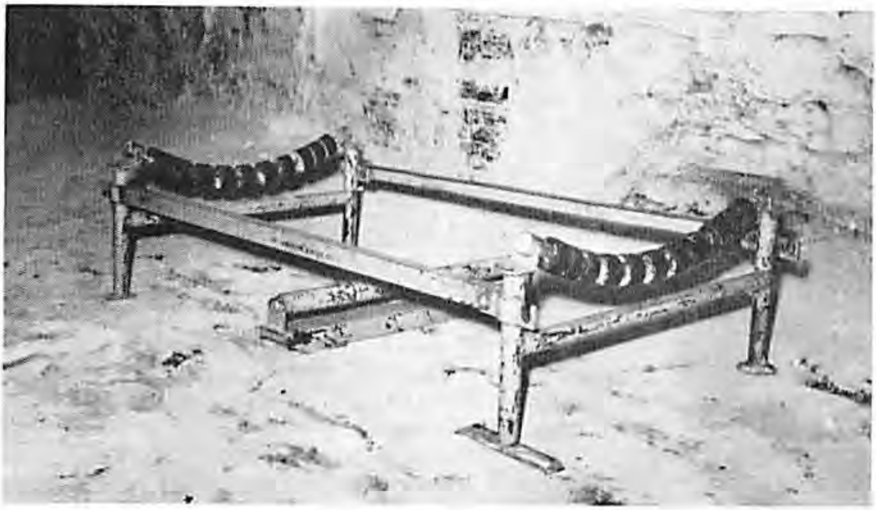
The extensible belt consists of the drive unit, which contains storage space for 100 ft. of belting, and the hydraulic and electrical components necessary for control and operation. This unit is approximately 28 ft. long and is mounted on hydraulically operated cats which facilitate moving and positioning. The rubber belting is stored within this unit by means of a hydraulically operated cluster of pulleys which maintain a predetermined tension in the belt and allows for removal of the belting from the cluster as the tailpiece is moved away from the head section.

The tail unit is self-propelled and contains a self-aligning pulley which allows for improper tailpiece alignment. It also contains the hydraulic traction units, emergency stop controls, and a signal light that shows when the cluster mechanism in the head section is out of belting. The 16-ft. bridge conveyor which serves to tie the continuous miner to the tailpiece has approximately 11 ft. of travel by means of sliderails on the tailpiece before the tail section has to be moved up.

Fabrication or framework necessary to support the belt and to provide a troughed carrying run, consists of upright stands onto which are slung "limber rollers." These are made with Neoprene rubber discs molded onto a wire rope which is attached to pre-lubricated bearings on the ends. The upright stands are spaced on eight-ft. centers and are held together longitudinally with angle iron railings on each side. Return rollers are mounted on low fixed stands and are equipped with pre-lubricated bearings. Deflecting the return roller to one side or the other readily trains the return side of the belt while the "limber rollers" tend to be self-aligning on the carrying run. The return roller stands are placed at whatever intervals are necessary to keep the belt off the bottom.

Adding a 100-ft. roll of belt consumes three to five minutes and is accomplished by two men. Moving out of one room and into another, as stated previously, requires approximately 60 minutes. The two section mechanics take off belt while the two face timbermen and a recovery-man take out fabrication and move the tail piece. The miner operator trams the machine out of the place and helps with dismantling fabrication.

The belt take-off is made in sequence—that is, one section of top belt, and then one section of bottom belt. This method leaves a



Upright stands, Limberoller, and railings

clean path for the timbermen removing stands, which they store to the sides as this room will be a supply source for the next advancing room.

Drive Rooms on 90° Angle

The mining system used is a retreat system and only first mining is attempted. When the miner works out a room, the timbers are left intact since the room adjacent to the advancing place is used as a supply route. The timbers are recovered from the room next to the supply route and used to supply the advancing room. This cycle is followed until the section is completely finished. One hundred percent recovery of steel timbers is an economic necessity while about 50 percent of the wooden posts are recovered and 65 percent of the wedge cap pieces.

Each miner unit consists of one miner operator, two timbermen, and one mechanic. One pit car loading head operator serves both units and also one foreman is in charge of the two units. Supply track is laid on either side of the panel belt, thus providing each miner with a separate supply source. One 500,000 CM feeder and one 500,000 CM return cable is carried up each supply track, allowing for an adequate supply of power for each unit.

Several methods of driving rooms have been explored and much experience was gained in room work. Initially rooms were driven on a 60° angle to a depth of 260 ft. on 25-ft. centers. Seven rooms were worked out on each side of the belt and a safety block was left for protection. Despite the fact that reservations were left, we continued to be plagued by squeeze conditions. This was a constant worry to the management when it was realized that working on this angle the men and equipment were placed in a critical area. Sometimes it was found necessary to leave a block of coal five rooms wide to check a squeeze. At this point it was decided to drive all rooms on a 90° angle so the equipment would, at all times, be adjacent to solid coal and this, in turn, would better facilitate equipment moves in case of a squeeze.

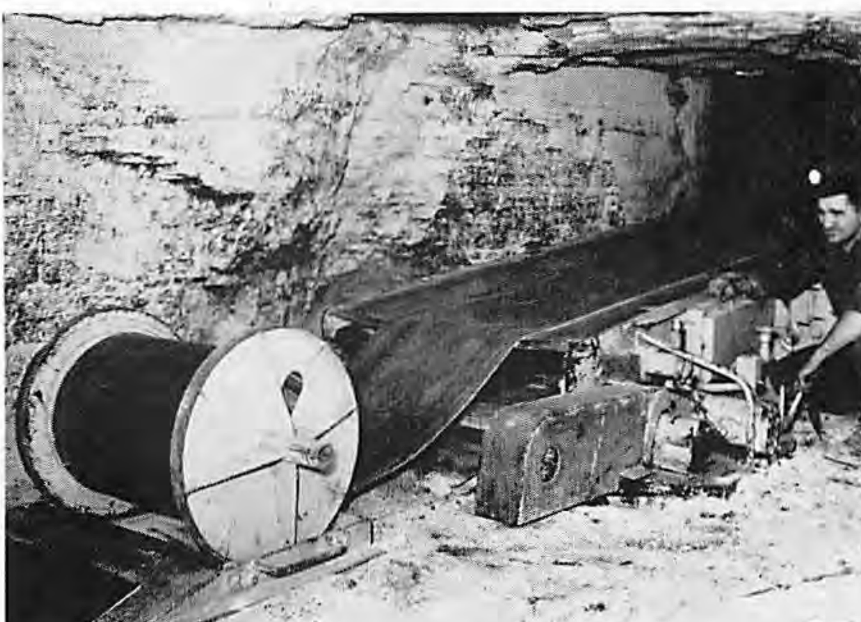
At the present time we are driving rooms at a 90° angle with two extensible belts. These rooms are driven in 640 ft. on 32-ft. centers without leaving any reservations. Under this plan our purpose is to leave an equal amount of coal in each pillar for protection. This system has eliminated all squeezes and additionally our percentage of extraction is somewhat greater.

May Accelerate Adoption of Continuous Mining

An extensible belt can be valuable in working out a large block of coal. For example, in one of our panel projections it would require seven sets of butt entries to work out the area, meaning that seven sets of butt entries would have to be tracked, wired, and ventilated. Under the extensible belt system this large block of coal will be worked out with three sets of butt entries. Consequently, deep rooms have reduced the development cost substantially.

To date maintenance has been one of our greatest problems and the loss of tonnage due to breakdowns has been frequent, but a well-planned maintenance program can minimize the breakdowns. While maintenance cost is high for one combination machine, we do not believe that the cost exceeds that of equipment used in a conventional unit.

We do sincerely believe that con-



Two men take from three to five minutes to add a 100-ft. roll of belt

tinuous miners and extensible belts will, in due time, take their rightful place in the mining industry. Since 1951 the tonnage mined by this revolutionary method has increased from 8,000,000 to 25,000,000 tons this past year. This tremendous increase in such a short period of time clearly indicates that, despite the many handicaps under which these machines operate, the reduction in labor and operating costs cannot be ignored by the industry. All over the world, during the past few years, the pace in all industry has increased rapidly and the advent of the continuous miner and extensible belt has provided the coal industry with the means of keeping up. In fact, almost every conceivable device that man's ingenuity has been able to develop to speed production and lower cost is at our hands.

Reprinted from Mining Congress Journal, June, 1957.

ROOF SUPPORT WITH CONTINUOUS MINING

BEN TUDOR
Mining Engineer, Compass Division
Clinchfield Coal Co.
Barbour County, West Virginia

Compass No. 1 Mine . . .

Accomplishes roof support without interrupting the loading of the continuous machine by means o two roof bolting drills mounted on the miner

Utilizes conventional and continuous mining units to produce an average of 6000 tons per day

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This report on roof bolting practices in connection with continuous mining deals with practices presently in use at the Compass No. 1 Mine of the Clinchfield Coal Co., Barbour County, W. Va. Compass Mine produces an average daily tonnage of 6000 tons. This tonnage is derived from one continuous miner with Joy shuttle car haulage and four conventional mechanical loading units which are composed of Joy loaders, Joy cutting machines, Joy shuttle cars, and Jeffrey roof drills. In addition, there is a Joy 1-CM with an extensible belt with which this report will deal.

"Island Type" Mining Plan

The mine is operating the Pittsburgh Seam of coal. This is about the southern most point in the State of West Virginia where the Pittsburgh coal is mined. Consequently, the mining plan is more or less the "island type" on a large scale as the coal occurs near the top of the hills where the outcroppings have been stripped.

The Pittsburgh Seam in this area averages about eight ft. in thickness. About seven ft. of coal is taken in the mining operations, with 6 to 12 in. of top coal left to prevent air slackening of the overlying shale top. Roof bolting is used throughout the mine to hold this layer of top coal. Bottom coal is also left because the seam is underlaid by a soft fireclay that disintegrates badly when in contact with water and is not solid enough to support the weight of the continuous miner. The layer of coal left on the bottom is high in ash and sulphur; and since it is not mined, a higher quality raw product is delivered to the cleaning plant.

Two roof bolting drills are mounted on the caterpillar frame of the continuous miner directly behind the timber jack and the one on the right side (shown) is just in front of the operator's controls

With a tightening wrench placed on the drill, the roof bolt is tightened under slow feed. The relief valve at slow feed cuts off at 1000 psi which develops a torque on the bolts from 150 to 160 ft. lb.

A roof bolter drills an angular hole to install a bolt on a 20-25° angle (note the 2½ ft. extension added to the drill stem). Bolts currently in use are ⅝ in. by 5 ft. long

The bolting pattern is staggered down the room on four-ft. centers and 2¾ ft. from the rib, considering only lateral dimension. Approximately one bolt per ft. in a 17½-ft. wide room is used

Conventional and Continuous Units Utilized

In this particular locality the Pittsburgh Seam is cut by numerous clay veins. These veins are highly irregular and have no particular common strike, running at random intervals and directions through the coal seam. The clay veins will vary in thickness from one or two ft. up to a maximum of eight or ten ft. Compass tries to be selective in choosing the working sections for the continuous operation so that the miner will not have to cut through an excessive number of clay veins. This is done by plotting the courses of the clay veins that have been found in nearby workings.

Development is usually done with conventional units. Entries 14 ft. wide are driven on 60-ft. centers while 14-ft. cross-cuts are broken every 60 ft. Entries are driven in groups of either 7 or 14, depending on whether there is a single conventional unit or two conventional units side by side. At 90° off of these developed main and submain entries the continuous miner drives headings or probably more accurately termed rooms. These rooms are on 60-ft. centers, 17½ ft. in width, and are driven up to a maximum distance of 1000 ft. Cross-cut centers vary but usually average about 80 ft.

When one room is driven to its extremity, the belt is left in place. The miner, the extensible tail section, and the extensible head section are trammed over to the adjacent, previously driven room. Belt is already in place there but has to be connected to the head and tail sections. The miner then pillars this room, taking everything on say the left side but mining only about ⅓ of the block on the right and next to the developed room. When this room is pillared, the miner leap frogs the previously developed room in which the belt was left in place.

A new room is then driven to its extremity with the belt recovered from the last pillared room as the miner retreated. After this room is developed, the miner head section, and tail section are trammed to the adjacent room where the belt is already in place. The miner then pillars the remaining ⅔ of the block on its left and only ⅓ of the block on the right, thus completing and starting a new cycle of operation.

This system is rather unique for it requires only a minimum amount of time to put the belt in operation when the miner and the self propelled head and tail sections are trammed back into a room. It does, however, require extra belt and stands, but this expenditure is justified by considering fast between shift moving with a minimum of delays by having the belt in place.

Excellent recovery is being obtained with the continuous miner and the extensible belt. About 90 percent of the coal is recovered and good, straight pillar breaks occur from the straight pillar line. There is seldom any evidence of weight riding over from the pillar line to the adjoining development.

Six-Man Crew Operates Miner and Extensible Belt

The Joy 1-CM continuous miner is a heavy-duty mobile machine for seams 54 in. or higher and is mounted on independently driven cat-units. This machine and extensible belt went into service at the No. 1 Mine in March 1955 and has certainly made a name for itself when considering some of the adverse working conditions such as clay veins, sulphur balls, and roof which has not always been the best. Tonnage per shift, of course, has varied. With natural conditions at their best, production has exceeded 700 tons per 8 hour shift—portal to portal—but the daily shift average, taken over a year, is right at 510 tons. Tonnage-wise this is comparable to the conventional units; however, the manpower requirements are only about one-half.

A six-man crew and foreman operate the miner and extensible belt. The duties of this crew are as follows: one machine operator, two roof bolters, one mechanic, and two general laborers. The machine operator and two roof bolters handle all the work assignments at the face; the other three men add belt and install intermediate sections in addition to handling miscellaneous jobs such as shoveling spillage, setting safety posts, and rotating roof bolt men for lunch.

In operation, the continuous miner rips out a channel of coal 42 in. wide and 18 in. deep, cutting from bottom to top of seam. Five of these 42 in. cuts make the room width of 17½ ft. Crosscuts are driven half way from each side and are at approximately 90° with the rooms. They are the same width as the rooms. Under normal operating conditions it takes approximately five minutes to make one sweep of the face, resulting in an 18 in. advance for the width of the face.

Type of Roof Drills

To accomplish roof support without interrupting the loading of the continuous machine, two Joy RDU-2 roof bolting drills are mounted on the miner. These are of the auger type and are hydraulically operated. A 26-hp motor and a 4-section hydraulic pump serve as the power unit for the bolting drills which operate independently of the continuous miner; however, their controller switch is synchronized into the miner's off-on switch as a safety feature.

The drills are mounted on the caterpiller frames of the miner directly behind the timber jacks and the one on the right side is just in front of the operator's control platform. This location of the drills puts the two roof bolting men the closest to the face, but at that they are approximately 12 ft. away. The operator and other men are never exposed to any unbolted roof.

To mount the drills, a specially adapted bumper has been installed on the Joy 1-CM. This bumper has been extended to hold the drill pump motor and pump, and it also supports a drill controller. The location of the miner's water filter has been changed from the center rear to the right side of the bumper and to the operator's left. The component parts of the roof drill are the feed unit, the rotation unit, the hydraulic centralizer assembly, the trunnion support, and the power unit.

The drill feed unit consists of a hydraulic motor driving a worm keyed to the hydraulic motor shaft. This worm in turn drives a worm gear which is splined to a chain drive sprocket. The chain drive sprocket then raises or lowers the entire drill rotation unit up and down a channel. This in turn raises or lowers the drill stem or the tightening wrench as required.

The drill rotation unit consists of a hydraulic motor driving a pinion keyed to the motor shaft. This pinion drives a gear which is keyed to a spindle. The spindle carries a hex extension which mates with the female end of the drill steel and the roof bolt tightening wrench. This entire rotation unit is raised or lowered by the drill feed unit. The speed of rotation is controlled by two valves; one drives at a high speed, while the other drives at a low speed.

The hydraulic centralizer assembly is mounted to the channel frame of the roof bolting drill. It is composed of two centralizer arms which are controlled by a hydraulic piston in a double acting valve. This centralizing assembly serves to position or hold the drill steel in place when the hole is being started. The arms in open position allow the rotation unit to pass through, thus increasing the feed length of the drill.

The trunnion supports the entire unit and is mounted in a bracket which is supported from the side of the caterpillar frame of the miner. One side of the trunnion is flanged while the other side is splined, thus permitting the roof drill to pivot. The degree of tilt or pivot is controlled by double acting valves and a nine-in. brake drum which is circumvented by a brake band. When the drill feed is in operation, the brake is automatically operated to prevent any lateral movement. This trunnion support is designed to let the drills operate 30° in towards the miner from vertical position and 24° outward from vertical.

The power unit for each drill consists of a 26-hp compound wound motor which operates at 1175 rpm. At Compass this motor is operated on 250 volt d-c and drives a four-section hydraulic pump. Composing the four sections are two 2-in. sections and two ¾-in. sections; the two-in. sections operate the fast drill feed, and the drill rotation valve while the ¾-in. sections operate the clamp jack, the slow drill feed, and the tilt boom valve. The drill's hydraulic system is separate from that of the miner's.

In the hydraulic system are two relief valves located on the input side. There is a valve whose cut-off pressure is 1200 psi on the circuit controlling the fast drill feed, and drill rotation. The other valve controls the clamp jack, the slow feed, and the tilt boom. This valve cuts off at 1000 psi.

Drilling Procedure

While the miner is ripping out the coal, the roof bolters on each side of the machine are busy drilling holes and tightening the bolts. The bolting crew follows a definite pattern which is coordinated with the miner's advance.

As the miner removes the first 18-in. cut across the face, each roof bolt man installs a vertical bolt which is approximately 2¾ ft. from the rib line. Finishing the first cut and as the miner moves ahead 18 in., the driller on the left side of the machine angles his drill 20° to 25° toward the center of the room and installs a bolt on that angle. This bolt is approximately 6¾ ft. from the rib line or 4 ft. from the previous bolt, considering only lateral dimension. Following the next 18-in. advance the driller on the right side of the miner puts in a bolt angled toward the center of the room. The dimensions would likewise be the same as for the second bolt.

Following the third advance of the miner, both drillers install two vertical bolts and thus start the cycle again. Hence the bolting pattern is staggered down the room on 4-ft. centers and 2¾ ft. from the rib, again considering only lateral dimension. Approximately one bolt per ft. (in a 17½-ft. wide room) is used. One hundred to 140 bolts per shift, depending on the tonnage, are used.

The type of bolts currently in use are ⅝ in. by 5 ft. long with a 1⅜-in. expansion shell. A 6 by 6 by ¼ in. bearing plate is attached to the bottom and hard washers are placed between the bolt heads and bearing plates to reduce friction between the two.

On the angular hole a small triangular, wooden, oak wedge is placed between the bearing plate and the roof. This wooden wedge, placed on the far side of the bolt serves as a spacer, compensating for the approximate 25° angular difference between the bearing plate and the roof coal. To obtain additional bearing for places in bad roof, 15-in. oak cap pieces are placed between the bearing plate and the roof. In extremely bad places, 4-ft. or 12-ft. oak boards are bolted to the roof with a consequent change in the bolting pattern.

In drilling, a 4-ft. augered stem, 1⅜ in. outside diameter, with a 1⅝-in. Carboloy or Kennametal bit, is used to start the hole. When the driller reaches the limit, the four-ft. stem is removed and replaced with a five-ft. stem, drilling as high as it can go, which is approximately 1½ ft. from the top. At this point a 2½-ft. extension is added to the stem and the hole is drilled to its entire depth of five ft. The bolt is placed in the hole. A tightening wrench is placed on the drill and the roof bolt is tightened under slow feed. The relief valve at slow feed cuts off at 1000 psi which develops a torque on the bolts from 150 to 160 ft.-lb.

The complete drilling and tightening operation described above takes an average time of approximately two minutes. The roof bolters under most conditions always work the drills fast feed. Breaking this two minutes down, one might say it takes approximately a minute and a half to drill the hole and the remaining half minute to place the bolt and tighten it. When considering it takes the continuous miner five minutes to sweep the face for one 18-in. cut, there is enough time existing for each roof bolter to place two bolts each or four bolts abreast across the roof if its condition should warrant.

At the Compass Mine no detailed records have been kept as to roof bolting bit costs for the drills on the continuous miner. However, from what material exists the writer would say that the roof drill bit cost would be less than two cents per ton. This figure also include the labor required to resharpen the bits. Total roof bolting cost would be approximately 35 cents per ton for bolts and 10 cents per ton for labor.

Need For Fast Bolting

In concluding this article we can say that a rapid means of roof bolting is a "must" in continuous loading. One should also have a means of fast bolting so that the method will be flexible enough to meet any needed changes in the bolting pattern. For instance, roof conditions may require a change from an advancing staggered pattern to a square pattern with bolts in line across the working place. With roof conditions at their worst, the combined bolting time of a lateral line of bolts must be sufficiently less than the amount of time required for the miner to make one sweep of the face. If it should take as much or more time to put in a lateral row of bolts as it does to make one cut across the face with the miner, continuous loading will consequently be sacrificed by bolting delays.

At Compass Mine the solution to this need of fast bolting has been solved by the side mounted roof drills. These fast operating drills have helped to minimize bolting delays and have not interrupted the continuous loading. From experience with bad roof, we have found these drills flexible to meet every needed change in our bolting pattern. With poor roof conditions, a need for four bolts laterally spaced across the room results. This is accomplished in four minutes (two roof bolters—two minutes per bolt), which is one minute less than the average time to sweep the 17½-ft. wide room.

It would be extremely difficult at this mine to bolt any other way because of the room occupied by the extensible belt trailing the miner. Neither could a pinning machine of any size work alongside the miner because, with the present room width at a maximum in this particular locality, there is not sufficient room between the rib line and the miner. One might possibly resort to a smaller pinning machine that would work alongside the miner, but again one would probably be limited to the flexibility of such a machine. Difficulty would also be encountered in reaching inconvenient places and the resultant would be a higher bolt cost with the continuous loading being sacrificed by bolting delays.

In final conclusion we can say that continuous loading must be followed by a fast, flexible, and safe means of roof bolting. It should in no way ever interfere with the continuous loading, yet it should be adaptable to all types of varying roof conditions. At Compass Mine, we have found this in two Joy roof drills side mounted on the continuous miner.

HOW MUCH BITUMINOUS EAST OF THE MISSISSIPPI?

IVAN A. GIVEN, Editor
Coal Age
New York, N. Y.

Committed reserves, present mines	12,580,000,000 tons
Total reserves, present mines	28,300,000,000 tons
Overall reserves mineable at today's or immediate future prices	152,000,000,000 tons

Acceleration is the order of the day in industrial expansion east of the Mississippi, with the new pot lines of the aluminum industry as added starters. One reason is the availability of low-cost coal-based power. This in turn depends upon the availability of coal—also at a low cost. The impact of this increasing demand on reserves therefore becomes a matter for thought and investigation. How much bituminous coal is available in the fields east of the Mississippi? And perhaps more important, how much is available at a reasonable mining cost?

COMMITTED RESERVES

It is obvious that the answers to these questions can be at best only approximations, since accurate information can be obtained only by thorough exploration of thousands of square miles of coal-bearing territory. This study of the situation, therefore, will be limited to a discussion of the reserves at going mines, with some comments on how these may relate to overall reserves in the area.

Reserves at going properties are divided into two categories for the purposes of this study:—first, "Committed," and second, "Total Mine." Committed reserves are those already assigned to operating properties. Total mine reserves are the sum of committed reserves plus other coal held by the operators but not yet assigned to any mining property.

Committed reserves have been approximated from information supplied for the 1956 *Coal Mine Directory* reprinted from the *Keystone Coal Buyers Manual*, a *Coal Age* affiliate. This information consists of (a) production in 1955 and

ESTIMATED RESERVES OF BITUMINOUS MINES OPERATING IN 1955 EAST OF THE MISSISSIPPI RIVER

	Calculated Committed Reserves, Tons	Average Life in Years at 1955 Production Rate: All Mines	Steel Mines	Strip Mines
Illinois	1,100,000,000	24	....	14
Indiana	340,000,000	21	....	14
Western Kentucky	500,000,000	19	....	20
Ohio	1,050,000,000	28	....	25
Central Pennsylvania	950,000,000	27	....	
Western Pennsylvania	1,800,000,000	35	....	13
Northern West Virginia	990,000,000	24	....	
Southern W. Va. High-Volatile	1,400,000,000	30	....	11
Southern W. Va. Low-Volatile*	1,620,000,000	35	....	
Eastern Kentucky	1,200,000,000	28	....	....
Virginia*	540,000,000	23	....	....
Tennessee	180,000,000	25	....	....
Alabama	910,000,000	70	....	....
Total	12,580,000,000	29	31	17**

*Low-volatile mines in Virginia included in southern W. Va. low-volatile.

**Includes data for a few strip mines in states where separate life figures are not shown.

(b) expected remaining mine life. This information is listed for mines producing well over two-thirds of the total coal mined in the United States and in the area east of the Mississippi. Multiplying the two yields a figure on "committed reserves."

It is obvious that the metho' has drawbacks but the results nevertheless can be accepted as reasonable approximations. On that basis, apparent committed reserves for thirteen producing fields east of the Mississippi are shown in the accompanying table. The total is 12,580,000,000 tons. At the 1955 production rate, the average life of these reserves would be 29 years. The actual life could be up to one-third or more less than the calculated figure, depending upon the allowance for losses in mining and preparation.

Separate calculations on years of life were made for steel-owned and strip mines. The average for the steel mines was 31 years; for the strip mines, 17 years—in both instances before any allowance for losses in mining and preparation. The apparent life of going strip mines ranges from 11 years in West Virginia up to 25 years in Ohio,

USGS ESTIMATES OF BITUMINOUS RESERVES IN STATES EAST OF THE MISSISSIPPI, JAN. 1, 1953

	Tons
Alabama	65,848,000,000*
Georgia	76,000,000
Illinois	137,009,000,000
Indiana	35,215,000,000
Kentucky	118,973,000,000*
Maryland	1,196,000,000
Michigan	220,000,000
North Carolina	110,000,000
Ohio	82,972,000,000**
Pennsylvania	72,376,000,000
Tennessee	24,985,000,000*
Virginia	10,833,000,000
West Virginia	105,672,000,000
Total	608,000,000,000**

*Pre-1928 estimate made under supervision of Marius R. Campbell.

**Pre-1928 estimate made under supervision of Marius R. Campbell. Survey by Russell H. Brant, Ohio Geological Survey, in 1956, puts reserves at 36,702,000,000 tons and the total reflects this lower figure.

with states in between as follows: Pennsylvania, 13; Illinois and Indiana, 14; and West Kentucky, 20 years.

Total Mine Reserves

Data on total reserves held by mining companies is somewhat meager. However, enough exists in the annual reports of certain companies, and in reports to *Keystone* by coal-mining and land-holding companies, to set a benchmark or two. Thus, companies producing slightly over 61 million tons in 1955 report total reserves of 4,234,000,000 tons. The committed reserves (calculated or reported) of these companies totalled 1,407,000,000 tons. Thus, these companies, for each ton of output in 1955, had 23 tons of committed reserves and 69 tons of total reserves, or a 1 to 3 ratio.

Does this 1 to 3 ratio hold for the entire bituminous industry east of the Mississippi? Probably not. It is based on holdings of larger and stronger companies presumably better able to acquire and hold reserves. At the other end of the scale is a fair number of properties with no reserves beyond those already committed. Between are properties with varying holdings between the extremes—these extremes, incidentally, including totals beyond 87 years, or three times the average of 29 years for committed reserves.

Companies producing over 2 million tons a year accounted for over

50% of the 1955 output. These are companies to which "larger" can be applied, as well as "stronger." If it can be assumed that half the present organizations east of the Mississippi average 87 years of reserves, and if two further assumptions can be accepted as reasonable, it is possible to obtain an indication of the reserves of present producers. One assumption is that one-fifth of the present producing capacity has no reserves beyond those already committed. The second is that the remaining 30% fall somewhere between 29 and 87 years—say an average of 50 years. With these assumptions, the approximate total reserves of present operations east of the Mississippi work out as follows (in million of tons, based on 1955 output):

Companies with only 29 years of reserves (20% of the output), tons	2,550,000,000
Companies with 50-year total reserves (30% of the output)	6,600,000,000
Companies with 87-year total reserves (50% of the output)	19,150,000,000
Total reserves, present bituminous mining operations east of the Mississippi	28,300,000,000

In appraising the reasonableness of this approximation, it is necessary to consider the method of calculation and the data employed. The results in this instance are presented because it is believed that in the absence of more concrete information from more producers the method and the data result in a closer approach to the actual total of reserves held by bituminous mining companies east of the Mississippi.

These reserves, for the most part, can be considered as coal that can be mined at today's prices, or at prices that may be expected to prevail in the relatively near future.

Overall Reserves

There is, of course, no question but what there is much more than 28 billion tons of coal that can be mined economically now or in the immediate future. The latest estimate of overall remaining United States reserves appears in USGS Circ. 293, "Coal Reserves of the United States (A Progress Report, Oct. 1, 1953)." Its estimates of total reserves east of the Mississippi is shown by states in an accompanying table.

For the most part, the reserves are those remaining as of Jan. 1, 1953, derived from recent surveys and estimates. However, figures for certain states still are based on studies made before 1928 under the supervision of Marius R. Campbell. Ohio is an example, with Circ. 293 showing total reserves of 82,972,000,000 tons. This total is 2½ times that arrived at by Russell R. Brant in 1956 and included in Ohio Geological Survey R. I. No. 29, "Coal Resources of the Upper Part of the Allegheny Formation in Ohio." Mr. Brant estimates the Ohio total at 36,702,000,000 tons, minus 1,914,000,000 tons of production. Coal in seams from 14 in. up is included.

The USGS estimate of total reserves east of the Mississippi is 655,485,000,000, from which probably could be subtracted the difference over the Brant estimate to bring the total down to approximately 608,000,000,000, including coal 14 to 28 in. and more than 1,000 ft. under the surface.

How much of this 608 billion can be considered economically mineable today or in the near future? One guide is given in Circ. 293, which notes that: "The reserves in ten states have been classified in considerable detail . . . In these states . . . typical of the United States as a whole, 5% of the total is measured reserves in beds 28 in. or more thick and less than 1,000 ft. below the surface, and 20% is indicated reserves within the same limit of thickness and less than 2,000 ft. below the surface. The remaining 75% is inferred reserves, reserves in thin beds and reserves 2,000 to 3,000 ft. below the surface.

Applying this 5:20:75 ratio to the USGS estimates for states east of the Mississippi, with adjustment for the new estimate in Ohio, results in a total of 152,000,000,000 tons that could be considered mineable at the prices of today or in the near future. Subtracting one-third for losses in mining and preparation brings the total down to 100,000,000,000 tons.

Summing up, the bituminous reserve picture east of the Mississippi approximates the following:

Committed reserves, present mines (*Coal Age-Keystone* calculation), tons	12,580,000,000
Total reserves, present mining operations (*Coal Age-Keystone*)	28,300,000,000
Estimated overall reserves mineable at today's or immediate future prices (USGS)	152,000,000,000

Even with a loss allowance of as much as 50% in mining and preparation, these totals indicate that all the coal anyone will need will be available at reasonable prices for a long, long time to come in the area east of the Mississippi.

FINANCING COAL'S GROWTH *

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What the bituminous industry's estimated money needs are. What the advantages of public financing are. What forms of financing are available. How the investment banking industry can help.

Our firm has had a long relationship with the bituminous coal industry dating back to the 1920's, and encompassing both periods of prosperity and adversity. Early last year, in March, we published a booklet, "The Bituminous Coal Industry," which was probably the first important publication to draw the attention of the investing world to the rebirth of bituminous coal. The booklet opened with these words:

"A major reversal of trend has taken place in the bituminous coal industry. For 25 years coal has been losing position as a supplier of our national fuel needs, but causes of this decline have lost their force. New opportunities for coal, which appear both strong and enduring now dominate the outlook and provide a sound basis for investment reappraisal of the industry."

In July 1956 we confirmed our faith in this statement as investment bankers by managing the highly successful public offering of the common stock of North American Coal Corp. This was the first public offering of the stock of a coal company in many, many years. It also was the first experience of this company and its officers and directors in such things as registration with the Securities & Exchange Commission, preparation of a prospectus, negotiation with an investment syndicate and introduction to public stockholders.

There are some features of this procedure which corresponds to undressing in public and these are not compatible with the historic practices in the coal industry. On the whole, however, the experience of financing through public offering of securities is a happy one and

* Presented at the 40th Anniversary Convention of the National Coal Association, Washington, D.C., June 6.

New properties and programs to improve existing operations to serve old and new users with lower-cost, higher-quality fuel bring in the problem of finding money for buying and installing plant and equipment.

something which the coal industry should embrace enthusiastically. It is a sound thing to broaden the market for coal securities with a corresponding enlargement of public investment interest, aiding in the proper evaluation of going concerns.

PUBLIC FINANCING ADVANTAGES

I would like to dwell on this subject for a moment. I will start in the terms of a single company—a good, prosperous, growing company.

It is privately owned with no public ownership or trading in its securities, and wishes to raise money to finance expansion. It probably can do so readily by borrowing from insurance companies, a pension fund and the like. It may not be hurt by lack of public market interest. However, its credit, and the terms on which it may borrow money, should be greatly improved by a wide market in its stock, even more so by listing on the New York Stock Exchange and all of the publicity that attends the affairs of a publicly owned company. Incidentally, these factors do not hurt the business of the company.

If the same company had only a small amount of the stock in the hands of the public, either because it was closely held by family groups or because there were too few shares outstanding, it would be worse off in some respects than if there were no public holdings. Investors generally do not buy stocks which may not have a ready market when they may wish to sell them. This limits the field of interest to investors with special collateral aims and speculators. Such stocks may fluctuate violently on little trading, possibly to the detriment of the company's reputation, but the stocks prevailingly will sell below realistic investment value. This in turn is of no assistance to a company's credit and hardly a satisfaction to its family owners of securities.

The Industry Picture

It is easy to translate the comments in regard to a single company to apply to the entire industry. At the most less than 30% of the country's 1956 production is in the hands of independent companies, stock of which have a public market and few of these have the desirable features of broad market-ability discussed above. Over the past 2 years investor interest in the stocks of these companies has risen with the change in industry prospects and stock prices have advanced greatly. Nevertheless, the market evaluation of coal stocks still is generally inadequate, considering their natural resource characteristics, their growth prospects and the underlying soundness of the business.

It is still a characteristic of the industry that the component properties and other assets of a company might be sold piecemeal to other companies with a higher realization than the price which its stock might bring in the market. Moreover, there is no inclination on the part of the public to place any particular value in appraisal of coal-company stocks on coal reserves. Many crude oil production companies are evaluated out of al relationship to their current or early prospective earning power because of public knowledge of their ownership of huge proven reserves of petroleum or natural gas. This is not true in bituminous coal, where the extent and value of reserves also can be determined. In fact, there is no particular differentiation made in stock evaluation between companies from the point of reserves, as long as they are not inadequate to sustain production for a reasonable period of time.

That this situation exists is a reflection of inadequate or immature investor knowledge of the industry, in part a result of the recency of the change in the economics of the coal industry and in part a lack of satisfactory market representation of coal company securities.

Financing Considerations

It may sound a little as though I had wandered from my basic subject, financing the growth of the coal industry, but I think that you can see that a foreword of this nature is useful in tackling the main theme.

The growth prospect in the coal industry is not, in the aggregate, an outstanding thing in comparison to well defined trends in such fields as chemicals, electric power, paper and oil. Moreover, it is responsive growth—not directly generated by the industry itself. Nevertheless, it is real growth, with determinable prospects and it provides opportunities for individual companies to build business in a handsome and even spectacular way if they have the management, reserves and money to capitalize on the industry base.

Within this generalization there are important limitations on the ambitions of many companies to get what they may regard as the key factor in this chance to grow—money.

As you know well, unless mining conditions are ideal, it is difficult to operate a small underground mine profitably. Today's operations require maximum mechanization. The capital investment involved creates a problem, not only in its accumulation or acquisition but also in obtaining a satisfactory return on its use, if the operation is not large enough or generally susceptible to mechanization. Size, both as to the operation and the company, is a limiting factor in financing.

Management is another significant consideration. Over the years, the coal industry probably has attracted less young executive potential than other industries as a field of promise. I believe that the situation is easier now but it probably is still more difficult to build depth and roundness in management in the coal industry than in other fields. Existing managements in many instances have been trained in adversity rather than opportunity. Also, family management has been more prevalent than in most industries.

A company seeking financial assistance will find it difficult to obtain money from either public or private sales of securities if it cannot demonstrate a sound management organization.

Reserves are important, as to amount, economic location and susceptibilty to efficient mining. To some extent reserve deficiencies can be cured through financing but there must be a base to assure the investor of continued profitable operation.

Finances, capital structure and financial record must stand scrutiny. A company does not seek new funds unless they are needed, but financing a cash deficiency which has arisen from improvidence, operation of uneconomic properties, overextension of resources and the like is not a proposition which has much appeal to the investment banker. Capital structure can be a problem. A company may have been forced in the past to borrow too heavily or may just have taken the easy way to borrow when it should have sought equity capital. Excessive debt not only affects the value of a company's securities, debt and stock but may limit its ability to interest new investors.

Forward thinking is logically a most important factor in eligibility for financial aid. A phrase has been coined in the field which has real meaning: "Career Companies."

Results From Money

Unless a company has basic aims to take full advantage of the growth opportunities now existing in bituminous coal, and has well worked out plans to that end, involving the use of the money it seeks, financing is not readily available to it. This applies in any field of endeavor. New money must carry its own load and contribute something extra or it is not being used economically. Whether we are talking in terms of either debt or stock the investor is entitled to know that his money is being used to build a value and that the company, as far as management aims and effort can achieve it, will succeed and progress.

It is easy to see that a large, well financed, profitable bituminous coal producer with good properties and a strong and progressive management team will have little trouble in raising money. This is not as amusing as it may seem. This is the kind of company that can find profitable uses for new money. The obsolescence factor arising from the advancement of methods and equipment, moreover, is pretty hard to keep up with out of self-generated funds in even the most profitable companies.

Financing opportunities are not, of course, limited to companies which already are so well situated. Any company which can pass the tests which I have outlined certainly can explore the possibility of raising new money with every confidence. The most important of all of these factors is management—proven and aggressive management. The next most important consideration is size. This is a real problem for the coal industry. Those companies which have come through the difficult years in the industry successfully and which have moved ahead in the more recent period of opportunity, have done so largely through their ability to reduce operating costs to compensate for rising wage levels and this has been achieved primarily through efficient mechanization of operations.

The Size Factor

There are size limitations as well as other factors which govern the extent to which mechanization can be employed. The coal industry is dominated by a few large companies but encompasses between 5,000 and 6,000 individual mines, most of which are separate operations. One spokesman after another in the bituminous coal industry has stated his belief that the future of the industry depends heavily upon the concentration of many of the small units to create more large companies. To be sure, a good number of the bituminous mines are so small that they have no bearing on the question.

There are many hundreds of companies, however, which are businesses in the true sense of the word but which can not afford to utilize fully the progressive methods of the larger companies, nor do they have the operating prospects which would give them a base for raising sufficient money for the purpose. They cannot conduct sales or arrange contracts in the manner of the larger companies.

As a group the smaller, yet possibly worthy, companies have suffered from the progress which has been made by the larger and more efficient organizations in reducing costs and making a good profit at extremely competitive prices. The solution to the problem which has been advanced by industry spokesmen is combining to obtain the substance, management facilities and reserves of a larger enterprise.

There are several difficulties in effecting combinations of smaller units, including the rather characteristically rugged nature of the coal operator, the reluctance of a management or an owner to share responsibilities, authority and ownership, the fact that, initially, combination might be more a sharing of problems than realizing immediate benefits, and the awkwardness of the initial negotiation when the participants may not be well prepared to provide a reasonably complete or accurate account of their own reserves, operations and finances.

All of this work is in the field of activity of investment bankers. There is a close parallel in the work which must be done preparatory to financing and preparatory to a combination negotiation. Moreover, combinations can result in development of a vehicle which can arrange new financing on a basis unavailable to its constituent parts.

The question arises, I am sure, as to the dividing line as to size between companies which can obtain new financing on satisfactory terms and those which cannot. At this moment, there is no useful basis for such definition. No two companies are alike. Different types of mining and different seams vary in their economic possibilities. The industry, outside of the leading independent companies, is privately owned and operating and financial data therefore are scarce. And the investing world's new interest in the industry is not well enough developed to show a real appetite for any but the best coal equities and credits.

For what it is worth, my own idea is that a 2,000,000-ton deep-mine operation is about the smallest for the type of financial assistance investment bankers could handle, and in this size, the company would have to be well equipped.

Forms of Financing

Basically there are two forms of financing: borrowing and selling stock. There are two markets: public and private.

The natural inclination of a company is to borrow money on long-term arrangements if there is a reasonable prospect that the use of the borrowed funds will take care of interest costs and repayment, with something to spare.

The ownership of the business is undisturbed and the benefits of the expansion are not dispersed. To a degree this philosophy is to be warmly recommended if the position and prospects of the business eliminate any risk that the debt would cause trouble. Borrowing can be overdone, however, without consideration of this risk factor. Financing the growth of a company —a continuous process—should be approached with careful long-term planning. The equity base of a company becomes all-important for borrowing opportunities of money which can be raised quickly.

The sharing of the ownership of a company may be something that an owner-manager group may face reluctantly. There are advantages, however, which are considerable, especially in a growth industry, where a new dollar can have a real chance to produce earnings. Although the existing owners may not get all of the benefits, earnings applicable to their stock holdings should increase. Equally important is the prospect of a public market for the company's stock. Without repeating the desirable aspects of such a step which were previously outlined, there can be added the prestige value among the industry, equipment suppliers, customers and others; the liquidity afforded family members frozen into investment but not usefully interested in the company; facilitation of evaluation and settlement of estates; the currency value of a marketable stock in acquisition of other companies and properties (including tax advantages in such transactions); the improvement of credit from stock marketability and the enlarged equity base; and the ability to attract young and able executives through stock option plans—which are becoming far more important than salary as inducement.

Stock v. Debt

By relying too completely on stock financing in an extended period of expansion, a company loses some of the leverage aspects of use of debt, where temporary use of borrowed money creates an earning asset which can safely make net contribution to the owner's profits.

Relying too heavily on debt, a company can assume unwelcome risk, can use up its borrowing power, which might be a real handicap, and can impair the value of its equity, if it sought to sell additional stock. Any company overburdened with debt may be at a business disadvantage as well.

There are many varieties of securities within the basic framework of debt and stock. A desirable type of issue in some instances, if the company's stock already has a market or one is being created, is convertible debentures. Such debt often can be arranged on better terms than straight debentures and there is the prospect that the debt will be paid off by conversion into stock at prices higher than the stock would bring at the time of issue.

The position of each company considering new financing must be studied with great care, and decision as to the type of securities to be sold should be made to fit its position, plans and prospects, in the light of security market conditions. This is a matter which must be worked out between the company management and the investment banker, each contributing his skill and knowledge to reach the final determination. It is not a matter to be entered into lightly.

You will notice that I have not mentioned bank loans, purchase money mortgages, equipment finance loans and other types of financing which do not fall in the province of the investment banker. These are all good if used the right way. They are all debt, however, in the sense previously discussed.

Placement Considerations

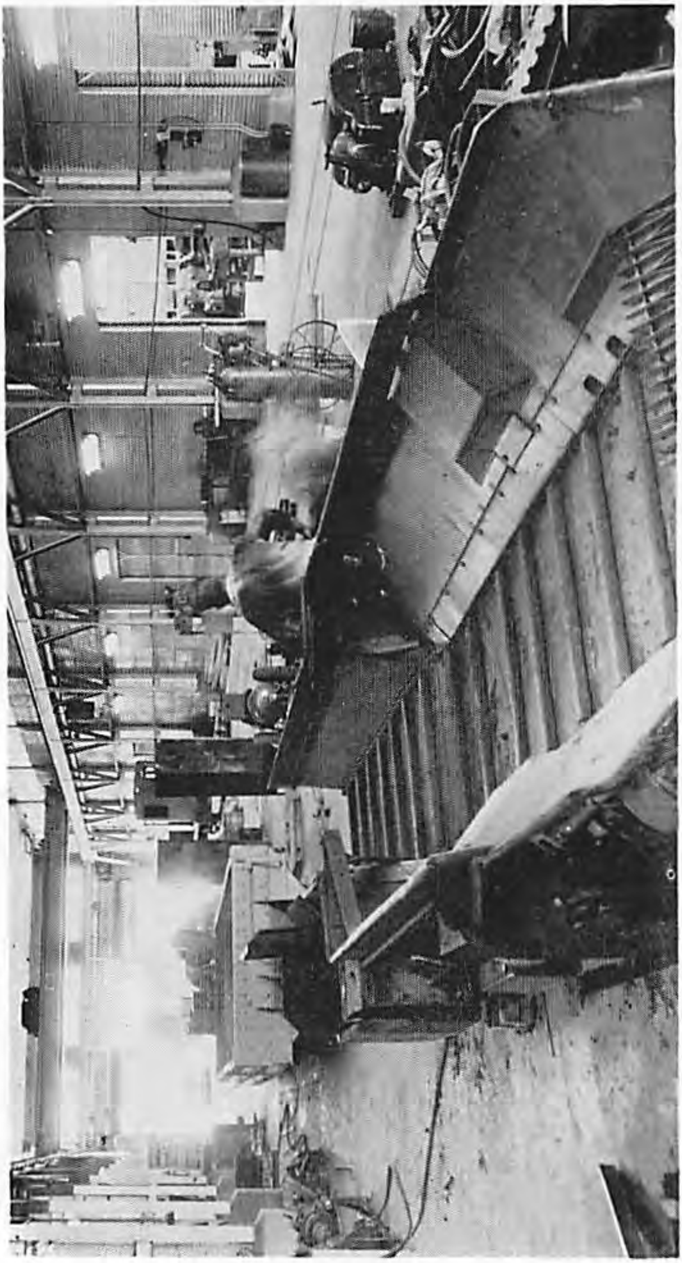
Private and public placement requires a brief comment. Private placement is ordinarily arranged by an investment banker with an insurance company, a pension fund, a university, a charitable or family fund or the like. Major investment houses are in close relationship with such institutional investors. Instead of registering securities with the SEC and offering them to the public with an underwriting syndicate, negotiations are conducted to sell such securities directly to one or more of these funds.

The advantage of this arrangement is that the company has in effect a single outside investor, who works with it in confidence and may be approached readily if there is any need to revise or expand financing arrangements. A relationship of this sort can be a useful thing. The disadvantage is that such an arrangement also can be confining as such investors usually demand certain veto powers regarding further financing, limiting management flexibility. Also, the benefits of a public market are not obtained.

Whether to use private or public financing also must be determined in each individual case.

The growing need of the bituminous coal industry for additional funds to expand production and improve the efficiency and economy of its operations to reduce costs is all too apparent. Our staff figures that the industry should spend between $1½ and $2 billion dollars over the next 5 years for these purposes, and that a great deal of this will represent new, outside money. This gives no consideration to technical developments in usage of coal arising from the industry's enlarging interest in research, which might provide new profitable uses for money.

The industry is in a new phase of growth and forward-thinking companies which seek to take advantage of their opportunities will do well to explore the possibilities of arranging outside financing. Our firm and many others in the investment banking field are highly aware of the useful work which is to be done in bituminous coal and I assure you of a cordial welcome and a sincere effort to be helpful.



Inspections should include scheduling equipment for overhauls. Close check on the maintenance requirements of the units will indicate when they should be overhauled. Set up a time table for equipment overhauls.

INSPECTION GUIDE FOR DEEP MINE EQUIPMENT

DANIEL JACKSON, JR., Assistant Editor
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SECTION HAULAGE EQUIPMENT

Equipment used in hauling coal from the working face to the transfer point includes shuttle cars, belts, and chain conveyors. This equipment should be inspected separately because (1) section haulage plays an important part in the production of coal and (2) the construction and operation of this equipment varies greatly.

The shuttle car is a complex machine which should be inspected frequently. Therefore, it should be understood that on each inspection considerable time must be spent to check it thoroughly. It is suggested that the shuttle car be checked during an off-shift or when it will not be in use for a period of time. The best approach in preparing for the inspection is to remove all guards, covers and inspection plates at one time to avoid distraction and interruption of the inspection.

The inspection can be divided into four parts:

Electrical
Mechanical
Hydraulic
Lubrication

Electrical inspection—Tools needed to inspect the shuttle car electrically are volt-ohmmeter, hook-on-type ammeter, insulation-resistance tester and a small spring scale to check the brush pressure of motors. However, an inspector's most valuable tools in detecting present and future trouble are his five senses.

Items which should be included in the electrical inspection are:

Motors
Operating controls
Contactor panel
Wiring and junction boxes
Cable-reel collector rings
Lights

All motors should be inspected before any other items are checked. On one type shuttle car this would include: two traction, two conveyor and one pump motors. The number of motors will vary with the type of car. Carefully check commutator for high mica, flat spots, burns and grooving. Also, see that the commutator is free from dirt and grease. The brush rigging should be checked for neutral point and brush-holder adjustment. Test brush pressure. See that short, chip-

Modern track haulage equipment must be inspected frequently to insure uninterrupted transportation. They should be inspected during off-shifts so that complete, detailed reports can be made on each unit.

MONTHLY—LOCOMOTIVE INSPECTION REPORT LOCOMOTIVE NO.________ DATE:________

MECHANICAL INSPECTION √ REPAIRED √ O.K.

MECHANICAL
- Gong or Bell
- Suspensions
- Frames
- Bumpers
- Sand Rigging
- Brake Rigging
- Spring Rigging
- Journals & Pedestals
- Wheels & Axles
- Gearing
- Gear Cases
- Air Brakes
- Hydraulic Brakes

GENERAL INSPECTION √ REPAIRED √ O.K.

- Checked all leads and bushings to apparatus
- Checked all insulating bushings
- Cleaned
- Tightened all bolts with lock washers
- Cover plates in place
- Seals
- All insulation checked
- Lubricated in accordance with Westinghouse Lubrication Chart

ELECTRICAL INSPECTION √ REPAIRED √ O.K.

MOTORS
- Commutator
- Brushholder
- Brushes & Shunts
- Fields
- Armature
- Bearings
- Gears & Pinions
- Axle Cap Bearings
- Axle Cap Bolts

ELECTRICAL INSPECTION √ REPAIRED √ O.K.

MOTORS (Cont'd)
- Axle Caps
- Frame Bolts
- General Condition

CONTACTORS, RELAYS AND BREAKERS
- Contact Tips
- Armatures
- Shunts
- Connectors
- Magnet Valves
- Cir. Bkr. Trip.
- Coils
- Arc Boxes & Horns
- General Condition

WIRING
- Condition
- Packing Glands
- Splices
- Clamps
- Insulation

HEADLIGHTS
- Lamps
- Reflectors
- Lens
- Packing Glands
- General Condition

AUXILIARY SWITCHES
- Contacts
- Bearings
- Arc Box
- Blowout Coil
- Connections
- Fuse Clips
- Shunts
- General Condition

CONTROLLER
- Main Drum
- Fingers
- Segments
- Arc Deflector

ELECTRICAL INSPECTION √ REPAIRED √ O.K.

CONTROLLER (Cont'd)
- Interlocks
- Blowout Coil
- General Condition

RESISTORS
- Terminals
- Grids or Tubes
- General Condition

REELS
- Commutator
- Brushholders
- Brushes & Shunts
- Armature
- Bearings
- Fields
- Collector Rings
- Terminals
- Splices (Number)
- General Condition

REVERSER
- Reverse Drum
- Fingers
- Segments
- Interlocks
- Magnet Valves
- General Condition

FUSES
- Headlight
- Main
- Control Switch
- Reel

ELECTRICAL INSPECTION √ REPAIRED √ O.K.

FUSES (Cont'd)
- Blower
- Breather

TROLLEY
- Shoe or Wheel
- Shunts
- Bearings
- Spring
- Bushing
- General Condition

BLOWERS AND BREATHERS
- Air Connections
- Elec. Connections
- Commutator
- Brushes
- Brushholders
- Bearings
- Air Vents
- Field Coils
- Armature
- General Condition

BATTERIES AND DETAILS
- Flush Cells
- Equalizing Charge
- Set Ampere Hour Meter
- Cleaned Plug Contacts
- Grease Nut Cups
- Spacers
- Plug & Receptacle
- Connections
- General Condition

REMARKS:________

SIGNED________ Inspector

Westinghouse Elect. Corp.

Good inspection charts as illustrated above are the foundation of any maintenance system.

ped and uneven brushes are replaced. If insulation shows signs of heat it may be advisable to take insulation-resistance test to determine its condition. Motors should be checked for excessive grease, oil and dust. Keep motors clean at all times.

Operating controls, such as off-on-reset switch, accelerating footswitch and conveyor, pump and light controls, should be checked for proper operation and condition. See that wiring and connections are tight and free from corrosion. Defects in control switches slow down the operation and endanger the life of personnel. Make sure that the controls receive a thorough inspection.

The contactor panel should be checked for proper sequencing of operation. Forward and reverse traction motor contactors should be tested for correct series-parallel operation. Make sure that mercury tubes are working properly and are of the same delay for each motor. Each contactor, single and double, should receive an individual inspection. This would include checking the wiring and connections for tightness and corrosion. Contacts should be checked for wear, also for burned and pitted places. Examine shunts for tightness and corrosion. Overload relays should be tested for proper operation and rating. The general condition of the panel should be checked for the presence of dust and moisture. Keep the panel clean and dry.

There are approximately 300 ft. of 2- and 6-conductor trees of various wire sizes in a shuttle car. Make sure that the wiring is in good condition. Also, check to see that wiring is in a safe place so as not to get damaged. Junction boxes, which serve to distribute wiring, should be examined, paying close attention to connections and insulation.

Trailing cable and cable-reel collector rings should be looked at frequently. Make sure that the cable has a fused nip with a properly rated fuse. Count the number of splices in the cable and examine their condition. A cable should not have more than six to eight splices to maintain proper voltage at the motor terminals. The end connection of the cable should be made so that it will not be pulled out of the reel in the event all of the cable is unspooled The collector rings should be inspected once a month for worn rings, faulty insulation and loose connections.

Shuttle cars should have lights at all times. Inspect the resistance and connections for faulty condition. Use a voltmeter to check the voltage being supplied to the light bulbs. Check bulbs and light sockets.

Mechanical Inspection—Mechanical inspection includes the following:

- Wheels
- Steering
- Cable reel
- Speed reducer
- Universal drive shafts
- Front axle and trunnion assembly
- Conveyor chain, drive and takeup shaft

Rims, tires and valves should be checked for damage which could result in a flat tire. Lug bolts and nuts should be tested for tightness. Lug nuts should be adjusted equally so that wheels will be mounted straight. Wheels mounted crooked will "wobble" causing damage to the wheel units and tires.

Shuttle-car tires should be inspected daily. See that they have sufficient air pressure and look for damage. Change those found to be bad.

Steering control segment and bevel pinion should be examined for proper mesh and condition of teeth. Close checks of the linkage, including drag-links, cross shaft, steering arms and segments, are of the utmost importance. Keep the steering mechanism in top operating condition for maximum performance and safety.

Cable reel sprockets of the drive and spooling device should be checked for wear. Look for worn and broken parts in the drive chains. See that the spooling device is aligned and operating properly. Examine all cable guides and sheaves. These aids to cable spooling prolong the life of the cable. Keep them in good condition.

Speed reducer and wheel drive units should be inspected for worn and loose bearings. Don't fail to check worms and gears for excessive wear whenever possible. Oil seals and gaskets are important. See that they receive close attention. Guard against oil leaks. Overheating and any unusual noise can indicate trouble. Check. Keep all bolts and nuts tight.

Universal drive shafts and couplings should be examined frequently. Make sure that all bolts and nuts are tight. Examine the couplings for wear. Frequent inspections of the couplings will help to prevent downtime.

Large capacity mine cars in use today require scheduled maintenance, such as proper lubrication and frequent inspections.

For a good inspection of the front axle and trunnion assembly, drive the shuttle car to a place that will permit getting under the car. The pivot axle bushings, spacers and front axle pins should be tested for slack and worn parts. The axle-brace assembly bolts should be checked for tightness. Pins, bushing, and spacers of the axle brace should also be examined.

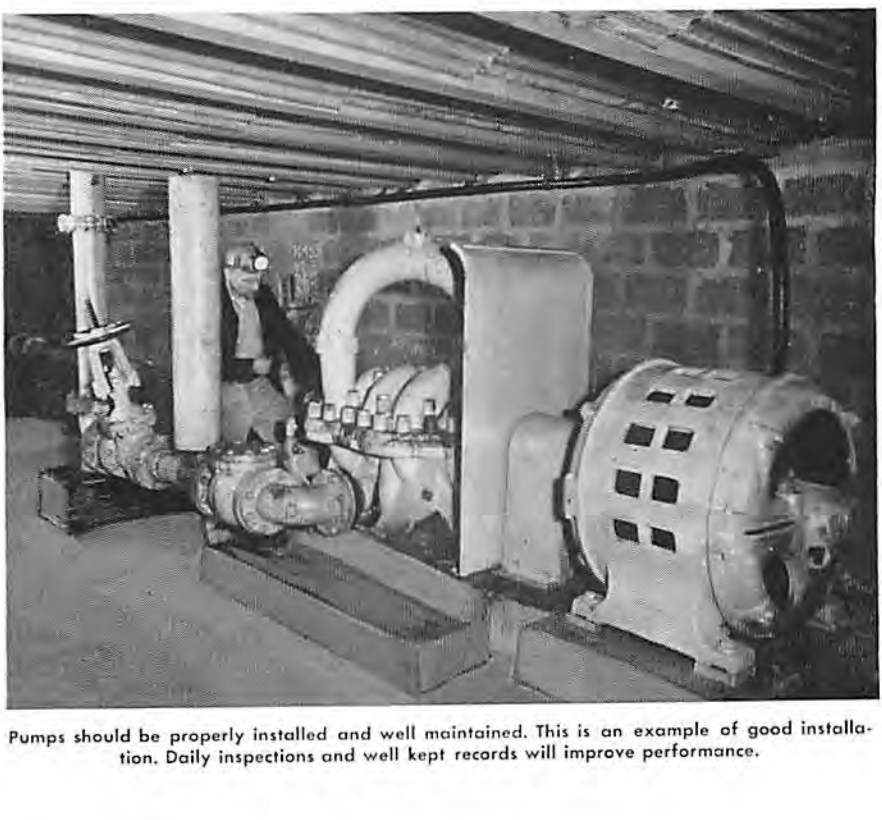
Proper alignment of the conveyor drive and takeup shaft should be checked. Examine bearings and sprockets for wear. Look for bent, broken and missing flights in the chain. See that there are no missing cotter pins and that rollers and connecting links are in good condition.

Hydraulic Inspection—Hydraulic connections should be checked frequently for leaks. Hose condition and location are important. Hydraulic hose that has been damaged or become rotten over a period of time results in equipment delays. Any hose that looks as if it might give trouble in the near future should be changed. See that hoses are located in safe places so that they won't be damaged. The storage tank should be covered at all times and the oil filter port screened to prevent foreign matter from entering the tank. The filter of the suction port should be cleaned frequently.

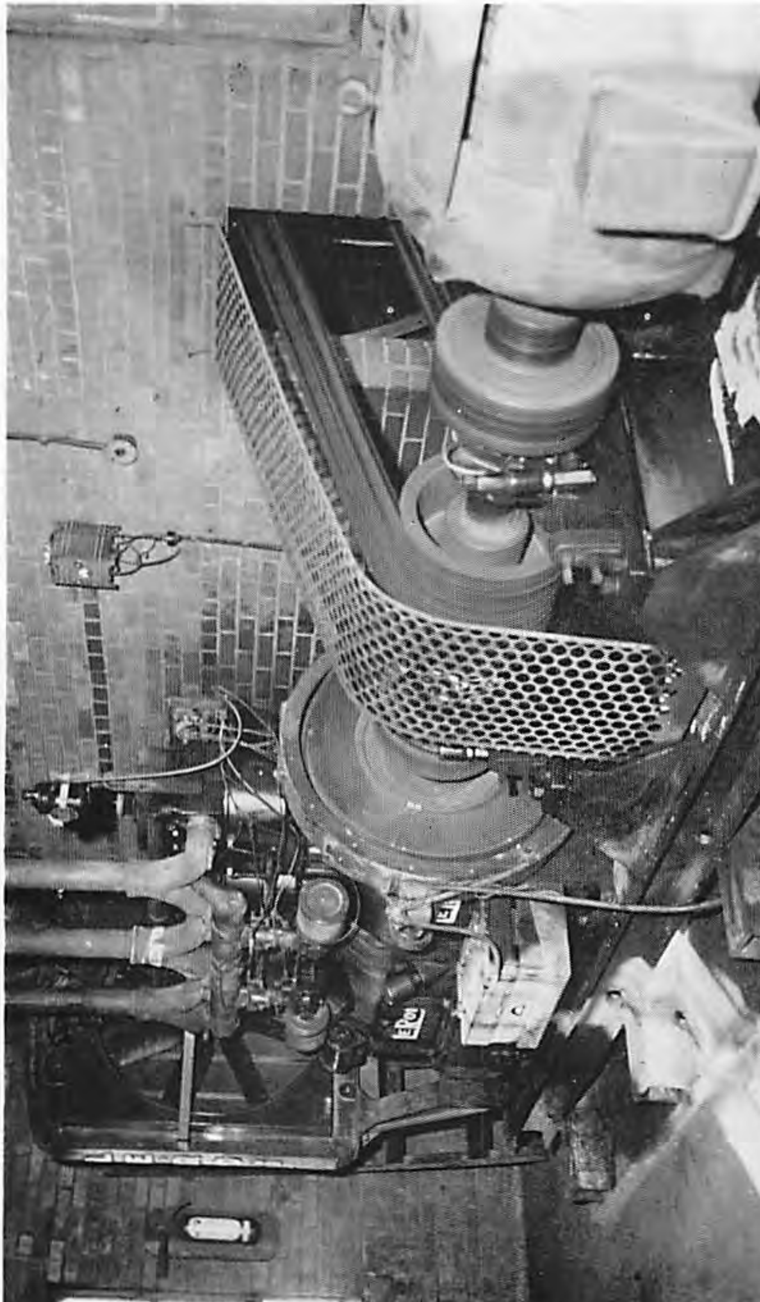
If oil forms in the tank check for leaks that would permit air to enter the system. A bad pump seal, gasket or hose can cause foaming. Steering and boom jacks often develop leaks. A close look will determine if repairs are needed. Take a reading of the output pressure of the hydraulic pump using a gauge to see if the pressure is sufficient. Check the relief valve for proper setting. The high and low torque of the cable-reel control valve should be tested. Proper settings are approximately 450 and 150 psi, respectively. Be sure that all control valves are checked for proper operation.

Lubrication—Comply with manufacturer's lubrication recommendations. Check to see that the correct grade of oil is being used in the speed reducers and wheel units. Make sure that they are not overoiled. The zone lubrication system of the car involves checking all grease hoses and fittings. See that all moving parts are being greased properly. Make sure that the hydraulic oil tank is full. Check lubrication record to see if motor bearings are being greased regularly.

Belt-Conveyor Maintenance—Belt conveyors do not require a great deal of maintenance. However, periodic inspections should be made



Pumps should be properly installed and well maintained. This is an example of good installation. Daily inspections and well kept records will improve performance.



Auxiliary drive units for fans are important. Installations equipped with auxiliaries insure continued fan operation when electric failures occur.

to insure proper operation. Inspection should include the following:

- Motor
- Speed reducer
- Controls
- Belt
- Rollers
- Lubrication

Use a hook-on-type ammeter to determine the motor load. Compare the load with the nameplate rating. If the load is excessive take necessary steps to correct it. Be sure to inspect the motor as outlined previously. The motor coupling should be checked to determine its condition and for proper alignment of the motor and speed reducer.

The speed reducer worm and gear should be checked. Note any excessive wear. Design of reducers may not always permit examining gears. If this is the case, check the amount of takeup-slack in the gears, excessive metal cuttings in the oil and any unusual sounds produced by the reducer. Any of these will indicate possible gear trouble. The sprockets, drive chain and drive-gears of the unit should be checked for wear. Examine the drive chain for proper alignment and tension. Correct alignment and proper mesh of the drive-gears are important. Check.

Various types of controls are employed in operating belt conveyors. Regardless of the type the aims are the same, that is, to start, stop and reverse the belt when necessary. Starters are designed to furnish, through resistance, the proper rate of acceleration for motors. This is accomplished by using a manual controller or an automatic starter. In either case, make sure that the sequence of acceleration is maintained. Detailed inspections of the starting device should be made frequently. On each inspection look for faulty contacts, wiring and connections. Check the resistance to make sure that it is in good condition. Prevent dust and moisture from accumulating in the starter or controller.

Belts should be examined for wear, cuts and breaks. Mechanical splices should be checked and renewed when signs of weakening are evident. Most important in belt maintenance is to see that the belt runs straight. When a belt is found to run crooked every effort should be made to correct it. Make sure that the belt does not run in water. Check all places that water might accumulate. Keep water from dripping on belt. See that belts are not exposed to heat. If belts operate outside make sure that they are protected from the weather.

Belt rollers should be checked frequently. Free-turning rollers will prevent wear and reduce power cost. Don't allow coal to gather around the rollers.

Proper lubrication of rollers will eliminate many belt troubles. Check lubrication records to make sure that rollers are greased regularly. Grease is harmful to belts and over-greasing should be avoided. Over-greasing can destroy the grease seals allowing dust to enter the bearings and resulting in failure.

Chain-Conveyor Inspection — Chain conveyor inspections are similar, in some respects, to those for belts. The motor and speed reducer, should be checked in the same manner.

Chain conveyors usually will not

operate efficiently at a length of more than 300 ft. If the conveyor exceeds this length make arrangements for tandem operation. Chain trouble will be at a minimum if this rule is followed. All pans should be examined for worn, bent and torn places. Replace any that are likely to cause trouble. Chains should be checked for bent and missing cotter pins. Flights should be equally spaced. Minimize sagging and keep pan lines straight.

Lubrication inspection should consist of checking the motor records to determine if the bearings are greased regularly. The speed reducer should be checked for correct grade and proper oil level. Drive- and tail-shaft bearings also should be checked to see that they are greased regularly.

Track Haulage Equipment

Locomotives — Thorough inspection of a locomotive can best be performed by placing it over the motor pit and removing all guards and covers. This will save time and the inspection can be carried out without interruptions.

The inspection should include all electrical and mechanical items and lubrication.

A check-list is the best means of making sure that all parts are checked. This list should include space for remarks.

Repairs and inspections should be performed during the off-shift. It is not necessary to check all parts at each inspection. Certain parts should be checked weekly, others monthly.

The inspection record, as shown in the accompanying illustration, is a time saver that will aid in making accurate electrical and mechanical inspections at regular intervals. Using this type of report and making good use of the five senses helps everyone concerned do a better job.

The best check on the lubrication of locomotives is to see that records are kept properly. The records should include the date lubricated, and the type and amount of lubricant used. See that lubrication charts are furnished for each make of locomotive.

Mine Cars — Mine car maintenance warrants careful study. Make sure that adequate facilities are available to take care of all repair work. Don't permit shop-cars to be the cause of "out-of-empty" delays that result in lost tonnage.

Survey the maintenance program. See that cars are greased at regular intervals. Make sure they are inspected periodically. Note conditions of wheels, bearings, bodies and frames.

Maintain an individual record of repairs and lubrication. This can best be accomplished by numbering each car.

Service Equipment

Rockdusters—Rockdusters should be stored in dry places when not in use. Make sure this rule is carried out. Before storing the rockdusters see that they are clean. Remove excess rockdust in hopper, on motor, in starter and blower. Cleanliness plays an important part in the maintenance of rockdusters. Keep them clean.

Motors and starters should be checked periodically. Perform the inspection as outlined previously.

Rockdusters are not used as often as most equipment. For this reason

Fan controls should be checked frequently. Pay particular attention to relay and meter settings, and contacts. Keep dust and moisture out of control panels.

the motor and starter should be protected against dampness. See that heater strips or lamps are installed to keep moisture out.

Again, the importance of cleanliness cannot be over-emphasized. The air system should be kept clean and not allowed to clog. Clogging produces a back pressure forcing rockdust into the blower. This causes excessive wear on the blower blades. A buildup of dust inside the blower can stall it. Inform operators of what can happen if it is not kept clean. Make sure that the blower is allowed to run several minutes after the hopper is empty. Check the blower and air lines frequently.

The important check points of the feeder mechanism are seals and bearings. These bearings, even though sealed, are subjected to highly abrasive dust. See that seals are in good condition. Grease bearings often.

Pumps—Keep a maintenance record on each pump. The record should include, among other things, the date and time of each inspection and the lubrication procedure. Also, note any repairs. This information can serve two purposes: (1) facilitating inspection by providing a record of previous trouble spots and (2) providing help in determining when the pump should be overhauled through a record of the amount of maintenance necessary to keep it operating.

The main points to consider when checking pumps are lubrication, packing and packing glands, and alignment.

Lubrication is the life of a pump. Care should be taken in selecting the right lubricants and in seeing that they are applied properly.

Conveniently located pumps are often over-greased. It seems that every person that passes gives them a few shots. A record posted at the pump will inform each person that the pump has been serviced.

Packing and packing-glands receive their share of abuse, too. Correct procedure for repacking a pump is to remove all the old packing and replace it with new. Usually new packing is just added to the old. Eliminate this practice. Make sure that all concerned know the correct way to repack a pump.

Check the packing and packing-gland adjustment to determine their condition. If the adjustment is out and the packing is leaking excessively, have the packing replaced.

Make sure that pump and motor alignment is correct. The suction and discharge lines also should be connected without stress or strain.

Further checking should include examining the suction line for leaks. Make sure that each line contains a foot valve or strainer.

Certain type pumps are equipped with an external clear liquid lubricating system. See that liquid flows freely. Check the lines for clogging.

Fans — Inspect fans frequently. Once a day is not too often. Actually, fans require very little maintenance. Starters, motors, and fan bearings should be checked. In most cases minor repairs will keep them in good operating condition.

Be sure that recommended repairs are made quickly. Double check to make sure repairs have been made.

CONSTITUTION AND BY-LAWS

Adopted June 24, 1913
Amended Nov. 12, 1926
Amended Nov. 8, 1929
Amended Nov. 8, 1935
Amended Oct. 21, 1938

ARTICLE I.

NAME AND PURPOSE.

The Illinois Mining Institute has for its object the advancement of the mining industry by encouraging and promoting the study and investigation of mining problems, by encouraging education in practical and scientific mining, and by diffusing information in regard to mining that would be of benefit to its members.

ARTICLE II.

MEMBERSHIP.

Section 1. Any person directly engaged or interested in any branch of mining, mining supplies, mining appliances, or mining machinery may become an active member of the Institute. Any person desiring to become a member of the Institute shall fill out a blank for that purpose, giving his name, residence, age, and occupation. This application shall be accompanied by one year's dues of $3.00. Each application for membership shall be submitted to the Executive Board, who shall make an investigation as to the qualifications of the applicant, and shall be authorized to elect to membership and issue a certificate of membership to such applicant subject to the ratification of the next regular meeting of the Institute.

Section 2. Any person of distinction in mining may be elected an honorary member of the Institute by two-thirds vote of the members present at any regular meeting. Any member who has been an active member of the Institute and shall have retired from active business in mining may become an honorary member.

Section 3. The annual dues for active members shall be $3.00 and any person in arrears on August 1, of the current year, after having been sent two notifications of dues, shall be dropped from membership. Members in arrears for dues will not receive the printed proceedings of the Institute.

Section 4. Any active member may become a life member by the payment of $50.00 and shall be exempt from further payment of dues during his lifetime.

ARTICLE III.

OFFICERS.

Section 1. The officers shall consist of a President, Vice-President, Secretary-Treasurer and twelve Executive Board members. The services of all officers shall be without compensation.

Section 2. Nominations for officers and the executive board shall be made by nominating committee of three (3) appointed by the Presiident at least thirty days before the annual November meeting, provided that anyone can be nominated on the floor of the meeting for any office for which an election is being held.

Section 3. The President, Vice-President and Secretary-Treasurer shall be elected by ballot, annually, at the regular November meeting and shall hold office for the ensuing year.

Four Executive Board members shall be elected by ballot, annually, at the regular November meeting and shall hold office for the ensuing three years.

To make effective this change, at the regular November meeting in 1938, in addition to the four Executive Board members who shall be elected for the three year term, there shall also be elected by ballot eight other Executive Board members, four for a two year term and four for a one year term.

Section 4. In case of death, resignation, or expulsion of any officer, the executive board may fill the vacancy by appointment until the next regular meeting, when the vacancy shall be filled by regular election. In case of a vacancy in the office of president, the duties shall devolve upon the vice-president.

Section 5. The executive board shall consist of the officers and twelve other board members.

ARTICLE IV.

Duties of Officers.

Section 1. The president shall perform the duties commonly performed by the presiding officer and chairman. He shall, with the executive board, exercise a general supervision over the affairs of the Institute between sessions.

Section 2. The vice-president shall preside in the absence of the president and perform all the duties of the president in his absence.

Section 3. The secretary-treasurer shall keep a record of each meeting, shall read and file all resolutions and papers that come before the Institute, sign all orders for money, and shall purchase necessary supplies.

He shall keep a true record of all money received by him and payments made on account of the Institute. He shall pay out no money except on an order signed by himself, and shall retain these orders as vouchers. He shall give bond in such sum as the Institute may provide, the premium on said bond being paid by the Institute.

He shall act as editor-in-chief for the Institute and may furnish the newspapers and other periodicals such accounts of our transactions and discussions as are proper to be published. His own judgment is to prevail in such matters unless objection is lodged at a regular meeting or by the executive board.

The retiring president shall act ex-officio in any capacity for the ensuing year.

Section 4. The president shall appoint an auditing committee annually to audit the accounts of the secretary-treasurer, and said audit shall be submitted to the November meeting of the Institute.

Section 5. The Executive Board shall perform the duties specifically prescribed by this constitution; it shall supervise the expenditures and disbursements of all money of the Institute, and no expenditure other than current expenses shall be authorized without first having the approval of the Executive Committee; it shall act as program committee for each meeting to determine what is to be published in the proceedings and shall perform such other duties as may be referred to them by regular or special meeting of the Institute.

ARTICLE V.

MEETINGS.

Section 1. Regular meetings shall be held in June and November of each year and on such days and in such places as may be determined by the executive board of the Institute. Notice of all meetings shall be given at least thirty days in advance of such meetings.

Section 2. Meetings of the executive board shall be held on the call of the president, or at the request of three members of the executive board, the president shall call a meeting of the board.

ARTICLE VI.

AMENDMENTS.

Section 1. This Constitution may be altered or amended at any regularly called meeting by a majority vote of the members present, provided notice in writing has been given at a previous semi-annual meeting of said proposed change of amendment.

ARTICLE VII.

ORDER OF BUSINESS.

At all meetings, the following shall be the order of business:

(1) Reading of minutes.
(2) Report of executive board.
(3) Report of officers.
(4) Report of committees.
(5) Election of new members.
(6) Unfinished business.
(7) New business.
(8) Election of officers.
(9) Program.
(10) Adjournment.

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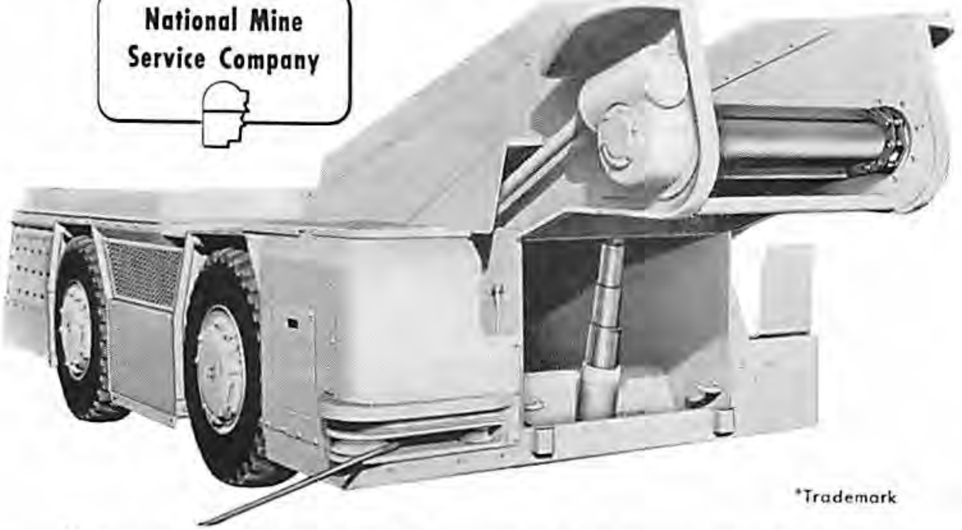

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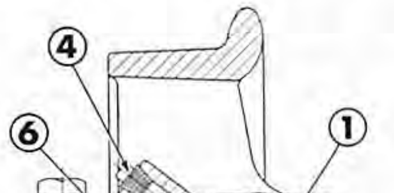

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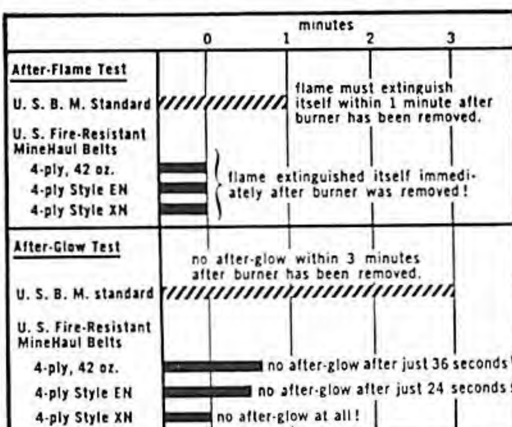

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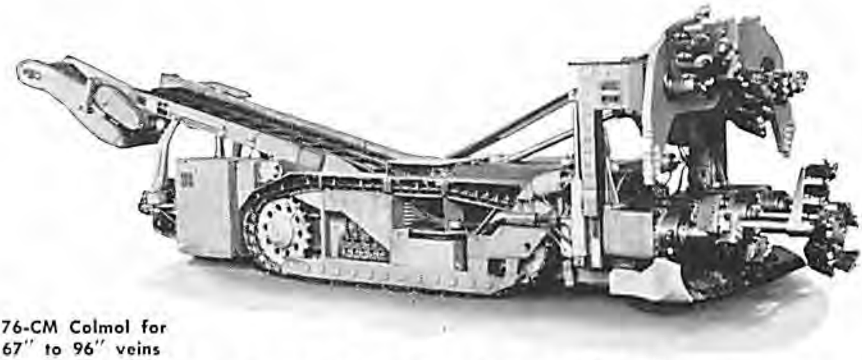

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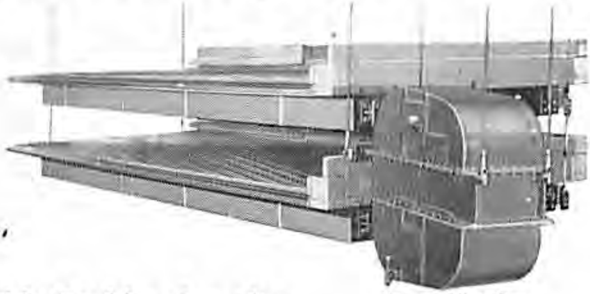

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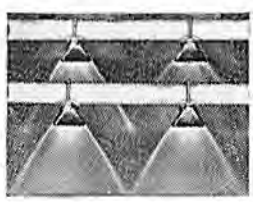

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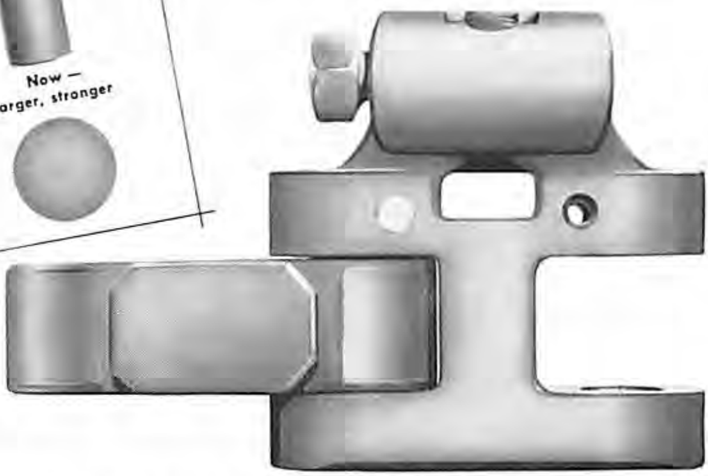

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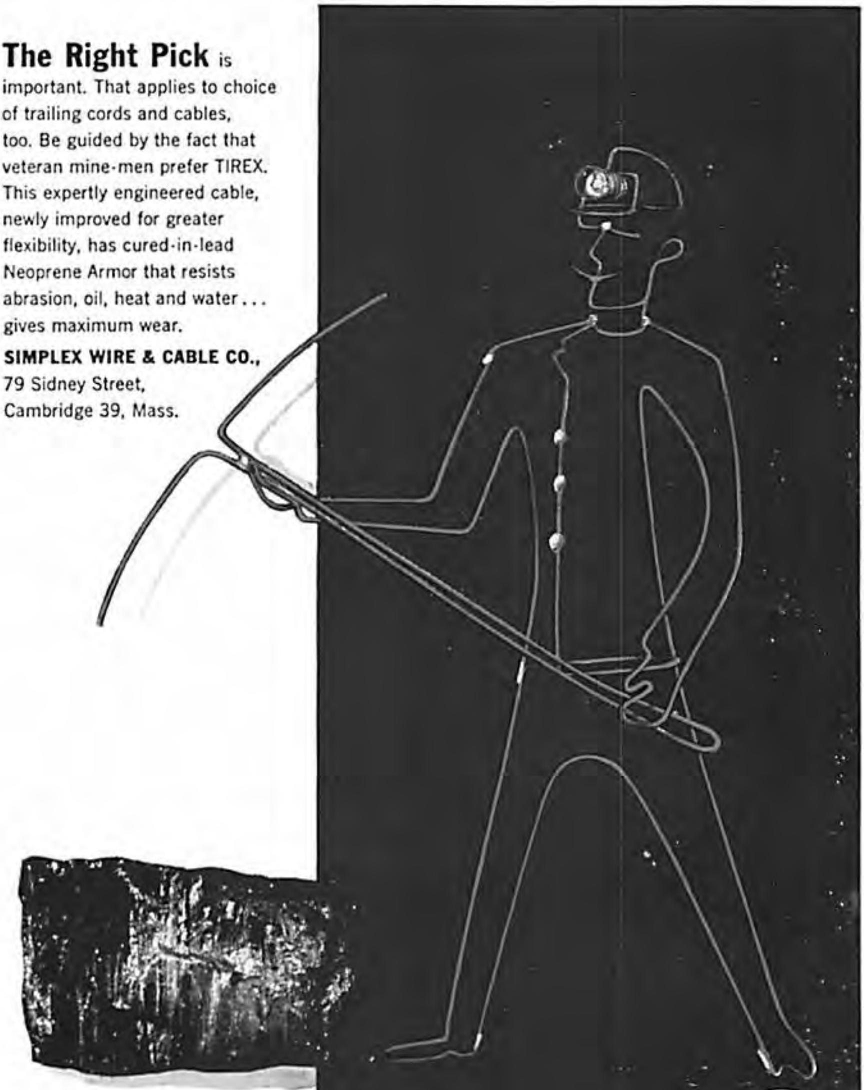

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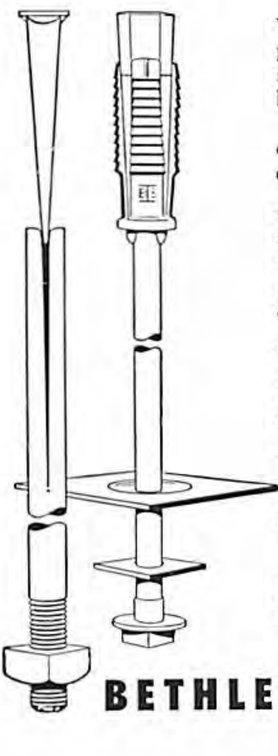


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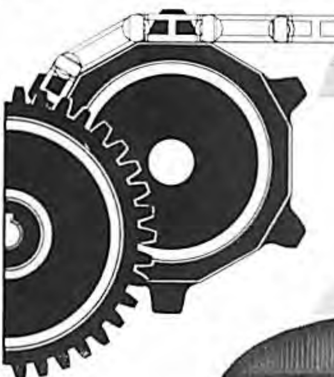

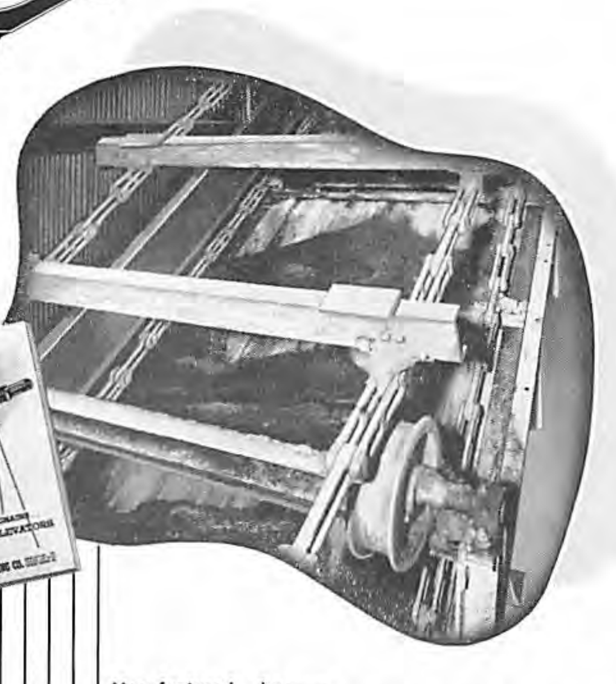

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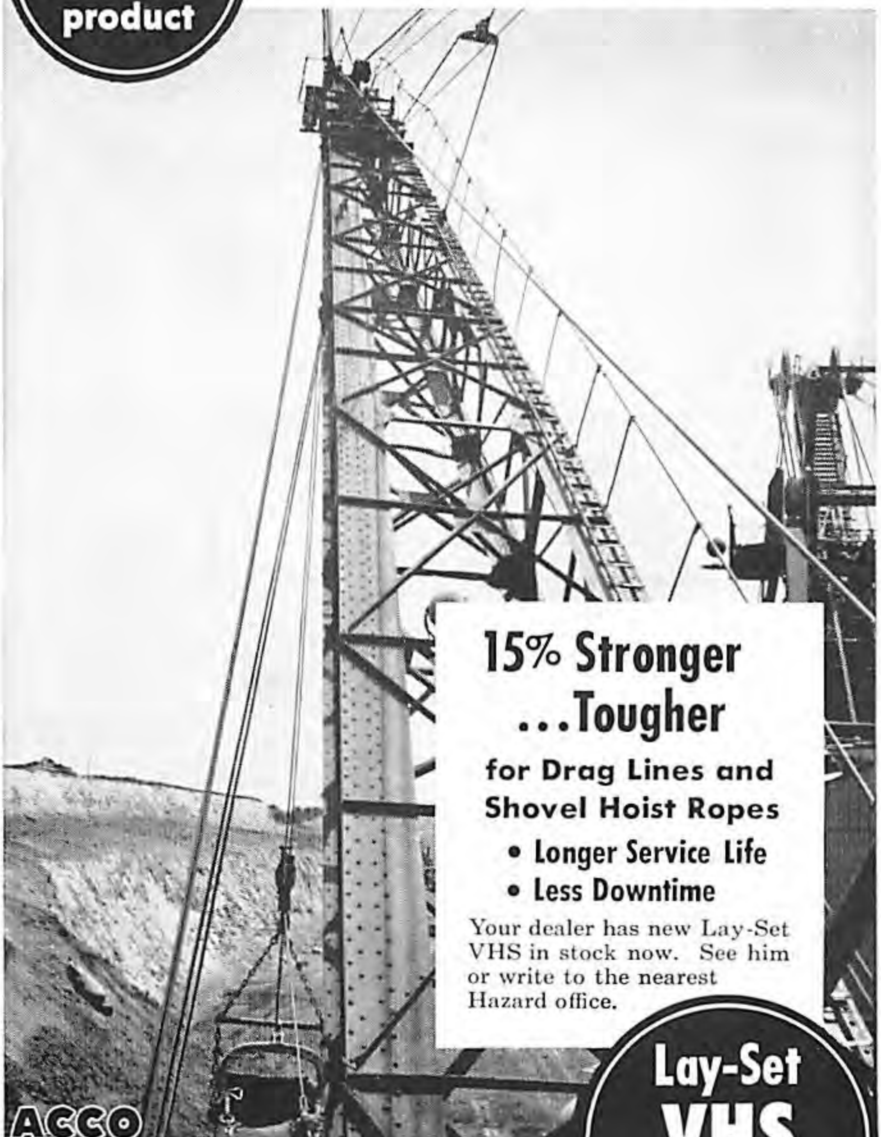

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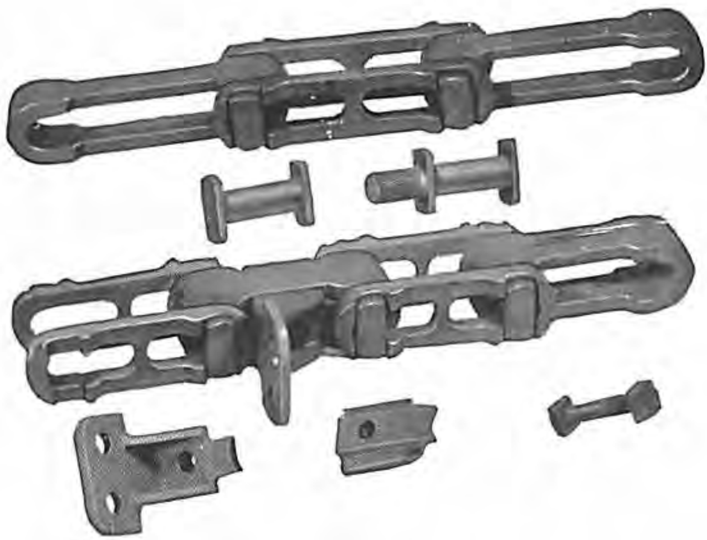

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