PROCEEDINGS
OF THE
ILLINOIS MINING INSTITUTE

Frank H. Reed.

FOUNDED FEBRUARY 1892

1932

THE GEO. D. LOUDEN PRINTING CO.
Champaign, Illinois

PROCEEDINGS

of the

ILLINOIS MINING INSTITUTE

Founded February 1892

1932

Summer Meeting
on Board S. S. Cape Girardeau
June 10-11-12

and

Annual Meeting
DANVILLE, ILLINOIS
November 4

George C. McFadden

President, 1932

OFFICERS 1932

PRESIDENT

GEO. C. MCFADDEN
Chicago, Ill.

VICE-PRESIDENT

CHAS. F. HAMILTON
Chicago, Ill.

SECRETARY-TREASURER

B. E. SCHONTHAL
59 East Van Buren Street
Chicago, Ill.

EXECUTIVE BOARD

GEO. F. CAMPBELL
G. S. JENKINS
E. H. JOHNSON
HARRY MOSES
JOHN G. MILLHOUSE
F. S. PFAHLER
C. J. SANDOE
H. H. TAYLOR, JR.
T. J. THOMAS
H. A. TREADWELL
PAUL WEIR
JOS. D. ZOOK

OFFICERS 1933

PRESIDENT

CHARLES F. HAMILTON
Chicago, Ill.

VICE-PRESIDENT

H. A. TREADWELL
Benton, Ill.

SECRETARY-TREASURER

B. E. SCHONTHAL
59 East Van Buren Street
Chicago, Ill.

EXECUTIVE BOARD

GEO. F. CAMPBELL
PAUL HALBERSLEBEN
E. H. JOHNSON
GEO. C. MCFADDEN
JOHN G. MILLHOUSE
FRED S. PFAHLER
DAVID I. ROCK
C. J. SANDOE
JOHN W. STEDELIN
H. H. TAYLOR, JR.
T. J. THOMAS
PAUL WEIR

PAST PRESIDENTS OF ILLINOIS MINING INSTITUTE

FOUNDED FEBRUARY 1892.

1892-3	JAMES C. SIMPSON, Gen. Mgr., Consolidated Coal Co., St. Louis, Mo.
1893-4	JAMES C. SIMPSON, Gen. Mgr., Consolidated Coal Co., St. Louis, Mo.
1894-5	WALTER RUTLEDGE, State Mine Inspector, Alton, Ill.
1895 } 1911 }	Institute inactive.
1912-3	JOHN P. REESE, Gen. Supt., Superior Coal Co., Gillespie, Ill.
1913-4	THOMAS MOSES, Supt., Bunsen Coal Co., Georgetown, Ill.
1914-5	J. W. STARKS, State Mine Inspector, Georgetown, Ill.
1915-6	WILLIAM BURTON, V. P., Illinois Miners, Springfield, Ill.
1916-7	FRED S. PFAHLER, Gen. Supt., Superior Coal Co., Gillespie, Ill.
1917-8	PATRICK HOGAN, State Mine Inspector, Carbon, Ill.
1918-9	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, Litchfield, 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' Association, Chicago, Ill.
1931-32	GEO. C. MCFADDEN, Asst. Vice-Pres., Peabody Coal Co., Chicago, Ill.

THE I. M. I.

We Are Indebted to Our Institute Poet and Loyal Member
J. A. Jefferis, for the Following—

In eighteen hundred ninety-two, in the State of Illinois,
A group of prominent mining men, who thought they could employ
A method of mining, more safe and sane, with a death rate not so high,
Met together, in a common cause, and founded the I. M. I.

They also thought the time had come when improvements could be made
To increase the output of their mines, which was their stock in trade.
The "camel back" or "Puncher," was their last word in machines,
And the rigid cage, they also used, with the diamond bar for screens.

They had some expert miners then, who could cut an even rib
With hand drill and black powder, fired by the lowly squib.
The one ton cars were large enough for any man to pull,
Or push out of his place again, when the box was loaded full.

The mule was quite a factor, and each "skinner" had his pet,
They had no way to speed him up or he might have been there yet.
The breast machine and the carbide lamp, which turned night into day,
Are not all gone, by any means, but they're surely on the way.

So many changes have been made since the days of ninety-two,
"Old Timer" would be paralyzed to see what we can do
With loaders and conveyors and our great electric power,
For the coal they hoisted in a day, we hoist within an hour.

It's true the mines have prospered and the men don't live the same
As they did a few short years ago, before the unions came.
They do not have the hardships they had in days of yore,
And with First Aid Teams, and other schemes, their death rate is much lower.

The equipment we are using now, and consider so complete,
No doubt, within a few short years, will be quite obsolete.
The same is true in life, my friends, ere long our work is through,
And we're pushed aside for younger men to show what they can do.

If the founders of this Institute could be with us and see
Their work was being carried on, as they thought it ought to be,
I'm sure they'd be quite happy that we never let it die,
And feel real proud, of the present crowd, in the grand old I. M. I.

"JEFF."
G. F. A., Ill. Term. R. R.,
June 11th, 1932.

CONTENTS

SUMMER MEETING AND BOAT TRIP

June 5, 1931

Annual Summer Meeting and Boat Trip of the Illinois Mining Institute held on S. S. Cape Girardeau, leaving St. Louis Friday, June 10, 1932, at 10:30 P. M., and returning to St. Louis Sunday, June 12, 1932, at 8:30 A. M.

The meeting was called to order on Saturday morning, June 11, by President George C. McFadden. There was a total of ninety members and guests on board.

G. C. McFadden: I am most happy to have the privilege of extending to old and new members of the Illinois Mining Institute and their guests a happy welcome. Our boat trip is an event to which all look forward with great interest, because it is the meeting of the year when we mix pleasure with work and apparently accomplish much with ease.

I will now ask the secretary to call the roll.

ATTENDANCE

ILLINOIS MINING INSTITUTE—BOAT TRIP

St. Louis to Beardstown and Return—June 10-11-12, 1932

ADAMS, W. C.....Koppers Rheolaveur Co., Pittsburgh, Pa.
ANDERSON, J. S.....Madison Coal Corp., Edwardsville, Ill.
ARGUST, W. C.....Peabody Coal Co., Taylorville, Ill.
AUSTIN, WM. .....Hercules Powder Co., Chicago, Ill.
ABRELL, JOHN.....Peabody Coal Co. Kincaid, Ill.
BARTLETT, A. G.....Burton Exposives Co., W. Frankfort, Ill.
BELTZ, JOHN S.....Jeffrey Mfg. Co., Columbus, Ohio
BIGGER, I. S.....Vacuum Oil Co., Cape Girardeau, Mo.
BLAKE, ARTHUR.....Peabody Coal Co., Marion, Ill.
BOWIE, ROBT.....Consolidated Coal Co., Herrin, Ill.
BREWSTER, B. B.....Consulting Mining Engr., Webster Groves, Mo.
BERGER, E. L.....Bell & Zoller Coal Co., Zeigler, Ill.
CAHILL, EDW.....Commissioner Coal Opers., Duquoin, Ill.
CHRIST, ROBT. J.....Peabody Coal Co., Springfield, Ill.
CHRISTIANSON, C.....Sullivan Machinery Co., Mt. Vernon, Ill.
CLARK, FRED K.....Hulburt Oil & Grease Co., Webster Groves, Mo.
CONWAY, JAS.....Consolidated Coal Co. of St. L., Mt. Olive, Ill.
COX, R. L.....Jeffrey Mfg. Co., Columbus, Ohio
CRAVENS, A.....Consolidated Coal Co. of St. L., Mt. Olive, Ill.
CHRISTIANSON, N.....Safety Mining Co., Chicago, Ill.
CARTER, DALE.....Bell Zoller Coal Co., Zeigler, Ill.
CAPE, SAM.....O'Gara Coal Co., Harrisburg, Ill.
DAKE, WALTER.....Joy Mfg. Co., Franklin, Pa.
ENGLISH, THOS.....State Inspection Dept., Springfield, Ill.
FLYNN, ED.....State Inspection Dept., Duquoin, Ill.
FENTON, J. R.....J. K. Dering Coal Co., Chicago, Ill.
FIRMIN, W. H.....Joyce-Watkins Co., Metropolis, Ill.

GARCIA, JOHN A.....Allen & Garcia Co., Chicago, Ill.
GREENE, D. W.....West Virginia Coal Co., O'Fallon, Ill.
HALBERSLEBEN, P. .....O'Gara Coal Co., Harrisburg, Ill.
HALL, GEO.....State Inspection Dept., Springfield, Ill.
HAMILTON, C. F.....Pyramid Coal Co., Chicago, Ill.
HARDY, WM.....Peabody Coal Co., Taylorville, Ill.
HARVEY, HADLEY.....Ohio Brass Co., Evansville, Ind.
HASKINS, LEE.....Bell & Zoller Coal Co., Zeigler, Ill.
HARTWELL, LEN.....Pyramid Coal Co., Pinckneyville, Ill.
JEFFERIS, J. A.....Illinois Terminal R. R. System, St. Louis, Mo.
JENKINS, G. S.....Consolidated Coal Co., St. Louis, Mo.
JENKINS, S. T.....Goodman Mfg. Co., St. Louis, Mo.
JOHNSON, E. H.....Safety Mining Co., Chicago, Ill.
JONES, JOHN E.....Old Ben Coal Corp., W. Frankfort, Ill.
JONES, BOB.....State Chamber Commerce, Springfield, Ill.
KLEIN, GEO.....Klein Armature Co., Centralia, Ill.
KNOIZEN, A. S.....Joy Mfg. Co., Franklin, Pa.
LEIGHTON, M. M.....State Geological Survey, Urbana, Ill.
LEMING, ED.....Union Colliery Co., Dowell, Ill.
LONG, J. A.....Jeffrey Mfg. Co., Terre Haute, Ind.
LOTT, GEO. M.....Jeffrey Mfg. Co., Chicago, Ill.
LINDSAY, GEO.....J. K. Dering Coal Co., Eldorado, Ill.
MALSBERGER, A. H.....Dupont Powder Co., Springfield, Ill.
MANCHA, RAYMOND.....Goodman Mfg. Co., Chicago, Ill.
MARBLE, G. E.....General Electric Co., Chicago, Ill.
MARSHALL, HARRY.....State Inspection Dept., Springfield, Ill.
MILLER, ALEX. U.....Bureau of Mines, Vincennes, Ind.
MILLHOUSE, J. G.....State Director of Mines, Springfield, Ill.
MOSES, HARRY.....U. S. Fuel Co., Georgetown, Ill.
MILLER, FRED.....Franklin County Coal Co., Herrin, Ill.
McFADDEN, GEO.....Peabody Coal Co., Chicago, Ill.
McFADDEN, NAT.....Peabody Coal Co., Taylorville, Ill.
McELHATTAN, D. F.....Peabody Coal Co., Duquoin, Ill.
O'BRIEN, EUGENE.....Pillsbury Flour Co., St. Louis, Mo.
OHLE, JOHN.....Franklin Hotel, Benton, Ill.
OLDHAM, R. J.....Centralia Coal Co., Centralia, Ill.
PATRICK, R. M.....Atlas Car & Mfg. Co., St. Louis, Mo.
PFAHLER, FRED S.....Superior Coal Co., Gillespie, Ill.
PICKARD, A. E.....Mt. Vernon Car Co., Mt. Vernon, Ill.
POWERS, F. A.....Dooley Brothers, Peoria, Ill.
REED, FRANK H.....State Geological Survey, Urbana, Ill.
RHINE, FRANK.....Duncan Fdry. & Mach. Co., Alton, Ill.
RODENBUSH, JOHN.....C. W. & F. Coal Co., W. Frankfort, Ill.
SANDOE, C. J.....West Virginia Coal Co., St. Louis, Mo.
SCHONTHAL, B. E.....West Virginia Rail Co., Chicago, Ill.
SCHONTHAL, JOS.....B. E. Schonthal & Co., Inc., Chicago, Ill.
SCHULL, FRANK.....Binkley Mining Co., Clinton, Ind.
SMITH, C. M.....University of Illinois, Urbana, Ill.
STARKS, J. W.....Peabody Coal Co., Taylorville, Ill.

STEIGER, A. E.....Pyramid Coal Co., Pinckneyville, Ill.
STINTON, W. S.....Vacuum Oil Co., University City, Mo.
SUTOR, DON M.....Sullivan Machinery Co., St. Louis, Mo.
THOMAS, JEFF.....Western Powder Co., Peoria, Ill.
THOMPSON, DEAN.....College of Commerce, U. of I., Urbana, Ill.
TIRRE, FRANK.....Better Business Bureau, St. Louis, Mo.
VLASAK, JOS.....St. Louis & O'Fallon Coal Co., East St. Louis, Ill.
WALSH, H. T.....Sullivan Machinery Co., Chicago, Ill.
WEART, E. T.....John A. Roeblings' Sons Co., Chicago, Ill.
WEIR, PAUL.....Bell & Zoller Coal Co., Centralia, Ill.
WILCOX, D. D.....Superior Coal Co., Gillespie, Ill.
WHITE, JOHN.....State Inspection Dept., Collinsville, Ill.
YOUNG, WM.....Crescent Mining Co., Peoria, Ill.

G. C. McFadden: At this time I desire to appoint a committee to draft a fitting tribute to the memory of our good friend and past President J. D. Zook, and I will appoint Mr. Paul Weir, Mr. John Garcia, Dr. Leighton and Mr. J. E. Jones as that committee, and I will ask them to read their report to the afternoon session.

The Program Committee has prepared for you papers on the subjects that deal to a certain extent with safety, as we all know the strongest aim of the Illinois Mining Institute is in safety. The mining laws of Illinois have as much to do with safety, as all the changes in the system and method of mining, as it applies in Illinois. We are in about the same position today as we would be with the traffic laws of twenty years ago had no changes been made to keep step with improved traffic conditions. Your Program Committee has felt that this is an opportune time to set forth and obtain in the discussions on this subject what changes should be made in the mining law to keep pace with our many changes.

I now have the honor of turning over the morning session to Mr. Sandoe.

Mr. Sandoe: I don't know of any question that requires more consideration at this time than the Illinois Mining Law. With our new methods of mining we are continually meeting conditions that require quite a few changes in our mining law. I know of no one better qualified than J. W. Starks to set forth the needed changes in this law.

J. W. Starks: I have tried to make this paper as short as possible, and I have left most of the things unsaid. The Illinois mining laws are the same as in any other state and if thought of as to their meeting present conditions you could kick the whole thing overboard.

MINING LAWS OF ILLINOIS AND OTHER STATES

By J. W. STARKS

Supt., Peabody Coal Company
Langleyville, Illinois.

Laws are rules of action laid down or prescribed by authority, the principles deduced from practice or observation. Specific laws are enacted in States to govern those participating in the different industries, hence State Mining Laws.

Mining Laws of Illinois are enacted in the General Assembly and are in relation to coal mines and subjects relating thereto, and providing for the health and safety of persons employed therein. Our multitude of laws of today are the efforts resulting from General Assemblies for a period of about three quarters of a century, and in a sense resemble the small building of that early date to which has been added a bewildering number of sheds as conditions changed during ensuing years. But few of our Legislators possess practical knowledge of mining and therefore are at a loss to readily determine what may be a good law or a bad law, and are often swayed in action by some fluent lobbyist, such as has displayed a force of considerable numbers at the State Capitol during the last two sessions of the General Assembly.

The General Assembly has created a commission known as The Mining Investigation Commission of the State of Illinois, consisting of three coal mine owners, and three coal miners appointed by the Governor, together with three qualified men, no one of whom shall be identified or affiliated with the interests of either the mine owners or dependent upon the patronage or good will of either. The Commission has power and authority to investigate the methods and conditions of mining in the State of Illinois with special reference to the safety of human lives and property and the conservation of coal deposits.

The Commission with the duty of making a report to the Governor and to the General Assembly of a proposed revision of the Mining Laws of the State, together with such other recommendations as the Commission should seem fit and proper relating to mining in the State of Illinois. A Commission of this character is of great value in assisting the General Assembly to formulate a sane and comprehensible mining code.

Coal is mined from the northern boundary of Ilinois to within a few miles of the Southern tip or a distance of 400 miles. Practically every condition encountered in mining bituminous coal in the United States exists in Illinois mines. Some Illinois mines are of the so called non-gaseous type and some of the gaseous group. Coal is mined from seams ranging from two to ten feet in thickness. Some mines are very dry and others very wet. Some of the seams mined are practically level while others are very irregular broken by faults and throws. As we have all the conditions in other coal producing states, we are interested in matters pertaining to these states and particularly in their Mining Laws as com-

pared to the Mining Laws of Illinois, as all the acts of the legislators profess to safeguard life and property.

Illinois, West Virginia, Pennsylvania and Ohio each have a Department or Division of Mines.

The duties and powers of the Chief of the Department of Mines in West Virginia, Pennsylvania, and Ohio are set forth in the Mining Laws of each State in a very concise manner, but the laws of Illinois are somewhat indefinite. There exists both a Director and a State Mining Board each charged by law to function along parallel lines. The writer prefers the West Virginia act and the wording thereof, which is as follows:

"There shall be a State Department of Mines, which shall have for its purpose the supervision of the execution and enforcement of all the laws pertaining to the inspection of mines, enacted for the safety of persons employed within or at the mines within this State and the protection of mine property used in connection therein. The Department of Mines shall be in charge of an official known as the Chief of the Department of Mines. He shall have full charge of the department and shall supervise and direct the inspection of mines as provided by law."

I believe that the State Mining Board, the Miners Examining Board and County Mine Inspectors should be abolished as all entail useless expense to the State and that all persons seeking certificates required by law be examined by a board consisting of Director and State Inspectors or a Board of Inspectors functioning under the direction of the Director.

The laws of Ohio surpass others in clearness as to procedure in case of charges of neglect of duty or incompetency and to a certain extent protects officials from random charges. Their manner of selecting the personnel of the trial board should be satisfactory.

The Illinois law requiring operators to furnish Inspectors and Recorder maps drawn to a scale of not smaller than 200 ft. to the inch should be changed. The State Inspector is not provided with an office in which to file documents of any character and the office of most County Recorders are to small for filing of small documents. The maps of many of our mines when drawn to a scale of 200 feet to the inch are as much as 14 feet in length. A map drawn on small scale or a photostatic copy of master map on sheets of standard sizes suitable for filing would serve Recorder and Inspector, provided boundary lines be clearly outlined. Extensions should be made within one month after operation ceases in a mine or any section thereof.

The words "by and through their consent only" should be stricken from paragraph (a) Section 14 relating to powers of State Mining Board pertaining to new method of mining during experimental stage. The paragraph dealing with method of firing shots has become obsolete in mechanical mines.

Paragraph (k) Section 14 Illinois Mining Law, dealing with trappers at doors, should be stricken out, and Section 45 of the Ohio Mining Law inserted. The paragraph reads as follows:

"Ventilating doors in each mine, the doors used in assisting or directing ventilation thereof shall be hung in a manner which will cause them to automatically close, and such doors shall be left closed except at such times as persons or cars are passing through them. The responsibility for having doors closed when

not in use shall rest with the person who opens them."

Paragraph (n) Section 14 should be changed to read "At all mines" as there is no sane argument that can be presented to justify the difference of classification of mines as to number of men employed. An old mine working but few men may be far more dangerous than a mine working over a hundred men.

Paragraph (b) Section 16 should be changed that employees of mine employing 10 men or less receive the same protection as men employed in larger mines as they are as liable to be squeezed if bumpers are not provided on cars. In fact, 8 per cent of all the men employed in the mines of Illinois are employed in mines which are exempted from furnishing the same protection for safety that is required by law to be furnished by operators of other mines. This inequality should be corrected as the life and health of the employee of one mine is just as valuable as to that of another mine.

The clause which reads, "In all mines where closed electric lamps are used exclusively, said mines shall be examined within four hours preceding the time the day shift goes on duty," should be stricken as the law specifies that mines generating gas in dangerous quantities, the examination of that split of air in which gas is generated shall be made within six hours preceding every day upon which the mine is to be operated. Why penalize the safer mines by enforcing an increased number of examiners. The 10 foot limit should be changed in reference to boundaries.

Section 4 of the Shot Firers act should be stricken from the Mining Law as the law is obsolete, unnecessary and unfair to Illinois Operators. The law was enacted May 20, 1905 when black blasting powder was the only agent in use in Illinois for the purpose of blasting coal. Since that time permissible explosives have been perfected for the same purpose. Both the permissible explosives and mechanical methods are used in other states while all the men are in the mine.

Section 112, Ohio Mining Law reads as follows, "At a mine where the firing of shots is restricted to specific times, no miner shall fire a shot until the time appointed for him to do so, and then only in such rotation as designated."

Section 158, Ohio Mining Law: "After each blast the miner shall exercise great care in examining the roof and coal and shall secure them safely before beginning to load coal."

Section 65, West Virginia Mining Law: "No shots shall be fired in any place known to liberate explosive gas until such place has been properly examined by a competent person who is designated for that purpose and no shots shall be fired in any place where gas is detected until such gas has been removed by means of ventilation. No person shall fire more than one shot at a time, and after firing such shot he shall not return to the working place until the smoke has cleared away, and before starting to work he shall make careful examination as to the condition of the roof, and do what is necessary to make the place safe before beginning to load coal."

Section 9, Pennsylvania Laws: "The mine foreman shall direct that coal is properly mined before it is blasted 'Properly mined' shall mean that the coal shall be undercut, center cut, top cut, or sheared by pick or machine, and in any case the undercutting shall be as deep as the holes are laid.

When the coal seam is five feet six inches or more in thickness 'properly mined' shall mean that in all entries less than ten feet wide wherein the coal is undercut, it shall also be sheared on one side as deep as the undercutting before any holes are charged and fired, or the coal shall be blasted in sections by placing the first hole near the center of the coal steam. He shall also direct that the miner set sprags as often as necessary at a distance not exceeding seven feet apart, under the breast of undermined or center cut coal for safety.

The mine foreman shall direct at what hours blasting shall be done in the mine, and a notice of the time shall be posted at a conspicuous place at the mine, and a copy of the notice shall be kept on file in the office.

Section 14, Pennsylvania Laws pertaining to Shot Firers: "In such portion of a mine where explosive gas is being generated in quantities sufficient to be detected by an approved safety lamp, and in which locked safety lamps are used, the mine foreman shall employ a sufficient number of competent persons who are able to speak the English language, to act as shot firers, whose duty shall be to charge, tamp, and fire all holes properly placed by the miners, and to refuse to charge any holes not properly placed. No holes shall be fired by any person other than a shot firer.

They shall use none but incombustible material for tamping which the mine foreman shall see is provided for them at convenient places inside the mine. Under no condition shall the shot firer use coal dust or any combustible material for tamping. All such holes shall be fired by an electric apparatus, and no other person other than the shot firer shall connect the wires of or operate said apparatus.

Each shot firer shall keep a record of and report to the mine foreman every hole that he has refused to charge, every blown out shot, and every hole that has mis-fired. It shall be the duty of shotfirers and miners who are permitted by this act to fire their own shots, to visit and examine the places where shots have been fired before leaving the mine, to see that there is no fire or any other danger existing. In all mines in which coal is blasted from the solid, all holes shall be fired when all the workmen are out of the mine except the shot firers and other persons delegated by the mine foreman to safe-guard property.

No shot firer or any other person shall fire a shot in any working place in the mine if his safety lamp can detect explosive gas at the roof. In gaseous, dusty mines in which approved locked safety lamps are used, he shall fire no holes unless the entries and rooms which are dry and dusty are so thoroughly wetted as to prevent the existence of any dry dust, for a distance of not less than eighty feet from the hole to be fired, unless the dust is rendered inert to exposibility by rock dust: Provided, however, that in all mines wherein the coal is being blasted from the solid, the mine foreman shall direct and see that the provisions of this section are fully complied with."

You will note that men are not required to be out of mine when shot firers are in the mine in any of four states excepting Illinois, or in case coal is blasted from solid. What were the conditions in Illinois when the shot firers act became a law? Rockdusting of underground workings to neutralize coal dust was unknown in the state. Of the total number of shipping mines 78.74 per cent were on hand mining

exclusively using 82.91 per cent of the powder, and producing slightly over one ton of coal for each pound of powder—black blasting powder was used exclusively.

Instead of improving and making safer shooting methods, the shot firers law was enacted and reason is outlined in Introductory of Coal Report of 1906. The introductory was written by David Ross who at that time was Secretary of the Bureau of Labor Statistics and preceding that time had been a miner and member of the General Assembly.

Here are some of the statements contained in the Introductory:

"In the powder using mines where machines are not employed, the product was 27 tons to the keg. These figures cannot be construed in any other light than a criticism, either of the qualification of the men now employed in the mines, or as a rebuke to their work methods. It requires no further inquiry to condemn any system of mining necessitating the use of powder where the actual results, as in this case, yield but a portion over one ton to every pound of powder burned. These facts, regrettable as they are, fully confirm and justify, in the interest of life, the necessity for and the wisdom of that provision of a recent law requiring that all employees shall be out of the mines during the process of blasting.

In face of such situation, the merest consideration for human welfare demands that an unskilled hand should not be permitted to touch a deadly explosive where the life of an innocent person may be involved. Under the present practice the only lives endangered are those of the shot firers. While the law leaves much to their discretion in the matter of shots that ought not to be fired, they are in many instances forced to take chances and the death roll among that class, since the new regulations become effective, indicate with what fatal results.

The provisions of the law that not to exceed a certain amount of powder shall be used in any one blast, have been persistently disregarded by careless, indifferent and incompetent men, as the person now designated as shot firer has no means of determining the quantity of powder in a blast, particularly when fuse is used, his life is in danger every time he lights a shot.

The only effective way of avoiding such contingencies, thereby saving the lives of the shot firers, is to absolutely divorce the present class of miners from all contact with powder or other explosives.

This plan contemplates the employment of a corps of practical men in each mine where coal is blasted off the solid; men specially trained in that line of work, with a thorough knowledge of the power which explosives of all kinds exert, whose duty it would be to drill, prepare and explode all blasts. This system would leave to the so called miners the work chiefly of loading coal, a task which only most of them are adapted."

I wish to add to the statement that approximately 85 per cent of the miners in Illinois at the time Mr. Ross gave the word picture of conditions were immigrants from non-coal producing European countries. But, conditions have changed. Immigration does not effect the labor in our mines. The miner of 1906 has 26 years additional experience, and there is no just reason why shooting cannot be carried out in an orderly manner through the day in the same manner as other states.

Section 118 of the Ohio Law deals with the important subject of clothes in the following manner: "Each man

working in and about a mine shall exercise discretion in wearing such clothes as will afford him protectior from injury, and offer the minimum danger from getting same caught in machinery or otherwise."

As final suggestion for added legislation granular powder and open lights should be forbidden in Illinois coal mines.

To secure a simplified and practical code it will be necessary that the Mining Investigation Commission be permitted to function without intimidation or coercion from person or persons having some personal or political reason to obstruct their efforts. The Committee on Mines in General Assembly should refrain from public hearings until such time that Investigation Commission makes a report.

A Board appointed by Governor to consist of one operator, two miners, one member of the faculty of the College of Engineering, University of Illinois, one mining engineer not connected with or employed on a salary basis by operators or miners; whose duties shall be to hear appeals that may be taken from decisions of the Department of Mines, in questions pertaining to new methods of working, application of the mining laws, or any matter pertaining to mining which is now supposed to be dealt with by the now so called State Mining Board, excepting the holding of examination for certificates of competency or qualification.

John Millhouse: The paper that has just been read, I believe is very interesting to all you men who have direct charge of mines. Mr. Starks has quoted many important needed changes, and it should receive your very serious consideration.

To begin with I believe we have about the most elaborate set of mining laws that there is in the United States. And as Director of Mines and Minerals, I believe that I am thrown more in contact with this law than any other person in the State. We all know that the law we have at the present time doesn't meet the changed conditions we have had in the past ten years.

I believe you are all familiar with the Mining Commission which we now have in this State. It is composed of nine men: three operators, three miners and three disinterested parties. This commission was formed to propose new laws, or old laws to be abolished. It has a hard and serious task to perform.

Since the new system of loading coal mechanically was introduced, there has been one serious condition brought to the attention of the Mining Department, and that is the storing of powder in the mines. We have not yet found a safe and satisfactory way of meeting this condition. I am sure that every one recognizes this as a great hazard, but very little has been done to try to meet this problem.

In regard to our shot firers' law, I sometimes think that this law does not meet the problems for which it was intended, and that is especially true among our miners. Some men seem to be charter members on defining the purpose of the shot firers' law. I believe you all agree with me that the shot firers' law was enacted for one purpose only, and that was to save lives. And when this law was enacted the idea was to have the smallest number of men in the mine when the shots were fired, in case there was an explosion. And there have been more lives lost from firing of shots than there was before the law was enacted. I believe that the average mining man does not realize this. And I know I am right in saying that most

of the explosions that have destroyed lives were caused from two reasons: either the shot was not properly placed or overloading.

Not long ago a shot firer found three shots in one place that were improperly placed and had they been exploded it would have been suicide to him. The matter was called to my attention and I advised the superintendent to go to that man and verify what he was going to say to him and what it meant to that shot firer, and if such a thing happened again that he would hold him responsible.

Sometimes when we give our opinion on some condition we are very severely criticized for it. Out of one of these cases recently, our Attorney General has rendered an opinion that I do not approve of. And that is that shot firers can only examine and shoot the holes. The other day at Murphysboro they had a trial over this opinion.

I believe that we should all have the privilege of expressing our opinion of safety for the men that work in the mines, and the property of the mine.

I know how we all feel when a serious accident happens, and that we are all trying to avoid them. We can not make laws to get all the conditions we want.

There are many other features of our mining laws that I would like to speak of at this time. The future does not look any too bright at this time. I hope I have said something constructive. I wish I could say more. I am deeply interested in this subject.

JOHN E. JONES:

The comparisons made by Mr. Starks in his paper concerning our own mining laws are very fitting. He also goes further and compares the mining laws of Illinois with those of other states, showing that we are lacking in some respects. I agree with Mr. Starks that the coal industry of Illinois is handicapped in its cost of production when compared with our competitive states.

The thought I have pondered upon for many years concerns the subject discussed at this time. It not only concerns Mining Laws, but all the laws of the land. In some respects laws are like individuals. They are alike in that they have their conception, birth, infancy, maturity and senility. Here the likeness stops. The individual dies, but the law does not. There is a bare possibility that it can be killed, but even this is remote. It must first do a lot, a whole lot, of harm. The prohibition law is a good example of this. It apparently was easy enough to enact. The forces to kill it will have to be hundreds, yes thousands of times stronger and in face of the enormous economic and social harm for which it is responsible.

You have heard both Mr. Starks and Mr. Millhouse upon this subject of mining laws. I am sure you will agree with me that these two men could evolve an efficient set of mining laws to govern present coal mining conditions. But neither of these two men would attempt to write a detailed mining law to fit our industry ten years from now.

The creation of laws, and more laws, seems to be the desire of legislatures throughout the nation. It is no secret that many of the laws are the result of lobbying forces and desire for selfish political success. Some laws as written are but subterfuges, the motives for their passage being some-

thing else than apparently shown in the act. Some laws are given with a wholesome feeling of security that they are for improvement, but for unforseen causes their results are disappointing. Others are good and are of value, and as long as they remain so should be kept on the statutes. In this connection I wish to quote from Thomas Jefferson:

"Some men look at constitutions with sanctimonious reverence, and deem them like the ark of the covenant—too sacred to be touched.

They ascribe to the men of the preceding age a wisdom more than human, and suppose what they did to be beyond amendment.

I knew that age well; I belonged to it and labored with it.

It deserved well of its country.

It was very like the present but without the experience of the present.

I am certainly not an advocate of frequent and untried changes in laws and constitutions. . .

But I know also that laws and institutions must go hand in hand with the progress of the human mind."

Such an expression from so great a man certainly needs no comments from me.

At best any new law is an experiment. We jump from the period of not having it to the period of having it, all without an intervening period of trying it. Many laws that are playing havoc with us, both as to society and to industry, would die a natural death if called upon to be passed a second time. For me to recommend a period of probation for all new laws would be foolish. I can, however, speak for our own industry and go on record that for many years back it would have been better to have had the new laws for a definite period of time giving opportunuity "that laws and institutions may go hand in hand with the progress of the human mind."

Thos. English: The methods of mining coal have changed very much in the last few years. Less explosives can be used under the present methods. And along with the many changes that have taken place, I doubt very much if the State law can be enforced.

There are two things in mining today that are very injurious as far as men are concerned. One is improper placing of shots, and the other is overloading. Neither is as it should be. But I do not know of anything in the mining law that prevents the operator from shooting his coal as a mine manager says so.

Now in connection with your shot firing law. The law says that no more than three shots can be fired at any one time in any one place. I at one time put up a notice that no more than three shots should be fired at one time, and recommendations were made to the Governor for my removal. I was wrong then, but the result was the shot firers' law.

Shots should at all times be properly placed, and as Mr. Millhouse says, overloading is a very dangerous practice. We have also had several accidents because a shot was not tamped properly. Shot firers are negligent in

stalled is, of course, the copper or other conductor. Aluminum will compete when copper is relatively high. An estimate of the first cost of copper feeders is very simple with any assumed conditions. Annual interest and other fixed charges may be estimated for assumed or specified rates. Table No. 4 shows these charges which are fixed, regardless of days worked.

feeders would be such as to give between 50 and 75 volts total loss or an operating voltage on the motors of 200 to 225 volts. The feeder size would be about 5,500,000 cm. and 7,500,000 cm., respectively.

In the tables and figures, the results for 137.5 volts have been indicated. This has been done to show the smallest possible feeder size to deliver the power of 400 kw. to the face. At

Table 4

Assume copper cost at 15 cents per pound installed, fixed charges at 15 percent per annum for 400 kw. load delivered at 10,000 ft. from generator.

Volts	275	250	225	200	137.5
Volts lost	0	25	50	75	137.5
Amperes	1,454	1,600	1,776	2,000	2,908
Size in circular mills		13,700,000	7,600,000	5,720,000	4,530,000
Cost		$126,000	$70,500	$52,500	$42,000
Fixed charges per annum		$18,900	$10,575	$7,875	$6,300

Taking the totals of these costs will give an idea as to just what voltage should be maintained at the face.

Table 5

Totals of all losses and fixed charges

Volts delivered	275	250	225	200	137.50	With sub-
Volts lost	0	25	50	75	137.5	station
Working days	Total costs per annum					
50	$19,953	$12,836	$11,546	$18,958		$ 5,223
100	21,007	15,097	15,217	31,617		6,437
150	22,060	17,358	18,888	44,275		7,650
200	23,114	19,619	22,559	56,934		8,864
250	24,167	21,880	26,230	69,592		10,077
300	25,221	24,141	29,901	82,251		11,291

For the condition stated, it will be noted that for 50 working days, feeders to give 75 volts loss or 200 volts delivered, gives the lowest overall cost while for 300 working days 50 volts lost or 225 volts delivered gives the minimum.

Reducing these figures back to costs per ton, and showing the results graphically, we would have curves between costs per ton and days worked, as shown in Figure I.

Hence, under the assumed conditions, the most economical size of

that point one-half of the power is lost in the feeders. Naturally, all equipment would be slowed down to a minimum, and whenever a momentary demand for greater power might be made, all equipment would tend to stall.

Since the size of feeder for this load and distance is very large, then the alternative of a substation suggests itself. Assume the costs of a sub-station as shown in Table No. 6.

Using the fixed charges as indicated and assuming 25-volt d. c. loss with

Table 2

Loss in Feeders for 400 KW. Load Delivered

Volts at load	275	250	225	200	137.5
Volts loss	0	25	50	75	137.5
Amperes	1,454	1,600	1,776	2,000	2,908
Kw. loss	0	40	89	150	400

Working days	Dollars lost per year =Kw. × 8 × .02 × days ÷ efficiency (.82)			
50	$ 390	$ 866	$1,462	$ 3,900
100	780	1,732	2,924	7,800
150	1,170	2,598	4,386	11,700
200	1,560	3,464	5,848	15,600
250	1,950	4,330	7,310	19,500
300	2,340	5,196	8,772	23,400

the life of electrical and mechanical equipment working under poor power is not possible of exact determination. As the voltage decreases, the amount of work possible to be accomplished is reduced in proportion, so that it is not believed that the mechanical maintenance will greatly increase. However, the repair of armatures, fields, and controllers will rapidly increase as the voltage drops below the rating of the equipment. However, the losses in production and direct power losses in the lines will far more than outweigh the purely repair costs. These are assumed as follows in Table No. 3.

The losses mentioned previously are reduced by good voltage conditions at the working face, but to keep the voltage up at the face costs money, and an evaluation of such costs and a comparison of the losses against the costs is where the principle of economics comes into the problem. Merely keeping first cost of feeder lines and generators down to the minimum possible on which to operate may be, and probably in most cases is, false economy. So now we shall consider the costs of keeping the voltage up to certain standards at the working face.

The largest item in extending power supply from a generator already in-

Table 3

Assume electrical equipment in section as listed above, and further that one complete rewind of armatures and field coils costs $4,000.

Volts	275	250	225	200	137.5
Volts lost	0	25	50	75	137.5
Assume life of armatures working days	1,000	670	430	280	60.0
Cost per day for rewind	$4	$5.97	$9.30	$14.28	$66.67
Added cost above minimum	0	1.97	5.30	10.28	62.67

Working days	Added cost dollars per year			
50	$ 98.50	$ 265	$ 514	$ 3,133.50
100	197.00	530	1,028	6,267.00
150	295.50	795	1,542	9,400.50
200	394.00	1,060	2,056	12,534.00
250	492.50	1,325	2,570	15,667.50
300	591.00	1,590	3,084	18,801.50

voltage and speed during the time that the equipment is actually working. Now the principal production equipment is provided with motors rated on a one-hour basis. These motors are good for approximately one-half their rating when operated on a continued load basis. Hence, we can assume that the average equipment when worked intermittently at a rate equivalent to one-half full load rating has reached safe maximum load.

If additional load equipment is provided to overcome the loss of production due to low voltage, then the additional labor will be in proportion to the added equipment and the net result will be very much the same.

Since there are so many variables to be considered and since these may have widely divergent values in different fields, it is thought that possibly a concrete example with all assumed conditions stated, and the final results figured out, might best bring out the nature of the problem.

First, it might be stated that a small load near by the source of power offers the simplest problem, while the other extreme is that of a large load at a considerable distance. Hence, our example will be one where there appears to be a question as to the dividing line between one or more solutions.

Assume a typical load in a mechanically loading section, 10,000 ft. from the power supply, as follows:

1 15-ton locomotive	150 hp.	2 men
6 loading machines	210 hp.	12 men
6 5-ton locomotives	300 hp.	12 men
3 7-ton locomotives	210 hp.	6 men
2 track-mounted mining machines	120 hp.	4 men
6 drills	12 hp.	6 men
	1,002 hp.	42 men

With an assumed loading of 50 percent of the rating above, the average load would be 501 hp., which, with rheostatic losses included, might be assumed to require 400kw. delivered power at the load center.

Assume that there are 45 men involved in the section at an average rate of $5 per day, the labor cost would be $225.00 per day. Assume 2000 tons per day then the labor cost would be $.1125 per ton. From these figures, the following Table No. 1 is calculated. And, if as previously stated additional equipment were added to make up for the drop in production, due to low voltage, then approximately or even slightly more labor cost would be added. This would cover item No. 2 listed.

The solution to the question of added repair cost is difficult, since

Table 1

Assume 45 men at $5 per day used on production machines of load section. Assume loss of production at one-half of proportion of voltage loss below 275 v.

Operating voltage	275	250	225	200	137.5
Lost voltage	0	25	50	75	137.5
Labor cost per ton	.1125	.11815	.1238	.13365	.16875
Labor cost lost per ton	0	.00565	.0013	.01695	.05625

Working days	Dollars lost per year			
50	$ 565	$1,130	$1,695	$ 5,625
100	1,130	2,260	3,390	11,250
150	1,695	3,390	5,085	16,875
200	2,260	4,520	6,780	22,500
250	2,825	5,650	8,475	28,125
300	3,390	6,780	10,170	33,750

The following papers by Carl Lee, Paul Weir, A. E. Steiger, John E. Jones, H. A. Treadwell, W. J. Jenkins, David W. Jones—all members of our Institute—were presented at the 1932 meeting of the American Mining Congress at Cincinnati, Ohio, and reprinted by the Mining Congress Journal in the July 1932 issue. We are grateful to both these organizations for their full permission to give these papers to you herewith.

ECONOMIES TO BE REALIZED THROUGH PROPER POWER DISTRIBUTION

By CARL LEE

Electrical Engineer, Peabody Coal Co., Chicago, Illinois

There have been numerous articles written pertaining to the question of power supply for mines. Probably the majority of those in authority or responsible for the operation of the mines realize that an adequate power supply at the working face is desirable. Yet it seems that nearly every mine presents a new case to be solved, not only originally but each and every time there is a major change in working conditions. Also, as each mine develops and spreads out over a greater territory and as the entries become longer, there eventually arises the complaint of poor power at the face. This quite naturally occurs since the size in cross section required in the feeder lines increases in proportion as the distance increases. The doubling of distance calls for a doubling of size, hence doubling the distance calls for four times the total weight; therefore, at a given unit cost, four times the cost of feeder lines.

In this article an attempt will be made to evaluate some of the items involved in the economy of power supply. No attempt will be made to include a discussion of purchased versus generated power. Also, we will pass over lightly the case of shortage of generating or converting equipment. Frequent opening of a circuit breaker is readily observed and understood by all.

The final solution of the problem should not be based on the minimum requirements or the first cost of the feeders alone. The proper basis for consideration is the one which includes all items in the final cost of production. These might be outlined as follows:

1. Production losses due to slowing down of all types of main and auxiliary equipment, such as for cutting, drilling, loading, hauling, pumping, ventilating, etc.; or

2. Labor required to operate additional equipment necessary to keep up total production.

3. Direct power losses in the lines from the power supply to the load.

4. Maintenance and repair cost affected by low voltage.

5. Interest, depreciation, and other fixed charges on equipment and power lines.

If it were possible to place exact figures on the costs of the items in Nos. 1 and 4, we could arrive at a very close solution of the entire problem. However, the answers to those details have usually been more or less vague and, therefore, passed off as a matter of opinion one way or another.

If we assume additional equipment is not provided to make up for losses due to poor power, then we could reasonably assume that the loss of production is proportional to the loss of

tempting to cut it. It requires more gas to heat through the scale than to cut the iron.

The valve seats in regulators become worn and cracked and allow the pressure to creep up when the torch is not in use for a few minutes, causing excess strain on the hose and requiring considerable time to again regulate the torch. This weakens the fibers in the hose and causes numerous small leaks, the result being loss of gas. Valve seats cost but a few cents each and require but a few minutes to change. Doing this when necessary will prolong the life of the hose many times.

Keeping tips clean is another matter of vital importance. I have noticed men cutting with holes in tips two-thirds closed, and instead of cleaning them out they screw down the pressure regulators to greater pressure. I have seen cutting being done where a hose pressure of 20 pounds would have been ample, and on account of dirty tips they were using 80 or 100 pounds. Pressure should never be greater than enough to blow out molten metal.

Chas. Hamilton: If there is no further discussion on these papers, I will now turn the meeting back to Mr. McFadden.

A. E. Pickard: I have been authorized by the Mt. Vernon Chamber of Commerce to extend an invitation to this Institute that the Fall meeting be held in their City.

Wm. Starks: I don't know who is responsible for this invitation, but I want to offer to this body, Danville, because it is just about the business center of mining for the State of Illinois. A lot of fellows connected with the coal mining industry in Illinois have come from Danville, and the President of our Institute holds that place as his home. I don't know of any place more fit than Danville as the place to hold our Fall meeting.

J. E. Jones: I appreciate very much the location of Danville. Also that our President holds Danville as his home. However Southern Illinois is a big factor in the coal mining industry in this State. We have turned Mt. Vernon down many times and I want all of you to consider that. Of course I can appreciate the fact that Danville is the business center of mining.

Harry Moses: Danville has been a constant bidder in the years past for the Fall Meeting, and we are bidding for this meeting again. However we believe in giving the other fellows a fair chance, but we do not want to do anything that the Illinois Mining Institute does not want done. However as Danville is the home of our President, I believe it would be fitting to hold our Fall meeting there.

C. J. Sandoe: How long has it been since the last fall meeting was held in Danville.

A. E. Pickard: It was held there two years ago.

G. C. McFadden: It has been customary in past years to delay selecting the Fall Meeting place until after the summer trip and then the meeting place is usually decided by the Executive Committee. However I would like to know who would be in favor of Mt. Vernon and who would be in favor of Danville.

(A standing vote was taken on Mt. Vernon and Danville and Danville was given the preference by a big majority).

J. E. Jones: I can see that we have been defeated in our preference, and I make a motion that we express our preference for Danville.

Frank Tirre: I believe that we should go on record as giving a vote of thanks for those who have presented papers.

ent oxygen pressure must be used to blow the molten metal free from the hole and to supply additional oxygen to continue the burning. A section of the iron pipe used as a lance will be consumed in the process, dependent on the thickness of the plate pierced.

This method, as soon as some skill has been acquired, will enable the operator to burn a clean cut hole within a very few seconds. Heavy pieces of shafting can be cut using the above method.

Be careful that the operator is suitably protected with asbestos gloves and goggles, as the process is very violent.

ELECTRIC ARC METHOD:

Use an ordinary welding resistance capable of delivering about 400 amperes.

Take a rod of ordinary welding wire about 1-4" diameter and 24" long. Wrap the rod tight with two or three layers of asbestos tape from one end to within an inch or so of the other end. Immerse the finished wrapped rod in water until the tape has absorbed all the water it will hold. Place the wrapped electrode in the holder and proceed with striking an arc. A clean hole can be cut in a plate several inches thick by this method. The arc melts the steel and the water which is rapidly converted into steam expels the molten metal from the hole.

USES AND ABUSES OF THE OXY-ACETYLENE TORCH

By WILLIAM REUTER

Mechanical Engineer Southern Division, Peabody Coal Company

In the last few years it has been found the torch can be used profitably in the pit car shop. And still it is not used nearly as economically as it should be.

Usually there are a number of car repairmen in a shop, each man doing his own cutting, and generally none of them are skilled in the use of the torch. The result is the abuse of the equipment, and the waste of gas and air.

It would be better to train one man and let him do the torch work for all of them.

You can go into a car shop and find a man using a cutting torch to heat irons which are to be bent or straightened, as the case may require, instead of using the welding torch for that purpose.

The cutting torch uses an excess of oxygen, and it has a cooling effect in the center of the flame, which in turn takes longer to heat a piece of iron than the welding torch. I will say the welding torch will do the same job in one-half the time, with one-half the consumption of oxygen and acetylene as the cutting torch, so long as it is used for heating purposes only.

Then you will find a man using a large No. 4 cutting tip to cut 5-8" or 3-4" bolts when a No. 2 is plenty large enough. Here again you have a waste of oxygen and acetylene. The large tip will use twice the amount of gas as a smaller tip to accomplish the same result. There is no reason for using a tip larger than No. 2 for any work in the car shop.

It will be found that considerable saving can be made in gas, if the operator will strike each bolt to be cut a blow with a hammer before at-

loading machines, in their final location before the relay locomotive pulls them, that we can save moving the equivalent of six loaded cars, and save two starts on downgrade setting and one start on upgrade load setting. In other words instead of just placing the load so that it clears the switch, set it at a position behind the switch far enough so that the remaining loads can be spotted without having to disturb any loaded cars.

SAFETY VALVES

By WILLIAM REUTER
Peabody Coal Company, Southern Illinois Division

It is a common occurrence to go into a boiler room and have the fireman complain about leaky safety valves. Some have been worked on by mine mechanics, and the usual result is that the pressure will blow down from 15 to 25 pounds before closing off, or they will claim the valve is worn out.

I have never seen a worn out safety valve, or one that could not be repaired.

Any mine mechanic can, if he is a mechanic, reface and grind the valve and seat to a perfect joint. The trouble most of them have is regulating the amount the pressure will blow down before valve closses. They pay no attention to the expansion ring and expect adjusting screws to make the necessary adjustment. It must be remembered that the same amount must be faced off the expansion ring that has been taken from the top face of the valve seat. And under no consideration should the valve be assembled until the mechanic is sure the top face of the expansion ring is as low as the top face of the valve seat.

You should then be able to keep the blow down to within three to five pounds of the seat pressure by making final adjustment with adjusting screws.

PIERCING HOLES THROUGH HEAVY STEEL PLATES

By WILLIAM BURNETT, JR.
Division Electrical Engineer, Peabody Coal Company, Marion Ill.

Two methods of burning holes through heavy steel plates can be performed as follows:

OXYGEN LANCE METHOD:

Take a piece of 1-8″ or 1-4″ wrought iron pipe about six feet long and connect it to an oxygen tank through a suitable hose. Use a pressure reducing valve so that oxygen can be fed through the pipe at a pressure of approximately 30 pounds per square inch.

The job is to pierce a hole in a three inch steel plate. Start the hole with the ordinary oxy-acetlylene cutting torch and as soon as the metal starts to run, stop the work with the torch and at once use the oxygen lance described above. The procedure is to furnish sufficient oxygen from the 1-8″ or 1-4″ pipe to continue the burning and pierce the hole. Suffici-

SAVINGS IN ELECTRIC POWER TO BE OBTAINED IN GATHERING COAL FROM LOADING MACHINES

By WILLIAM BURNETT, JR.
Division Electrical Engineer, Peabody Coal Company, Marion, Ill.

Assume four car trips to be handled by the gathering locomotive from a loading machine to location where relay motor picks up the trip.

One of the greatest power consuming operations is the starting of trips. Refer to the table of moves made using the two systems, of just clearing the switch with the last loaded car, or placing it in a position far enough behind the switch so that it will not be moved again.

From the table it is a proven fact that by setting loads, leaving the

DOWNGRADE LOAD SETTING

First Scheme	Second Scheme
1. Starts from loading machine.	1. Starts from loading machine.
2. Stops outside of switch.	2. Stops outside of switch.
3. Starts—Reverse to couple.	3. Starts—Reverse to set load.
4. Stops—Couples up at switch.	4. Stops—Couples up and blocks.
5. Starts forward to release blocks.	
6. Stops—Removes blocks.	
7. Starts—Reverse to set loads.	
8. Stops—Blocks and uncouples.	
9. Starts forward to switch.	5. Starts forward to switch.
10. Stops outside of switch.	6. Stops outside of switch.
11. Starts to loading machine.	7. Starts to loading machine.
12. Stops at loading machine.	8. Stops at loading machine.

UPGRADE LOAD SETTING

1. Starts from loading machine.	1. Starts from loading machine.
2. Stops—Outside of switch.	2. Stops—Outside of switch.
3. Starts—Reverse to couple.	3. Starts—Reverse to set load.
4. Stops—Couples up.	4. Stops—Couples up and blocks.
5. Starts—Reverse to set load.	
6. Stops—Blocks and uncouples.	
7. Starts forward to switch.	5. Starts forward to switch.
8. Stops outside of switch.	6. Stops outside of switch.
9. Starts to loading machine.	7. Starts to loading machine.
10. Stops at loading machine.	8. Stops at loading machine.

CARS MOVED

1st Move	1 Load	3 Empties	1st Move	1 Load	3 Empties
2nd Move	2 Loads	2 Empties	2nd Move	1 Load	2 Empties
3rd Move	3 Loads	1 Empty	3rd Move	1 Load	1 Empty
4th Move	4 Loads	0 Empties	4th Move	1 Load	0 Empties
Totals	10 Loads	6 Empties	Totals	4 Loads	6 Empties

different size drills, feed of drill, size of drill in inches and decimals, proper size drill to use for rivets, bolts or taps, etc. Such a card framed under glass and hung close to the drill press would, I am sure, save time and money many times above its cost. Numerous other savings can be produced here if propertly investigated.

Stocks, dies, taps both machine and pipe, deserve some consideration. I just wonder how many expensive sets in either machine or pipe sizes are complete. If it is important to have these sets ordered and bought, it is just as important to keep them intact. I know of mines where two and even three sets of machine taps, dies and stocks are on hand and not one complete. How much cheaper it would have been to have kept one set complete, instead of having not one complete set out of three.

Emery wheels, circular saws, hack saws, etc. Every manufacturer of importance gives advice on the product he makes and suggests what such equipment will do. Emery wheels, unless of special make or service, are stamped or tagged with recommended speed which is usually 5000 to 6000 ft. rim speed per minute. I would advise 4000 to 5000 feet per minute for best results. Too much speed heats and burns the material to be ground and robs the wheel of the grinding duty for which it was built, namely cutting. Circular saws come under the same class, too much speed heats and burns the saw, due to the bulk material it cuts.

Trip Hammers. I just wonder how many of us know some of the simple rules governing this simple machine. How many strikes per minute should a fifty pound hammer make? How much distance should there be between the block and the weight to give best results? What should be the spring tension? I leave this for you to decide.

I have submitted far more than I had intended and then, have not by far, covered shop equipment. My only hope is that those who listen or read this little write-up will find it an incentive to promote greater economy and efficiency in mine shop practice. I do not want you to think that our mines are models of such, far from it, but I do hope this will breed results. A word to the wise is usually sufficient and savings can be made in any branch of the operating end of mining industry if properly investigated and pursued, seeking and following advice and suggestions and exchange of ideas of others, then putting the good ones to work.

SUGGESTIONS FOR GREATER SHOP ECONOMIES AT MINES

By GEORGE P. VOLTZ
Mechanical Engineer, Peabody Coal Company, Springfield, Ill.

We hear much talk, discussion and suggestions these days on greater efficiency and economy. Check and double check methods are used to curtail in ordering new material and utilization of old or duplication of old stock and unusuable or obsolete material to as large an extent as possible. All these methods have produced remarkable results and savings. There are many more branches in the mining industry which I feel could and should be checked and double checked. I intend to mention only one of these which I will call waste in shop, and shop tools.

The gas and electric cutting and welding equipment on account of its present day prominence deserves first mention. No one can question but that either one is a valuable and saving shop tool. It surely would be a burden to get along without this equipment today, but I feel that a large portion of the savings credited to their use are camouflaged. We hear of the remarkable savings created by their use but seldom if ever hear of failures and losses due to poor or improperly done repair jobs. Good men, good judgment, good jobs, good records, good costs, check and double check on welded jobs against new material jobs, life and service of welded jobs against new material jobs, etc., are essential to properly credit welding, also to weed out such repairs that do not warrant welding. Only competent men and such men require checking as to proper tip size, economy in the use of materials, correct materials, etc., are essential.

The drill press I consider second in shop prominence it is one of the most simple of machine tools and sees the most service. It seems to be the consensus of opinion that anyone can operate a drill press, which is true, as it requires so little judgment to make it a harmless machine. But take a look at the condition of the drills and drill racks at most mines and it will tell quickly who is paying the piper. Burned and broken drills, ruined chucks and chuck holders are in evidence of poor judgment; overspeeding and underfeeding of large drills; underspeed and overfeeding of small drills. Improperly ground drills can be found at most mines almost anywhere around the drill press.

SOLUTION: Have such men as are competent only use this machine. Have drill stands made with each size drill kept in its designated place, and drills sharpened and in good shape for work. Too much time is wasted in looking over a lot of broken, dull or burned drills to find the desired size. A drill of every size and every size in its place ready for service; a chuck to fit the drill size also in its place is essential. No Morse taper drill below 1-2" should be bought. It costs more to produce the Morse shank on small drills than the drill itself. Straight shank drills below one-half inch should be used and a suitable chuck to use this size and smaller is essential. A proper card, most drill makers have these for distribution, are available for the asking. These cards or instructions, cover proper speed of

KINK BOX

TRUCK FOR MOVING JOY LOADER HEAD IN LIMITED CLEARANCE

By LEE HASKINS
Superintendent No. 1 Mine, Bell & Zoller Coal & Mining Company
Zeigler, Illinois

Maintenance counts at least as much as any other factor in the success or loading machine operation. For unless the machines are constantly kept up, large tonnages cannot be obtained, the machines depreciate more rapidly than they should and the mechanism is blamed for a fault which lies largely with the management. That is why it is so necessary "to grease the skids" along every step of the way taken to expedite the maintenance jobs.

An example of one of the many aids which might be improvised for speeding up the handling of these maintenance jobs is a truck developed at the No. 1 Mine of the Bell and Zoller Coal and Mining Company at Zeigler, Illinois, for transporting Joy machine heads from the working section to the shaft bottom, up the shaft in the cages, and thence to the welding shop on the surface when a rebuilding job is necessary.

This moving is accomplished on an all-steel mine truck so designed that it carries the machine head in a diagonal position. If the head was loaded flat on the truck it would have to be lifted from the truck for loading onto the cage for the reason the Joy head is too wide for the cage; the width of the cage being 70 inches and the width of the Joy head, lying flat, is 75 inches. With this special truck the head can be taken anywhere that a pit car is taken and without re-handling.

In submitting this operating idea, Ernest Prudent, Chief Electrician, and Wm. Neibsch, Master Mechanic of the coal company, give the following important details of design and construction: The supporting frame is made of angle iron electrically welded together and to the truck base. The design is such that the angles on the underside of the loading machine head will fit between the truck framework, a feature which prevents movement of the head in the line of truck travel. Two lugs welded to the lower end of the inclined frame keep the head from slipping off the truck. Wheels, axles and bearings were taken from an old Goodman breast machine truck, wheel base 36 inches. The truck is 9 feet long and most of the angle iron was made up of small pieces of scrap.

We have found that this truck has made quite a saving in labor in handling the Joy heads from the working face to the top and back for repairs.

rail bearing area of the hewn, causes us to favor the sawed stock.

As timber seasons it gets hard, but Pine, Gum and some of the other woods do not require nearly as many strokes of the track layer's hatchet in driving a spike, as does well-seasoned White Oak.

Our experience with treated Pine and Gum ties which are relatively soft as compared to Oak has proved to us that the spike holds because the wood is sound and not necessarily because it is hard.

The experience of the railroad's indicates that the greatest factor in tie life is the treatment and the ability of the preservative to keep wood sound rather than that any particular kind of wood is superior to another.

We have found that Gum with no tendency to split from car wheels passing over the ties and a soft wood which takes treatment well should make a satisfactory tie for mine use. It is easy to spike in and gives no trouble in retaining the spikes. It does not tend to split and crack seriously if stored outside for a considerable period.

I believe that treated timber which will maintain its original strength and qualities over a long period is going to do a great deal toward generally reducing the sizes of many timbers now used in mines.

In conclusion and more especially on the assigned subject will say in regard to sizes:

Ties should be of ample size to support with ease the maximum designed loads. The thickness should be great enough to allow the setting of spikes of ample length to hold the gauge but at no time should the spike fracture the lower face.

The breadth should be great enough to allow a fair stagger of the spikes thus building in a rigid tension on the track which tends to hold it in alignment.

Props, legs and bars should be of ample size including a fair factor of safety for the purpose intended.

Where permanency beyond the natural life of timber is desired treated timber should be used.

With regard to Specifications will say:

All timber should be cut from sound live trees and free from defects that impair the strength of the piece for the purpose intended.

Treatment Specifications as adopted by the American Wood Preservers Association and the American Railway Engineers Association as to preservatives, quantities, and standard practices should govern.

Chas. Hamilton: I am sure that this interesting paper should bring out some discussion.

W. H. Firmin: I have nothing to suggest, but I will be glad to answer any questions asked.

We have used Zinc Chloride for mine timber and Creosote for top timbers. Unfortunately in Illinois the use of treated timber has not been in use as long as it has in the East. But they have had marked success with it in the East.

We have found that ties of the same size that have been recovered and are used again, those that were treated will stand up under much more weight than the untreated ties.

Papers from the Kink Box were next presented by the members.

foot of the hill meant that any cars that got off the track coming down the hill would give these ties severe service. The Yellow Pine ties showed a tendency to split and chew up where the wheels passed over them. Most of these original ties have been replaced for this reason, but where they have escaped the mechanical wear due to the car wheels, the spikes are as solid as in any new Oak tie.

Additional installations of Yellow Pine ties show them to be satisfactory generally except where derailments tend to shatter and crush the wood fibre.

Yellow Pine ties have now been in service 4 years on the bottom of one of the mines where the incoming loads are blocked with "scotch blocks." This particular work had always proven to quickly show up a tie that was getting soft or rotten.

During the fall of 1931 a motor road was abandoned in which 700 treated motor ties had been spotted and where they had been in use three years. Every one of these was recovered and put into a new motor road extension. We did not find a single tie with any trace of rot or any that were not serviceable due to mechanical wear.

Seasoned hewn White Oak ties installed at the same time and later, showed almost all of the sapwood rotted off and reduced to about the size used as room ties. The largest portion of the untreated ties were such that they could not be profitably reclaimed.

We have a stretch of motor road with 55 pounds rail on treated ties, bonded on one side with regular bonds and on the other side with pieces of 4-0 round and trolley wire. This road has been in service over 3 years and a test made just prior to April 1, 1932 disclosed that not even one of the make-shift wire bonds was broken. There has been no maintenance work required on the road as yet and a careful inspection showed every tie in the same condition as when installed.

I am unable to give you figures picturing a radical reduction in the number of motor ties used, as shifting of territories with some being idle (which would reasonably have taken a great number of replacements), increased track footage, and other variables make it impossible to accurately say that tons per motor tie used had increased or decreased.

The practice has been to install treated ties in new motor road extensions, and in recent months, an increasing number have been used as replacements in existing motor roads.

The following table, showing motor tie replacements, and tonnages at one of the mines, is indicative of the results we hope will eventually be more evident.

Motor Ties Installed

	Tons Hoisted	Treated	Untreated	Tons per Tie
1925	149,321		3,527	42.3
1926-27	114,064		10,973	10.5
1928	157,378	1,865	3,133	31.5
1929	295,033	2,609	4,928	39.1
1930	402,580	2,252	3,798	68.2
1931	343,048	5,342	1,531	50.1

Our short experience in the use of treated ties, the small number installed, along with the many variables does not show the result that can reasonably be expected.

The company has purchased a number of different kind of woods in both hewn and sawed treated ties. The regular size of the sawn timber with uniform thickness and full width of face available for rail bearing surface and staggering of spikes, as against the uneven and often small

erly sized prior to treatment.

This type of deck with 2 inch floor has a cost advantage in that it only requires 1450 BFM against 2400 BFM where cross ties and one inch floor are used, besides a material saving in the cost of installation.

In the short period since this was put in there are naturally no evidences of decay or wear.

The O'Gara Coal Company cased a shaft in 1929 with Yellow Pine timber which was all framed prior to treatment with Zinc Meta Arsenite. This shaft makes a great deal of water and the ZMA preservative was selected because of its permanency, where Zinc Chloride would tend to leach out and Creosote, while permanent, might carry a fire hazard as well as being difficult to handle. To date this casing appears to be in perfect state of preservation.

Props

One section of O'Gara No. 1 mine gave a great deal of trouble due to props rotting rapidly and where there was any considerable weight native Oak gave about one year service.

It was decided to install treated 5 inch tip Yellow Pine props along permanent roadways and in air courses in this section.

The first were installed in June 1930 and since then all original timbers have been replaced.

Where untreated props in this area showed the effect of weight within a year there are no evidences on any of the Yellow Pine except where rails used as cross bars with untreated caps may be crushed into the wood. This is due to no fault of the prop but to the failure to distribute the load over the props entire surface.

Early this year we purchased a car load of treated hardwood props and in time will be able to compare their merits with the Pine.

This is a good time to tell you a story of our experience during the two years experiment on desired permanent props.

In the beginning our local mine men, accustomed to only Oak, were doubtful of the ability of the Yellow Pine to carry the load. The Pine, when dry, weighs about two-thirds as much as Oak. So, though very skeptical at first because of this light weight, they are now partial to the Pine, since they know it will carry the load and is much lighter to handle.

This great difference in the weight of the two species is a real factor, especially where they must be carried any distance by the men. This in turn is undoubtedly reflected in labor costs.

Where bottoms are extremely hard there often arises the need to saw props to proper length. This should be avoided wherever possible but if necessary the end of the prop should be painted with some preservative solution to give the exposed heart wood as much protection as possible.

Mine Ties

O'Gara Coal Company installed their first treated motor ties early in 1928. These were sawed Yellow Pine treated with 1-2 pound of Zinc Chloride per cubic foot of timber.

The first ties put into the track were in a switch at No. 3 mine where motor trips coming off a hill gave them extremely hard usage.

The softer wood (as compared with White Oak) plus recent treatment allowed the spikes to be driven so easily that the mine manager had a car of our regular untreated Oak ties unloaded at the switch as he was positive the soft wood could not last a week.

The location of the switch at the

STANDARDIZATION OF MINE TIMBERS, SIZES AND SPECIFICATIONS

By PAUL HALBERSLEBEN

O'Gara Coal Co., Harrisburg, Illinois

I have been assigned the subject "Standardization of Mine Timber, Sizes and Specifications." I shall deviate from this enough to give some of the results obtained from the use of treated timber at O'Gara Coal Company mines.

Two years ago Mr. A. R. Joyce, Vice-President of Joyce-Watkins Company addressed this same body on treated timber using as a basis for his conclusions, regarding the adoption of treated timber for mines, the results shown by the railroads through their use of it.

Any coal mine adjacent to railroad property that at sometime or other has had the need to "borrow" ties, that the railroad company carelessly stored near the mine, has some evidence of the long life possible underground of treated timber.

The O'Gara Coal Company purchased their first treated motor ties early in 1928. The total treated timber purchases to the first of January 1932 are 44026 motor ties, 11147 room ties and 3826 props. In addtion to this 115000 board feet of treated lumber has been purchased as well as treated cross and switch ties for mine railroad track replacements and treated poles for power lines.

Lumber

The treated lumber has been used for various purposes. That used in pit cars has not been in service long enough to give any positive conclusion regarding its life, but we expect good results from composite cars; steel body with treated (oak) bottoms which have been in service less than two years.

We have one pit car of treated Yellow Pine lumber that was put in service in 1929. It shows the usual abrasions on the surface of the wood from the coal but no evidence of decay or breaking. This is in the same mine where untreated wooden cars purchased in March 1929 from a standard pit car Manufacturer have had a number of bumpers and other boards replaced. Some of this early replacement may be due to breakage in wrecks but we have seldom if ever found broken bumpers on what we would call a new car, say up to 18 to 24 months old. The lumber breaks after it becomes weak from rot which may not be evident from an external examination.

The railroad track scales in use at the O'Gara mines have the common parallel I-beam supports. They were first installed with single timbers placed above each I-beam for rail support with a deck of 2 inch material between the timber and the rail. This main timber, because of the many spike holes and its position directly over the I-beam, rotted quickly.

The replacement was made with cross ties laid crossways which had to be notched out over the I-beam to maintain the proper grade and the deck then sheathed with one inch plank. This installation had a life of less than 8 years.

During 1929 the last replacement was made of treated Gum timber along the line of the first plan of single timbers with 2 inch planking prop-

that we will be able to get the Bureau of Mines to carry some of this expense.

D. D. Wilcox: I wish to take this opportunity to express my appreciation to Mr. Miller for the honor he has paid our company in his paper.

I don't know as I have so much to say, but I want to say that in all things Mr. Miller has been one of the most faithful in his work. He has helped the safety movement along all through the Illinois field, and has been at our call whenever we have asked for him. And I don't know of any one man that has done more.

When the safety movement first began, the companies were flat on it. But one knows that since the movement has got impetus they have helped both financially and educationally. Close co-operation between the miners and operators is the secret of the whole thing.

I think that I can say with the rest of the men here that this is one of the best papers that has ever been read before the Institute. It should help us all in applying practical safety methods to our problems.

G. C. McFadden: Before we adjourn, I would like to know if any of you have any articles to present to the Kink Box to be read this afternoon.

AFTERNOON SESSION

G. C. McFadden: Since our meeting last fall we have lost two members: Mr. C. E. Carstrom, Vice-President of the Safety Mining Company and J. D. Zook, President of the Illinois Coal Operators Association, and past President of the Illinois Mining Institute. Our committee is ready to report, and as a mark of honor to those who have gone on, I am going to ask all of you to stand.

Report of Committee on Resolutions on the Death of Joseph D. Zook

Joseph D. Zook, Director of our Institute and President during 1931, passed away on May 28, 1932, while on duty at Springfield, Illinois. His untimely death was a shock to the coal mining industry of the nation. The loss to our Institute is keenly felt at this its first meeting since the death of Mr. Zook. The progress of our Institute has been in no small part due to the untiring and able support of our friend and co-worker.

We, the officers and members of the Illinois Mining Institute, appreciate the good fortune that was ours to have known and to have worked with Mr. Zook. We hereby express our profound sorrow at this the June 11th, 1932, meeting of our Institute.

ILLINOIS MINING INSTITUTE
John A. Garcia
Paul Weir
M. M. Leighton
John E. Jones.

G. C. McFadden: On behalf of the Illinois Mining Institute, I thank you gentlemen: I wish to express deep appreciation for the tribute you have paid our good friend J. D. Zook. The tribute to be set in the records, and a copy to be sent to the family.

I will now turn the Afternoon Session over to Mr. Chas. Hamilton.

Chas. Hamilton: On account of the desire to proceed promptly with the program, I will now ask Mr. Halbersleben to read his paper.

Paul Halbersleben: In preparing this paper I have tried to be fair and present the facts as we found them, based on our experiences within the last few years.

and during this time has produced approximately 4,500,000 tons of coal; another company operated two mines and produced 6,553,551 tons without a fatality. The six companies of the State that were awarded Holmes Safety Association Certificates of Merit produced a total of 25,947,533 tons without a fatality.

In addition to the above record of production per fatality, there are some mines in the past two years that have worked over an extended period without having a lost-time accident. One mine in particular, using Joy loading machines, operated five of the twelve months of 1931 without a lost-time accident and commencing September, 1931, it worked up to February 1, 1932—five consecutive months, —without a lost-time accident. During this time the mine worked 122,-424 man hours. In addition to this record we know of several cases where face bosses have worked their sections for a year or more without a lost-time accident. These records were not considered possible a few years ago, and show what can be done if a determined effort is made.

In conclusion, the best records made by some of the companies of the State were made during the past two years, with a demoralized condition of the industry resulting largely from the depression, labor unrest, and poor working time, all of which usually are considered contributing factors to a higher accident rate. Therefore, considering these records made in the past two years, and those made by other companies prior to that time, it is believed that if the industry of the State as a whole will make safety an operating problem, there is no reason why the State as a whole can not produce at least a million tons per fatality, as well as greatly reduce the non-fatal injuries simultaneously reducing human misery and the dollars and cents cost of producing coal.

C. J. Sandoe: I would like to hear a few discussions on this paper.

W. C. Argust: I listened to the paper very carefully and I believe that every man connected with the operation of coal mines will agree with Mr. Miller. I think to practice and observe safety pays. We have found that we have been able to cut down our cost rate very much by keeping in mind the safety of our employee. And besides paying big dividends, I do not know of any more important work connected with the industry than safety.

C. J. Sandoe: There have been several companies that have been mentioned because of their safety record. A good safety record is something to be proud of.

B. B. Brewster: I had the occasion to serve as an officer in the Rocky Mountain Institute. In the State of Utah they have the most rigid laws of any state in the Union. Permissible equipment was required by law in this state. After this law was passed we made an investigation throughout the whole Rocky Mountain District, and we came to the conclusion that the fundamental things were proper ventilation, and proper supervision, and with 100 per cent ventilation and 100 per cent supervision of the men in the mine we will not have one-tenth the accidents.

W. C. Argust: I am just wondering if it would be possible for our Institute to get some copies of Mr. Miller's paper made, and sent out to the members. I believe it would do a lot of good.

C. J. Sandoe: The papers will all be in the year book.

G. C. McFadden: In answer to Mr. Argust's suggestions, we will be very glad to do this. It may be possible

the lower cost of upkeep, there is the added safety factor. Therefore, we believe that if more permissible equipment were installed and properly maintained, it would still further reduce the hazards due to electricity.

First Aid

During the past few years there has been an intensive first-aid training campaign conducted in the State by the State Department of Mines and the United States Bureau of Mines, and in co-operation with the operators and miners. Down to date, about 21 companies have had their employees trained 100 per cent. Some of the companies that put over intensive safety programs, started by first having all of their employees trained in first aid. They state that the training made the men more susceptible to safety work and that it was of great benefit in reducing their accidents. According to the State Department of Mines, there was a total of 53,727 trained in first aid from 1911 to January 1, 1932.

Goggles, Safety Caps and Shoes

Illinois has been somewhat backward in getting started in the use of "hard-boiled" hats, safety shoes, and goggles. However, of late some companies have been more or less successful in the installation of these safety articles and have been rewarded by the prevention of some very serious injuries, and possibly fatalities. One company that started a short time ago to install these articles now has 294 employees wearing safety shoes, 271 wearing safety caps and 106 wearing goggles, out of a total of 637 employed. This indicates real progress, and it would be worth while if all the companies in the State would make an intensive drive to get these safety articles into use.

Co-operation

We have heard it stated many times that it was impossible to get co-operation from the men in safety work. While we have the greatest respect for the opinion of others, we cannot agree with this. It is believed that if the men are sold on the idea of safety, they will co-operate. This requires sincerity of purpose and considerable effort on the part of the officials. In other words, it is a question of salesmanship. We have observed some cases of voluntary co-operation on the part of the men that was everything any one would desire. In fact, the co-operation given by the men in some instances was far better than that given by mine officials. It should be borne in mind that the human element is the most important factor in the safe and efficient operation of a mine, and if it is possible to get this element working with you, instead of against you it will pay large dividends, and is well worth the time and effort.

In addition to the progress of safety, in the State as a whole, many records have been made by sections of the State, and by different coal companies, as follows: During the year 1928, the Seventh Inspection District produced 1,469,909 tons per fatality; in 1929, the Twelfth Inspection District produced 1,054,972 tons per fatality, and in 1930, the Third Inspection District produced 1,010,232 tons per fatality; in March, 1930, the State produced 1,372,430 tons per fatality, and in June of the same year, it produced 1,430,502 tons per fatality. In January, 1932, the State produced 1,283,741 tons per fatality. A group of mines operated by one company produced 10,139,290 tons without a fatality; another mine has worked more than 22 years without a fatal accident,

While the present types of electric cap lamps may not represent perfection, there is no question that they are a decided improvement over the open lights, in both illumination and safety. The first decision by the Safety Board of the United States Bureau of Mines, was one reading, "In all coal mines, the portable lamps for illumination should be permissible electric cap lamps."

Some have expressed the opinion that when a mine is worked with closed lights, the ventilation will be neglected. This would be poor mining practice and would mean disaster sooner or later. However, in connection with our recent mine inspections practically all the closed-light mines visited maintained better ventilation, as far as the oxygen and methane contents and the volume of air at the face workings are concerned, than some of the open-light mines. We also know of closed-light mines in the State where each face boss carries a flame safety lamp and is required to examine each place for gas before any electrical equipment is permitted to operate. This is an excellent practice and should be adopted in all closed-light mines.

According to the 1930 Coal Report, a total of 23 mines in the State, were using closed lights, and we do not know of an explosion or mine fire due to their use; on the other hand, since some of the most disastrous mine fires and explosions that occurred in both gaseous and supposedly non-gaseous mines, were due to open lights, it would certainly reduce the hazards if all mines were using closed lights.

Electricity

Electricity has been one of the most important factors in the development of mines. However, with its use has come certain hazards, such as possible electrocutions, mine fires, and explosions. In the five-year period 1921-1925, forty were killed by electricity, and during the five-year period 1926-1930, twenty were killed in Illinois coal mines—a reduction of 50 per cent over the previous five-year period. (This number of deaths does not include those killed by explosions that may have been due to electricity).

In some of the first electrical installations made, very little consideration was given to guarding against electrical hazards. However, of late years many of the companies are making an effort to standardize the best methods of installing electrical equipment, such as fireproofing rooms for motor generator sets, transformers etc., equipped with automatic closing doors that cut the current off the equipment when the door is shut, guarding trolley wires at crossings where the wire is les than 6 1-2 feet above the rail, requiring that permanent splicing of all machine cables be made at the electric shop, more rigid inspection of electrical equipment, the wearing of insulated shoes by all those working around electrical equipment, and the training of all employees in artificial respiration.

There is one important factor pertaining to electrical equipment that should be given more consideration, and that is whether or not it is permissible. At the present time, the permissible type of equipment is manufactured for practically all work where electrical equipment is required, yet we know of only one mine in the State that is using it. The electrical engineers of the Bureau of Mines, and those of companies that have permissible equipment installed, claim that while the first cost is greater, the maintenance is less than that of the open type, due to its more rugged construction. In addition to

some companies have purchased high-pressure rock-dusting machines and are now rock-dusting all air-courses and rooms, as well as the entries equipped with trolley lines. The United States Bureau of Mines recommends the rock-dusting of all open passageways in all coal mines, except anthracite, because they have records of explosions that have crossed over small rock-dusted areas and continued propagation in rooms or air-courses that were not rock-dusted.

The writer has investigated explosions in Illinois mines which, he believes, were stopped by rock-dusting and as a result saved many lives.

Ventilation

It is believed that considerable progress in ventilation is being made by many companies. More attention is now given to air-courses, stoppings, and doors, than ever before.

One company operating a mine in southern Illinois, had poor ventilation on one side, but could not remedy it without operating the fan at an excessive rate of speed. Finally, the officials decided to clean a main air-course from the air shaft to the first overcast. After cleaning 1500 feet, at a cost of $3500, they were able to reduce the fan speed and at the same time get about the same volume of air at the bottom of the downcast as before the improvements were made. Before the change was effected, we made an inspection of this mine and were unable to get air readings in the majority of the face crosscuts, and air analysis showed low oxygen and unusually high methane contents. After the improvements were made, the mine was inspected again, and showed from 4,000 to 16,000 cubic feet of air per minute passing through the face crosscuts, with the oxygen improved and the methane content reasonably low. In addition to the improvement of the ventilation at the face, slowing down the fan also reduced the power cost. Prior to making the improvement, the power required was 104.6 kw.; after the improvement, it was 55.6 kw.—a difference of 49 kw. The monthly saving in purchased power consumption was $458.64, and in addition a saving of $80.85 was made on the demand charge, or a total saving of $539.49 per month. This saving in power paid for the cost of the improvements in six and a half months.

Many companies have taken advantage of the Bureau of Mines' services in the use of air analyses for the determination of the oxygen and methane content and for the opening of sealed fire areas. The State Department of Mines recently equipped two of their stations with Orsat apparatus and they are collecting and analyzing air samples as the occasion requires. In addition to the use of air analysis apparatus, several companies have purchased different types of methane indicators.

Air analysis is a real step in the progress of safety. It has enlightened officials as to the real condition of the air in many of their mines that they had thought well ventilated until the analysis was made, which often showed that the oxygen content was too low, or the methane content too high or probably both. Many of the operators who have received this service from the Bureau of Mines have profited by the information and improved the ventilation when necessary.

Closed Lights

As a result of the increased number of explosions and mine fires due to open lights, the closed light, or electric cap lamp, was introduced.

year period, 1916-1920. From 1926 to 1930 inclusive, 65 men were killed by explosions. This is a reduction of 4.0 per cent over the previous five-year period, 1921-1925, and a reduction of 32.0 per cent over the five-year period 1916-1920.

Doubtless the use of closed lights, improved ventilation, a better understanding of the properties of mine gases by the mine officials, rock-dusting and the use of permissible explosives, are some of the factors that have contributed to the reduction in the fatality rate of gas explosions.

In the six-year period, 1926-1931, inclusive, 28 men were killed by the use and handling of explosives. (This includes those killed by coal dust explosions caused by blown-out shots). This is a reduction of 65 per cent as compared with the previous six-year period 1920-1925, when 80 were killed, and is the best record of any six-year period between 1882 and 1926. In 1930-1931, four men were killed, two in each year, which is the best two-year record since 1882.

From 1882 to 1915, practically all of the coal was blasted with black powder, but since the introduction of permissible explosives, the amount of "permissibles" used, has increased from 1,342,334 pounds in 1915, to 3,971,130 pounds in 1930.

Again, there has been a radical change in the handling of explosives in some mines. In the past we have observed large quantities of permissible explosives and detonators stored in one large box at some centrally located point near the mouth of panel entries, from which daily supplies were obtained for charging shot holes. We have also observed primers, detonators, and sticks of explosives lying on the floor, in crosscuts of rooms and entries or at the face; but after being apprised of the hazard of such practices, some of the mine officials have provided additional storage boxes on each entry and have not permitted more than 35 pounds of explosives to be kept in a box at any one time. Small magazines built in the rib and located in an old room, entry, or crosscut, and not less than 50 feet from electric wires or other explosives, have been provided for the storage of detonators. Some have provided asbestos-lined boxes in which the drillers store their primers until used, and also require that the leg wires of electric detonators be short-circuited until they are ready to shoot the shots.

The use of "dobie" shots or mud-capping when breaking falls of rock or slate, is a common practice in many mines. This is a very hazardous as well as expensive practice and has been discontinued in many mines after the mine officials learned of the hazards connected with it.

Unquestionably the introduction of permissible explosives into many mines and the safer practices in the use and handling of explosives have been contributing factors in reducing accidents.

Rock-Dusting

The United States Bureau of Mines, since its inception, has advocated the use of rock-dust to prevent the propagation of explosions by coal dust, and while Illinois was not the first State to use rock-dust, it was one of the first, the Old Ben Coal Corporation having adopted the use of rock-dust in 1917. According to the 1930 Coal Report, there are 35 mines now using rock-dust in the State. Practically all of the mines visited were using general rock-dusting in entries equipped with trolley wires, and ruck-dust barriers in air-courses at the mouth of cross and panel entries. However,

is made to this end. In the past too much reliance has been placed upon the opinion of both mine officials and employees, as to the time period slate will stay up before it is necessary to timber. Many men have been killed or seriously injured by slate that was reported "absolutely" solid before it fell. Such being the case, what is the solution to the problem? Some companies have adopted systematic timbering rules which require the men to maintain the timbers within a certain distance of the face when the roof is good and to place additional props when the roof is poor. Some companies also require each official to carry sounding rods and require both face bosses and face employees to sound the roof at regular intervals; if there is any loose slate it is either pulled down or securely propped before men are permitted to work under it. There are other companies that require the face to be spragged while it is being undercut, drilled, or squared up.

That accidents from falls of roof and sides can be greatly reduced, if not eliminated, is shown by records of the Bureau of Mines. One company reduced this class of accidents between 60 and 90 per cent by closer supervision and systematic timbering. One mine in particular, in Illinois, had only one acident from falls of roof during 1930, and it caused the loss of only three days' time.

Haulage

Notwithstanding the progress made in haulage systems in Illinois mines, haulage accidents, like those from falls of roof and coal, have shown very little if any decrease. Of those killed underground, haulage was responsible for 25.5 per cent in 1926, 18.5 per cent in 1927, 16.2 per cent in 1928, 24 per cent in 1929, and 18.8 per cent in 1930, with a five-year average of 20.8 per cent. The total number killed by haulage from 1882 to 1930, was 1086, or 18.3 per cent of the total number killed underground.

Some of the most common causes of haulage accidents that I have observed are coupling on the "fly," jumping on and off rapidly moving trips, "back poling," and "knuckling" cars. The records of some mines of the State show that these practices can be eliminated and haulage accidents greatly reduced. I wish particularly to cite the case of one company operating a group of four large mines, and employing a total of 90 tripriders. In 1930, 127.7 per cent of the tripriders employed in the four mines were injured, and one of the mines had 180 per cent of its tripriders injured. On November 1, 1931, an order was put into effect at the four mines, prohibiting coupling on the "fly," jumping on and off rapidly moving trips, "knuckling" cars, etc. From November 1, 1931, to April 1, 1932, a total of eight tripriders were injured from all causes, or only 8.8 per cent of the total employed in this capacity by this company; certainly a very encouraging and worth-while reduction. This company reports that during this five-month period, contrary to their expectations, they suffered no loss of tonnage as a result of putting this order into effect. The same experience is reported by other companies that have discontinued the aforementioned unsafe haulage practices.

Explosions and Explosives

During the five-year period, 1916 to 1920, inclusive, a total of 96 men lost their lives by gas and dust explosions; from 1921 to 1925, inclusive, 68 men were killed by explosions—a reduction of 29 per cent over the previous five-

product of the regular operation of the mine.

It is believed that the executive should look upon an accident as a danger signal, and an indication that something has interfered with the efficient operation of the mine, and that the cost of coal is increased. This is proved by the enormous cost of accidents. We have found that the compensation and hospitalization cost in some of the mines in Illinois varies from about .02 cents to nearly 12 cents per ton, and that the average cost per accident, including lost-time and no lost-time accidents, varies from $60 to $250. We have also found that the accident cost per day for each day the mine operates, varies from $54 to $224.

In addition to the above direct cost due to compensation and hospitalization, there is the indirect cost which some authorities claim may be as high as four or more times that of the direct cost.

We believe that the cost of accidents as cited above is sufficient reason why all executives should take a personal interest in safety instead of leaving it solely to the mine officials and other employees. If safety is considered as an operating problem by all executives, the same as is production, then we will see a further reduction in the accidents in the State. In fact, it has been observed that generally the mines with the lowest accident costs are those where the higher officials take a personal interest in accident reduction.

Falls of Roof

A study of the Illinois Coal Reports show that there is very little, if any, improvement in the accident rate from falls of roof and sides. The average for the five years , 1926-1930, shows that 55.5 per cent of those killed underground were killed by falls of roof and sides. During the 10-year period, 1921-1930, 1438 were killed underground, and of these, 755, or about 52.5 per cent were killed by falls of roof and sides. In 1930, 67.9 per cent of those killed underground were killed by falls. In addition to the fatalities, 18 per cent of the injuries causing seven or more days lost time in 1930 were due to falls.

Mr. J. W. Paul, in Information Circular 6570, published by the United States Bureau of Mines, makes the following statement: "In the matter of falls of roof, it is found that 85 to 87 per cent of all fatalities occur at the working face of a room, entry, or in pillar work. It is at the working place that the greatest roof hazards are encountered, and when 75 per cent of the employees spend approximately 90 per cent of their working time at the face, it is logical that here is where injury is most likely to occur."

In line with the above statement, one inspector informed the writer that covering a period of about 12 years, 75 per cent of the fatalities he had investigated, occured between the prop line and the face.

It is realized that roof conditions vary to a large extent in different parts of the State and even in the same mine, and that there are many variable factors that must be taken into consideration in roof control. However, notwithstanding these conditions, roof hazards can be controlled in all mines, whether utilizing hand or mechanical loading, if the proper care and attention are given by both management and employees in securely timbering the places.

Our observations in the past two years, have convinced us that accidents from falls of roof and sides can be controlled in the coal mines of this State, if a determined effort

and this should not be necessary, as the progressive operator will correct unsafe conditions and practices, and not wait for drastic legislation which may come as a result of some disaster.

Table No. 23, page 43, of "A Compilation of Coal Reports of Illinois," shows the fatality rate per 1,000 employed and million tons of coal produced, from 1882 to 1930. This table is divided into four periods; the first period of 6 years, from 1882 to 1887, when nearly all mining was done by hand, shows a fatality rate of 2.4 per thousand employed, and 5.96 per million tons produced. The second period, of 14 years, from 1888 to 1901, when mining machines were first introduced, shows a rate of 2.0 per thousand employed and 3.8 per million tons produced. The third period, of 25 years, 1902-1926, during which haulage locomotives came into general use, shows a rate of 2.4 per thousand employed and 3.1 per million tons produced. The fourth period of four years, 1927-1930, during which loading machines were introduced, shows a rate of 1.8 per thousand employed and 2.1 per million tons produced.

The fatality rate of Illinois compares favorably with that of other large coal producing states, both as to men killed per thousand 300-day workers, and per million tons produced.

	Fatality rate per 100 300-day Workers. Table 62, page 97, U.S. Bureau of Mines Bulletin 341. 10-year average, 1919-1928.		Production per fatality. Table 69, p. 103, U.S. Bureau of Mines Bulletin 341, 10-year average.	
			1929	1929
Alabama	5.10	3.70	170,799	249,221
Illinois	3.59	3.26	422,086	556,492
Kentucky	4.14	4.55	324,306	305,367
Pennsylvania (Bit.)	3.47	3.79	361,046	373,740
West Va.	6.13	5.64	244,059	283,850

That the mining industry is making progress in accident prevention, and that mines are becoming safer, is shown by the following excerpt from the Holmes Safety Chapter Notes[3] of March, 1932: "In all the panic years, except that of 1931, the fatality rate per million tons of production was higher than the average of the five-year period in which it occurred; 1931, on the other hand (according to present available data), has a fatality rate per million tons production, of but 3.27, as compared to 3.75 for the period 1926-1930. The rate of 3.27 killed per million tons produced is by all odds the lowest or best in the past 25 years."

According to the reports of the State Department of Mines, the fatality rate per million tons produced for the 5-year period, 1926-1930, is 2.214, while for the depression year 1931, it is approximately 1.99 or, 501,696 tons per fatality—far below the country's average of 3.27 per million tons.

One of the most encouraging signs of ultimate greater safety observed in recent years, is the personal interest being taken by the executives of some of the large Illinois mining companies. This is as it should be. If the executive is not interested in the safe operation of his mine, he can not expect the mine officials to be, and if the mine officials are not interested, they in turn can not expect the employees to take an interest. Only too often when one of the higher officials makes an inquiry as to why the tonnage in some section dropped, or the mine is shut down entirely, is he told that there has been a serious accident or a fatality. What is usually done about it? In many cases it is just considered another accident, or a

[3]Published by U. S. Bureau of Mines in co-operation with the Holmes Safety Association.

PROGRESS OF SAFETY IN ILLINOIS[1]

By A. U. MILLER[2]
of the United States Bureau of Mines

It is said that the first discovery of coal on the North American Continent was made in what is now the State of Illinois, and that the first actual mining by white men was at Mt. Carbon, in Jackson County, on the banks of the Big Muddy River at a short distance from its junction with the Mississippi River. These mines were opened in 1810 and worked to a limited extent for many years.

The exploration for coal prior to 1830 was confined to the out-croppings of seams along the bluffs of rivers and streams, and it was not until the population extended inland and the need of water wells arose, that discoveries of coal were made back from these streams.

The building of railroads brought a notable increase in the production of coal. The first shaft in the State was sunk at DuQuoin in 1855, shortly after the completion of the Illinois Central Railroad, and was followed during the next ten years by the development of the coal field at Alton, Kingston, Rock Island, Danville, Braidwood, and Bruceville.

The Government began keeping records of coal production in 1833, and these records show that the yearly production for Illinois increased from 6,000 tons in 1833 to 6,720,000 tons in 1881.

Beginning with 1882, yearly reports by the operators have been made to the State government. These reports were made to the Bureau of Labor Statistics until 1917, at which time the Civil Administrative Code placed all subjects relative to mining under the jurisdiction of the Department of Mines and Minerals. Since 1917 these reports have been compiled and tabulated by this department and published as the Annual Illinois Coal Report.

The annual reports show that the industry has expanded from a production of 9,115,661 tons, with 20,290 men employed in 1882, to a production of 89,979,469 tons, with 91,372 men employed in 1918. This latter year was the peak year for Illinois as to tonnage, but the peak year as to employment was in 1923, with 103,566 employed. This period of rapid development was also accompanied by marked improvements in mining conditions and methods, and although the annual production of Illinois has decreased since 1921, the industry has continued to keep in the vanguard of progress in mining methods.

Prior to 1870, Illinois had no mining law; during that year, however, the State constitution was amended, empowering the general assembly to pass such laws as might be necessary for the protection of the life and health of the miners, including the sinking of escape shafts and requiring mine ventilation. Since 1870, the mining law has been added to and revised may times, and the opinion has been expressed that the present law should again be revised to meet changed mining methods and conditions. While this may be true, yet it is believed that the present law compares favorably with that of other states.

After all, it is impractical to make laws to cover every detail of mining,

[1]Published by permission of the Director, U. S. Bureau of Mines. (Not subject to copyright).

[2]Associate mining engineer, U. S. Bureau of Mines, Vincennes, Indiana.

examining places to be shot down, and some of the men are more interested in getting the coal down than in the safety of the shot firer.

The shot firer should be a practical miner, and a lot of them are. He should give more attention to the examination of the holes he is to shoot than most of them do. Another thing in this connection, the best time to fire a shot is when it is first placed, as the moisture in the coal reduces the explosive force considerably.

The mine examiner is employed for eight hours, but it is only about four hours or so between the time he enters the mine until he signs his books. I believe that too many mine examiners leave too many things to the discretion of the miner.

Bill Starks: I have known Mr. English for a number of years and I know the position he took on shooting in that field he spoke of.

The law is not the only thing that is wrong, it is also the application of the law. It is also a fact that politics are often played in the interpretation of the law. We have seen this demonstrated recently in Illinois when there happened to be a man who wanted to be Governor.

I don't know how long the present conditions will exist. The Mining Commission is not getting anywhere. How can they when the miners say no to a proposal and the operators say yes? That leaves it up to three men independent of the coal industry. You can't make laws like that. Personally, I think that this last investigating commission has been a dud. The things that the operators want the miners do not want, nor will they get them as long as things are as at the present time.

The present mining law covers a lot of pages in our statute books. You could write all that need be in the books in about ten pages.

Usually the miners appointed on the Investigating Commission are competent miners. But how are they going to know all the conditions imposed upon the management of a mine? And how are the three independent members to know these things? And that is what is wrong with our mining laws today. They have been written under the direction of the United Mine Workers of the State of Illinois.

C. J. Sandoe: Our next paper on this program is to be presented by Mr. Alex Miller of the United States Bureau of Mines.

Alex Miller: In preparing this paper I have drawn largely upon my own experiences, and it deals for the most part with my own observations in and about the mines, and particularly the ones I have visited in Illinois.

corresponding costs and 5 percent a. c. line loss, the last column in Table No. 5 would be derived. Also, on Figure I, the costs per ton are indicated. Therefore, under all the assumed conditions, the substation would be amply justified. In fact, it shows a saving of 2 cents per ton for 300 days operation and 6 cents per ton for 50 days operation over the most economical size feeders.

In order to show more clearly the distribution of the costs on the feeders having 50-volt loss, which size appears most economical of the feeders alone, Figure II has been included.

Similarly, the distribution of the costs on the substation has been shown of Figure III.

Since there are so many variables in solving problems of economy in power supply, it is realized that to cover the entire range of probable conditions would require far too much time and space for this occasion. However, it is hoped that the foregoing will point the way to the solution of similar problems under the special conditions as may be found in the many mines.

Table 6—Cost of 400 KW. Substation

The cost of an inside substation is made up of fixed costs plus variable costs, dependent on the distance. For our purpose, assume the following:
400 kw. set and board $12,000
Bore hole and room 4,000
Line (exclusive of copper) at 50 cents per foot. Copper at 15 cents per pound of size to give 5 per cent line loss.

Distance, feet	Fixed cost	Pole line	Copper	Total	Fixed charges
2,500	$16,000	$ 1,250	$ 175	$17,325	$3,038.50
5,000	16,000	2,500	700	19,200	3,320.00
10,000	16,000	5,000	2,800	23,800	4,010.00
15,000	16,000	7,500	6,300	29,800	4,910.00
20,000	16,000	10,000	11,200	37,200	6,020.00

ECONOMIES OF TREATED TIMBERS

By PAUL WEIR
Vice-President, Bell and Zoller Coal and Mining Company

This Cincinnati meeting of the American Mining Congress has to do largely with the modernization of the coal industry. Timber utilization is very properly one of its important subjects. Any discussion involving timber utilization leads quite quickly to the preservation of timber from decay or rot. The things which I will attempt to bring out in this paper are of a general nature and are not necessarily confined to our own experience on our own properties. They involve no technical discussions of the preservatives employed or of processes. The art of wood preservation may be likened to the art of mechanical loading in that both are thoroughly established and are out of the experimental stage. The problem consists in the economical application. This economical application comes from close co-operation between coal operators, timber producers, and timber preservers.

Rot in wood is caused by fungi or parasitical plants that grow in timber

and feed on the wood substance. Preservatives operate by poisoning the food supply of these plants. Other things being equal, the preservative used is the one which will accomplish this poisoning in the cheapest manner. The goal of timber utilization is to have timber wear out instead of rotting out. In some temporary work, it is more economical to permit rot to claim the timber. In permanent or semi-permanent work it is undoubtedly true economy to preserve the timber against rot. The choice between preserving or not preserving is one of dollars and cents.

In general, coal operators have not come to a realization of the savings in treated timbers. In times gone by they have been frightened by prices asked for the treated product. They are accustomed to purchasing raw timber on specifications which imply a rather liberal inspection policy. The tolerances permitted have been quite large by comparison with those used by the railroads, who are the largest customers that timber - preserving companies have. These preserving companies accustomed to railroad tolerances and inspections base prices on mine timber accordingly. Frequently this has resulted in mining companies paying for sizes that they did not need or desire.

The treating of crossties has permitted the railroad to use nondurable woods as a cheap and abundant source of supply. Woods classed as durable as opposed to nondurable are heart of white oak, heart of long-leaf yellow pine, redwood, black cypress, and cedar. If the original mechanical strength of a tie or timber is adequate, treating will prolong that strength for a long period of time. There is no necessity for anticipating decay, and consequent impairment of strength, by using oversize timbers. The usual practice in many mines where timber rot is a factor consists in using sizes of timber not called for by actual conditions. Expected rot is taken care of by increasing sizes rather than by using minimum sizes and treating these sizes. When it is remembered that the cubical contents of a round bar or leg varies as the square of the diameter and that cost varies directly with the cubical content, the importance of this factor will be realized. In many cases raw 10-in. tip legs could be replaced by 7-in. tip-treated legs. The cubical contents of this treated leg is less than one-half of that of the raw leg. It is safe to assume that the strength of the 10-in. raw leg will not exceed that of the 7-in. treated leg after a comparatively short space of one and one-half years to three years under ordinary mine conditions. Likewise the size of raw ties is frequently greatly increased to take care of expected deterioration. Rail bearing surface beyond need is provided. Thickness in excess of actual spiking requirements is specified. For heavy-duty mine service, a 5 by 7 treated tie in many cases is preferable to a 6 by 8 raw tie. The difference in size alone overcomes quite a large part of the difference in cost between treated and untreated ties.

Mention has previously been made of tolerances in sizes. Few mining companies hold to a rigid inspection. Those who do, get exactly what they pay for, but at an increase in cost compared with those whose inspection is based on average appearance. Without going into the merits or faults of either system, some things can be said. A timber producer who is accustomed to producing on close tolerances will closely approximate the specified tip size of a leg. A producer who has never been held to close tolerances

will permit a wide variation in tip sizes with a considerable percentage of his output undersize. Treated timbers usually are produced by established companies whose main volume comes from railroads, consequently the average size of treated timbers produced on the same specification will exceed that of the raw timber. This is especially true of hewn ties. Firm specifications with strict inspection and smaller tolerances will permit in many cases the decreasing of nominal sizes of timber without decreasing the average size. In comparing costs of timbers, whether raw or treated, this factor of tolerances must be considered for the reason that it can easily explain variations of 10 to 20 percent in quotations.

For the past few years, coal operators have had no occasion to anticipate their requirements of raw timbers. There are more unemployed timber producers than there are unemployed miners. Treated timber presents a different picture. In order to keep down the cost, the timber must be peeled and must be air-seasoned before and after treating. This reduces to a minimum the freight charges and handling charges, because all excessive moisture is eliminated and treating is facilitated. It is obvious that coal operators must anticipate their treated-timber requirements months ahead if they wish to get the best product at the lowest possible price. Standard specifications and sizes for the mines of one company or for a group of companies, together with their anticipated requirements for at least six months in advance, constitutes a program which is necessary if the cost of treated timbers is to be kept at an absolute minimum. This information in the hands of a commercial timber treater will permit him to purchase advantageously and to deliver when needed the proper sizes correctly treated. If this commercial timber treater operates his own sawmill, he can convert some of his waste materials into sizes of timber which can be used at mines. When this can be done he is in a position to pass on to the coal operator a considerable saving.

The selling price on all raw timber is based to a large extent on cubical contents of the stick plus the labor of peeling and hewing or sawing. Freight on shipments of timber is based on weight, which is a product of cubical contents. Cost of treating is based on cubical contents. Cost of unloading and loading is based largely on weight. It is extremely desirable to reduce to a minimum the sizes of treated timbers used. A careful engineering study of conditions at any mine will reveal those timbers the size of which might be reduced without impairing their fitness for the work to be done. This study should take into consideration the tendency to use oversize raw timbers to offset the weakening effect of rot. It should also include the question of tolerances on inspections. If these things are done and results are carefully analyzed, it will be found that the delivered cost of treated timbers is surprisingly low.

There is a deplorable lack of accurate data on the service life of both raw and treated timbers. Inasmuch as the economics of timber costs are based on service life and the data on this life is incomplete, we can only arrive at general conclusions at this time. In arriving at these conclusions, much weight can be given to the well-known experiences of this country's railroads. Bulletin No. 33, "Methods and Costs of Treating Mine Timbers," published by the Carnegie Institute of Technology, gives in detail the results

which have been obtained by various railroads by treating their ties. In Chapter V of this publication the results of tests made by the Chicago, Burlington & Quincy Railroad are given. The tests showed the average life of untreated ties to be from about 3 years in the case of nondurable woods to 8.5 years in the case of white oak. These same tests showed the average life of treated ties had not been reached after 17 years. The oldest test in coal mines of treated timbers dates back to 1906. At that time the United States Forest Service commenced tests in the Silver Creek Colliery of the Philadelphia and Reading Coal and Iron Company. Eighty-eight percent of the original timbers listed for test in Bulletin No. 33 were still in place and in good condition after 20 years of service. In September, 1931, Galen Wood, chemical engineer, made an additional report on these tests. A quantitative analysis for zinc chloride was made by Mr. Wood on five of the original timbers. He found from two to five times the amount of zinc chloride needed to prevent decay still remaining in the timbers after 25 years of service. Every mining company, whether using raw or treated timbers, should keep a service record of some kind. The February issue of The Mining Congress Journal presents an article by R. M. Wirka, entitled the "Why and How of Mine Timber Records." Definite suggestions are made for compiling records. Date nails should be used on all treated timbers. The simplest plan is to have the treating company apply the nails.

When the service life of raw timber and treated timber is definitely known, the choice between them is a matter of calculating annual charges. To the prices of each, f. o. b. mines, must be added the cost of unloading, the cost of storing, the cost of delivering, the cost of removing old timber, and the cost of placing the new. Frequently there will be found a saving in these items in favor of treated timber. The American Railway Engineering Association uses the following formula for calculating charges.

$$A = \frac{Pr(1+r)^n}{(1+r)^n - 1}$$

Where A = Annual charge
P = Amount of initial investment
n = Average life of timber
r = rate of interest expressed decimally

Based on 6 percent interest rate, the annual charges due to initial expenditures of $1 are as follows:

1 year	1.060	15 years	.103
2 years	.545	16 years	.099
3 years	.374	17 years	.095
4 years	.289	18 years	.092
5 years	.237	19 years	.090
6 years	.203	20 years	.087
7 years	.179	21 years	.085
8 years	.161	22 years	.083
9 years	.147	23 years	.081
10 years	.138	24 years	.080
11 years	.127	25 years	.078
12 years	.119	26 years	.077
13 years	.113	27 years	.076
14 years	.108		

The use of this formula and table can be illustrated by a specific problem. The cost of raw 5 x 7-6 ft. 0 in. hewn oak ties is 35 cents, f. o. b. mine. The cost of 5 x 7-6 ft. 0 in sawed oak tie treated with zinc chloride is 60 cents, f. o. b. mine. The additional charges to be added for handling and placing is 83 cents per tie. The life of a raw tie is three years. Its annual charge is $1.18 x .374, or 44.1 cents per year. The initial expenditure on a treated tie is $1.43. If this treated tie had a life of only four years, its annual charge would be $1.43 x .289, or 41.3 cents per year. An ad-

ditional life of only one year in this particular case covered the increased cost of a superior tie treated with zinc chloride.

Actually the mechanical strength of the treated tie will be preserved 10 to 20 years. In so far as coal mines are concerned, it will be found that the cost of labor of replacing timber sets or ties is at least equal to the cost of the treated timbers. In most cases it exceeds the cost of the materials. Railroads with men working at lower scale of wages in the open find the use of treated ties profitable. The labor cost of replacing a railroad tie is taken by them to be one man-hour. It is conceivable that the cost in coal mines is even greater because of artificial illumination and ventilation, and in addition the close quarters in which miners must work. The savings which accrue through the use of treated timbers are due largely to the savings in the labor cost of replacement.

L. C. Drefahl, in the 1930 Proceedings of the American Wood-Preservers Association, says: "It has been estimated by Government engineers that of the 2,400,000,000 bd. ft. (200,000,000 cu. ft.) of timber used in the mines annually, 5 to 15 percent should be treated, or approximately 250,000,000 bd. ft. (20,000,000 cu. ft.). In 1928 about 9,600,000 bd. ft. (800,000 cu. ft.), or less than 5 percent of this prospective amount, was reported as treated, mostly with zinc chloride and creosote." He continues, "The amount of treated timber used in mining is obviously only a fraction of the possible annual requirements."

I am giving you these figures to show that the mining industry has not grasped the savings in treated timber in the manner that the railroads have. It is possible to obtain a conception of the annual savings which could be effected in the mines of this Nation by making certain reasonable assumptions. The cost of treated lumber when nondurable woods are used is approximately 50 cents per cubic foot. The cost of raw timber is probably 60 per cent of this, or 30 cents per cubic foot. The average labor cost of replacing timber sets and bars will exceed the cost of treated timber, but let us assume that they are an equal. This means that the labor cost on both treated and raw timbers is taken at 50 cents per cubic foot. The average life of raw timber does not exceed four years, and an assumption on that basis is logical. The average life of treated timbers exceeds 16 years, but we will use that life as typical.

The cost in place of raw timbers on this basis is 80 cents per cubic foot, and of treated timbers $1 per cubic foot. The annual charge per cubic foot on raw timbers is 80 x .289, or 23.12 cents. The annual charge per cubic foot on treated timbers is 100 x .099, or 9.9 cents. The saving is the difference, which is 13.22 cents per cubic foot. These calculations apply only to the 20,000,000 cu. ft. which Mr. Drefahl states should be treated. Translated into savings per ton of coal production, it amounts to approximately one-half cent.

Undoubtedly this is a conservative estimate. The coal mine uses for which treated timber should be considered are many. Underground they include shaft and slope timbers, permanent and semi-permanent timber sets, ties and switch ties in permanent and semi-permanent track, aircourse timbering, mine-car lumber, and rock-dust barriers. On the surface are permanent structures, such as buildings, tipples and head-frames,

railroad ties, and poles for power lines.

The efficiency of all preservatives depends upon their toxic values. The oldest and best established ones are creosote and zinc chloride. The use of either of these or a combination of the two will cover practically all conditions. Inasmuch as zinc chloride is soluble in water, an amount larger than the usual one-half pound per cubic foot should be specified when used in wet places. Likewise the use of creosote in dry places underground might be questioned, not because of its inflammability but because of the dense smoke it produces if timber which has been impregnated with it burns. Creosote and zinc chloride are by no means the only suitable preservatives. They do have the advantage of wide use over a long period of time, consequently more is known of their preserving qualities. A full discussion of various preservatives is given in chapter 2 of Bulletin 33, "Methods and Costs of Treating Mine Timber," published by the Carnegie Institute of Technology.

In a previous paragraph mention has been made of the tendency to use over-size timbers. Obviously it is impossible to definitely determine the loads which timber sets will be called upon to bear. The size of crossbars must be determined by experience. In the average bituminous mine, more bars fail because of rot than because of excessive loads. While calculations for the size of crossbars means little, calculations for the size of supporting legs are indicative if not conclusive, where no side pressure exists. In the use of treated timbers where the mechanical strength is preserved indefinitely, there is no justification for supporting crossbars with legs of a size which will withstand two or three times the breaking strength of the bar. This statement applies to flat workings. In our own mines, after a thorough investigation, we made a substantial decrease in tip size of legs. We are now using 6-in. and 7-in. sizes in place of 8-in., 9-in., and 10-in. tip sizes.

Mention has been made of cubical contents in several preceding paragraphs. Generally speaking, where timbers, raw or treated, move to a mine by railroad haul, the price is set on a cubical content basis, which is another way of saying weight. Freight is based on weight. Treating cost is based on cubical contents. The cubical contents of sawed ties or lumber are easily calculated. In the case of round bars or legs there is used, the American Wood-Preservers Association formula which is:

$$\text{Contents} \frac{D^2 + d^2 + Dd \times 0.2618 \times L}{144}$$

Where D = Butt diameter
d = Tip diameter
L = Length

At present in commercial treating plants in our district the cost of applying ½ pound of zinc chloride per cubic foot is 12 cents on sawed materials and 16 cents on round sticks. These prices include seasoning before and after treating, also loading into cars for shipment. The higher price on round timbers is due to the fact that the capacity of the treating cylinder is decreased. Square or rectangular pieces take up less space. Prevailing prices on sawed hardwood ties treated with zinc chloride delivered to southern Illinois mines is approximately 40 cents per cubic foot. A 5 x 7-6-ft. 0-in. hardwood tie cost approximately 58 cents. The prices on treated round pine timbers is approximately 43 cents per cubic foot delivered to southern Illinois points. The price on treated pine ties is approximately 3 cents per cubic foot less than hardwood.

It is well known to every mining man that the forces of nature and compound interest operate 24 hours per day and 365 days per year. This same statement is largely true of the parasitical plants which feed on wood substance. Rot proceeds with the same speed and sureness as compound interest; in fact, rot is thought by some to be accelerated during shut downs. During these trying times of intermittent operation, maintenance costs show a substantial increase. Treated timbers and ties are a practical means of helping to keep down this maintenance cost.

In this paper I have attempted to bring out those things which seem to me to be questions which arise in the minds of coal operators when treated timbers are discussed. My approach has been through the practical rather than the technical. No coal operator can overlook savings of any character. The economy in the use of treated mine timbers is worthy of consideration by all.

ECONOMIES OF ARC WELDING

By A. E. STEIGER
General Superintendent, Pyramid Coal Company

When one undertakes the study of any certain phase of industry it is always interesting and beneficial to go back to the pages of history to learn, if possible, the progress made and the difficulties encountered in its development.

Like many other of the highly essential factors now found in modern industry, there is little or nothing recorded in the archives of history which would actually indicate the origin of welding, either with reference to time or place.

It would be reasonable to assume, however, that welding did not precede the advent of metals. We naturally conclude, then, that the art of welding was developed in a crude fashion soon after primitive man learned to make iron. Undoubtedly the early history of welding is closely related to the history of metals.

The date and manner of discovery of iron is entirely problematic. Historians have arrived at various conclusions as to the manner and time of its discovery by ancient people. Research of those interested in archaeology would lead us to the belief that the discovery of gold, copper, and bronze preceded the discovery of iron.

However, there is credible proof that the inhabitants of the ancient Sumerian and Accadian cities put iron to extensive use as far back as five thousand years before Christ. These cities were located on the eastern shore of the Mediterranean Sea in what is now the country of Turkey. Research has led us to the discovery of the early use of iron in widely separated countries of the world.

Like the use of iron, the art of welding has progressed unnoticed during the centuries until today it is an indispensable factor to our industries. The past decade has witnessed many major developments in the welding field. Industries in general have taken a new attitude toward accepting this method as a dependable construction tool.

It is only reasonable that we follow the development of iron and steel for it forms the basis for arc welding. With the development of the Bessmer and Martin processes for making low

carbon steel a new era dawned in industrial progress. These two processes were developed during the nineteenth century and really mark the dawn of the Steel Age.

Today much thought and consideration is being given the possibilities in the welding field and no angle or problem is too small to escape attention. Old methods are being supplanted by new and improvements are being made with the sureness which brings perfection.

We have three General Electric, 300 amp. welding machines in service at our plants.

Considerable welding has been done on the lower bases of our large stripping shovels. Anyone familiar with strip mining will realize that the failure of a structual in the base is one of seriousness and will readily know that such an incident can halt production if the conditions are adverse.

One occasion which I call to mind was that of a main girder breaking on one of our stripping units. Had we not been equipped with welding machines at our plant, it would have been necessary for us to shut down until such time as this girder could have been replaced. Fortunately, with the aid of the arc welding machines we were able to make the necessary repairs without retarding production. This failure was an open fracture in the main girder on the lower base. By relieving the weight of the revolving frame with jacks, we were able to repair the girder in place. After the welding was completed in the original plate we then re-inforced the weld with plates riveted in place. As an added precaution the edges of the plate were then welded. We find it practical to weld about 50 percent of the outside radius of the re-inforcing plate. In order to provide flexibility we make it a practice to weld up 4 in., then leave 4, making the weld completely around the plate. This was a permanent repair.

Another repair job which we encountered and in which this method played a major role was that of a breakdown on another of our units. This time the break occurred at the lower end of the right back leg, supporting the boom, dipper handles, and A-frame. The hitching to which the legs are attached is constructed of steel castings, riveted to the main deck of the revolving frame. We experienced unlimited success in this repair job by the application of welding. The point where the break occurred was almost inaccessible. The repairs were made, however, with a loss of only 18 hours running time. Had we not have had access to a welder it would have been necessary for us to renew the broken part which would have taken at least six days. We would have been forced to remove the ballast from the machine, water tanks, and some other braces in order to make the repairs. We accomplished the repairs by welding the casting in place which supports the back leg and re-inforcing with a 2-in. round iron, placed around the casting. This repair was made about 18 months ago and was a permanent repair job.

The greatest advantage of arc welding to us is that by its use we can make repairs without removing the parts which have failed. This eliminates the necessity of shutting down the unit for a great length of time, which to any industry, means a material money loss. Another valuable feature is in making these repairs we reclaim and prolong the life of numerous parts indefinitely.

We have made quite a number of repairs to large sheave wheels such

as point sheaves for our large shovels, some of which have failed shortly after being put in service, due no doubt, to stresses set up in wheels when casted. The wheels being cast steel, the fracture usually develops in the spoke where it intersects either the rim or hub. In making these repairs we use the arc and weld up fracture to original form and re-inforce by laying an extra piece of metal, either round or flat, where it will fit best and weld this in place over the break. We have two such sheaves which have been repaired in this manner that have been in service at length and we feel we will experience no further trouble from these sheaves in the same place. To replace new would have cost considerable money and about four days running time in each instance. We have also repaired large gears with the same success.

We have found arc welding a dependable tool in building up drainage pump foundations from structurals. We use it in assembling almost exclusively.

In the event of breaking out a tooth in a gear which shows little wear we find that we can reclaim these gears by drilling and putting in studs of mild steel, welding together in a mass with carbon steel electrode and machining to proper shape. Many gears have been repaired in this manner and given us an additional 50 per cent service or better.

We use the welder in making repairs to our dipper handles on our large shovels where fractures occur in the I-beams or angles which make up these handles. We weld the fracture and reinforce, as our experience has led us to the belief this is the best way to do the job. These repairs are made with handles in place, eliminating the time and expense of removing.

In repairing our dippers and dragline buckets which are constructed of steel castings, steel plates, or manganese we use such electrode as may be required for the kind of metal contained in the broken parts. We have had very little reason for complaint in connection with repairs of this nature.

We use the arc extensively in building up dipper teeth for our large stripping units. These teeth are steel forged. After they are worn down we build these teeth up using a high carbon electrode for a base and covering it with a layer of standard hard surfacing electrode. Afterwards we heat the teeth to a degree sufficient to relieve all stresses set up by welding. We find these teeth can be built up as many as three or four times and made to move approximately as much yardage each time as they did originally.

Arc welding is used extensively in making repairs to our tipple, such as welding broken conveyor pans without removing them, building up crusher teeth, and repairing broken beams and structurals. It is also used on our locomotives in welding in new flue sheets, welding up fire cracks and repairing the frames. We have also found it economical to apply it to repairing of pipe lines and water supply system, and welding together waste parts of drill hole casing, making them to suitable lengths for use.

We consider arc welding practically indispensable to the maintenance of our operation. We have always found in it a dependable tool, one in which to place utmost confidence. In summing up, we believe the arc weld is one, if not the most important of repair tools. When properly handled its performance is efficient, economical, and practical.

SAFETY IN BLASTING COAL—CARDOX

By J. E. JONES

Safety Engineer, Old Ben Coal Corporation

One of the most interesting studies in the history of mining is that of "Blasting." Its evolution is resplendent with experience and research, both of which could give to history a record of cost as gory and heroic as that of a battlefield.

In a study upon this subject one is most apt to give thought to the purpose, to its beginnings, and to the reasons for progress. I have often pondered upon the courage of the first person who prepared a powder charge and made the first blast in a coal mine. We have no record as to who he was, or what happened. We do know that there was a thrill in the adventure. Probably the incentive lay partly in his inability to perform as much physical work as his comrades, thus making demands upon his thinking that he might remain in competition.

The terms "shot," "shooting," and "fire" as used in coal mining were taken from similar expressions and commands as used in warfare and with firearms. Many of us here today can remember when the terms were quite applicable and fitted very well. Our mining laws upon blasting are the result of those experiences made in an effort to compel practices found to be of the least hazard.

It would be difficult to coin another word that would give the meaning conveyed when "fire" is shouted just prior to the blast. By it is meant for persons within the danger zone to get to a location of safety from flying material, whether on the surface or in a mine. The ordinary definition of the word fitted into coal mining because in addition to flying particles, fire was itself an added hazard. To reduce and possibly remove this hazard has been the object of good practice and scientific research for half a century.

Safety and efficiency are analagous terms in all industrial progress. Possibly in no other field than that of blasting have these two been of such fundamental importance. The energy concentrated, and work to be accomplished, have called forth as great or perhaps greater ingenuity towards safety, and therefore efficiency, than other evolutionary processes.

The loosening and breaking down of materials from their parent locations, either for their use or for their removal, has been a problem nearly as old as civilization itself. Its history is as romantic as that of tools, transportation, or any other of mankind's industrial pursuits. It begins in the remote past and is not yet fully solved.

When materials began to be exploited the work was done by hand tools. Other than the labor involved and slowness of procedure, this probably has never been surpassed in so far as safety to workmen and quality of product are concerned. The necessity for speedier recovery and faster removal demanded the adaptation of the explosive force of war time to peaceful pursuits. Especially was this true in the fast-growing New World, where exploration, discovery, and development were faster by far than the growth in population.

As one might expect, the very nature of blasting is fraught with danger. Possibly in no other industrial

pursuit is the word "safety" so largely used. It is a modifier that is affixed to explosives, squibs, fuse, and even to certain practices. Much of this has been caused by overzealousness resulting in confusing "less dangerous" with "safety." The wish has often been the father of the thought. As great an authority as Alfred Nobel at first claimed that his blasting oil, "nitroglycerine," was a safe explosive—that it could hardly be made to detonate except when struck a heavy blow or when confined and ignited by a suitable igniter.

In days gone by some manufacturers were prone to believe and broadcast a false standard of safety with respect to their explosives—but now that the inherent danger in better understood, greater and more precautions are taken and accidents from manufacture and use have been much reduced. The lessons learned have been of assistance in the development and use of the device which forms the subject that has been allotted to me.

Even a brief story upon the evolution of "blasting" would be too lengthy for the time at my disposal here. In lieu of such a story I want you to consider a theoretical blasting medium which has 100 per cent of the hazards that can pertain to the blasting of coal. From this maximum of hazards I wish to eliminate them one by one in an effort to approach a 0 percent of hazards.

This theoretical substance is handicapped:

(1) By the property of extreme inflammability, not only an initial ignition but propagative, endangering safety from conflagration and explosion of the substance.

(2) By susceptibility to shock, its instability easily resulting in premature explosion.

(3) By disintegration, possibly changing the substance from an explosive to a slow-burning compound.

(4) By necessity of expert attention and handling, a condition apt to be occasionally overlooked due to the large number of blasts required and the large number of men employed.

(5) By overcharging to guarantee complete breakage, thereby resulting in overblasting and resultant flying material.

(6) By ignition of blasted coal, fire-damp, or coal dust resulting in mine fire or explosion.

(7) By poisonous or otherwise obnoxious gases, and smoke.

(8) By a destructive force affecting other than the material blasted.

(9) By unsuccessful detonation entailing a hazard of removal, or hazard of its loss in coal shipped.

(10) By iginition of fire-damp from detonator.

(11) By premature detonation in transportation or handling.

All of the foregoing 11 points apply to my theoretical blasting substance in its storage, transportation, preparation, use, and physiological effects.

I now assume an assignment to myself giving authority to demand requisites to eliminate the hazards, these to approach a hazard percentage of zero. Having such authority, it is logical that my first and greatest demand is to employ a noninflammable, therefore nonexplosive, substance. In this one demand I eliminate most of the hazards under ignition and explosion in the transportation, storage, handling, and use of the substance.

My second requisite would be discharge without flame. Requirements Nos. 1 and 2 would wholly remove the fire and mine explosion hazards from blasting initiation. The disaster haz-

ard also would be eliminated. Except for the physiological effects and perils from overcharging, all of the 100 per cent hazards would thus be removed.

Most of the physiological hazards and the smoke hazard are eliminated because combustion, and therefore the products of combustion, is removed by my first demand. To complete the removal of such hazard my third demand would be the use of a substance harmless to respiration.

To offset perils from overcharging, my fourth requisite would be a unit charge, a certain definite amount of energy for each mine that could not be added to nor subtracted from; and further giving no disrupting effect to materials in the solid because of the slowness of the blast.

A fifth requisite would be necessary, that of no susceptibility to shock, thus permitting handling without fear of premature blast.

I can conceive that with these five requisites, the blasting method resulting would approach the 0 percent of hazards as closely as the use of average tools, and closer than that of some tools. I do not know of any blasting principle that wholly conforms with this imaginary standard. Cardox, in my opinion, is an approach embodying to a large extent the requisites I have assumed.

The first, third, and fifth of my imaginary demands are wholly complied with in the Cardox system of coal mining. The carbon dioxide used is noninflammable, nonexplosive, nonpoisonous, and is not susceptible to shock. The percentage of CO_2 resulting in the atmosphere at the location of the blast and immediately following it is so small as to be considered negligible.

Compliance with my second imaginary demand is not wholly met, for electric ignition is used. There is, however, a very close approach complying with the permissibility requirements of the United States Bureau of Mines. The heating element is surrounded by the CO_2 under many atmospheres of pressure and its function is performed inside of the steel cartridge in a substance that is wholly noncombustible. The luminous particles escaping with the expanding and liberated carbon dioxide through the ruptured disc are far below the temperature of methane ignition. The amount of carbon dioxide compressed into the cylinder is ample, if sufficient to burst the disc, to quench the flame from the heater. Electric arcs from the blasting magneto that might result at the naked parts on the inby end of the cable may be formed if the magneto is sufficiently powerful. This hazard can be removed by having a magneto that will generate a maximum arc too weak to ignite firedamp but sufficiently strong to fire the heater match.

My fourth demand is rather well complied with because of the slowness in the discharge of Cardox. Pressure here, of course, is equal in all directions. The time element, however, is an important factor in preventing damage to the roof and walls. The blast resembles a heaving of the material, the heaving action continuing after the initial blast because of the expansion of the CO_2 as it permeates the fractures caused by the initial shock blast. The roof and walls are not as much affected as they would be from a sudden and violent blast penetrating into the solid in a sort of inverse ratio to the time element because the breakage of coal to be loosened is not sufficiently sudden for the release and maximum benefit of the blasting force. In this, loosened roof and walls, and flying

coal are reduced. However, unless a chance is given for the coal to be properly blasted, a flying shell may result.

By virtue of the five imaginary demands I have laid down, the handling and storage hazard is removed. This, too, is embodied in the Cardox method. There is no need of special storage on the surface or in the mines. A lost or misplaced shell is not a hazard; simply a lost piece of equipment.

While Cardox does not quite reach the strict demands I have made for attainment of the 0 percent of hazards, it makes a close approach. With training and a more general knowledge of this relatively new blasting device this 0 percent can be even more closely approached coupling with it an increased quality of product.

Experience in the Cardox method of blasting substantiates the prophecies made for it. But blasting accidents have not been the only ones reduced. The firmness of roof and walls produces a less hazardous condition within the mine, a hazard that results in approximately one-half the injuries sustained in coal mining. The less shattered condition of the coal is also a safety factor in loading.

In its reduction of the individual type of accident and of the disaster, Cardox is an important step in the progress of the twentieth century.

CARE AND RECOVERY OF SUPPLIES UNDERGROUND

By H. A. TREADWELL

General Superintendent, Chicago, Wilmington & Franklin Coal Co.

In this subject, "Care and Recovery of Supplies Underground," I will attempt only to show how one can so manage in the use of their major supplies as to make a considerable reduction in underground expenses.

In the average coal mine the timber cost is a significant item of the underground material expense. T cost can usually be reduced if care is exercised in the method of distribution of timber to the various working places.

In some mines the crew on the gathering locomotives have sufficient time to deliver the timbers to the working places. Where it is possible to do this, it is generally found to be advantageous to have a material yar inby the parting where the motor delivers the coal and receives the empties.

In this material yard is stored all the different sizes of timber, rail, and ties. Whenever timber is needed at the face the loaders pass this information on to the motorman, and the motor crew load the material onto the next empty going to that place. There is never any surplus of timber to be left in the gob. The timber of right length is delivered at the right place, where and when it is needed.

The storing of track material in this material yard will greatly reduce its loss, for often under the old method it was left where last used, only to be looked up when needed at some new place. Only too well we know the results of this haphazard method. The material is lost or covered by a fall and new material is

ordered from the top, thereby resulting in an evitable additional cost to our materials.

In large mines where the haulage is fast and the slightest delay to a motor crew means a loss of tonnage, it is impossible to deliver timber with the gathering motor crew.

In such mines the foreman in charge of a section should order only the amount of timber sufficient for his immediate needs, and he should make a concise, detailed list showing the correct number, size, and length of pieces, and the exact location to where the material is to be delivered. The night foreman should see that these instructions are carried out. A large number of mine managers will say it can not be done, but it is possible to deliver timber in the right quantity where it is needed. If you are going to successfully reduce the underground cost of material and supplies, it is necessary to eliminate the loss through careless distribution, which carelessness allows so much material to be covered up in the gob or left at places where it is not needed.

Of course, there can be a large saving made in the pulling and reusing of timber. To do this successfully heavy tapered cap pieces should be used and especially trained men should be employed on this kind of work. The recovery of timber is a topic in itself, and while it is very interesting and generally affords a saving where possible to use it, it is not in use in the average coal mine. It is generally used today more as a factor of roof control in special methods of mining rather than for the saving made through the reuse of the timber.

Another possible factor of saving is in the handling of track material. I wonder if any of you men have ever figured out what becomes of all the fishplates that are sent into a mine. I have often felt that there is an unwritten law among tracklayers that fishplates can be used but once and then must be thrown into the gob. Where do they go? I do not know, but I can tell you how to partially stop them from disappearing. Make it a hard and fast rule that these fishplates should always be fastened together and connected to a rail whereever possible. If they are fastened together and the roadway in entries and rooms are kept fairly clean, you will thereby reduce this loss.

How often have you seen track spikes and bolts in old powder boxes and in piles along the entry, and even in old rooms? You have seen them as often as I have, and why? Because the men either did not have a bucket in which to carry them, or were too lazy to use that bucket. Track fastenings cost a considerable amount of money; roughly speaking, $2,000 a minimum carload; and you can not afford to waste them. If these are allowed to be scattered about promiscuously they may finally wind up in a carload of steam coal being shipped for use in automatic stokers. If so, you will probably lose a customer, and one can't afford a loss through carelessness of such sort.

Therefore, I would recommend that you have a material shanty in each section in which you store your switch throws, bridles, fishplates, bolts, and spokes, and don't permit them to be left kicking around the entries. Furnish your tracklayer with small buckets in which to carry spikes and bolts, and see that he uses them. Always furnish him with a good spike bar and a wrench so that he can recover some of the spikes and bolts. The only new equipment that is necessary to put the above into effect is a

couple of small buckets, and I can assure you this expenditure will prove profitable.

A third factor of possible saving is in the use of trolley and wire material. Everyone realizes that to get good service and long life out of trolley lines, the wire must be well stretched, fairly level and straight.

In order to maintain a level trolley the wires shoud be hung at a varying distance from the roof. To overcome variable height of the roof, do you use additional bells on the hangar to make the necessary extension? Some do, and this is an expensive method. I have often observed $10 worth of bells on one hangar where the use of 15 cents' worth of 1¼-in. pipe would have proved to be more satisfactory. A single bell is all that is needed on any hangar.

Have you ever heard coming down the entry a couple of men clanking and moving along like a couple of pack mules? I have, and they generally were wire men carrying wire stretchers, a box with bells, a few bolts, tools, and other necessary supplies. Then you have probably seen them hunting around in a crosscut, kicking up the dirt, or looking behind timbers, hunting for some hangars they have cashed at some other time. Did you ever watch the road cleanings dumped? If so, you have seen bells, clamps, expansion bolts, and every kind of wire material in it. You will reduce this loss by the use of a wire truck.

Where it is possible to use a wire truck this method is much simpler and less expensive. This truck is fitted with all the different material needed for wire work. Then the main underground supply can be kept at one place around the bottom, and there is no need for the wire crew to cash surplus material all over the mine, one-half of which is never found or used. The section foreman should keep only a very limited supply of wire material in his material shanty for emergency repairs. By the use of this wire truck you will prevent the leaving of supplies scattered around the mine to be lost in the gob.

In the last few years we have watched the growth of mechanical loading. One of the main problems in mechanical loading is the handling of repair parts, supplies, and oiling. It is a problem to have the repair parts at the right place, at the right time, and not to carry an excess of repairs in stock.

One company solved this problem to a certain degree by the following method: They work on an average of five loading machines on a territory or cross entry. Of course, they have the required number of cutting machines, drills, and haulage motors here, and this section is a small mine in itself.

Centrally located in this territory is a repairman's shanty, and the repairman stationed here keeps a small amount of the most used repair parts. Now, when a breakdown occurs, he makes the necessary repairs, and then immediately calls the main shop on the bottom for a replacement of the parts used on this piece of work. These parts are sent to him on the next main line motor trip to his section.

In the shop on the bottom a general supply of repair parts are carried. This supply, although limited, covers the list of usual parts that break and cause delays. Whenever the supplies of the underground shop are exhausted they are replenished from the regular stockroom on the surface.

In this main shop on the bottom a motor is kept, to be used for conveying supplies to any part of the mine

when it is necessary to make an especial trip.

The repairman turns in a report at the end of the shift and charges the supplies to the machine that has been repaired. In the office these reports are entered on a card for each machine, and from these cards the cost of machine maintenance is closely watched. Any carelessnes of operation or maintenance is located at once, for these records are kept on all loading machines, cutting machines, and haulage motors.

You may think that this method involves too much clerical work for the repair men, but they can make out these reports in five minutes. These reports are then turned in to and tabulated at the office.

On certain types of loading machines the oiling is a serious problem. The old haphazard method used in oiling cutting machines and motors will not work on loading machines. It is too expensive, and the results of careless oiling soon show up in the cost of supplies. To overcome the oiling problem, one company built up an oiling truck equipped with a pressure tank, to which was attached a meter for the purpose of keeping an exact record of the amount of oil used on each machine. This truck is equipped with an automatic Zerk gun, so that the machine is oiled and greased at the same time by one crew. The amount of material used is recorded and charged to the machine. A report of the amount of oil and grease used is left on the machine for the operator, the repairman and the foreman. Then a copy of this report is sent to the office, where it is entered on the machine card. Thus, an exact lubrication cost is at hand and quickly shows us a machine that needs attention. Since this method of handling repairs and lubrication has been installed, the repair cost on a machine has been materially reduced and the amount of repairs to be kept on hand has been reduced 30 percent. Also the oil cost per ton is about one-fourth as much as formerly.

The trailing cable on the different pieces of equipment in coal mines is given the least care and causes the most unnecessary delays of any single piece of equipment. It is abused through careless operation, run over, crushed by falls, kinked and pinched. When it blows up it is hurriedly spliced and given no more attention until it blows up again. I would like to call your attention to U. S. Bureau of Mines Report of Investigation 3154, called "The Splicing of Rubber Sheathed Trailing Cables," by L. C. Ilsley and A. B. Hooker. May I suggest that you read it carefully, for it contains many practical suggestions. If you will make use of them you can prevent many cable failures and thereby increase the life of your cables and reduce cable cost. Past experience has taught me that correct splicing of cables has reduced cable costs.

Many methods of handling underground supplies could be cited, but they would all point to the one general rule. Have all supplies necessary for the work at the place where and when they are needed, but don't have an oversupply and don't leave them laying around after the job is completed. Show your men a workable method of handling supplies, give them the necessary conveniences to put it into effect, and then see that they do it.

If there is a careful, economical handling of supplies, their recovery will be reduced to a minimum, and that phase of operation will naturally take care of itself.

LOW COST AND LOADING MACHINES

By W. J. JENKINS
President, Consolidated Coal Company of St. Louis

To the average mine operator the words "low cost" and "loading machines" are practically synonymous. And rightly so, when compared to operations at the same mine on a hand-loading basis. Compared, however, to another mine enjoying similar conditions, similar equipment, similar tonnage and working time, a mechanized mine may be a relative high-cost mine.

The prime determining factor that goes for low cost is the continuity of the loading operation of the loading machine. The cost of production is indirectly proportional to the ratio of loading time to operating time.

So, instead of considering "low cost," we will consider the ratio of loading time to operating time and enumerate some of the factors that tend to raise this ratio; or rather, we might say, raise the "loading percentage."

A high loading percentage is largely the result of a perfected system of operation. The system used is determined by local conditions and the equipment available. Let's enumerate a few of the main items that enter into the picture. The system being considered in a "general layout" and in a "loading-machine crew layout":

A. General Layout
   1. Supervision.
   2. Haulage.
   3. Partings.
   4. Power.
   5. Repair service.

B. Loading Machine Crew Layout
   1. Supervision.
   2. Section layout.
   3. Size of crew.
   4. Loading-machine operator.
   5. Car service.
   6. Co-operation.

In considering the general layout, we mean everything from the parting to the bottom, and the mine manager is the one directly in charge of this. Along this line, everything must perform like clockwork to get the maximum amount out of your property. The mine manager or some one delegated by him must be in constant touch with all portions of the mine. An adequate and dependable telephone system is absolutely essential. A breakdown on one loading-machine unit should not be allowed to hamper the operation of other units; the remaining units must be speeded up to compensate for this loss of tonnage. The men employed on this "general" territory must be advised of just what they are supposed to do at all times. In case of accident, where they are not advised, they should get in touch with the management and get their instructions. The whole thing boiled down to fact is that the operations must be directed from a central point to keep all lost motion out of the operations.

Regarding the haulage: This will probably never be settled to the satisfaction of all concerned. However, a few facts mentioned here can be taken for what they are worth.

The supply of empty cars to the loading-machine units is necessarily dependent upon the haulage, and the maximum point of efficiency will be reached only when the transportation is accomplished with the main-line haulage locomotives working at peak

capacity. By this is meant each motor handling the maximum number of ton-miles. Along this line, for a motor on a given run, a certain length of trip will produce the maximum number of ton-miles in eight hours.

The only way to determine the length of trip is to chart out the time per ton-mile or time per car-mile for various lengths of trips made over the same run, and when this has been determined as far as practical, try to operate close to this peak.

On haulage ways, the rail should be heavy enough to withstand the traffic over them, with a minimum of track work. Any derailments will result in lost time not only to the haulage but on all loading machines being served by this haulage. Grading the main-line haulage road will show big returns on the investment, both by increasing the ton-mile capacity of the locomotives and by decreasing the "demand load" on the power, which is quite a substantial charge when utilizing purchased power. Along this line, the ideal curve is one that can be taken at full speed, saving the time and power necessary to again accelerate the trip to full speed. In many cases we realize that this is not possible, but every effort should be made to attain as close to this condition as possible.

A double-track haulage system is highly desirable, but is impracticable in most mines sunk some 10 to 20 years ago. In these instances the haulage must be handled on a single track, account of local conditions. In these mines the traffic must be arranged to keep the trip rolling the entire way to the bottom. These, of course, are minor problems that must be worked out locally.

Along with the good roadbed, it is understood that an adequate power supply to the locomotive is absolutely essential.

Partings

In planning the partings they must be close enough to the loading units to serve them readily, and should be amply adequate. While it is not always possible to have the parting long enough to hold two full trips, they should hold at least a trip and a half, so that when a loading unit hits good loading territory it can take advantage of it and not be held up waiting on the haulage system. It is the practice of the Consolidated Coal Company to keep empty cars enough at each loading unit to keep that unit supplied for at least one hour's interruption to the haulage system. While this sounds expensive, it is preferred to a negative expense incurred through having the loading unit idle. Should the haulage be delayed, the time can be picked up by putting an extra locomotive into service long enough to recover the cars lost by this delay.

In locating the partings it is desirable to keep them as near together as the method of development will permit, both from the standpoint of serving the units by the repair crew and from the standpoint of maintaining as little main-line haulage track as possible. With more than 10 machine units located in a mine, it will probably be necessary to make two groups.

The economy of two groups is readily apparent, compared to having the partings at all extremities of the workings.

Power

With the introduction of mechanical loading, the power supply has undergone as much change as any other

item. Under hand loading, a voltage drop of 75 to 100 volts at the face was the common practice in nearly every mine in the State. However, the introduction of mechanical equipment has changed all this, for the reason that:

1. Low voltage results in loss of tonnage on practically every device operated, the loss being inversely proportional to the under-voltage operation.

2. Maintenance to equipment increases with under-voltage.

3. Loss of use while repairs are being made is an item—tends to offset expected savings.

4. With the large power consumptions necessary in mechanized mines, the operator can not afford to pay for power burned up in resistance, with no productive result. For example, under hand loading a 20 per cent voltage drop at the face was not unusual. However, with mechanized loading this would result in paying 25 percent bonus on your power, or an excess cost of a cent per ton, and in these days a cent per ton is important money.

It is the practice of the Consolidated Coal Company not to permit the d. c. voltage at the face to fall below 260 volts at any time. Toward this end, each two units are powered by a M. G. set located as close to the territories as is practical, and when voltage at face drops to 260 volts (full load), the M. G. set is advanced.

Repair Service

On the hand-loading basis where men were employed by the ton, repair service took the line of least resistance. Repairs were made when convenient, since the employe was not paid when his machine was not producing, even though no fault of the man. However, with the man employed by the day, his pay continues even though his equipment is not producing, and the surest way to keep cost down is to keep the equipment producing. This fact has produced results to a point where, at the present day, the maintenance department is probably the highest specialized department in the mine, and the men in this department are usually retained on idle days.

In many instances the importance of maintenance is underrated. Taking into consideration:

1. The wages of the mechanical-loading crew.

2. The loss of realization on the expected output from the unit.

The cost during the period the unit is nonproductive will run well over $1 per minute. This indicates the necessity for having the maintenance crew in close proximity to the units. The Consolidated Coal Company, at one of its mines, has 10 loading machines operating within seven minutes walk of the repair shop. While not on trouble calls, the maintenance gang works on overhaul jobs in the shop. When a call comes they drop this work, and resume it on their return. These men are trained on both electrical and mechanical maintenance and are under the direct supervision of a technically trained man. While all the men under him can handle any of the trouble calls, one specializes on loading machines, one on cutting machines, one on locomotives, one on drills and wiring, and one on substations. The round of the loading units is made by these men four times a day, even though no call for service is made, because oftentimes a defect will be noted by them and corrected before any serious delay or damage is done. During the half hour at lunch time, every machine is inspected and any necessary repairs made during this in-

terval. On idle days each machine is given a thorough going over, with the view in mind that a "minute saved is dollars earned."

In the underground repair shop a stock of repair parts is kept, also spare cutting machines, drills, locomotives, etc.

As for loading machines, the ideal system is to keep a spare territory all equipped. Should a loading machine get in such shape that it could not be put in operation within an hour, the whole loading crew is transported to this reserve territory and carries on there. This system is being carried out at one of the mines of the Consolidated Coal Company with very good success.

It will be noted from the above the mine manager's duties do not permit him to spend much time sitting on the bottom figuring "all is well" as long as the cars keep coming in, because under mechanized loading, trouble is not reflected in the haulage until several hours later. Instead, he must be out "hunting for trouble" and locating it before it occurs.

Having sketched over the points in the general layout, let us get in to where the coal is actually produced. Here also, as in the general layout, supervision is the vital factor.

In the selection of bosses, it is interesting to note that some of the so-called "coal-getter" under hand-loading practice fall down under the mechanization program. The bosses have to be leaders, rather than pushers. They must have the respect and confidence of the men to get them to carry out their plans.

The statement made by one of our superintendents recently was that "unless a boss wore out a pair of shoes every three weeks he was not properly making his territory."

With this somewhat curious statement in mind, let's look into the duties of a face boss in mechanical-loading mines.

1. He must inspect and have made safe every room on his run before the men are permitted to enter of a morning.

2. He must see that proper car supply is furnished to loading machines.

3. He must see that every room is properly cleaned and safe, and center and ribs marked off after loader moves out and before cutting machine moves in.

4. He must see that rooms are properly and quickly cut.

5. He must see that holes are properly drilled.

6. He must see that holes are properly tamped with correct charge.

7. He must see that track laying is kept up in proper shape to facilitate fast loading.

8. He must see that rooms and crosscuts are turned at proper places.

9. He must see that car changes are made in proper manner to expedite car changing and prevent his various operations from interfering with each other.

10. He must see to it that the loading machine makes "moves" as short as possible.

11. He must see that the timbering is kept up to keep places safe.

12. He must keep an adequate amount of supplies on hand at convenient places.

13. He must see that there are always enough loadable places on hand for the next day's work.

14. He must at all times instruct the men as to proper and safe methods and see that they perform their duties in this manner.

And after having done all these things and kept his parting full of loaded cars and his cost down lower than any of his associate bosses, he

can then sit down and save his shoe leather.

From the above, it is quite apparent that "bossing" is not what it used to be. Still as one of the old timers expressed it, "I like it, since there is something doing every minute."

Section Layout

This will unquestionably vary with every company and every mine. However, the section should at all times be laid out with the cost feature in mind.

As to the number of crews a boss can handle—this will vary with different companies, and may vary from one to four crews, according to the individual ideas of the management.

Our own company has adopted the plan of one boss for two loading units as being the most economic layout.

With this in mind, taking this figure, the territory is laid out so that the two units do not interefere with each other and, further, that the several operations of each crew do not interfere. The layout should be such that the relay motor can keep the service motor supplied with adequate empty cars and take away the loads. This means good road, not only on the entries but in the rooms as well, since derailments mean delay. The turns should be of ample radius. As a general rule, double the radius used in the mine during hand loading and you will be about right. This makes for high-speed transportation.

The room width, of course, depends upon local conditions and the type of car change on the room width. The average car change time should not exceed 45 seconds in good operations. It can be kept lower, but if cost of doing so offsets the gain, the result is not desirable.

One of the most important things in the section layout is to keep the haulage ways clear and keep the rooms in such order that the loading machines do not have to do extra moving and digging to clean up a place. When a place is cleaned up the crosscut should be large enough to permit the loading machine to move through the crosscut into the next room, without having to go clear to the entry.

The Loading Machine Operator

In all cases, the choice of an operator can not be stressed to strongly. Since he is placed in charge of the most vital piece of machinery on the job, he should be a man endowed with the power of leadership. With the men on the crew respecting his ability, they strive to make things easier for him and to help him in trying to lead other operators. He, likewise, should be a willing worker, and in performing his work leave as little unnecessary work for the rest of the crew as possible. The loading-machine operator might be classed as the star performer on the crew, and one with a radical viewpoint will soon ruin the morale of the whole crew, in spite of the efforts of the boss.

Car Service

The question of car service is one of general disagreement, the choice being between cables, mules, battery motors, and cable reel locomotives.

Storage-battery locomotives have been chosen by the Consolidated Coal Company as the ideal type for our mines, on account of their combined speed, power, and flexibility, and in our opinion the most economical to operate. They are on about par with the cable reel regarding speed and power, except in mines with excessive grades. Regarding flexibility, they do not have to return the same way they enter, which is extremely desirable in

mechanized practice, and their power requirements or charging load is carried at night and not added to the already high peak day load. On the relay or swing motor there is not much choice between the storage-battery motor and the cable-reel locomotive. However, to keep equipment as inter-changeable as possible, the Consolidated Coal Company uses the storage-battery locomotive on all but main-line haulage service.

Cooperation

To get the most out of all the above-mentioned items, cooperation is necessary among the entire crew, and if the operations are directed properly a spirit of rivalry develops among the different crews, each crew trying to outrank their rivals; the loading operator tries to set a high mark on cars loaded, the motormen to set a record on cars pulled. This spirit carries the balance of the crew along with it, and at quitting time you will probably overhear the settling of bets as to who had the low tonnage and had to "buy the cigars."

A very humorous case developed at one of our mines, where a loading machine operator who had an extremely good territory had the ambition to try and load as much coal as both operators on a less favorable territory. While he has never quite accomplished the task, nevertheless, during the last two months of the wage agreement he has come within less than 5 percent of doing so on six or seven occasions. To prevent him from entirely breaking the spirit of the two crews, the gossip locally is that we plan to make a face boss out of him on the resumption of operations.

ACCIDENT PREVENTION WITH PROTECTIVE CAPS, HARD-TOED SHOES AND GOGGLES

By DAVID W. JONES
Superintendent, Valier Coal Company

The introduction of protective caps, hard-toed shoes and goggles for the use of men employed in coal mines required both patience and persuasion. A few of the men grasp the merits of safety suggestions and wear the safety articles, not only as insurance for their own personal safety, but to encourage others who are not so careful and are more likely to suffer a preventable injury. Such men deserve credit for their good judgment and intelligence.

A second group of men give an attentive ear to safety suggestions, but their minds do not concentrate a sufficient length of time to cause them to become safety conscious.

A third group comprises men who have been persuaded to take precautions against preventable injuries, either by actually suffering from such an injury or by witnessing one to a fellow-workman.

The rest of the men are in a class which is indifferent to safety suggestions and even after being injured, will not make an effort to be more cautious or will not be inconvenienced by worrying about a recurrence. Such

men are inclined to feel that their destinies are pre-determined and are the hardest ones to deal with in safety matters.

After the Valier Mine was fully mechanized, a study of the accident reports indicated that the new methods of mining had reduced the number of the more serious injuries, but the number of minor injuries had increased. Most of the avoidable ones were to the head, toes and eyes. It was realized that it would be necessary for the men to wear hard-crowned caps, hard-toed shoes and goggles to protect themselves against injuries of this nature. They are always accidental, for a man will not deliberately subject his head to a hard blow or stand under a falling rock which might crush his skull. He must wear a safety cap at all times while in the mine to protect his head when the unusual situation is encountered. Likewise, a man must wear hard-toed shoes at all times while he is working, for he does not know when he will drop a rail or prop on his toes and break them. Goggles are in a different class and it is not necessary for a man to wear them continuously. Each man can not be protected with the same type of goggles. Wire screen goggles will protect the eyes of cutting machine men and pick men in a practical way. Wire screen goggles can be cleaned quite easily and can be put on and taken off just as frequently as the wearer feels that they are required. A mahine man should wear a safety cap to protect his head against falling jack-pipes, as such accidents are common and often serious. A motorman should wear a pair of goggles fitted with non-shatter glass to protect his eyes against particles carried in the ventilating air. A motorman should, by all means, wear a safety cap. A striking example of the protection gained by wearing a safety cap occurred when a main line motorman raised up from his seat to put the trolley pole back onto the wire after it had jumped off and struck his head against a cross-bar. The blow was sufficient to knock him down into the cab of the locomotive and stun him temporarily. If this man had not been wearing a safety cap undoubtedly he would have been knocked unconscious and fallen from the locomotive onto the track while running at fairly high speed. For men working in air courses and exceedingly dusty places, a close fitting type of rubber goggles with safety glass is well suited to keep the very fine dust out of the eyes.

It is not sufficient to suggest to the men that they equip themselves with the different safety articles to avoid preventable injuries. Such articles must be accessible and available for use at the opportune time. A man may narrowly escape toe injury many times during a day and then sincerely decide to puchase a pair of safety shoes and not take further chances. However, unless it is possible for him to obtain safety shoes without much inconvenience, it is likely that he will not do so until after he has been injured.

At the Valier Mine, a small quantity of the safety articles recommended to the men for their use were offered for sale through the storeroom by payroll checkoff. The hard-toed shoes were priced at practically cost. The hard-crowned caps and various goggles were offered to the men at one-half the cost price.

The serious thinking men referred to as belonging to the first group, responded immediately and among the other men there was much criticism as well as praise for their efforts. Men were curious to know to what

extent benefit was afforded. The safety caps and hard-toed shoes especially, were subject to much inspection and test. The results in general were favorable and after many of the men became accustomed to wearing the caps and shoes the novelty wore off and no inconvenience or discomfort was noticeable. After several cases had been reported where head, toe and eye injuries had been prevented by these safety articles, the men in group No. 2 began to line up with the safety-thinking ones. After a number of men in group No. 3 had been injured and had been talked to along safety lines, they realized how much better off they would have been with protection at the low cost offered. When they returned to work, they were equipped with protection and they were the means of convincing others of the advantages to be gained by using every precaution possible. For instance, practically all of the regular timbermen purchased safety caps after learning of the experience of one of our men who was struck on the head by a piece of falling slate, weighing about 8 pounds. A sharp corner of the rock struck the front of the hard-crowned cap, tore off the lamp bracket and cut into the cap. There was no question as to what the result would have been, if this man had not had on a safety cap.

Many eye injuries were prevented by the timely wearing of goggles. One man wearing a pair of goggles with safety glass, had one lens completely shattered and to his surprise and happiness found the eye had not the slightest injury. A number of damaged specimens showing dents in the hard toes and crushed toe caps where injuries had been avoided, were obtained from men wearing safety shoes. Other foot injuries had been made slight instead of serious where the blow was struck on the foot between the toes and instep. A motorman presented a pair of goggles showing small pieces of copper imbedded in the glass, caused by the trolley pole flying off and the arc throwing molten copper.

In order to give publicity to some of the more serious accidents which had been avoided, a display cabinet was mounted on the bulletin board at the shaft. The new, as well as the damaged articles were shown, with the history of the accidents printed on small cards. It was soon apparent that our efforts along safety lines were being rewarded by fewer preventable accident reports covering injured heads, toes and eyes.

After the first 100 men had been converted to the safety class, we planned to reach the second 100 men who wanted the safety protection, but offered excuses for not being able to obtain it. Accordingly, it was announced that each man who had purchased a safety cap at one-half price would be given full credit for the amount he had paid for the cap when he purchased his second pair of safety shoes. Employes thereafter who purchased their first pair of safety shoes at the regular price would be given a safety cap for use in the mine—free of cost. In other words, the company agreed to equip each man with a safety cap who wore safety shoes.

The wearers of goggles were informed that the company would replace broken lenses and rubber bands which were broken or worn out in the mine. In cases where men required prescription lenses in goggles, the company still agreed to pay one-half the purchase price and send away the man's regular glasses to have similar correction applied to the safety lenses.

This program was continued until the second 100 men were lined up for safety, and again plans were made to attract the third 100 men to the safety-thinking class. Many men felt that it was necessary for them to completely wear out all their old ordinary shoes before they could afford to purchase new safety shoes and this condition led to the announcement that employes could purchase safety shoes and be given a safety cap free, on a partial payment plan of a 50-cent check-off per pay period. This plan had immediate response and we are now following it. The best day for shoe sales is our regular pay day, when a man buys a pair of safety shoes, knowing that he will not begin paying the 50-cent checkoff until the next pay day. Thus, the men are paying for the shoes as they are wearing them out. As the shoe sales increased, the cost of handling and stocking became self-supporting and it became necessary to stock a few different grades to satisfy the peculiarities of the men. Heavy safety shoes were provided for those who were not required to be fast on their feet. Lighter types and more flexible safety shoes were offered to trip-riders and men engaged in active moving.

In conclusion, I wish to state that we feel that our efforts have been rewarded, both from the standpoint of operating efficiency and financial expenditure. The accidents prevented have more than paid for the expense of providing first class safety caps and goggles. Aside from the pecuniary interest which started the safety campaign it has been a source of gratification to see a man display a safety cap which had saved a fractured skull, or see the crushed toe of a safety shoe which had saved the toes of a man and enabled him to continue work.

After all, the safety cap is the most essential safety device offered. Most of the broken bones of the body will mend, but a crushed skull is nearly always fatal.

A satisfactory reward comes in knowing that the sight of an eye has been saved, by making it possible for an employe to protect his eyes with goggles furnished to him at one-half price, because if merely a suggestion had been offered instead of the article itself, the man would not have responded to it.

In time, we hope that the safety caps, safety shoes and goggles will not be looked upon as accessories in the mine, but become so generally used that the men who do not make an effort to avoid preventable accidents with them will be in a small minority.

Valier Mine Reportable Injuries, Man-Shifts Worked and Man-Days Lost

During the first three months of the year 1932, there were 147 reportable injuries for 31,840 man-shifts worked, or an average of 216 man-shifts worked per injury reported.

Out of a total of 147 injuries reported, the total lost time amounted to 313 man-days. These 313 man-days were lost as follows:

Percent			Days each
33.2	Two men with crushed hands lost	104 Man-days	52
26.2	Three men with broken legs lost.	82 Man-days	27
9.3	One man with an injured eye lost	30 Man-days (not wearing goggles)	30
6.0	One man with crushed toes lost .	18 Man-days (not wearing safety shoes)	18
25.3	The balance of the time, or.....	79 Man-days were lost by 14 men which amount to an average of 5.6 man-days lost per man..	5.6
100.0			

PROCEEDINGS OF ILLINOIS MINING INSTITUTE ANNUAL MEETING NOVEMBER 4, 1932

The Fortieth Annual Meeting Held at the Hotel Wolford, Danville, Illinois, Friday, November 4, 1932

MORNING SESSION

The Fall Meeting of the Illinois Mining Institute was held in the ballroom of the Hotel Wolford, Danville, Illinois, on Friday, November the fourth, 1932.

Mr. George McFadden, President of the Institute, called the meeting to order at ten A. M., and addressed the membership as follows:

PRESIDENT McFADDEN:

Members, officers, guests and distinguished speakers of the Illinois Mining Institute: I take great pleasure in opening the fortieth annual meeting of the Illinois Mining Institute. I have the honor to present Hon. C. E. Madden, Mayor of Danville. (Applause.)

MAYOR MADDEN:

Mr. President, Ladies and Gentlemen: I assure you that I do love to have a large body like you come to Danville and it is a great pleasure to welcome you here again. Danville has a lot of things we are very proud of. It might be interesting to you to hear that you are in one county that has not had a single bank failure. Our banks are in good shape, our Building and Loan Associations are all in good shape, and we have about forty thousand of the best people in the world here in Danville. Among them, we have a lot of coal miners that we are proud of. (Applause.) Communism does not thrive in our city. (Applause.) We have everything here that it takes to make a good town, and, outside of Chicago, I do not believe there is a town in Illinois that has had more high class conventions held in it. Gentlemen, when you come here, we try to leave an imprint on your memory so that you will want to come back to Danville, and if Harry Moses cannot find you what you are looking for while this convention is on, why, just call on me and I will have the Chief of Police go out with you. I am mighty glad to have George McFadden come back here. He is one of the boys we are proud of. All I can say is that when Harry Moses told me this gang was coming, I just threw the keys of the city away, and I thank you for the privilege of being here with you today. (Applause).

RESPONSE TO MAYOR MADDEN BY PRESIDENT McFADDEN:

Mayor Madden, I deeply appreciate your remarks and wish to express on behalf of the Illinois Mining Institute their appreciation of your hearty welcome to Danville, the city that that illustrious statesman, Joseph G. Cannon, called home, which is, as well, the home of many members of this Institute. The "I. M. I." stands for the advancement of the mining industry in all of its ramifications. It is a pleasure to meet in Danville, one of the few mining districts in this State where the duly elected law-enforcement officers have seen fit to assert their authority to prevent outside intervention in the operation of the mines of this community. Your city and County authorities are to be congratulated and highly commended

for such action, which is not forthcoming in communities where political expression is given more significance than their duties, which has been the condition that has prevailed in many of the districts today where we have so much labor unrest. Many of the active members of this Institute (including father and son) were trained in this district, which for more than thirty years has produced an average output of around two and a quarter million tons of coal per month, (equivalent to the entire production of the State of Oklahoma.) We are glad to return to this district, which has been blessed with the type of workmen who are capable and qualified to do a job well. Thank you. (Applause.)

We have some ventilation experts with us this morning and I am going to appoint as a committee of two, Johnny Jones and Ben Schull, to look after the ventilation of this room during our meetings today. (Applause.)

Voice from the rear: Please close the trap door in the Main East! (Laughter).

One of the above committee, opening a window near the reporter, a gale of wind blew in, and Mr. McFadden instructed Mr. Schull to "reverse the air." (Laughter.)

President McFadden: We will now proceed with the Order of Business, which is: Reading of Minutes of last meeting.

Motion, (duly seconded and carried:)

I move that we dispense with the reading of the Minutes at this meeting so that we may have more time for the program. So ordered.

President McFadden: The next Order of Business is the report of the Executive Board. Mr. McFadden, by virtue of his office being Chairman of the Executive Board, made the following statement:

There were no called meetings of the Executive Board during the year; however, there were a number of partial Board meetings. The membership during the year was very active in aiding and assisting the Mineral Industries Committee, the Museum of Science and Industry and I might say that it was through the co-operation of the members of the Illinois Mining Institute that made it possible for the American Mining Congress to have such a successful meeting in Cincinnati last May. The officers and members of our Institute were, I am sure, very helpful in assisting the organization of the new Mining Institute of Indiana. You have, I know, stood ready to aid the industry as a whole, and had the occasion warranted, your Executive Board would have met in full session, with full representation, to handle any questions of major importance, which, however, did not appear during the year.

The next Order of Business will be the report of our good Secretary, Mr. Schonthal:

SECRETARY'S REPORT

November 4, 1932

To the Officers and Members of the Illinois Mining Institute:

We have just gone through a very hectic year in the coal industry in this State. The Institute has been less active than it has been in the past few years because of conditions with which you are all familiar. We feel gratified, however, that we have been able to maintain our position as well as we have, in that we have our membership in fairly good condition, as follows:

Regular members who have paid dues for year ending October 31, 1932	331
Life members	22

Honorary members	4
Total enrollment	357

This compares with 375 last year, or a loss of 18 during the year. During the year we took in 80 new regular members, two life members. Seventeen members sent in resignations, and we have a total of 82 members who paid dues in 1931 but who failed to pay in 1932 but whose names have not been dropped from the rolls; these 82 are still eligible for membership, and we hope to have them with us in the coming year.

We have been rather unfortunate in having lost two regular members and one life member by death, the latter our very good friend and past President. Letters of condolence were dispatched promptly to the families of our deceased members, as follows:

C. E. Karstrom.....March 24, 1932
Joseph D. Zook.....May 28, 1932
Edward Cahill.....August 4, 1932

Our cash position has been maintained in a very satisfactory fashion. Our income from dues, profit on year book, and interest on bonds, increase our cash position, as you will note from the financial statement.

Our boat trip in point of attendance was not quite equal to our 1931 trip, but because of reduced rates to our members at a decreased differential between the cost to the boat company and the fee for members, showed a slight loss on this trip. We hope that during the coming year many of the problems that our members had before them during the past year will not be present and that we shall be able to be much more active than we have been in the year just closed.

All officers and committees functioned to the very best of their abilities, and the Secretary wishes to express his appreciation of the assistance given by the officers and the members when requested.

Respectfully submitted,

B. E. SCHONTHAL, Secretary.

President McFadden: The next Order of Business will be the report of the receipts and disbursements, and I will ask Mr. Johnson to read the Report of Cash Statement as of November 2, 1932.

REPORT OF AUDITING COMMITTEE

Receipts and Disbursements

Receipts:

Cash in bank 11-1-'31		$1338.88
Dues collected from 331 regular members—$3.00 each		993.00
Interest earned on bonds		160.00
Profit from year book	1152.92	
Less paid in 1931	60.00	1092.92
Total receipts		$3584.80

Disbursements:

General expense: postage, printing, mailing, etc.		$ 292.30
Loss on boat trip		52.25
Extra expense of secretary		100.00
Two U. S. Treasury Certificates @ 4¼% purchased		2158.50
Total disbursements		$2603.05
Balance on hand 11-2-'32		$ 981.75

Life Membership Account

Cash on hand November 1, 1931	$ 80.33
Two life memberships sold in 1932 @ $50 each	100.00
	$ 180.33
Interest earned on Life Membership Account	3.51
Total	$ 183.84

Bonds Owned by Illinois Mining Institute

One—$1000 bond Chicago, Burlington & Quincy Railroad
Due February 1, 1977, bearing 4½% interest.
One—$1000 bond Missouri & Pacific Railroad
Due February 1, 1965, bearing 5% interest.
One—$1000 bond Western Union Telegraph Company
Due August 1, 1936, bearing 6½% interest.
Two—$1000 U. S. Government Treasury Certificates
Due 1947-1952, bearing 4¼% interest.

The above is in accordance with audit and is found to be correct by the Auditing Committee

Motion by C. J. Sandoe: I move that we accept the Secretary's report, but I want to make some remarks on the Auditing Committee's Report, so I move that we accept the Secretary's Report, as read. (Motion duly seconded.) Carried.

President McFadden: The Secretary's Report will stand approved as read.

Mr. C. J. Sandoe: On the Auditing Committee's Report, I notice that we have donated one hundred dollars to the Secretary of this organization for expenses. I do not know of any other man who could afford to give the time to the Secretary's work that Mr. Schonthal does, and also provide a loafing place for those of us who go to Chicago,—answer a lot of d—— fool questions, and get up a Year Book, most of the work on which I know is laid on him. I feel as though in our financial condition we should this year donate him fifty dollars per month or six hundred dollars a year, and I so make that motion, for one year only.

Mr. Jefferis: He is hardly worth it, but I'll second the motion. (Laughter.)

The question was raised as to whether this increase would be in violation of the by-laws. Mr. Sandoe replied that it must be made as a donation; otherwise it would be in conflict, and stated: "I made the motion as a donation, for this year only."

President McFadden: Any remarks?

Mr. Johnson: I just want to say that this one hundred dollars, which is down there as "Expenses of the Secretary" in my opinion and the opinion of the other members of the Auditing Committee and probably many other members of the Institute, certainly fails to compensate by a large amount the actual out-of-pocket expenses of the Secretary, and that does not include the loafing place that he has to supply and the time he expends, which I think is much in excess of the small amount that has been allowed him previously.

Secretary Schonthal: I am very grateful. You most of you know just how I felt about this. The first thing I have on my mind is the success of the Institute. I have had some mighty good help from everybody and whether anything is donated or not,

I am going right along, for I believe in the Institute and I have always done the best I could for it, so I thank you very much. (Applause.)

President: You have all heard the Auditing Committe's Report? What is your pleasure?

Mr. Jefferis: I move its adoption, as amended and revised by the motion to provide for six hundred dollars compensation for the Secretary instead of one hundred dollars, for this year only.

President McFadden: All those in favor of the adoption of the Report of the Auditing Committee, as amended by motion to increase amount from one hundred to six hundred dollars, for this year only will signify by saying "Aye." Contrary "No." The Ayes have it, and it is so ordered, and is unanimously adopted.

President McFadden: The Secretary's report, as you remember, covered the condition of the membership, but the Chairman of the Membership Committee, Mr. Harry Moses, is present, and I'm wondering if he has anything to say at this time.

Report of Membership Committee

Mr. Harry Moses (Chairman): Mr. President, the Membership Committee has been rather inactive this year, due to the fact that we have had a hard year in the industry. But the Committee wishes to give all due honor to the President and Secretary-Treasurer for the part they have taken.

Mr. McFadden: The next Order of Business is "Unfinished Business."

Secretary Schonthal: There is no unfinished business.

President McFadden: Then the next Order of Business is the

Report of the Nominating Committee

Mr. John A. Garcia (Chairman): Mr. President and Members of the "I. M. I.": The Nominating Committee had a rather difficult job this year. There was so much available timber and so much rivalry for the different jobs that we could not agree. We met a number of times and had several quarrels and near-fist fights. But finally we selected, I think, the best set of officers we have ever had, meaning no disrespect for the present incumbents. The balloting of the Nominating Committee finally resulted in an unanimous verdict to sign the report of the committee and turn it over to the Secreary to be read at this meeting. (Report read by Mr. Schonthal.)

Hearty applause followed the reading of the name of each officer, which list is as follows:

OFFICERS:

Charles F. Hamilton, President.
H. A. Treadwell, Vice-President.
B. E. Schonthal, Secretary-Treasurer.

EXECUTIVE BOARD.

Geo. F. Campbell.
Paul Halbersleben.
E. H. Johnson.
Geo. C. McFadden.
John G. Millhouse.
Harry H. Moses.
Fred S. Pfahler.
C. J. Sandoe.
John W. Stedelin.
H. H. Taylor, Jr.
T. J. Thomas.
Paul Weir.

President McFadden: You have heard the Report of the Nominating Committee and a motion is now in order:

Mr Jefferis: I move that nominations now be closed and that the Secretary be instructed to cast a ballot

in favor of the election of the candidates named by the Nominating Committee.

Motion duly seconded.

President McFadden: It has been regularly moved and seconded that the Secretary be instructed to cast one ballot in favor of the election of the candidates named by the Nominating Committee. Are you ready for the question? All in favor will say "Aye" —Contrary "No." Carried. The Secretary is now instructed to cast the ballot.

Secretary Schonthal: It is so cast for the names submitted by the Nominating Committee.

President McFadden: The ballot has been cast for the candidate's names and I declare them duly elected to their respective offices.

The Secretary has some communications to read at this time; a telegram from Frank Rhine, a letter from our good old friend Sam Jenkins; also a letter from one of the old-timers in Illinois, Dr. Rutledge, Chief Mining Engineer of the Bureau of Mines, Baltimore, Maryland.

President McFadden: Any other comments to make at this time by any of the members present?

A member arose and said: On hearing of the financial condition in which the society is, that we have eighty-odd members who have failed to pay their dues, I am wondering if it would not be well at this time to make the dues two dollars instead of three, thereby strengthening our organization with more members.

Another member replied: That is such a terrible thing to enter in now I think it would be well to refer it to the Executive Board for consideration, as there are too many things to be taken into consideration. I do not make that as a motion, however.

Mr. McFadden: The suggestion could be worked out, but with the change that we have made in our financial structure, I doubt whether it would be advisable at this time. It would take a year to work that out. The change was made, originally, from two to three dollars, and that change required a year. It is my personal belief that if a member can afford to pay two dollars he will willingly pay that extra dollar to affiliate himself with an Institute of this kind.

The regular business session has carried us to the point of the program. Your Program Committee and Arrangements Committee have worked diligently to provide one of the best programs we have ever had occasion to present to the Institute. I am not going to tell you very much about it because I am sure you will be well satisfied and I want you to be the judge at the end of the program.

I am going to ask Professor Callen to preside as Chairman for the morning program. Professor Callen, please come forward. (Applause.)

Professor Callen: Mr. President, Members of the Illinois Mining Institute, and Distinguished Guests:

I do not know why President McFadden asked me to preside, but I will accept the responsibility. The first thing I will tell you is that lunch will be served on this floor and the price will be seventy-five cents. The banquet tickets for tonight will be one dollar and a half, and we would like to have you reserve your tickets as early as possible so that the hotel management can set up the tables. Please co-operate with us today and get your banquet tickets early so that there will be adequate seating and eating accommodations.

The first paper scheduled on our program is:

Mine Track Work: Its Relation to

Safety, Production and Maintenance, by J. B. Haskell, Chief Engineer and Designer of Track Equipment, West Virginia Rail Co., Huntington, W. Va.

Gentlemen, I take pleasure in introducing Mr. Haskell. (Applause.)

MINE TRACK WORK, ITS RELATION TO SAFETY, PRODUCTION AND MAINTENANCE

By J. B. HASKELL

Chief Engineer and Designer of Track Equipment, West Virginia Rail Co., Huntington, W. Va.

Underground coal transportation is in reality an industry within an industry. It is an industry charged with the task of transporting more coal than is transported by the railroads of this country, and it is a task that must be performed economically and efficiently if it is not to be a handicap to the major industry which it serves.

There is a point or so called bottle neck that is the limiting factor of production in many lines, a point that restricts all other production preparations. Experience has shown that transportation is usually the bottle neck of coal production. In both hand and machine loading, the supplying of cars as needed and their movement to the tipple is vital to the success of the operation. And so it is essential that a means must be supplied whereby the cars, empty or loaded, can be moved economically and quickly. The planning of the haulage system with its main and secondary tracks must take into consideration the methods of mining, the present and future production from each section of the mine and the condition and capacity of the rolling stock.

The increase in power and weight of mine locomotives and the improvement in car design permitting the movement of longer, heavier trips at greater speeds than heretofore, make it essential that the track work must be well designed, properly installed and of good material. Short radius curves, depressed joints, horizontal kinks either at the joints or in the rail itself, curves put in by careless hand methods that allow the greater part of the curvature to be concentrated near one point, all make for slow, expensive transportation.

Some of the new steel mine cars are so rigid that they do not weave and adjust themselves to track irregularities. They are, therefore, subject to derailment when passing over uneven track. Even though derailment does not occur on such track, it is expensive track on which to operate, no matter how cheaply it was purchased and laid.

Bad track is expensive track. It is wasteful of power. Whether it be out of alignment either vertically or horizontally, the power necessary to move cars is increased very materially. Every lurch of a car or a motor means frictional resistance. Every unnecessary or unduly sharp curve causes extra slippage of the wheels and increased power consumption. The track should be such that trips can be moved at full speed between terminals without the necessity of slowing down at numerous places or coming to complete stops. Starting a trip and accelerating to full speeds develop

the gavel, and if he throws any bricks at the toastmaster I will gavel him down. (Laughter). Gentlemen, I have the honor of presenting to you the new President of the Illinois Mining Institute, CHARLES F. HAMILTON.

Mr. Hamilton spoke as follows:

Mr. Toastmaster, Guests and Fellow Members of The Illinois Mining Institute:

Mr. Garcia has taken a rather unfair advantage of me because we have had two or three little trips together in the last month or so and got pretty well acquainted, and at this Illinois Mining Institute banquet, John, you have handed out so many flattering and funny remarks, I hardly know what to say, for I had no idea they were going to be recorded. However, seriously speaking, I deeply appreciate the honor which you have conferred upon me by electing me to the Presidency of this Institute. When I review the progress that has been made under the administrations with which I am most familiar—those of John E. Jones, Professor Callen, the late Joseph D. Zook and the extremely efficient administration which has just closed under George McFadden, I realize that I have some task on my hands and that what limited ability I may possess will have to be used in directing the affairs of this Institute,—and to that end,—I pledge you the best that I have. (Applause.) * * * * Many panaceas and remedies are offered for bettering the present condition of the coal industry, but I can think of no better plan than to go back to primitive conditions, and all of us stick together for good or bad. The Toastmaster has referred to me as a "college boy," which has made me think of the days when I was studying English literature—especially the works of Rudyard Kipling. His poem, "THE LAW OF THE JUNGLE" it seems to me is especially appropriate at this time, as well as under primitive conditions. If I recall it correctly, it goes something like this:

"Now this is the law of the Jungle—
as old and as true as the sky;
And the Wolf that shall keep it may
prosper, but the Wolf that shall
break it must die.
As the creeper that girdles the tree-
trunk the Law runneth forward
and back—
For the Strength of the Pack is the
Wolf, and the strength of the
Wolf is the Pack."

I thank you. (Applause.)

Toastmaster: I wish to announce a telegram from Paul Weir in which he says he regrets he was detained from attending our meeting and sends his regards to all.

We have so many celebrities with us, and our hour is so crowded, that I cannot do justice to the occasion. I know you are all anxious to hear the distinguished speaker of the evening, but I would like to have a few words of greeting from the President of our sister Institute,—the Indiana Mining Institute—one of the fellows from way down "On the Banks of the Wabash,"

MR. JOHN HESSLER:

Mr. Toastmaster and Gentlemen:

It gives me considerable pleasure to be with you this evening. Our Institute in Indiana is but a year old, but in that year it has accomplished more than the most hopeful of us ever expected. Our Institute in Indiana was helped wonderfully by the encouragement and assistance of the many friends from the Illinois Institute who attended our initial meeting and gave us the inspiration that we needed to carry on, and I will say, frankly and freely, that the help we received from the membership of your Institute is

JOHN G. MILLHOUSE, of Springfield, our beloved and efficient Director of Mines and Minerals. (Applause.)

FRED S. PFAHLER: A progressive operator. Absent. (Applause.)

C. J. SANDOE OF ST. LOUIS: That sweet-voiced singer of the "S. S. CAPE GIRARDEAU" whose voice is always sweetest at about "three o'clock in the morning." (Applause.)

H. H. TAYLOR Jr: A chip off the old block. (Applause.)

T. J. THOMAS, of the Valier Coal Company. Efficiency personified. (Applause.)

PAUL WEIR: That smiling sphinx of Egypt is absent again. (Applause.)

GEORGE McFADDEN: From Chicago and everywhere! (Applause.)

JOHN W. STEDELIN: Also from down in Egypt, is not with us tonight. (Applause.)

You have elected (or rather re-elected)

B. E. SCHONTHAL of Chicago as Secretary-Treasurer, the first man I have heard of in many years getting a promotion in salary. (Laughter.) Whenever I see his smiling face, I always think of either cupid or kewpie. (Laughter.)

When your Nominating Committee got around to the Vice Presidency, they evidently decided to inject a little color in the slate, so they induced a red-head to accept the job. Never in my memory of this Institute have we ever had a red-headed or a bald-headed Vice President. He is a man of many colors and is physically strong as an ox. At Cincinnati, he took your rotund Secretary and tossed him up in the air to the ceiling, and I was trembling with fear as to what might happen had he taken hold of a man of such physical contours as myself. Gentlemen your new Vice President,

HARRY A. TREADWELL: (Applause.)

Now, as to your new President, he is nuts and good meat for any toastmaster. Your committee decided that it would be good business to mix things up and occasionally have a college boy occupy the seats of the mighty. This time we grabbed off Cornell rah-rah boy. He operates an alleged shaft mine in Indiana and that permitted him to qualify. His poker face enabled him to stand the strain of the election and at no time during these last two hectic weeks in the battle of the ballots have I ever seen him bat even one of those beautiful hazel eyes. You recall "Those Nights in June," out on the poop deck of the "Cape Girardeau" on the Mississippi River, (Laughter) — but with the august majesty of the law here beside me I had better not make any further reference to the poop deck.

Mr. Hamilton is a man of few habits and singular hobbies. He claims that he is going to found a new industry . . . one a factory for taking the scent out of Limberger cheese. . . . His last hobby is a real unique one . . . a pheasant ranch. He has invited the Executive Board down to visit him for a day of quail shooting, dinner, etc., at the Pyramid Country Club, near Duquoin.

I take great pleasure in introducing to you gentlemen a thoroughly experienced coal man. His splendid record as a coal operator—his fine ability as an executive—combined with a charming personality, assure you of another successful year of Institute management. Since he is the President, I cannot limit his time for answering, but I will say that I hold

be said without contradiction that he has gained a knowledge of mining conditions throughout the world that few men have been able to obtain. That gentleman, a distinguished engineer, is here tonight, and I take great pleasure in introducing him as Toastmaster for the evening.

MR. JOHN A. GARCIA:

Your remarks, Mr. McFadden, are reminiscences of younger and happier days. I would be only too glad if I could dilate upon them and tell stories of our youth, particularly in the Danville district, but time does not permit. Perhaps some day we can get together and tell tales of other days.

Gentlemen, as Mr. McFadden told you today, this is our fortieth anniversary. Any organization of this size that goes back over a period of forty years and can survive especially the last five years of agony this industry has gone through and still draw such a fine crowd as we have here tonight, and under the present business conditions, surely has a vital and necessary place in the scheme of things. However, our program is crowded and I have neither the time nor the talent to properly tell the wondrous story of this organization through all those eventful years, so I am going to ask some of the more eloquent speakers of the evening to touch upon the subject.

My business tonight is to introduce the speakers and not to tell stories. Speaking for your officers, I wish to express their appreciation of the splendid work done by your Arrangements Committee here in Danville. As I mention your names, you will please stand:

HARRY MOSES: (Applause.) Son of the original Danville Moses, whose pedigree goes back to the time of Pharaoh's Daughter who found the first little Moses in the bullrushes (so she claimed) (Laughter) and "got by" with it. (Laughter.) Also

DAVID I. ROCK: (Not present.) (Applause.)

MARK ORD: Please stand up and let's take a look at you. (Applause.)

FRED E. BUTCHER: Ill, and cannot be with us.

JAMES DUBOIS: (Applause.) Here is a man who goes to bed at seven o'clock and gets up at four, thereby proving the old adage, "Early to bed, and early to rise, makes a man Heathy" (and he is the healthiest man I know)—also very wealthy —because in his wisdom he has found contentment, and that is richness indeed. (Applause.)

JOHN HOPE: (Applause.)

ANOTHER McFADDEN! (Joseph, this time.) (Applause.) This man is, to my knowledge, the best job-holding man in the mining industry. When I came to this district twenty-five years ago he and all his relatives were on the payroll. It is evidently an old Scottish custom and they have been on it ever since. I want to warn all employers that when you get a McFadden on your payroll you have them for life, but, I also want to tell you you are mighty lucky to have them.

I should like to introduce to you the members of your new Executive board and new officers. Please stand up and favor us with a smile and then sit down!

GEORGE F. CAMPBELL, of Old Ben Coal Corporation (Franklin County). He is not present as usual.

E. H. JOHNSON, "Cardox Ed," of Chicago. (Applause.)

PAUL HALBERSLEBEN: I never can get that name right. (Applause.)

HARRY MOSES: As I have said before, he was found by Pharaoh's Daughter. (Applause.)

The time required to adjust a cleaning plant varies with the system chosen, the character of the coal and the results desired. This time generally varies from 200 to 300 working days.

The success of any mechanical cleaning is not only how low you can get the impurities, but also how uniform you can maintain the product. A plant that produces a product with a maximum variation of 1 percent is very successful.

Due to overproduction in the coal industry, the coal market in the last two years, as well as today, and probably will remain so for some time to come, is what is customarily called a "buyer's market" and the customers are taking advantage of this condition to force a reduction in price on the slightest variation in the quality of the coal. Therefore, the operators are compelled in order to resist continually dropping prices, to produce a uniform product.

Chairman Sandoe: Gentlemen, I would like to hear any discussion of the paper you have in mind. No one responding for a discussion of Mr. Treadwell's paper, the Chairman of the afternoon session, Mr. Sandoe, said:

Chairman Sandoe: This closes the program for the afternoon, and if there is to be no discussion, I will turn the meeting over to

President McFadden: who said—

I know you are getting impatient, but I am only going to talk to you a very few moments. I have not had an opportunity, as yet, to see the Geological Survey exhibit, but this is an opportunity we do not have very often, and as we are going to have some time between now and the banquet, I would suggest that we all visit the mezzanine floor and see this exhibit.

Tonight, we are to be honored by the presence of Judge Walter C. Lindley,—members of the Board, and other distinguished guests, who have traveled a long distance to be with us. It would be fine if we could all be ready and in our places promptly at 6:30.

I want to take this opportunity to thank all of those who have made the sessions this morning and this afternoon such a success.

I now declare this meeting adjourned. We will meet again at the banquet at 6:30.

Adjournment.

Banquet

The banquet of the Illinois Mining Institute was held in the ballroom of the Hotel Wolford, Danville, Illinois, at six-thirty P. M. About two hundred and forty members and guests were present. A delicious turkey dinner was served.

President McFadden called the meeting to order, introducing REV. H. J. HASCH, who eloquently invoked God's blessing on the assembly and the food. The President then made the following address:

President McFadden: I cannot tell you how happy I have been in having the honor to serve as your President during the past year. I want to thank the membership for their loyal support.

Twenty-five years ago, a large producing company controlling some fifty mines came into this district and operated several mines. In those days the chief engineer of that company was also the general manager and the chief operating man. It was my pleasure and privilege to have been an employee of that chief engineer and I had the honor of being directly associated with him for about twenty-five years. During that time it can

drawn are only true of the samples and not the raw feed that will be delivered to the cleaning plant.

After the washability curves are made you will determine the type and method of cleaner, that is best adapted to the cleaning of this coal.

As soon as the system has been chosen a large, carefully made up sample should be shipped to the test plant. Another set of washability curves should be run on the sample to be compared with the first set of curves and also with the test as run, and if they all check and the system chosen is mechanically sound, your installation will prove successful. The plant will work if the characteristics of the washability curves check with the feed. However, the percentage of recovery will vary according to the variation between the tested samples and the raw feed.

The general characteristics of Illinois coal make the cleaning problem very simple. Our coal is hard enough that we do not have to take into consideration excessive breakage because of additional handling. However, as we wish to hold the breakage to a minimum, it is generally best to do as little screening before cleaning as possible and size the coal for shipment after it is cleaned.

The impurities to be removed will consist in a general way of blueband, sulphur burrs, roof shale and fire clay. The difference in specific gravity between these impurities and the coal is great enough to make separation easy.

If the wet method is used to clean the large size from 6″ to ¾″, the operation is simple and the only difficulty to be encountered will be in the operation of the refuse outlets to handle the six inch material.

The wet process manfacturers will try to tell you they will only clean up to 4″ and not to exceed 4½″, but it is possible to clean the 6″ size. It is being done by one operator in this state and is also being accomplished by other operators in the East, who are using the dry method.

The wet process is not new to a number of the older operators in this state, but since the days of the old washer there have been many changes. Modern inclined launderies or the automatic control jigs are very different from the old type they used. The efficiency is greatly increased and the water consumption very much reduced. In the selection of a wet method one should keep in mind that fire clay and roof shale go into solution in a short time. Therefore, it is important to choose a system that will remove the refuse quickly from the circulating water.

In Illinois we have quite a lot of flat, slabby impurities that are classified as floaters and are difficult to remove. Therefore, some method of upflow, which will have a tendency to turn these floaters edgeways and sink them, should be used or they will be found in the clean coal. It is generally easier to sink a floater by the wet method than the dry.

If the dry method is used to clean 1″ to 0, the cleaning will be simple as you will practically eliminate the sludge problem and the necessity of dewatering the fine coal. The dry method is particularly adapted to the cleaning of this size of coal. If you can arrange to dedust the raw feed to the dry cleaning unit, you can greatly reduce the dust hazard in the cleaning plant. You will also be able to remove a larger amount of fine refuse from your dedusted feed without an excessive loss of fine coal. The dust removed in this process can be returned to the clean coal if desired or used in your own plant.

these obsolete plants might have been replaced with modern units or the overloaded plants might have carried on. Had a good fuel engineer visited the owner as did the solicitor of the power company, we might have retained our customer.

The one common improvement that these competitors are able to give is a uniform product. This is not a difficult proposition for the gas and oil industry or the central stations, and some Eastern Coal Operators are attempting to accomplish this result through the installation of mechanical cleaning plants. It becomes necessary, therefore, for the Illinois coal industry to give careful consideration to the advisability of installing mechanical cleaning plants to meet this competition. No general rule can be laid down as the problem of no two mines is exactly identical even when located in the same field. However, in addition to the possibilities of obtaining a better and more uniform product, mechanical cleaners frequently offer a reduction in the cost of cleaning and may be justified from this standpoint alone, even when the improvement in quality over hand cleaning would not justify the additional expense.

As the installation of mechanical cleaning is a major expenditure, the choice of plant is very important.

First, let me say that no cleaning plant is a cure-all, nor does it work perfectly over the full range of sizes. You can either obtain a plant that is designed to give you a good product and fit a happy medium of your requirements, or you can choose a very complicated high first cost plant, difficult to operate and expensive to maintain, but a plant that will give an exceptionally fine product over a wide range of sizes.

I would not even attempt to suggest which system of cleaning, wet or dry, you should choose. Each system is adapted to a certain field. In a general way, the wet method is very successful on the larger sizes down to 1" or ½", and the dry process from 1" to 48 mesh. Below 48 mesh, as a general rule, little cleaning is accomplished by either method, except through special layouts of low capacity per unit.

It is generally difficult to accomplish much cleaning between 10 and 48 mesh. Therefore, unless for some special condition it is necessary to reduce the ash in this very fine size, don't attempt it, and you will thereby reduce the cost of your plant as well as the operating cost of cleaning.

It is well to remember in choosing between the wet and dry method that water drains quickly from plus 1" and very slowly from minus 1", and particularly the minus ½". Water in fine coal is a serious detriment both in transportation during freezing weather and in the use of the coal. Wet plants must be protected from freezing weather and you must arrange for a sludge disposal. Dry plants have the dust hazard and you will have to solve it.

The first step in the choice of a mechanical cleaning plant is the sampling of the raw feed. Too much importance cannot be stressed on obtaining a true sample of the coal that is to be cleaned. More cleaning plants are condemned as failures because the sample furnished to the testing plant was not true, than all other causes.

The cleaning characteristics of the coal is determined by washability curves. These curves are only true of the sample from which they are made. If the sample is not a true picture of the coal, the conclusions

A MAJOR PROBLEM THAT CONFRONTS THE ILLINOIS FIELD TODAY

By MR. H. A. TREADWELL

Benton.

General Superintendent of the Chicago, Wilmington & Franklin Coal Co.,

The coal industry is one of the old and important industries of the country and like most primary industries consisting of hundreds of independent companies, it makes but little real progress except under the lash of competition.

A new type of competition has developed today to such proportions that it will require the most strenuous efforts on the part of the Illinois coal industry if it is to be met successfully. This competition can be divided into three general groups, Eastern High Grade Coals, Natural Gas and Oil, and Central Power Plants of big Utility Companies.

Eastern Sales gained a foothold in our markets by a reduction in sales price due to the low wage scale in non-union fields and then they had the additional opportunity to enter our markets because of shutdowns in our fields due to continued strikes. Now some operators in the Eastern fields are attempting to tighten this hold on our markets by furnishing a mechanically cleaned, uniform quality of coal which the customers demand and by also furnishing a dustless coal through the use of Calcium Chloride, et cetera.

Gas and oil competition is a serious problem at this time because the pipe lines, which were designed for future business, have excessive carrying capacity in the present market, and allow these companies to dump their products on the market at a very low price.

It is only a waste of time to attempt to discredit this gas and oil competition, because the customer, who changes to gas or oil does so because he desires clean firing, automatic control and an opportunity to pay his fuel bill as he uses the product. Since the customer desires this class of service, the coal industry must furnish it or lose the business.

The three large items in the above service can be met by the coal trade at about one-third the cost of gas to the customer and one-half the cost of oil. To satisfy the customer who will change to gas or oil, we must be ready to meet the three conditions.

1. Sell a uniform clean product of coal sized to the service it is to be used for.

2. Treat the coal to make it dustless, when required by the customer.

3. See that the proper size of automatic stoker is installed.

Central power plants have forced out a lot of small individual steam plants that were our best coal customers. These small steam plants change over to purchase power because their plants are worn out, obsolete or are overloaded, and a good solicitor of the power plant has sold them the idea. The coal salesman just shakes his head and says: "It is too bad, but he will find out his mistake and come back." However, they seldom do. Had the operator been watching these small plants and seen that these small users were supplied with uniform fuel and were properly fired,

tion to justify the installation and operating costs. Of course, in some cases it may be necessary to clean the fines in order to make them marketable at any price, but the matter of cost as compared to realization should receive most careful consideration.

Another possibility is the aspiration of the dust, which in many cases may have to be wasted, but often the mere dust removal without any cleaning may increase the value of the resultant product—particularly with coals with a high ash and sulphur and a low fusion point.

It must be obvious that there is no one answer to all preparation problems. Careful preliminary studies of all phases of the problems are absolutely necessary and the plant should be designed to fit the job rather than to have to change it afterwards to suit the market or the particular coal being treated.

Chairman Sandoe: On behalf of the Institute, I wish to thank both Professor Mitchell and Mr. Morrow for their wonderful papers. These are problems that we will have to solve sooner or later and I would like to have some free discussion on these papers. Or if any member has a question to ask, I am sure these gentlemen will answer them entirely satisfactorily. We are open for discussion.

Mr. H. H. Taylor, Jr.: I would like to ask Mr. Morrow what is the difference in costs between hand picking 4x1½" coal and mechanically cleaning that coal, on the same coal, and under the same labor conditions as described by Mr. Morrow in his paper?

Mr. Morrow explained at some length about hand picking 4x1½" coal and cleaning of the same mechanically.

Chairman: Any other questions?

Mr. Cooley: About a year ago, or perhaps a little more, I was in a meeting similar to this with Mr. Morrow in Nova Scotia, and I came home, thinking about some things Mr. Morrow said about the coal industry lagging behind in Indiana and Illinois. * * * Mr. Cooley then explained about the potential number of capacities of cleaning plants and stated that in 1927 the specification for coking were raised, which is largely the reason for the increased cost of same. * * * He also said: "Aspiration really does add another size for industrial and stoker use and dedustless coal really adds another market to Illinois coal, and that it is one size that very apparently is demanded at a premium."

Chairman Sandoe: Anybody else care to discuss this question?

Mr. H. F. Hebley:

Talks on uniformity of product, and goes on to say:

"As Mr. Morrow brought out, you can adjust your equipment to take care of your coal on a chain-gear stoker; you can design for it, and the percentage of ash may or may not have an appreciable effect on the stoker." He goes on to describe two tests he ran on some coal, one on a wet, and one on a dry system, to show how the ash actually ran, as follows:

Wet—4.4

Dry

Cleaned—5.0

which, you can readily see, is very nearly the same.

Chairman Sandoe: Anybody else care to discuss this question? No one responding, he said: The next paper is entitled: "A Major Problem That Confronts the Illinois Field Today," by Mr. H. A. Treadwell.

of coal as found in the ground which largely determines the difficulty of cleaning. There are many cases where roof rock getting into the outside sample may show that the coal is easier to clean than the same tests made on the bench samples.

In Prof. Mitchell's table showing the size limitations of the various commercial coal cleaning processes, we are rather of the opinion that in any discussion of this size range, the efficiency of cleaning in the various sizes should also be stated. It is one thing to put coal 6" to dust into a cleaning unit and an entirely different thing to make a reasonably exact separation from coal and rock in all sizes from 6" down to 100 mesh.

We would point out that the choice of process depends in part on the tonnage to be handled as well as on the desired accuracy of the separation. Perhaps it can be said that one of the principal American contributions to cleaning of coal has been the development of large capacity units.

We are somewhat doubtful as to whether high capacity generally goes with low efficiency, as today some of the most efficient plants I know of are those handling the largest tonnages in single units.

In general, for commercial use, we are very doubtful whether it is economically advisable to consider the cleaning of coal of all sizes at the same gravity. The anthracite operators have fully recognized this fact, and they have set up different tolerances for the different sizes of coal. It should be noted that, in general, mass cleaning of coal has the effect of separating the upper sizes at a lower gravity than the finer sizes. In other words, when cleaning 4x½" coal by mass treatment, there will be a greater amount of 1.60 Sink in the ½"x1" coal than in the 2"x4" coal, and very fortunately this condition happens to coincide very well with actual market demands.

In discussing the economics of coal cleaning we would call attention to the common practice of charging preparation costs to the total tonnage rather than to the tonnage of sizes actually cleaned or picked. In many cases only the + 2" coal is hand picked; at some plants an attempt may be made at picking 1x2" coal but the results of hand picking on this size cannot be considered very satisfactory.

If the costs of picking were charged to the sizes actually picked it would show up a different picture and we believe that, particularly in the large tonnage plants, the cost of mechanically cleaning ⅜"x4" coal will in many cases be lower than the hand picking costs, provided credit be given for the increased value in the ⅜"x2" size and also for the recovery of coal from the hand pickings which are now usually wasted and which generally contain about 50 percent of recoverable coal.

The matter of cleaning the — ⅜" coal for steam use may present a very different problem; the cost per ton of cleaning this size can readily be two to three times the cost of cleaning the ⅜"x4" sizes, depending on the amount of centrifugal and heat drying that may have to be done to satisfy special markets.

In wet washing we have the sludge and drying problem when treating this size; in dry cleaning we have the expense of dust collection and the lower efficiency on the extreme fines. It would seem, therefore, that this size should particularly be studied, when contemplating mechanical preparation, in order to definitely determine whether the increase in cost will result in a sufficiently higher realiza-

inite specifications as to the percentage of allowable impurities if he is to produce an economic design of the preparation plant. Unfortunately today it is far too common to talk about "clean coal" as if it really meant something whereas in actual practice it may contain anywhere from 1 percent to 5 percent of removable impurities.

As mentioned by Prof. Mitchell, this problem has recently been taken up by the American Standards Association; the purpose of this movement being to define definite tolerances for percentages of allowable impurities. Many preparation engineers feel that if the bituminous coal operators themselves do not agree on some standard for their product, the consumers will eventually make one for them, and coming in this way it might not be economical.

Many tests of the 2"x4" hand picked coal have shown that on the average it will contain 2 per cent of material sinking at 1.60 gravity, and this certainly must be considered as extraneous matter in this size of coal. The variation over quite a large number of samples showed from 0.7 percent to 4.5 percent, and yet in each case this would be labelled as 100 percent clean coal.

The same kind of tests have been made on prepared coal 1"x2" in size. The average of all tests showed 3.2 percent material sinking at 1.60 gravity, with a variation of from 1.2 percent to 7.2 percent in individual cars.

Again this would seem to raise the question of the importance of being more definite in speaking of clean coal.

There are doubtless some cases in which mechanical cleaning in 4x6" coal is justified, but it is also true that in other cases the injurious effect on the other sizes might be greater than the advantages gained by cleaning this particular size. In general it would seem that, as this grade of coal is largely sold on appearance and not on analysis, hand picking is probably the preferable treatment, and as long as the sizes of minus 4" or minus 4½" are being mechanically cleaned, there will be no loss of coal into the refuse, as the pickings from this larger size can be crushed and mechanically cleaned along with the other sizes.

We note that Prof. Mitchell speaks of the advantages of a uniform coal. It seems to us that this factor cannot be too strongly emphasized. After all, one of the chief advantages from the consumer's standpoint, of competitive fuels such as oil and gas, is that from their very nature they tend to be inherently uniform in quality.

We note that recommendation is made to test at from five to six different gravities, but we are rather of the opinion that in the majority of cases that tests at a smaller number of gravities will give sufficient data as to the characteristics of the coal, and it has been our experience that very often it is difficult to obtain satisfactory checks on the same samples, particularly at the lower gravities. The handling involved in testing at too many gravities itself introduces an element of error.

We are glad to note that Prof. Mitchell stresses the importances of bench sampling in the mine in order to determine its cleaning characteristics. We believe that there has not been enough attention paid to investigations of this character in the past, and that very often the seam sample, especially when split into benches, will definitely show up characteristics of the coal that can readily be obscured when taking overall samples at the tipple. It is the character

results than he was getting with the higher cost fuel.

In some cases where a high steaming rate is desired, and when working under fluctuating loads, it has proven very desirable to greatly reduce the percentage of extreme fines thereby permitting the use of greater volumes of air to support the necessary combustion.

The increase of use efficiency due to proper sizing for the particular job may enhance the value as much as the removal of the last 1 or 2 percent of ash in the finer sizes and in many cases may partially compensate for a lower ash fusion point.

It would be interesting to see a parallel table showing the increase in screening and picking facilities in Illinois to compare with the reduction of mechanical cleaning as shown in Prof. Mitchell's paper.

Possibly another reason for the decline in the production of mechanically cleaned coal in Illinois might be found in the lack of drying facilities common to the older types of wet washing plants. It should be noted that the advent of dry cleaning processes forced the wet washing systems to pay much more attention to the moisture in the shipped product.

In the writer's opinion, tipple design has progressed to a higher state of efficiency in Illinois than in many other coal producing states which have a larger ratio of mechanical cleaning to total production.

Under these conditions perhaps the present interest in mechanical cleaning in Illinois can be traced to the rapid development of mechanical mining, coupled with the increasing demand for greater uniformity of product on the part of the consumer.

In any discussion of coal preparation it is important to remember that this subject is more closely allied to selling than to mining and that marketing is an economic problem.

The object of the producer is to enhance the value of his products to the consumer and thereby to increase his net realization. To do this requires close co-ordination of his preparation and marketing, and flexibility to take care of changes in market conditions.

The consumer is primarily interested in the most economic utilization of a fuel. This implies that it must be inherently suited to his particular use. Any unit burning coal of varying quality is ordinarly adjusted to function with the poorest fuel supplied; consequently much of the additional value of an average higher grade fuel is lost. Therefore the consumer can only afford to pay for a uniformly prepared product which produces tangible results and the producer cannot profit on any part of his preparation that does not add to the realizable value of his products nor can he expect to be compensated for uneconomical cleaning methods.

The consumer's requirements may be summed up in two words, "suitability" and "uniformity." The fuel must have inherent characteristics, and preparation, suitable to give the most economical results in the consumer's use; but more than on any other factor, efficient results depend upon uniformity.

Ultimately, then, the yardstick of the consumer is the most important factor and the design and control of the preparation plant should be mainly based on it, giving due consideration to the cost of the process as compared to the realization.

It seeme to me that Prof. Mitchell is very much to the point in first endeavoring to define clean coal before attempting to discuss how it may be produced. It must be obvious that the designing engineer should have def-

Chairman Sandoe: Thank you, Professor Mitchell. Inasmuch as the next paper on the program touches upon coal cleaning, also, I think it would be well if we were to hear both papers, and then have the discussion.

We are very fortunate in having here with us today a gentleman who has traveled all the way from Pittsburgh, Pennsylvania to give us this paper. He is a man who is considered a coal expert.—Mr. J. B. Morrow, Preparation Engineer, the Pittsburgh Coal Company, Pittsburgh, Pennsylvania, (Applause) who will talk to us about

"THE ECONOMICS OF COAL CLEANING"

Discussion of Prof. David R. Mitchell's Paper, "Coal Cleaning Problems in Illinois" Illinois Mining Institute November, 1932

By J. B. MORROW

In discussing Prof. Mitchell's paper it should be understood that I am primarily thinking about the general type of coal produced for the Domestic and Steam Trade in Illinois. The preparation of by-product and gas coals is, in many cases, a rather different problem.

Fundamentally the object of coal preparation is to increase, economically, the value of a fuel by making it more suitable to the uses of the consumer. This can be accomplished in three major ways—

1.—Screening or sizing.
2.—Mixing or blending.
3.—Cleaning.

By combinations of any or all of these methods we can prepare coal to meet standard specifications—a process of standardization which is the more desirable the more nearly it approaches the unvarying quality of packaged goods where the package you buy today and tomorrow is the same as that you bought yesterday.

It should be noted that it is readily possible to get good cleaning and still have poor preparation because of faulty screening and mixing, and on the other hand, it is possible to get a passable grade of cleaning, combined with good screening and mixing facilities.

The first of these three major ways of increasing the value of a fuel became a problem early in the commercial development of the coal trade; this is indicated by the following quotation from a New Castle document, dated 1740,*:

"In this year the mischeivous practice of screening coals was first introduced at Willmington Colliery by Mr. William Brown." Many operators even today are heartily in sympathy with the sentiments expressed against Mr. Brown's "mischievous practice." The advantages the consumer derives from sized coal have been dealt with so often that further comment here seems superfluous.

The second way, mixing and blending is coming to the attention of the steam trade more forcibly every day. In many instances it has been definitely proven that control of the percentage of fines, with respect to the coarse, has resulted in increased boiler efficiency and the uniform mixture of the fuel has permitted the operator to maintain his adjustments with a minimum of attention. In those cases where it has been proven advisable to take out part of the coarser coal, there is an actual decrease in net cost per ton to the consumer and he can still maintain equal, if not better,

* Read before the Utah section of the A. I. M. M. E., January 20, 1931 by W. D. Brennan of the Utah Fuel Company, Salt Lake City, Utah.

end show a greater profit than high efficiency and lower capacity. When considering possible processes or plants, it is a good idea to construct curves or tables showing the relation of costs to recoveries. For instance, curves plotted showing the relation of cost to say 6, 7, 8, 9, or 10 per cent ash coal will give exactly the information needed for a rational solution of such problems.

It has been frequently stated that Illinois coal shows a remarkable uniformity over wide areas. That is true of the coal substance. Impurity content varies widely and certain sections of a mine may be so dirty and recoveries will be so low that it would not pay to clean the coal from these sections even though a profit were indicated for the mine as a whole. Also, free impurities and bone material vary widely as to size and specific gravity distribution so that it is probable that most Illinois coals do not lend themselves to mass cleaning of all sizes at one specific gravity. That is, higher yields conforming to specifications desired can usually be obtained by cleaning the larger sizes at one specific gravity and the fine sizes at still other specific gravities.

Generally speaking, at least insofar as concerns sizes usually cleaned mechanically, the larger sizes show a greater yield and hence a greater profit than the finer sizes—due to the finer sizes containing more free impurities than the larger. This is not universally true of Illinois coals for exceptions are known in which refuse or high ash middlings are concentrated in some one of the larger nut or furnace sizes.

In conclusion I wish to again emphasize the importance of a thorough preliminary examination of all factors affecting the washability of a coal before a cleaning plant is contracted for, in order that the operation may be as profitable as possible. Such factors include: the physical and chemical properties of the raw coal and associated impurities, capacity and elasticity of the cleaning plant, sizing and mixing equipment, existing markets and those in which it is hoped to enter with an improved product.

The following bibliography of publications pertaining specially to coal cleaning in Illinois is included for those who are interested in pursuing this subject further.

Bibliography

1. "Coal Washing in Illinois," F. C. Lincoln, Bul. 69, Eng. Exp. Sta., Univ. of Ill. 1913.

2. "Dry Preparation of Bituminous Coal at Illinois Mines," E. A. Holbrook, Bul. 88, Eng. Exp. Sta., Univ. of Ill. 1916.

3. "The Utilization of Pyrite Occurring in Illinois Bituminous Coal," E. A. Holbrook, Cir. 5, Eng. Exp. Sta., Univ. of Ill. 1917.

4. "Cleaning Tests of Central Illinois Coal," Thomas Fraser and H. F. Yancey, T. P. 361, U. S. Bu. Mines, 1925.

5. "Coal-Washing Investigations," H. F. Yancey and Thomas Fraser, Bul. 300, U. S. Bur. of Mines, 1929.

6. "Coal Preparation Problems in the Illinois Field," D. R. Mitchell, T. P. 362, A. I. M. E. 1930.

7. "Washability Tests of Illinois Coal," A. C. Callen and D. R. Mitchell, Bul. 217, Eng. Exp. Sta., Univ. of Ill. 1930.

8. "Combustion-Cleaning of Coal," R. D. Snow, Proc. Ill. Min. Inst. 1931.

9. "Modernizing Preparation," K. R. Bixby, Coal Age, 37, 6, 1932.

At the close of Professor Mitchell's paper, Mr. Sandoe said:

Table 4—Probable Size Limits of Commercial Coal Cleaning Processes.

	Upper Size Limit—in.	Lower Size Limit—in.
Jigs	6	½-⅛
Rheolaveur	6	1-64
Wet Tables	2	1-64
Link Belt-Simon Carves	4	1-32
Spiral Separators	4	⅜
Norton	4	1-32
Spiral Separators	4	⅜
Chance Sand	6	3-16
Wuensch	6	Dust
Air Sand	6	3-16
Draper	2	1-64
Aid Tables	2	1-64
Clean Coal Company's Process	6	Dust 3-16
Menzies Hydro-Separator	4	½
Hydrotator	3-16	1-120
Stump Air-Flow	½ (?)	Dust

Assuming that washability tests have been made and a thorough study of processes made, the operator will find that the method of treatment has narrowed down to two or three processes or combinations of them. It is then desirable to confer with the sales force as to specifications desirable and the possibility of entering new markets. A study of complaints is helpful at this time and should be assembled according to whether they are from domestic or industrial consumers. Quite different specifications may be needed to suit these two classes of customers—the one is usually interested more in appearance and the other in actual ash and sulphur content. The complaints can be still further subdivided into actual causes, such as presence of free and visible impurities, high ash, high sulphur, fusibility, poor distribution of sizes, lack of or excess fines, presence of dust or lack of uniformity. Every complaint should be considered as a problem in preparation or cleaning and machinery set in motion to solve them if possible.

After all of these various factors have been taken into consideration, a final selection can be made as to the method of treatment best suited for the conditions at hand. Hand-picking is, of course, the only solution for the 6-inch lump size commonly made, but there is the additional problem of whether to treat the hand-picked lump refuse or not. If so, can the coal present be recovered by a rotary breaker, or should it pass through a coal crusher and then be sent back through the cleaning plant?

The question then arises as to whether handpicking or mechanical cleaning should be adopted for the furnace and larger nut sizes. Under present arrangements with pickers only on the coarser sizes, the preparation costs are spread over the entire tonnage of the mine. If the costs of handpicking are charged directly to the sizes cleaned, it will often be found that the costs per ton for labor alone for these sizes are as much or more than what the per ton operating costs of a cleaning plant would be. Each mine presents a problem all its own as to where mechanical cleaning should start and handpicking begin.

After all of these preliminary investigations are made, individual washability curves can be constructed and yield tables calculated for the sizes or combination of sizes that could be treated by various processes under consideration. Flow sheets should then be made of the various methods of treatment under consideration since no process or combination of processes is ever designed exactly the same for different coals.

The four main factors to be considered are capacity, elasticity, efficiency and cost. High capacity generally goes with low efficiency and lower costs per ton and may in the

the mine for that is the condition under which it would be cleaned. The coal must, therefore, be brought to the as-mined moisture content prior to testing or the technique of testing be such that results can accurately be predicted for this condition before any calculations are made as to possible yields and financial return.

It is not alone sufficient to conduct the tests so that results obtained will show specific-gravity fractions corresponding to the as-mined moisture content, but all data, including weights as well as ash and sulphur percentages, should be calculated to the dry basis. This is necessary because of the variable moisture content of air-dried fractions. The clean coal end of the fractions may show as much as 10 per cent water which will decrease as the specific gravity of the fractions increases until the water content of the final sink may be as low as 1 per cent. Weight percentages, calculated from data not on a dry basis will therefore tend to show erroneously high recoveries.

In addition, too much emphasis cannot be made on the importance of using a number of solutions of different specific gravities so that the character of the rock end as well as the clean coal will be shown. For preliminary investigation purposes solutions of 1.30, 1.35, 1.40, 1.50, 1.60, 1.70, and 2.0 specific gravities are recommended. Then, if very little intermediate or middling material is present, some of these can be eliminated, so that for a great number of coals specific gravities of 1.30 1.40, 1.50, 1.60, and 1.70 are sufficient.

Also, a careful study should be made of the character of coal and associated impurities. Flakiness tests are sometimes desirable, and in all cases slacking tests. Clay and shale impurities in Illinois coals nearly always have the undesirable property of disintegrating rapidly in water. When such impurities are present, the heaviest sink should be removed first if aqueous solutions of zinc chloride or other salts are used for the float-and-sink tests.

Prior to the actual working out of a flow sheet which is used as a basis for the selection of a process or combination of processes for treating the coal, a thorough study of the coal in the mine should be made by means of channel samples and in some cases by bench samples in addition to the usual washability tests of screen sizes; float-and-sink tests of the commercial sizes and crushed hand-picked refuse or middlings; slacking tests of impurities and sometimes friability and flakiness tests. Too much emphasis cannot be placed on the importance of acquiring the above information completely and accurately.

Problems Pertaining to the Selection of a Method of Cleaning

Reference has already been made to the inefficiency of the old time cleaning plants in this state. In the last decade new processes or improvements on old processes have been developed until there are a number of such that can be used for Illinois coals with a high degree of efficiency for the sizes and type of cleaning problem they are adapted to. A list of modern coal cleaning processes is given in Table 4 showing the probable size ranges for which they are adaptable. Operators contemplating the erection of a cleaning plant should make a thorough study of the operating characteristics of all commercial types of coal cleaning processes. There is no one universal process. There is, however, a process or combination of processes that will do a better cleaning job for a particular coal than any other process.

ground mechanical loading, with a consequent increase in amount of free extraneous impurities present in the coal, has caused producers to give more thought to coal cleaning. Coal cleaning is usually considered as a necessary adjunct to mechanical loading. That is not true in this state for other than the coarser sizes which are handpicked. This existing condition is remarkable when it is remembered that Illinois leads all the major coal producing states in amount of mechanically loaded coal, which tonnage comprises about 60 per cent of the state's output.

2. There is an increased stringency of consumer specifications, which is to be expected in any buyer's market.

3. Increased engineering data are available showing actual monetary savings that can be expected from the elimination of non-combustible impurities in all types of coal burning equipment.

4. The value of having a uniform fuel is being appreciated more fully by most consumers.

5. There is an increased use of Illinois coal for by-product coking mixtures with the realizing that the presence of free impurities are hindering its further adoption.

6. A desire is being manifested by operators to keep their customers satisfied, thus combating the further inroads of competitive fuels, by furnishing them a clean and uniformly sized product.

7. There is a growing realization that for whatever purpose coal is used, best results will be obtained if it is cleaned of objectionable impurities.

It is not to be inferred from the foregoing that mechanical cleaning of sizes below those normally handpicked should be adopted at every mine. There are mines operating in clean beds that produce a high grade, low ash coal, and it is doubtful whether increased purity obtained by cleaning would justify an expenditure for a cleaning plant. Market conditions are different in this field than in the eastern fields or Alabama, where a great percentage of this cleaned coal is sold for metallurgical purposes and direct savings are manifested in the cost of producing a ton of pig iron. To be justified in Illinois, where most of the coal goes to domestic or industrial consumers, increased financial return must be due to such more or less intangible items as increased customer satisfaction, greater working time and in some instances to savings made due to increased efficiencies of coal burning equipment and savings in freight costs.

Problems of Washability Testing

The general procedure for testing a coal for washability has been given a number of times by numerous authors and needs no repetition here. However, there are certain precautions to be taken in testing our coals, a lack of observance of which leads to costly errors in interpreting data.

Illinois coal varies in water content from a low of 5 per cent to a high of about 17 per cent. This is not moisture-producing wetness, but the normal moisture content of the coal bed. These coals lose this moisture easily and at the same time the specific gravity of the coal changes rapidly. Under the temperature conditions found in the usual testing laboratory, a coal normally containing 15 per cent of moisture in the as-mined condition may drop to 4 or 5 per cent before tested. Float-and-sink results, in order to have value, must show yields and ash content to be expected on coal as it would come from

ly rapid and in 1908, Illinois ranked first as compared with the other coal producing states in total amount of washed coal. In Table 3 some data, mostly compiled by F. G. Tryon of the U. S. Bureau of Mines, are presented showing the trends in production of mechanically cleaned coal in Illinois.

It is to be noted that Illinois showed a rather consistent increase in amount of coal cleaned from the data of the earliest records up to 1917 and thereafter sharply declined. Prior to the world war years, Illinois always ranked first, second, or third as compared with the other coal producing states. The production of washed coal has fallen off until it has almost reached the vanishing point and at the present time Illinois ranks seventh, being surpassed by all the other major coal producing states in the order named: Alabama, West Virginia, Pennsylvania, Ohio, Washington, and Kentucky.

Table 3.—Trend in Production of Mechanically Cleaned Coal in Illinois.

Year	Raw-Coal Produced	Washed Coal Produced	Per Cent of Total
1907	51,317,146	2,465,767	4.8
1909	50,904,990	3,466,097	6.8
1911	53,679,118	2,154,697	4.0
1913	61,618,744	3,664,928	5.8
1917	86,199,387	4,651,154	5.4
1927	46,800,000	560,642	1.2
1929	61,127,759	527,000	0 9
1931	45,152,623	700,000*	1.6

*Estimated by the Author.

This is a rather startling fact, especially in view of the fact that Illinois exceeds all the other major coal producing states east of the Mississippi River in amount of coal loaded mechanically.

The question presents itself as to what has been the trend in the other major coal producing states. Alabama and West Virginia show a consistent increase back to the earliest records. Pennsylvania shows a large increase in the period prior to 1917, followed by a slight recession and since 1927 a very large increase.

Let us critically examine conditions in Illinois to see what economic factors have contributed to this decline. The following condensed statements are presented of possible contributing causes and conditions, combinations of which have tended to practically eliminate mechanical coal cleaning from Illinois mines:

1. The limited success obtained in coking Illinois coals.
2. The less critical attitude of consumers during and immediately following the World War years.
3. The idea developed to the exclusion of all others that proper sizing was more important than cleaning for mechanically operated stoker plants.
4. Inefficiency of the then existing washing plants on certain sizes.
5. Retention of large amounts of water in the washed screenings and slack sizes.
6. Development of the mechanical stoker to burn high ash coal efficiently.
7. The finding and development of areas of comparatively low ash and sulphur coal in various parts of the state.
8. No premium obtained for washed coal over unwashed coal.

Now then, we have seen from the data given that for the first time in fifteen years there has been an increase in amount of coal washed over the preceding year as against the decline which set in in 1917. Also, there is a decided turn in interest given to this subject of coal cleaning, as shown by the time given to it at this meeting.

The following reasons can be given for the increased interest shown in coal cleaning in Illinois:

1. The rapid development of under-

Table 2—Pennsylvania Anthracite—Standards of Preparation* (Percentage of impurities and of over and under size allowed in each size).

Size of Coal — Inches	Each size may contain			
	% of		% of next larger	% of next smaller
	Slate	Bone**		
Broken 4⅜x3¼	2	2		15
Egg 3¼x2 7-16	3	3	5	15
Stove 2 7-16x1⅝	4	4	5	15
Chestnut 1⅝x13-16	5	5	5	20
Pea 13-16x9-16	7½	7½	5	15 buck 5 rice

* Peele, Mining Engineers' Handbook, 2nd edition.

** If percentage of slate is entirely removed the percentage of bone may equal the total of slate and bone.

It has been the general feeling among anthracite operators that these standards have been so effective in combating the inroads of other fuels into their natural markets, not only bituminous coal and coke, but also gas and oil, that the tendency has been to make these standards increasingly stringent. In fact, a new set of standards, not available for publication, was made effective April 1931, which lower appreciably the amount of slate or bone permissible in any one size.

Are such standards necessary or even desirable in Illinois? There are many arguments pro and con in regard to standardization of prepared bituminous coal. It is not my intention to discuss these, but simply to point out conditions existing at the present time, with special reference to Illinois. Many large consumers have adopted standards of their own, the list of whom is continually growing and which if continued will mean a more or less chaotic condition, since the producer will have to prepare his coal to meet a different set of standards for every customer. It would seem far better to have one set of standards for all. Such standards would benefit producer and consumer alike —the consumer by being assured of uniform shipments conforming to definite specifications and the producer by having a yardstick with which to measure his preparation.

This problem of standardization of clean bituminous coal has been taken up by producing and consuming groups and initiated as a project by the American Standards Association according to a recent bulletin of this body. The purpose of this project, at the present time, is stated in the A. S. A. bulletin, as follows:

"Specifications outlining allowable limits of inacceptable material in prepared bituminous coal, whether mechanically cleaned or not, in sizes coarser than two inches, the purpose being to define clean coal and not to standardize screen sizes."

The Present Status of Coal Cleaning in Illinois

Practically all Illinois mines have excellent handpicking facilities, and there has been a steady development in this phase of cleaning from the beginning of coal mining down to the present time. In the case of mechanical cleaning there is a different picture. The second bituminous coal washer in the United States was erected in Illinois in 1870. Development for a number of years was fair-

of impurity just as easily and that the amount found was not excessive for a car of cleaned, well prepared coal.

Further, is handpicking sufficient or must a coal be mechanically treated before we can label it 100 per cent clean coal—and I might add that practically all coal is sold as 100 per cent clean even though it has received no treatment, other than passing it over a sizing screen. Handpicking of the large 6" lump sizes has no competition from mechanical cleaning devices. There is in the minds of some a question as to which is the best to use on sizes below 6 inches. Handpicking is notoriously inefficient and the smaller the size the more costly and less efficient it becomes. Besides, it is very wasteful of coal. Tests on hand picked refuse from the 6x3-inch size have shown that by crushing and further cleaning as much as 50 per cent of these pickings could be recovered as good coal.

In 1930 I published some actual data of picking tests for three samples of Illinois coal which show the extreme variation possible in handpicked shipments of lump coal. Lumps varied from 5.6 to 17.7 per cent ash at one mine. To show further the difficulty of visually selecting low ash from high ash coal, I have presented in Table 1 some analyses of pieces of coal picked out as refuse by an anthracite coal inspector. These results were given me several years ago by a mining engineer from the Pennsylvania anthracite field. It is to be noted that the samples picked out as refuse varied from a low of 3.3 per cent in ash to a high of 45.2 per cent. One sample was picked out of the pile labeled coal by the inspector and surprisingly it contained 31.4 per cent ash.

The material given in this table is solely for the purpose of pointing out the difficulty of visually judging the quality of coal and not with the idea, as some may infer, of criticizing existing inspection practices.

I doubt if anyone at the present time can definitely say what clean Illinois coal is or should be. In 1925 the Pennsylvania anthracite operators adopted a set of regulations or standards which has solved this question, at least to their satisfaction, as evidenced by the close adherence to the standards adopted by all of the responsible companies. As a matter of interest, these standards adopted in 1925 for the larger sizes of coal are given in Table 2. The smaller sizes, not listed, must conform to a maximum ash content of 12 per cent.

Table 1—Specific Gravity and Ash Analyses of Selected pieces of egg size anthracite.

Sample No.	Specific Gravity	Ash %	Inspectors Designation
1	1.51	6.8	Refuse
2	1.54	16.2	"
3	1.50	12.0	"
4	1.65	9.1	"
5	1.40	3.3	"
6	1.75	28.6	"
7	1.71	40.0	"
8	1.52	20.6	"
9	1.78	45.2	"
10	1.82	31.4	Coal

effect to aspirating. Aspiration will result in the collection of a lower ash dust than would be obtainable by screening. This may be an advantage, or a disadvantage, depending upon the use and value of the two products —the dedusted coal, and the dust.

Chairman Sandoe: Any other discussion on this paper? No response. There being no further discussion, we will now have Professor Mitchell's paper.

"COAL CLEANING PROBLEMS IN ILLINOIS"

and I take great pleasure in introducing to you this afternoon, Professor David R. Mitchell, Assistant Professor of Mining Engineering, of the University of Illinois: (Applause.)

COAL CLEANING PROBLEMS IN ILLINOIS

By DAVID R. MITCHELL
Assistant Professor of Mining Engineering, University of Illinois

Introduction

This paper was prepared upon request of the Program Committee who specified that it be general in scope in order that questions for discussion be brought out. Therefore, very little information of a specific or detailed nature has been included and I hope the following general discussion will have the effect desired by the Committee.

Clean Coal—What Is It?

Before discussing the subject of coal cleaning, it is well to know what we are talking about; hence, the question—what is clean coal? Is it coal with 1, 2, 3, 4, or 5 per cent of removable impurities or is it coal with a definite ash and sulphur content? Or again, as has been suggested by one engineer, is it coal with a definite heat content without regard to the amount of incombustible or other undesirable impurities present? I raise these questions because it seems to me there is entirely too much misinterpretation or lack of correct information as to what is actually meant when speaking of clean coal.

Just recently I was interested in the outcome of a series of boiler tests on competitive coals; one of which was supposed to have an ash content of around 9%. Much to the surprise of the coal company engineer and the engineer for the consumer, the analysis showed only 7% of ash. At once the coal company was charged; it is true in a friendly way, but nevertheless the insinuation was made that the coal company shipped a specially prepared lot of coal for these tests. What the engineer for the consumer could not understand was that by the method of preparation in use, shipments could vary from a low of about 6% in ash content to a high of 12%. Similarly, a coal salesman was relating an experience whereby he was confronted by an irate customer who had picked out 3 or 400 pounds of slate and pyrite from a car of 6x3-inch furnace size of coal. What did he do? The only thing for him to do was grant the customer a rebate and keep him feeling good, for the customer must always be considered as being right. It would not do for the salesman to tell the customer that if he had done a really good job of picking, he could have found 8 or 900 pounds

to my mind, which has so far been developed, is in connection with the wet cleaning plants, where it very materially assists in solving slurry disposal. If about minus 60 mesh dust is removed before treating by a wet cleaning system, the dust so extracted may be mixed back with the cleaned screenings, thus reducing the moisture content and preventing it from freezing, making a marketable product which will not cause you trouble. In some mines it has been developed that the very fine dust is low in ash, and therefore a valuable fuel, which should not be wasted. In any type of cleaning, it is admitted that the very fine dust is very much less benefitted by the cleaning process than are the larger sizes. I think that is all. (Applause.)

Chairman Sandoe: Thank you, Mr. Waterman. Is there any other discussion of this paper?

Mr. Thompson: I am with the Koppers Company. I had the great pleasure last winter of visiting Europe with several mining engineers, and I have, I believe, seen all of the dust-collecting systems that are in use in Europe, many of which were described in Mr. Hebley's paper. As a result of that visit, our company will be in a position soon to market two dust collecting systems, as we believe that there are places in the coal cleaning industry where dust collecting will be advantageous. We found, in Europe, that practically all of the manufacturers or builders of coal cleaning plants, both wet and dry, were advocating and installing dedusting systems. . . .

The thing that interested me, and as coal operators, the thing that will interest you, is the merchantable result. You can do all these things with coal, but whether it will pay is a difficult problem. It is easy enough from a technical and engineering point of view to dedust coal and clean it, but the question is whether it is merchantably profitable—and it is from that viewpoint that the work must be done. . . .

Considering some of the things that are done to European coal—one thing interested me—and that is that in Continental Europe the wages of labor are about one-fifth of what they are in this country—and the price of coal is probably two or three times greater than the price of coal in the United States,—so that the economics are all upside down. What you can do in Europe and what you can do in Illinois are entirely different things.

Mr. Sandoe: Any other remarks?

Mr. Thomas Fraser, Consulting Engineer Hydrotator Company, Cleveland, Ohio:

In considering the removal of fines from coal, there is a certain difference in effect between screening and aspirating that may be of importance in some instances. When the dust is removed by aspiration the air current has a selective, classifying effect, taking the lighter coal particles and leaving dirt particles of equal size in the dedusted product. This effect is usually observed in pneumatic table plants. The dust collected over the fine coal tables is lower in ash than the raw coal left on the table to be treated, or at least cleaner than the fines of the raw coal as shown by screen test.

Dedusting by screening, on the other hand, removes the fines by size only. With the type of cloth ordinarily used for very fine screening, presenting a long narrow aperture for removal of undersize, there is some tendency to remove thin, flat slate particles with the undersize. Under these conditions, screening has the opposite

posited on the filters there is a gradual building up of resistance and consequently means must be provided for shaking or rapping the cloth frames or bags to free the dust. In some of the cloth filters that are available, it is done automatically, in periods that can be varied from every few minutes to hours. Other equipment has the fan placed on the outlet side of the filter and thus keeps the filter below atmospheric pressure. When it is necessary to shake the bags, atmospheric air is admitted to the filter casing, collapsing the filter bags and shaking the material from the cloth.

In conclusion, it may be said that dedusting coal where applicable will very materially improve the washing results and cleaning results and also help the proper combustion of coal when used for steam raising and heating purposes.

H. F. Hebley.

Chairman Callen: Thank you, Mr. Hebley, for your very interesting paper, the discussion on which will be postponed until after luncheon.

I again urge all members to obtain banquet tickets on the way out of the room.

We will now adjourn.

Recess Until 2 P. M.

(Luncheon in Hotel Wolford Banquet Hall.)

AFTERNOON SESSION

The afternoon session of the Institute was called to order at two P. M. by the President, who again called the attention to the Mineral Research Laboratories exhibition on the mezzanine floor, saying everyone was invited to visit it after the close of the afternoon's program.

He then announced that the Chairman for the program in the afternoon would be C. J. Sandoe. (Applause.)

C. J. Sandoe: We have had a very fine paper on "Dedusting of Coal" just before recess, and I would like to have a discussion of that paper so that we may all get the benefit of it. Let us hear from some of the shining stars of this industry.

Discussion of Paper "Dedusting of Coal"

The first response to Chairman Sandoe's request for a free and full discussion of Mr. Hebley's paper came from

C. W. Waterman, Vice-President of the McNally-Pittsburg Mfg. Corp.:

Mr. Chairman: I am C. W. Waterman of the McNally-Pittsburg Company.

The paper which was so ably presented by Mr. Hebley on "Dedusting of Coal" I think very fully covered the various systems. But there is a question, I know, in the minds of all you operators, as to what you are going to do with the dust, after you extract and collect it. I have suggested that the dust might be used where consumers are now using powdered fuel. In his paper Mr. Hebley very ably illustrated the feasibility of transporting coaldust in specially constructed tank cars, but we have found, in discussing this problem with the operators, that they are unable to interest powdered fuel users in purchasing the dust so transported, for the reason that they were unable to safely store such dust for use in their plants. Of course, we all know the dangers of trying to store coaldust. That is a problem that will undoubtedly have to be solved in the future. In the absence of the operators' ability to sell their coaldust, they have to waste it in a storage pile, which has been the objection to dedusting. The most advantageous use of dedusting,

commercial stokers applicable to the heating systems of large apartment buildings and hotels. Generally, the equipment found in these buildings consists of firebox or horizontal return tubular boilers fired with underfeed stokers. When coals having a large percentage of fines containing a high ash content with a low fusion point, are burned on this equipment trouble is experienced with the packing of the worm feed and clinker due to the ash being lifted into the incandescent zone of the fuel bed.

Where high draft is maintained, as in high buildings having their stacks carried above the roof, the fines tend to be lifted off the fuel bed and drawn into the fire tubes of the boiler. The packing of the fines in the fuel bed makes an impervious blanket of coal above the center of the tuyere box and the blast air of the stoker takes the path of least resistance and blows a series of holes in the form of a circle around the impervious crown, thus causing poor combustion due to poor air distribution. To over come this difficulty if the fine sizes are removed the fuel bed will be more porous, will have less tendency to lift off the grate and will give less trouble with ash.

Dedusting:

The removal of dust from the larger sizes is generally accomplished with screens, by aspiration or a combination of both these systems. Screening is never, one hundred percent efficient and it generally carries some of the smaller sizes over with the larger sizes.

With aspiration there is a tendency to lift by air velocity larger pieces of material than are required for the separation; but the fines will have been removed.

There is a relation between velocity and the size of particles carried in suspension and is expressed as follows:

$V=(12\ DR^2)\ (10^3)$

Where D=Density of dust in grains per cu. centemetro (coal taken at 1.30 specific gravity.)

R=Radius of particle in centemetros.

V=Terminal velocity in centemetros per second.

This relation expresses the uniform velocity which a particle attains when falling in still air.

Other modifying factors such as the shape of the particle, whether it is flaky or round, influence the velocity found by the above formula. However, a velocity of approximately 5000 feet per minute will allow practically no dust to settle.

Regarding the quantity of air required to carry the dust out of the coal it varies from 66 to 150 grains per cubic foot of air.

Filtration of Dust Laden Air:

Once air lines become laden with dust it is necessary to keep the velocity sufficiently high until it is possible to extract the dust from the air. Many methods are used for this purpose, but the combination cyclone and cloth filter gives good results when the velocity through the fabric is kept low. Generally, a velocity of from 1.0 to 4.0 feet per minute through the cloth will give good results and will not shorten the life of the material. Moisture laden air in passing through the cloth, especially if accompanied with acid fumes, will of course, shorten the life of the material and for this reason it is often advantageous to inject sufficient hot air into the mixture to lower the relative humidity before passing the dust laden air through the fabric. As the dust is de-

of stiffness to meet the requirements previously met by the other joints.

Chairman Callen: We are going to depart slightly from the order of the program. Mr. J. B. Morrow will not be with us until this afternoon, so I will ask Mr. Henry F. Hebley of Allen and Garcia Company of Chicago to read his paper at this time on: "Dedusting Coal."

Mr. Hebley delivered a very interesting as well as technical lecture on the subject, which was illustrated with stereoptican slides depicting the types of machinery used in the various processes of dedusting coal. He also displayed samples of screens from 14 to 200 mesh together with bottled samples of coaldust.

DEDUSTING COALS FROM THE MIDDLE WESTERN FIELD

By H. F. HEBLEY

Allen and Garcia Company, Chicago, Illinois.

The removal of dust from coal has received great consideration in Europe recently and many designs have been evolved to accomplish this separation.

Generally, the sizes to be eliminated are below 10 mesh. By their removal, coal preparation is as a general rule, simplified. In the cleaning of coal, the sizes below say, 20 mesh, are rather difficult to improve in a wet cleaning system and the sludge problem set up by having the washery water contaminated with the very fine material, especially if that coal dust is accompanied by soft clay particles, is expensive to overcome. When cleaning coal by a dry process the air lifts the dust out of the coal feed and either creates a dust nuisance throughout the plant. Also, when using air as a medium for cleaning, the small sizes receive less benefit from the cleaning action, and a point is soon reached where no improvement is obtained in the sizes. Thus, it has been found profitable to remove the dust before treatment.

Coals from various fields naturally show different characteristics, and this statement holds true regarding the finer sizes. Some fuels have dust which is essentially clean and free from ash. With these coals, in the case of cleaning the coal wet, the fines can be mixed back with the wet clean coal and thus reduce the moisture content of the slack sizes. The dust can also be mixed with the cleaned product being discharged from a dry cleaning plant, giving a coal of improved ash content and greater yield.

In the midwest field (Illinois, Indiana, West Kentucky, etc.), in the majority of cases the dust ash content percentage increases as the sizes decrease. Under these conditions; it may be profitable to discard the dust rather than attempt to remix it with the cleaned product. Midwest coals being essentially free burning coals find a great application in steam raising. Quite often the fusion point of a coal is influenced by the percentage and quality of ash in the fine sizes and its removal allows a fuel bed of the proper porosity to be maintained. This has been found true in using coal for domestic and semi-

with Peabody Coal Company:

I don't know why Professor Callen called on me, but Mr. Haskell did bring up one point in his paper on which I believe further comment might be made from the electrical power standpoint, which I believe some of you members will have come up with your electricians in the near future. In the majority of mines, use is made of the rails for the return electrical circuit. Regardless of what ratio is assumed for carrying capacity of the rail to that of copper, there is always added resistance, due to rail joints as connected by copper bonds. The use of 50 and 60 pound rail is becoming quite common. Heretofore, only angle bars have been obtainable for splices for these sizes. We are now promised a straight splice bar similar to common fish plates. With that on one side of the joint, we propose to use a short U-shaped bond placed horizontally under the base of the rail and welded to the edge of the flange. This will reduce the joint resistance to about 20 percent of the present value when using bonds extending beyond the ends of the fish plates. Assuming that this arrangement proves satisfactory, we will derive a very nice saving in cost of return circuits.

Chairman Callen: Mr. Lee, the statement was made by Mr. Haskell that the laying and maintenance of better track would probably reduce the maintenance of the electrical equipment. Can you tell us anything about that?

Mr. Lee: Well, that's pretty hard to prove, that is, by direct facts. Certainly we know that locomotive manufacturers claim that they put good steel in their axles, yet we have a lot of them break. There must be reasons for that, and certainly bad track must contribute to the breakage of axles. I have an idea that those who watch their costs on maintenance of cars will take something of the same attitude.

Chairman Callen: How about it Mr Burkhalter, will you speak from where you are, or come up front? Mr. Burkhalter comes forward.

Mr. Burkhalter: To use a short bond as Mr. Lee suggests would mean that you would have to space your ties so that you can get directly under the joint with the bond. . . . I think it is a good idea and has been worked out by Mr. Lee, who originally started this subject,—whether the fishplate has the equivalent strength of the angle bar for the joint. I believe Mr. Haskell, in his paper, claims that the development they have made has that mechanical strength, but I think there will be more of the short bond used in the future than there has been in the past.

Mr. Lee: I would like to correct Mr. Burkhalter. I did not originate the idea. In talking to others, I saw the advantage of it, and I am in favor of it, myself, although there may be some opposition. One of our friends thought that it would not work.

Chairman Callen: Is Mr. Rock in the room? I wonder if he has anything to contribute to the discussion? He has a lot of long hauls. But I do not spy him back there now. Is there anyone else who desires to contribute to this discussion? (No one responding,) Prof. Callen said: "I am going to ask Mr. Haskell if he cares to make any closing remarks on this subject?"

Mr. Haskell: Nothing but that I am in agreement with what has been said about space between ties and bonds. The short bond greatly improves the conductivity of the joint. There is plenty of strength and plenty

turnout. If rails are curved on the job, quite a large percentage of the turnout laying cost will be chargeable to hand methods of rail curving

The manufacturing plant is in a position to help effect real economies. It is uneconomical to do manufacturing work at the mine that the factory is in a much better position to do. New material is oftimes cheaper than repairs. If the repairing of certain track equipment is under consideration, it is well to carefully check this cost against the cost of new material. It is often the case that the user thinks that the benefits derived from the use of standard articles reacts more to the benefit of the manufacturer than to himself. Such, however, is not the case. A certain benefit does accrue to the manufacturer, but even more benefits react to the user.

Manufacturers of track material are glad to co-operate to the fullest extent with the users of such material in the matter of its design, selection and use. I have in mind cases where the laying of track problems before a manufacturer, have resulted in tangible benefits to the mining companies involved.

As previously stated, you cannot reap the benefits of high mine production unless the coal can be gotten out economically. So that anything that can be done to improve trackwork is of great help to economical production, and this improvement is summarized in properly selected equipment, well laid and well maintained.

In conclusion, may I again emphasize the danger, trouble and expense that always accompanies badly designed, improperly installed and poorly maintained trackwork and the consequent importance of a trackwork system that is carefully planned, well designed, properly installed and adequately maintained. Whatever expense is entailed by so doing will repay you with big dividends.

Chairman Callen: This paper on "Track Work" is now open for discussion. It is President McFadden's hope that the discussion of these papers will be general and interesting and just as profitable as the paper itself.

Professor Callen requested those who wished to take part in the discussion to come forward to the front seats. No one responding, he called on Mr. John C. Quade, who said:

Mr. Chairman: Being an engineer myself, I appreciate the value of this paper. It is very well gotten up and I think there are a good many points in it that we can discuss. It is one of the best prepared papers on "Track Work" that I have ever heard. I thank you.

Chairman Callen: Who will be next? Are there any questions you want to ask Mr. Haskell? Perhaps some of you do not agree with Mr. Haskell's ideas?

Discussion on "Mine Track Work, Etc."

Mr. Johnson: I noticed in Mr. Haskell's paper he states that the small sized frogs can be used for either a right or a left hand switch?

Mr. Haskell: Yes.

Mr. Johnson: And you recommend the purchase of the curved rail along with the frog?

Mr. Haskell: Yes.

Chairman Callen: Is Mr. Carl Lee here? (Mr. Lee stands up, and is asked to come forward). The Chairman thanks him for doing so, and remarks: "That's one gentleman who obeys instructions to the letter."

Mr. Carl Lee, Electrical Engineer,

ing are the No. 2, 2 1-2 and No. 3. The proper turnouts for entry or main line service are dictated by condition of roof, type and speed of traffic and space available. The A. M. C. recommends No. 3, 4, 5 or 6 for this service.

The frog angle alone does not establish the lead and radius of the turnout as many track workers believe. The toe distance, switch length and switch angle are important controlling factors. So the matter of the switch itself must be carefully considered. The number of the frog having been decided on, it is obvious that a car passing over the turnout will have to be deflected angularly from its original path an amount equal to the frog angle by the time it reaches the frog. It is equally true that the more smoothly this deflection is made the better operation will be secured. Therefore, the deflection must be made in as even increments as is possible. This means that the general line of the turnout as made up of a straight frog and a straight switch joined by a curved rail to which both frog and switch are tangent, should follow reasonably close the line that would be made by a simple curved turnout. The advantage given by the straight frog and switch being that the turnout may be used for either R. H. or L. H. and that manufacturers carry straight frog and switches in stock but not curved frogs and switches. As an example of the comparative efficiency of a straight frog and switch turnout as compared to a curved turnout, I have observed a No. 2½ turnout laid adjacent to a 50′ radius turnout, serving the same traffic and showing the same smoothness of operation. After being used five years both types of turnouts showed the same amount of wear.

It is well that turnouts be laid out by standards developed by the engineering department or by the use of standard turnout tables that may be secured from any trackwork manufacturer. There is no known, easily applied rule by which the lead of turnouts may be figured with any degree of accuracy or uniformity. The various rule of thumb rules in common use by many track men give only very rough approximate results, giving inaccurate leads to the extent of from one to eight feet, depending on the gage and number of the turnout. The new A. M. C. standards give the formulae by which turnouts should be figured as well as tables of turnout leads for the commonly used gages.

Standardization of design and increased use have made it possible to adopt methods of manufacture of track equipment that have so lowered prices that it is real economy to buy such materials of a standard type. It is an economy in both money and time. In the case of our Company, it is our aim to carry in stock for immediate shipment standard frogs, No. 2, 2½, 3, 3½ and 4; and 3′, 4′, 5′ and 7′6″ switches in all rails 16 pound to 40 pound, inclusive. We also carry frogs, Nos. 3, 4, 5 and 6; and 5′, 6′, 7′6″ and 10′ switches in 60 pound rail. Thus if a user orders material of this standard type he gets immediate service. If he orders fractional number frogs, frogs of certain special degree or odd, badly cutting length switches such as 7′ or 8′ he must, no matter where he orders it, wait for his order to be specially fabricated and pay accordingly. It is likewise an economy to buy the filler rails as a part of the turnout. The manufacturer is equipped to turn out sets of rails bent to a true curve, that when laid in place, will make a smooth

steel ties may be used every fourth or fifth tie to good advantage. They thus act as gauge rods, take the load off the spikes and give renewed life to an old track. In the laying of the track, if wood ties are used it has been found necessary to usually lay them at close intervals, allowing only enough room between the ties to insert a shovel. This gives tamping space and facilitates tie renewal. Excellent results have been had from steel main haulage ties spaced both 24" and 30". Room steel ties are usually spaced too far apart, but under average conditions a spacing of 36 or 42" can be recommended.

When a bolted clip type of steel main haulage tie is installed, the nuts should be pulled up tight and then again after a few weeks' service they should be again tightened, taking up any stretch and set that may have occurred in the bolt and clip. Metal ties offer no mechanical or electrical hazard other than that which is illustrated by the old story of the lady who asked the street car conductor if it were possible to get a shock from stepping on the rails in the track. "Yes," he replied, "if you put your other foot on the trolley wire at the same time."

The rails as laid on curves should be curved, not sprung into place and a slight elevation made on the outer rail. This elevation should continue for the full length of the curve and should be run off in the tangent rails at a rate of about 1" per 30 feet. The amount of the elevation varies according to the sharpness of the curve. It has been found that the following elevations work very well in practice for 30 inch gage: 40' radius curve 1-¾"; 50' radius curve 1-½"; 60' radius curve 1-¼"; 80' radius curve 1"; 100' radius curve ¾"; 150 radius curve ½"; 200' radius curve ⅜". The amount varies directly as the gage, so that 44" gage would be 44-30 of these amounts. Proper elevation of the outer rail lessens curve resistance very materially. If the curve is on wood ties, tie rods are very useful to hold the gage and resist the thrust on the outer rail.

In addition to the very important essentials of alignment and surfacing that are necessary to efficient operation of a haulage system, must be added the essential of well designed turnouts. It is known that a motor or a car can pass through a turnout made up of almost any conceivable combination of frog number and switch length, but best all around results can be obtained from but one combination of frog and switch. When room service is being considered, the radius of the turnout is decided upon by a consideration of the length of wheel base, the angle of the rooms relative to the entry, the width of entry, the condition of the roof and the amount of cutting it is advisable to do on the corners of the room neck to clear the equipment used. Bad roof and the difficulty of maintaining a long unsupported opening dictate a short, sharp turnout. The answers to a questionnaire sent out indicate that a No. 2 turnout is in use by more mines than any other number of turnout. However, a No. 2 is too short for best operation of equipment having a 42" wheel base or over. In operations where such equipment is used, a No. 2 1-2 turnout best serves the needs. The No. 2 1-2 turnout is second in popularity according to the reports received. No. 1 3-4 room turnouts are used, especially with mule haulage, but if governing conditions as heretofore mentioned will permit, a No. 2 turnout is better. The three numbers adopted as standard by the A. M. C. for gather-

unnecessary friction and wear. Many handbooks give the proper amount of widening, but in general the amount should be ¼" for light curves and not exceeding ⅝" for extremely heavy curves. Where gard rails are used the flangeway should be widened the same amount as the track gage is widened.

Our Company has furnished track material for a variety of different gages totaling thirty-two in number, but of these there are six gages that seem to be the most popular; namely, 30 inch, 36 inch, 42 inch, 44 inch, 48 inch and 56½ inch. Of these the 42 inch gage is probably used more than any of the other gages. These gage references have to do mainly with coal mining, as a metal mining industry in general uses very narrow gages for underground track.

Although the subject of ties has received very serious consideration, it by no means is as yet a closed book, especially as pertains to main haulage.

The swing has been toward steel ties for room work, and millions—I use the word advisedly—of steel room ties are in use and are giving entire satisfaction. Many mines could add to the production efficiency of steel room ties by a little more care in their selection and installation. The tie should obviously be selected with relation to the weights of rail with which it is to be used and this carries the assumption that the rail size has been determined on after a careful consideration of the traffic that it is to carry. But some mines buy a heavy tie for very light rail and vice-versa, mainly because they happened to get started that way. Tie manufacturers can give intelligent recommendation as to the best tie rail combinations and they will gladly give them because it is to their interest to have their customer receive economical satisfaction. Room ties should not be spaced over four feet and a shorter spacing will give better results. Ties will be found in many rooms spaced eight feet or more, but where this condition prevails, bent and broken rails, bent ties and derailments are common. Steel ties are an economy from many angles. Their ultimate cost considering their longer life is less than wood ties, they are more easily transported, they save from two to four inches of head room which is sometimes very needful and they are easier to install. Steel ties are also used in great numbers on turnouts either with special ties at the switch and the remainder of the ties being standard ties inter-laced to serve both tracks, or as a set of turnout ties, each of which is a special through-tie. I have been told more than once by mine officials that wood ties as opposed to steel room ties were too expensive to use even if they were laid down free at the Mine. An effort has been made in past years to use steel ties for main line haulage, but due to inadequate designs they did not prove entirely satisfactory. But in the last few years improved types have been brought out that meet the requirements, and so there is a growing demand for heavy main line steel ties. Examples of main line track laid with steel ties can now be found in many mines, track that retains its alignment as well as any track laid on heavy wood ties. Steel ties may require more careful blocking and tamping than wood ties so that the track laying labor per tie is greater, yet due to the smaller number of ties, the track laying labor per foot is no more. Steel ties hold the rails to exact gauge and prevent spread or overturned rails. Even if the wood ties are not all removed,

ly improves track conditions. It must be remembered that as the weight of a rail is increased, strength and stiffness increase at a much more rapid rate. The stiffness varies as the square of the weight—thus an increase of 33⅓ percent in the weight of a rail from 30 pounds to 40 pounds gives an increase in stiffness of 78 per cent. The price per ton remaining practically constant, it can readily be seen that additional money spent for heavier rail brings a good return in stiffness and strength.

Heavier track is easier to maintain in alignment. To use a common expression, it is more inclined to stay put. Rails heavier than 60 pound are in use for main haulage in some Mines, but it seems that unless unusual circumstances prevail, 60 pound track can be so laid and maintained as to give excellent results under any but the most exceptional mine traffic. In considering the weight of rail to be used, the type of section must also be given due thought. A decision must be made as to whether the ASCE section of the ARA-B section will be used, as it is taken for granted that odd or bastard sections would be eliminated if at all possible. In the large sections such as 80 pound or heavier, the ARA types have found favor because of the difficulty of properly rolling heavy rails with wide flanges such as the ASCE Sections. In the sizes in more common use in mine haulage, this rolling difficulty does not apply and by far the greater tonnage has been rolled in the ASCE Section. This section having a much wider base than the ARA-B Sections, offers more resistance to sidewise thrusts tending to overturn it. It also provides a larger bearing surface with less tendency to cut into wood ties and for a given weight of rail offers more lateral stiffness. The use of the ASCE rail makes it possible to secure frogs and switches from manufacturers' stocks. I know of no manufacturer that carries equipment in stock made of ARA-B rail.

As these rails are laid it is preferable in general to use splice bars with the lighter rail and angle bars with the 40 pound and heavier rail. Where splice bars are used, a tie should be under the joint, but where angle bars are used, the joint should be midway between the two ties. An angle bar is designed to give, when properly bolted up, the same degree of stiffness at the joint as the unbroken rail itself gives, so that it is, therefore, better that there be no tie under an angle bar joint. There is now coming into use a combination splice-angle bar joint that is so designed that while not materially lessening the mechanical efficiency of the joint, it improves very greatly the electrical efficiency. A standard angle bar is used on one side of the rail, while on the other side is used a specially designed splice bar that is so made as to give sufficient stiffness and yet leave the top side of the rail flange free from obstruction. On this flange and within two or three inches of the end of the rail is welded a short bond having only a total length of five or six inches. This short bond as compared to the usual length bond greatly improves the electrical conductivity of the joint.

It is an accepted fact that rail joints should be staggered to give a smoother riding track, although we have in service many installations of sectional track with square joints that are giving good service. Gage on straight track should be the exact specified gage, as proper wheel clearance is allowed by the car manufacturer. However, the gage should be widened on curves to eliminate both

age, deterioration and disturbance resulting from its use as well as from natural elements." Thus track maintenance includes tightening bolts and fastenings, replacing bad rails and ties, raising low joints, adjusting the track to line and surface, keeping curves true, repairing or replacing frogs and switches, inspecting and policing the track and performing many other detail duties. Admitting the importance of these items, it is essential that they be handled on a systematic basis. Usually this work is best handled by an experienced individual or crew who both install new work and maintain the old.

The securing of efficient transportation is a problem so important to modern mining that it must command the attention of any who would continue in this highly competitive field of modern industry. Some coal is being moved by the various conveying systems that are finding applications in the industry, but it is doubtful if they will prove as economical for moving coal as first impressions might indicate, other than the so-called "face conveyors" which are used for delivering coal from the face to mine cars spotted at a convenient place in a heading. Conveying systems usually mean a specially designed mining system.

Special conveyors in the form of belts have successfully conveyed large tonnages for long distances, but successful installations of this type have usually been the result of very special conditions. Animal haulage persists in some places, and under certain conditions functions with fair satisfaction, but electric locomotive haulage is most widely used and will undoubtedly continue to deliver coal for an indefinite length of time. This type of transportation has many advantages over other systems, among which are its flexibility, economy and the possibilities it offers for standardization.

There are many elements that have to do with the making of a good track system, any one of which, if neglected, lowers to some extent the efficiency of the system.

Perhaps there is nothing of more importance in the development of a good track system than the selection of the correct size of rail to be used. It is, of course, determined largely by the weight of the rolling stock passing over it. There are a number of rule of thumb methods of estimating the correct rail size when the weight the heaviest load is known. For example, a rule of ten pound per yard for each gross ton load on each wheel has been frequently used, giving in the case of a twelve ton motor a wheel load of three tons and a rail weight of 30 pounds. This rule applies fairly well for room work, but gives results that are too light for other purposes.

Twenty pound rail has long been popular in room work but it has been found too light for heavy cutting and loading equipment. 30 pound rail has been found very satisfactory for room work where heavy equipment is in use. 30 ton Olroyd machines and Meyers Whaley shovels are operating in many mines on this weight of rail, as a number of mines when installing such machines have abandoned 20 and 25 pound rail in favor of 30 pound. On the basis of answers received from questionnaires sent out by the A. M. C. it can be said that 30 pound is the most widely used room rail, 20 pound second and 25 pound third.

Forty pound rail serves very well for butt entries and 60 pound is much used for main line. There are many mines using 40 pound for main haulage but the use of 60 pound rail vast

peak loads which use much power as well as have a serious effect on power demand charges. The fewer the peaks the motors are required to develop, the less the power cost and the less strain there is on the equipment.

I do not believe that sufficient consideration has been given to the bad effects that poor track has on mine car and motor equipment. It is, of course, obvious that low joints, bent rails, unsupported points, faulty turnouts or any form of uneven or irregular track, will produce strains and wear in cars that will result in heavier maintenance charges that would otherwise be necessary. But there is a damage to motors and electrical equipment that must make use of bad roadways. It is not so apparent, but it is just as real and it is of a very serious nature. Serious, because damage to such equipment is so expensive to repair and can so easily tie up costly units that may be badly needed in service. Bad track increases tremendously the maintenance charges of all equipment that passes over it. Inefficient track is also wasteful of man power through slower trip speeds, derailments, coal spillage along the haulways and other related evils necessitating more hours of work per ton of production.

The danger that besets life and limb on track of this kind must not be overlooked. Haulage accidents show up as a very heavy percentage of mine accidents and it is a surety that any contributing cause to these is a very important matter. Tabulated reports of mine accidents show that those pertaining to haulage have the questionable honor of being second from the head of the list. A poorly fitted up switch, a derailment, a motor or car knocking out a roof support and a heavy hazard to life and property is the result. The consideration of bad joints brings to my mind a statement made to me recently in a partly joking, partly serious vein. While talking about tracks with a Superintendent at a West Virginia operation he made this remark, "We must get the depression out of our joints." He was surely correct no matter what interpretation is put upon his words. It is difficult to state what amount of saving can be made by putting the tracks of a Mine into first class condition as the expenses caused by bad track, while very real and very great, are often such that they do not show up in any tabulated form. However, any consideration of what I have said must present convincing evidence that the transportation system of an operation should be in such a condition that coal can be transported over it safely, rapidly, with minimum power and with minimum labor.

Sometime ago the Pennsylvania Coal & Coke Company at their Ehrenfeld Mine found that light, poorly maintained track made it impossible for them to hold up their required production. They replaced their 40 lb. track with heavier rails laid on good, well ballasted ties. The track was put into good alignment and proper joints were applied. After 2,400,000 cars of coal had passed over this new track, it was found that locomotive derailments had been but three and these not due to the track. Trip running time had been decreased 28 per cent, the life of locomotive wheels had been increased 40 per cent and the labor cost of hauling coal had been decreased 40 per cent.

Next in importance to properly laid track is the maintenance of that track. An authority on track says that, "Maintenance is the continual work of keeping in condition for proper service a structure subject to wear, dam-

responsible, to a large extent, for the success we have had in Indiana. I hope that the pleasant relationship between the two Institutes will continue in the future as in the past and that we will go hand in hand, working jointly for the improvement of the mining industry. Our two States, not only now, but for the past few years, have faced very depressing conditions in the central competitive field.

I notice here at the Speaker's table an old friend with whom I first became acquainted as an official of the Mine Workers. Some time ago I visited one of the mining towns in Indiana, and on their building, we could see nothing but "SAFETY FIRST." Some four or five years ago I had occasion to visit a mining town in Kentucky owned and operated by the same company and managed by that same individual. I got into that town at midnight on July fourth and the first person that I came in contact with was a representative of that company and also a representative of the law. He wanted to know who I was, from whence I came, and whither I was traveling. I tried to tell him that I was a friend of the mine superintendent of that company; he was not acquainted with the gentleman. I told him that I was well acquainted with a distinguished citizen of Danville (calling him by name,) and I was immediately escorted to the hotel and a suite of rooms was turned over to me. You can imagine how weary and tired I was after traveling some five hundred miles. My better half and I just got into bed as quickly as we could,—and lo! and behold, the bedslats gave away, and we found ourselves on the floor. That district representative has often wanted to know my opinion of that mining camp and what I thought of it. I have never had occasion to tell him, until this evening, that I have often wondered about what kind of timbers they used for bedslats, and how to make them safe. My friend was Tom Moses. (Applause.)

I am very glad to be with you tonight. You have had a wonderful meeting. We will have our annual meeting on December third in Terre Haute and I hope that as many of you as can attend will favor us with your presence and carry on the good work that the Indiana Mining Institute was organized for. (Applause.)

Toastmaster: We also have with us tonight a gentleman who at one time was the President of the United Mine Workers of America, District Eleven, Indiana, now the Commissioner of the Indiana Coal Operators' Association and secretary of the Indiana Mining Institute. I am very sorry indeed that we cannot ask him to speak to us, because he is eloquence itself, but I would like to introduce to you a good friend of ours,

MR. HARVEY CARTWRIGHT: (Applause.)

Toastmaster: I also want to pay our respects to one of our Finest and Best,—our past President,

JOHN E. JONES: (Applause.)

Toastmaster: I have had some contact the past year or so with a gentleman of many accomplishments. He is now in charge of one of the most wonderful undertakings in America. He is building a great museum. He is actually and truly building an honest-to-God coal mine in Chicago. This man is the Director of the Museum of Science and Industry,—a gentleman and a scholar! I do not like to limit his time. I personally could listen to him by the hour but he is entitled to steal five minutes, if he wishes to. Gentlemen, I have the honor to introduce,

MR. O. T. KREUSSER: (Applause.)

Mr. Toastmaster, Members of The Illinois Mining Institute and Distinguished Guests:

After being your guest today, I am somewhat in the predicament of the colored boy who called on a farmer and said: "Boss, I wants a job." The farmer looked him over. He was husky and broad-shouldered. The farmer asked him: "Boy, are you **familiar** with mules?" and the colored boy replied: "Boss, I knows enough about mules without being **familiar** with them." (Laughter.) Before coming to this meeting, I thought I knew something about the coal industry, some of its problems, and probably some of its history. But like the colored boy, I feel that I knows enough about it without being **familiar** with it. (Applause.)

But some of you are interested in the work that we have under way in Chicago which has been made possible by one of our most famous citizens, Julius Rosenwald, who furnished a sufficient financial background to found a wonderful institute of culture —not art—but the culture of a universal interest in science and industry.

Probably the feature of most interest to you tonight is our immediate plans for the opening of the first section of this museum, that is, the 3000-tons per day bituminous coal mine at the Century of Progress Fair.

We, as a nation, are ignorant about the coal industry, and fail to understand some of the basic principles of producing coal, and we most of us are entirely unfamiliar with the history of the coal industry, romantic as it is. To properly understand coal mining, it is necessary that you smell the mine, feel the mine, and see it under operating conditions, so we have under way in Chicago a reproduction of a bona fide mine, the opening of which is scheduled to be concurrent with the opening of the Century of Progress, and will serve as an added attraction in making Chicago an interesting place to visit during the Exposition. This exhibit will involve about 60,000 feet of floor space, and will be a very complete story of coal, particularly coal mining in the middle west. The mine will be modern in all respects. In regard to both methods and equipment it will represent what is recognized as good practice today.

The equipment above ground includes a full-sized electrical, cylindrical, conical hoist with ten foot drums and sixty foot steel headframe, as well as a full-sized fan. All of the equipment will be operating to simulate regular production.

You will be able to go underground, and while we only actually take you fifty feet down, you will get all the feeling of going down five hundred feet, and the trip carries the sensation and illusion of a descent of that depth. Obviously, though, Lake Michigan prevents us from going down five hundred feet in Jackson Park.

The shaft bottom presents full-sized coal cars, with a rotary pump operating at the rate of three thousand tons per day, together with pumps, main haulageway, motors, cars, and an illusory trip of a mile to the working face.

At the working face, the visitor on foot makes a trip through the underground rooms, where the coal seams and rock have been accurately duplicated so as to serve as a typical example to the geology student as well as the visitor.

Even though Chicago does not have any No. 6 seam from which to mine coal, we have been able to bring enough No. 6 seam to Chicago so

that you will be able to see what a real mine in Illinois looks like.

We hope to have this mine open in time for the celebration in Chicago next summer; that will be our earnest endeavor, and we hope that you members here, who have extended so much valuable assistance in developing this project, will be our first guests.

I thank you.

(Applause.)

Toastmaster: John D. Ryan, will you please stand up? (He does so.) (Applause.)

Toastmaster: Gentlemen, I bring to your attention another MOSES! He is a Moses out of the Wilderness of smoke stacks—Pittsburgh. He has had the graciousness and kindness to come here from Pittsburgh to visit with us. A famous mining man, he holds one of the most responsible positions in coal mining—President of H. C. Frick Coal & Coke Co. He is a friend of many of us,—known to coal men everywhere, and beloved by many. I have great pleasure in introducing to you

MR. THOMAS MOSES: (Applause.)

Response of Mr. Thomas Moses:

Mr. Toastmaster and Gentlemen of The Illinois Mining Institute:

I was just sitting here wondering what the old-time members of this Institute would think if they could look into our meeting tonight—Dick Newson, David I. Rock, and the thousands of friends who helped to build this organization in its infancy and carry it along through many trials and tribulations. . . .

My friend on my right forgets (but I don't) the many hours of worry he gave me when he was President of the Miners' Union. (Laughter.) Gentlemen, I want to tell you it is a great pleasure for me to come back to Danville at any time. I had occasion to come here on business about a week ago. I had a visitor at my home, and he told me of the great necessity of my coming to this meeting. I got here on an early train this morning for the one purpose of meeting with you. Another thing that brought me here was that I understood our good friend George McFadden was retiring from the Presidency of the Institute and that this meeting was somewhat in the nature of a testimonial to Mr. McFadden. I have had the great pleasure of seeing George McFadden perform ever since he was a boy, and it has been a joy to know him. He appears to me today as one of the outstanding mining men of the country. I want to congratulate Mr. McFadden tonight and say that it does me good to see him, or any other man, successful, but when that man comes from Vermilion County, Illinois, then there is a special pride in it for me.

I would like to reminisce a little and hark back to the early days of this industry.

I came to this town in the year 1889. The necessity for employment for me was very great. I don't think I had over six bits in my pockets. I went down to see Mr. Kelly, who was then the most prominent coal operator in this field. My uncle, being much more experienced than myself (I being but a boy) went with me, and he did the talking. He said: "Mr. Kelly, this is my nephew. I came in here to see if we could get him a job." Mr. Kelly replied: "Well, I don't know. We got too many Irish on this job now." I said indignantly: "I'm not IRISH, I'M WELSH." "Well," says he "that's worse!" "But," said he, "I'll give the bye a chance," and I have been identified with the industry, in some capacity or other, from that day to this. I have

associated with all of the old-time mining men in this field; also a crowd of younger men, and it is my hope and belief that they will face the problem of the future with the same courage that we have faced them in the past. We have had hard times before this, but we never backed away from them. (Applause.) We have had to battle our way for our "place in the sun," and I hope you younger men are going to carry on in the future the same as we did, in the past. Let it not be said that the management of this industry has fallen on weaklings. (Applause.)

That you are going on to success, there is no doubt in my mind, so don't ever give up, for "The day is darkest, just before the dawn" (Applause.)

The Toastmaster: I feel it is particularly fitting that the speaker of the evening should be introduced to you by one of his own profession, who is at the same time, identified with the coal mining industry. That rather exceptional combination of talent is available to us in the person of Howard A. Swallow, and I call on him to respond. (Applause.)

MR. SWALLOW:

Mr. Toastmaster and Gentlemen:

Last Week, John A. Garcia, several other gentlemen I see here present, and I, were the guests of the Marion Steam Shovel Company on a special trip to the State of Kansas to see a new stripping job. We had a wonderful time, and on our way back from Pittsburg, Kansas to St. Louis, John asked me if I would introduce the speaker for this evening: Judge Walter C. Lindley. At that time, I had a very grave, serious doubt, that John would remember that he had invited me to do so, (Gavel very loud by Mr. Garcia,) but I am here, and he is here, and so I want to say, in fairness to him, that my suspicions were groundless. (Laughter.)

Mr. Garcia having introduced me as a coal operator and also a lawyer, my memory takes me back to twenty years ago, at which time there was in Danville a Joseph B. Mann—commonly known as Joe Mann, than whom there never was a better drilled lawyer in the State of Illinois. He afterwards practiced law in Chicago, and became a great after-dinner speaker at bankers' banquets. Mr. Mann was always on the program down towards the end, and as the Toastmaster would introduce him as the next speaker of the evening, he would say: "Gentlemen, let me present to you that eminent banker, Joseph B. Mann."

Mr. Toastmaster, I am an eminent banker, as well as a coal operator and lawyer. In fact, I go to the bank every ninety days, to renew my paper. (Laughter.) That is what all the coal operators understand doing, for the past five years. (Laughter.)

The gentleman I am going to present to you needs no introduction. *** If I were to tell you gentlemen all I know about the speaker of the evening, it would take from now until tomorrow midnight. He has no peer in the courts of the State or of the United States and he holds in his hands the destiny of the greatest industrial enterprise that ever went bad in the history of this country. He has that responsibility, and he is handling it like the man he is, with all the ability that he has.

It gives me great pleasure to introduce to you

JUDGE WALTER C. LINDLEY: (Applause.)

Address by

UNITED STATES DISTRICT JUDGE, WALTER C. LINDLEY

We are and for a considerable period have been living in anxious and troubled times, apprehensive of what tomorrow may bring forth. Not only is our security menaced, but our faith in the future is sorely tried. Therefore, it seems not untimely to discuss some of the features of the relationship of citizens to the common body politic and civic.

If we had nothing to build upon but the passions and greed of humanity, if we could visualize nothing beyond the dreams of individual nations, and the pettiness of certain leaders, we should have a feeling of utter despair. But because we believe in a law of progress; because we believe that every fortress that society has erected to protect and preserve civilization will be maintained; because we believe there is a certain vital spark of life inspiring humanity that will not die; that in this world there are groups of men, institutions of sobriety, bodies separated from all confusion, which maintain ideals above all mortal passions of men, we cannot despair for these are the truths upon which our nation is founded.

One threat of danger to our country today is in weak leadership, and in the trust that we too frequently place in inadequate or vicious leaders. There are great moral and social questions upon which all individual citizens can unite; problems which legislation cannot solve and which partisan policies cannot reach but which can be solved when traditional American principles are applied to the affairs of every day life. Let us examine some of them.

My own experience has largely to do with the administration of justice. There we think of the bench and bar as the responsible parties. But there is a third partner in the process,—the voting public. The people elect the judges or the executive who appoints them; they constitute the juries called to mete out justice. Despite this basic responsibility the mental attitude of a large proportion of the American people towards law is fundamentally the greatest obstacle in the way of an efficient administration of justice, both civil and criminal. In their point of view respecting the relation between the State and the individual, myriads of our citizens are positively unmoral; they are too often utterly devoid of any sense of personal obligation as functioning units in the organism we call the State; and when they function they seem governed by motives and reasons which, by the most liberal standards, cannot be dignified by the name "principles." Whereas bench and bar have defined in careful details the rules by which their conduct shall be governed and in terms which stir the admiration of thinking men, the voting public not only admits no duty upon itself to insist upon standards of high honor in those who have a responsible part in public affairs, but actually shows its contempt for virtue by discharging the obligation of suffrage in a manner which no high minded, or thinking person, who has left some respect for his own character, has the audacity to defend, unless, of course, he has discarded as unsound the very foundations of our economic and political system. The public attitude toward the administration of justice is no less reprehensible, no less a handicap to its efficient administration, than is the conduct of the voter at the ballot box an obstacle in the way of political government upon a high plane. Indeed, a citizen cannot at the

polls manifest his contempt for honor in the candidate for public office, without throwing the machinery of justice out of gear. Yet, the voters do so somewhere in every election in this great country; and the men and women who do so go home from the polls to join the unthinking in denunciation of the courts and of the lawyers because a criminal has escaped, or justice moves too slowly to suit in a particular instance. This is not flattering; but I am not here to flatter. I am somewhat impatient of the steady downpour of criticism upon the bench and the bar, sometimes from the very persons whose want of idealism and devotion to decency in the public service is shockingly manifested on election day. I appeal to the record; let it disclose the grave need for some sort of ethics, of finer standards of conduct, in the third partner in the enterprise of doing justice in this Republic.

In 1914, in one of the large states of the Southwest, a citizen became a candidate for governor in the primaries of his party. He had served in at least one penitentiary for train robbery; he had for many years been a robber and made a living at that business. Having served his sentence, he decided to abandon a career of crime and embark upon that of public office. Notwithstanding the notoriety of his prison record, he entered the campaign with unblushing zest and enthusiasm, seeking a "vindication" at the polls. He received only a partial "vindication" for he was not nominated; but with six in the race and a total vote of nearly one hundred thirty-two thousand, he was only fourteen thousand votes behind the winning candidate; and of the six he was third. Of all of the people of his party who went to the polls, approximately seventeen per cent wanted a former robber and ex-convict to serve as the governor of the state and as its official representative.

In another state, out of a total of three hundred eighteen thousand votes, one candidate received approximately twenty-eight per cent, or eighty-eight thousand votes, for nomination to the office of United States Senator. This man was, at the time he ran, under indictment for a serious offense against the laws of his country. Whether guilty or innocent, the fact remained that the machinery of justice had been set in motion and the officers of the law and at least twelve men had concluded that there was a reasonable ground to believe that he was guilty of a grave public offense. Without investigation, before the legal machinery could move to a completion, without any real knowledge of or even a desire to know the facts, over eighty-eight thousand voting citizens sought to exclude inquiry, and to foreclose, to obstruct, the due processes of the criminal law, by a vote of "vindication." When a large section of the public thus flouts decency, defies the efforts of the regularly constituted authorities to punish offenders, is it any wonder that respect for the law wanes and that difficulties in the way of its enforcement accumulate space? Codes of ethics for lawyers and judges do not reach this fundamentally dangerous popular attitude.

In 1920 the people of the nation elected a President. They had the opportunity to cast their ballots for candidates who aspired to hold an office made distinguished by the record of its first incumbent, George Washington, and by the immortal son of Illinois, Abraham Lincoln; an office honorable and powerful because it is the presidency of the greatest repub-

lic in the world. In filling this office, citizens should exercise care and the most conscientious judgment. Yet in this election it appears that there were nearly one million voting citizens in the United States who wanted for Chief Executive of the nation, a man who was at that time in prison, and who had been convicted of disloyalty to his own country in a grave crisis.

In 1922 there was an election in one of the eastern states to the very important office of District Attorney. One candidate who received more than fifty-one per cent, and thus outstripped his opponents and out-distanced the field, had shortly before been found guilty of an infamous offense. Yet he had the unmitigated effrontery to run, and a majority of the members of his own party who voted at the primary election apparently desired to be represented by a prosecuting attorney found guilty of a disgraceful crime, after full hearing and a fair trial. In the general election which followed, this same candidate, while failing of election, received over forty-two per cent of the total votes cast.

In a midwestern state recently a convention endorsed a lawyer who had a few years been suspended from the practice of law because of fraud and corrupt misconduct in which this member of the bar was actuated by the crassest sort of cupidity. Against him ran the incumbent of the office, a man with a spotless record as far as character for integrity was concerned. The suspended barrister's record in the supreme court decisions was made known generally throughout the district, but with no result as far as the vote was concerned, for he received substantially the solid vote of his group. Here, where high character is more important than great talent, a large and powerful body of voting citizens deliberately sought to put a man of small capacity and with a record of low dishonesty in his recent past into a judicial office with full knowledge, or, at least, with opportunity for full knowledge, that he possessed not a single quality that should commend his candidacy to a conscientious and upright man. A man with such an incident to mar his past could not obtain a license to practice law in many American states today; yet a large body of electors boldly put him forward as fit material for the judicial office. The voting public lags far behind the bench and the bar in appreciation of the moral or ethical aspects of its function in the administration of justice.

It is fashionable to denounce the courts, the lawyers, and the machinery of the law for their failure to catch the lawbreaker and punish him according to his dues. But it is a bit discouraging to labor hard to convict a criminal only to have him go to the people and win an election to a high office. It is a fiendish sort of humor which can find anything funny in this disgraceful condition. If such be the attitude of public opinion towards crimes and criminals, let us abolish the courts and determine the question of guilt or innocence by a vote of the people. If conviction of crime, has become a badge of honor, meriting high office as its reward, is it any wonder that lawlessness grows? We need a recognition by the citizens of a code of ethics, of standards of conduct, which will at least lessen if not make such offenses against political morality impossible.

You recall how Chaucer described one of the Canterbury pilgrims: "a knight there was, and that a worthy man who, from the day on which he first began to riden out, he loved

chivalry, truth and honour, freedom and courtesy." Then he summed it all up and said, "He was a very perfect gentle knight." And that is a statement of the way in which we, if we devote our attention to what is embodied in the meaning of these fine old English words, can accomplish something towards elevating the standards to which we refer. We cannot elevate those words into any higher meaning than they carry themselves; but when we are associating together in an endeavor to accomplish something that will make things better than they are now, we but better ourselves and in that way get nearer an appreciation of what is meant by elevating the standards for qualities such as integrity, honesty and courtesy.

Cost of Crime

It is well established through reliable statistical sources that crime costs this country directly and indirectly at least 13 billion dollars a year. This exceeds by 2 billion dollars the 11 billion dollars advanced to Europe during and since the war. It equals the amount of all of our expenditures for 12 months during the war. This item is made up of 4 billion dollars worth of property lost through criminal activities; the cost of maintaining the army of 500,000 men engaged in the suppression of crime, supplying them with weapons—courts, jails, penitentiaries, and prisons is another 4 billion. The economic waste through loss of potential productivity and the diversion of money to illegal activities such as commercialized vice, gambling, dope, booze and liquor is another 5 billion dollars.

There is a constant war against crime in which 12,500 people die each year—murdered; in which 500,000 police, judicial and enforcement officials are constantly at battle with the inert malevolence of 2 million criminals engaged in crime and unproductive activities. We have 200,000 prisoners of war, that is, inmates of institutions, and there are now at large approximately 135,000 murderers. In Chicago six policemen are shot to every criminal hanged.

Consider the facts from another point of view. Crime is one of the biggest businesses in this country. The annual cost amounts to more than the entire foreign trade of the United States. It exceeds the entire value of all of the agricultural products of the United States in 1920. It is a constant economic loss. Through taxes and insurance it levies toll like a tariff on everything you eat, or wear, or use for shelter. We pay for it in higher production cost, higher transportation charges, high prices to the consumer, greater over-head in business and government.

In this war upon crime citizens have their indispensable place. Election of capable officials, brought about by the unselfish activity of members of the order; cheerful service upon grand and petit juries and an energetic interest in matters affecting the community life; leadership in patriotism, civic righteousness,—all of these we can bring to bear upon this war of society upon crime.

Some time ago the Mayor of Youngstown, O., dismissed the vice squad of the police department. Not because there was no vice in Youngstown, but because the market for vice was stronger than the power of his policemen to control it. "I'm disgusted," he is quoted as saying, "with trying to make policemen enforce laws to govern people who refuse to obey their own laws."

What he has discovered with respect to his own town is true of practically every other city in the United States. As a nation we enjoy superlatives, but for one phase of our behavior we do not give ourselves full credit. We are the greatest nation of "fixers" in the world. The crooked politician "fixes" the troubles of his law-breaking constitutents. The rich father "fixes" difficulties growing out of his son's irresponsible behavior. Our national key-word is "fix."

I believe that most policemen want to do their duty. Then the question may fairly be asked why so many of them have become involved in corrupt combination. It all goes back to the fact that the police are not free agents, that they are mere pawns in the game. Here is how the combination works: The racketeer gives money to the ward-heeler; the latter pays it over to secure appointment or promotion for the policeman, or to buy his uniform and equipment; then, if the policeman has any gratitude at all, he will heed a word or two of advice from the politician when it comes to the business of protection.

So we have highly organized and superbly equipped police forces which are falling down on the job chiefly because they are opposed by the public they are sworn and paid to serve. The law-abiding citizen loses confidence in the police because he sees all about him evidences of corruption. He concludes that the force is not only in part bad, but is all bad. He voices his disapproval of necessary increases in its strength; lacking police protection, he is easily intimidated from assisting the police with information; when the police employ third-degree methods to fill this gap, the citizen turns away in disgust and when he sits on a jury he won't believe a policeman under oath.

Equally disquieting is the fact that the citizen himself is not law-observing. When he goes to a politician to have his traffic tag fixed, he is going through exactly the same process as the gangster.

Whatever may be your views as to what our constitution should be, whether or not you regard these tendencies I have pointed out to be the breaking down of the bulwarks essential to our stability, you will agree that it is the unquestioned duty of all of us to use our influence, in and out of season, to induce respectable industrious men to give more time and attention to public interests. This is a platform on which we all can stand. It cannot but result in bringing into active co-operation the dormant energies which may be directed to better government. This is not a party question—it is above, beyond, greater and more vital than any party policy.

"How long will thou sleep, O sluggard? When wilt thou arise out of thy sleep? Yet a little sleep, a little slumber, a little folding of the hands to sleep; so shall thy poverty come as one that traveleth, and thy want as an armed man."

Saith the political sluggard, "Let me alone." "Why should I neglect my business for the public good —I'll never be thanked for it; and besides I can do no good. It's no use, let those who like to do it!"— so shall misrule, the tyranny of the mob, and want come upon you as an armed man!

Ferrero, in his Roman History, at the conclusion of the first volume, speaking of the causes of the downfall of the republic, states that it was directly due to the indifference of the men of business, the men of education, the men of affairs, to mingling in public matters, and who "allowed

the elective institutions of the state to sink into the hands of the ambitious dilettanti and grasping adventurers who disputed for the suffrages and controlled the organizations of the Roman proletariat." "As in Europe and the United States at the present time," says the historian, " the great bulk of the upper and middle classes took but a languid interest in public affairs; they preferred to spend their time upon commerce and agriculture, study or pleasure, and were unwilling to take part in political conflicts or accept official responsibilities, to suffer the hardships of military service, or even the inconvenience of voting."

Look into your hands, my friends; there is placed there the gift of sovereignty. For the first time in history this country made the subject King. From neither the State nor the head of the State do you derive your rights. Out of yourselves alone arises the majesty of the nation, its justice, its might, and its glory.

You are the State. Out of your wisdom it is wise; out of your honesty it is just; out of your strength it is strong; out of your courage it is fearless, and out of your devotion it is safe. All of these qualities must arise to it out of yourselves, or it hangs its head in the presence of the world. It is but a composite of your thoughts and actions. It has none else to plan for it but its citizens. The America of tomorrow can be no greater than are you of today.

Let us consider our country all that it stands for from a distance. Where in all the world is there a national edifice so fair? Not the Sea King's rugged Citadel, from which we sprang; not France's Fane of Truth, though its every crystal pillar be hewn in beauty from the most exquisite thoughts of man; not Italy's ancient piles though spired and domed with gems from a magician's chisel; nor, surely, the feudal ruins that once were Central Europe.

Where, then, in all the world, is there a National edifice so spacious, so lofty, so inspiring? "On the banks of the Neva!" do I hear whispering voices say? What! that Red Thing! its minarets of flame playing amidst fountains of blood up from the embers of a once great nation! What suicidal impulse of the Western mind would bid us bring hither a single fagot from that colossal funeral pyre.

If patriotism be merely the love of one's country, by whomsoever that country be ruled, and the willingness to suffer, and, if need be, to die for it, then American patriotism needs be far more than that, for the American must stand ready to give all, not alone for his country, but also for the preservation of those principles of freedom which he holds in trust for mankind.

The greater, the dearest tradition of America, my friends, is that this is a government of laws and not of men. Presidents and governors and senators and congressmen may come and go. They serve their day and pass on, but the law endures forever. Respect for law, which means, following the rules of conduct prescribed by ourselves through our representatives, ever has been and still is the most distinctive basic principle in our scheme of government and in our traditions as a nation.

Let us here vow that we will do by the law as we would have the law do by us; that, when it presses us, we will ask, not, "is the law wrong?" but, "are we right?" Let us here promise that we will exalt the law; that we will hold it in respect; that when it is jibed at we will defend it, and when it is thrown down we will lift it again

from the earth, and set it up, if need be, with our blood.

The future rests with us. The fate of humanity may be in our hands; democracy can save or destroy the world. The pleading voice of a weary world, choked with the sob of the ages, is lifted to us. It beseeches us, in the name of God, in the name of Charity, in the name of freedom, in the name of justice, to be consistent, law-abiding, generous, and true, lest we, too, may go the way of the earlier nations. And it is just at this point that I would emphasize that this nation needs men, God-gifted men, of character, purity, vigor, and judgment. It needs men to stand in the hard places and fight the hard battles. It needs men to answer its questions and to solve its problems. It needs men whose lives appeal to our intellect, arouse our ideals, and touch the best in all of us.

Such men will proclaim and teach that American institutions and American law are the great bulwark behind which the forces of liberty are intrenched, and that the American Constitution is the outward and visible means by which the blessings of liberty have been secured. Such men will impose the principles of Americanism upon all newcomers and defend those principles against all attacks. Such men will do their work with enthusiasm, not for gain but because it is part of the plan. Such men will acquit their obligations to the Commonwealth and render good account of themselves when the "Master of all good workmen" shall sum up their lives.

There is a great painting that tells of American activity — a prairie schooner with its oxen toiling westward; bearing a family to some undiscovered home. Above the caravan hover the angels of hope and faith and love, pointing the way to go. Below is the spirit of commercialism and above the spirit of idealism, and the plodding life of America marches on between the angels and the soil. In the conflict of these two forces lies the problem of our future. Are we to be the victims of our own industrialism robbed by the very magnitude of our wealth, or shall we go under the leadership of the wisest and the best?

This country in its government should reflect the purity, the order, the patience, and the virtue of every home within its boundaries. It will not be the government we intend it to be until such is the case. It will never be such a country until we show a willingness to forget self in the opportunity to serve, a willingness to sacrifice in time, thought, and means for the sake of all. This is the best of the civilizations. There is no room for any thought except liberty, individuality, and the right to be free. Our fathers before us solved every problem that confronted them. They feared God and loved liberty, and though they sleep in the narrow trenches of death, their imperishable spirit lives in the American citizen of today and will live throughout all the years to come. They lived and fought and died that we might be free. Their sons in France sought in sacrifice an opportunity that our flag might be unspotted and unstained. They willingly died that all men beneath its folds should bear no chains nor live in dishonor, while a single star shone in the firmament of God. We shall keep the faith with our dead, —fathers, sons and brothers. If we break it, they will not sleep, "though the poppies grow in Flanders fields." And if we find that we cannot keep the faith without reserve, we should acknowledge that our civilization is a failure, and that we are too material-

istic to idealize the proud realities of life and respect the memories of those who recently went forth to fight and die that moral values might survive, liberty be vindicated, and Christian civilization emerge to its final triumph.

My friends I know of no better theme of life for us as Americans than that of the simple little poem. The unpretentious bard wrote thus:

"And when I come to die," he said,
"You shall not lay me out in state,
Nor leave your laurels at my head,
Nor cause your men of speech orate;
No monument your gift shall be,
No column in the Hall of Fame;
But just this line engrave for me:
'He played the game'."

So when his glorious task was done,
It was not of his fame we thought;
It was not of his battles won,
But of the pride with which he fought,
But of his zest, his ringing laugh,
His trenchant scorn of praise or blame;
And so we graved his epitaph,
"He played the game."

FACTORS THAT HAVE CAUSED AND PREVENTED ACCIDENTS IN ILLINOIS MINES

By JOHN G. MILLHOUSE
Director of Mines and Minerals State of Illinois, Springfield, Illinois

The task of trying to explain to you some of the factors which have contributed to the decrease of accidents in coal mines has been assigned to me by your Program Committee.

Some of the factors that have entered into the cause and prevention of accidents in mines is a subject which has been discussed by many able and efficient mining men at meetings similar to the one we are having here today. Numerous and excellent articles have been written on theories and practices for eliminating accidents, which have not only been discussed but put into practice, and have, to some extent, met with a varied degree of success. Accident prevention is a subject on which, up to the present time, no "hard and fast" rule has been formulated and adopted that would point the way to a solution of this very vexing problem of saving human lives and reducing accidents to a minimum in our coal mines. That there are many things entering into a discussion of a subject of this kind we will all readily admit.

Prior to 1882, no serious effort had been made to reduce mine accidents in Illinois, at which time suitable laws and regulations were enacted by the law-making bodies of our State government for the protection of those who worked in our mines. From that time on, a very noticeable decrease in accidents and increase in the production of tons of coal per man lost is very apparent. I believe this fact has been well established in all commonwealths of the United States where coal has been produced on a large scale.

We also know from observation and experience that there has been a marked improvement in methods of operation and systems used in mining coal during the last forty years which have been very important steps in

making safe and sanitary conditions under which men work in mines. There is also a higher standard of workmanship at the present time among our miners and those in charge of the management of our mines, and a greater spirit of co-operation between many of the coal corporations and miners for the prevention of accidents, than we have ever had during the history of our industry.

I have also observed that there is a closer personal contact between the miners, the coal companies and the authorities of the State government, which has been the means of bringing about better co-operation between all parties concerned than there would be without that intimate personal touch so necessary to interest men in their safety and well-being.

An excellent mine inspection service is maintained by the State of Illinois, composed of well informed, experienced men in mining operations and while much benefit has been accomplished by them, it is well to keep in mind that Inspectors cannot be at all of the mines every day and much has to be left to the men and the management for the safe operation of the mines they are working in.

Mines can be made just as safe as the men who own them and the men who work in them want to make them. Generally speaking, I believe that the human factor is of more importance in the prevention of mine accidents than any single agency I know of at this time.

We are fortunate in Illinois in having our own mine rescue and first-aid to the injured service. Eight stations are established and in use continually where this valuable information is taught to all who desire to acquire it. By this method, in a round-about way, we are bringing to the attention of the miners the value of accident prevention. We have progressed so far in this good work that in many of our mines the miners are trained one hundred percent in first-aid to the injured, and it is a very noticeable fact that where this high degree of proficiency exists fewer accidents are the result.

A large number of our coal-producing corporations are sold on the idea of first-aid and accident prevention. Many of the coal companies employ men as Safety Inspectors, whose business it is to be on the lookout for dangers which may appear at any time and have the same immediately taken care of. These Safety Inspectors try at all times to create within each man a belief that he alone is responsible for his own safety, instead of depending on the watchfulness of others. This, in my judgment, is one of the most outstanding factors which has come to my attention in the prevention of accidents in mines.

While a reduction of accidents has taken place in the State of Illinois, there are many dangers over which we seemingly have no control. The unexpected, hidden hazard which the most experienced miner cannot foresee and from which many lives are lost is one of the forms of accident which we are unable to guard against.

One of the most outstanding risks that I wish to speak of at this time is the use and abuse of explosives.

Explosives

In reviewing the records of our Department I find that from 1882 to 1930, 6,477 lives were lost. Out of this number, 622 fatalities were due to the use of explosives, which constitute 9.6 percent of the entire loss of life for that period of time.

During the year 1931, two lives were lost out of ninety killed that year, which is 2.2 percent of the fa-

talities due to explosions from powder, etc. This is a very material reduction in fatalities from that source for that year as compared with the average number of lives lost for the forty-eight years preceding that time, and I believe, is one of the factors which have entered into a reduction in the loss of lives in the State of Illinois.

In 1926, eight shot-firers lost their lives in the Springfield district from explosions due to windy shots caused by faulty drilling and by the amount of powder used. Our records show that at that time 1,250 pounds of coal were brought down to one pound of powder used, this all being done on what we call solid shooting. Today the records show from two to four tons of coal are mined per pound of powder used, which we can attribute to the discontinuance of solid shooting, although instead of undermining coal, shearing in the center has been adopted.

That the abuse and use of explosives, due, very often, to careless and unworkmanlike methods in the blasting of shots and in the storing of powder, have been a prominent factor in the high percentage of fatal accidents at the coal face, is true.

Also due to the abuse of the use of powder, bad roof conditions are made that are very hard to control and keep safe.

Through the efforts of an efficient supervising force, close co-operation with workmen, improved ventilation where possible, and a better understanding of the preparation and firing of shots, interest has been created to such an extent that the hazards incident to the blasting of coal have been very materially reduced. The improved explosives that have been brought into use, such as permissible explosives, etc., have also contributed very largely to the reduction of accidents from that source in the State of Illinois.

Gas Explosions

While the use and abuse of powder have been the cause of many lives being lost in our mines, it is very often the initial cause of another form of danger which all mining men fear very much: i. e.,—explosions due to the ignition of bodies of methane or firedamp which have such disastrous results. Our records show that from 1882 to 1930, 521 lives were lost through so-called explosions of gas. Of the sum total of lives lost during that period, 8 percent is attributed to gas explosions.

In 1931, in the State of Illinois, two lives were lost, constituting 2.2 per cent of the sum total of lives lost for that year. This shows a very material reduction in the fatalities due to this cause and may be attributed to several reasons. Closer and more careful inspections for gas,—a better understanding of the properties and occurrence of gas,—adequate ventilation facilities,—better forms of illumination,—and the advent of rockdusting, have been very important factors in the reduction of accidents due to gas explosions in mines.

Through the very able and efficient experiments conducted by the United States Bureau of Mines at their Bruceton Experimental Mine at Pittsburgh, Pennsylvania, much valuable information has been acquired and disseminated concerning the high explosive property that coaldust contains and has brought to our attention the danger that we have to contend with from that source.

We realize today more fully than ever before the terrible consequences that coaldust has in the propagation of an explosion in a mine. With the

coming into use of rockdusting, and with its proper application, it has been proved beyond the question of a doubt that explosions can be arrested at their initial point if the proper precautions are taken. Several instances are of record in this State where had it not been for the valuable agency of rockdusting, serious explosions would have resulted.

It is very gratifying to know that this practice has been generally adopted by many mining companies in the State of Illinois, and in some other States, through laws administered for its regulation.

In view of the fact that during 1931 no major explosions took place in our State where more than five lives were lost, I believe that rockdusting has been a very important factor in reducing accidents from explosions in the mines of the State of Illinois.

Haulage

During the past thirty years a great change has taken place in the haulage systems in our mines. I regret to say that a very slight decrease, if any, in accidents due to these changed systems of haulage, is manifest at this time. The hazards are the same, and practically the same percentage of lives are lost with the improved forms of haulage and do not show very much to the advantage of the changed methods in preventing accidents.

From 1882 to 1930—1,086 lives were lost, being 16.8 percent of the entire loss of life during that time in the State of Illinois. During 1931, fifteen lives were lost from that class of work, showing 16.7 percent of the entire number of lives lost in that year. Haulage still ranks second highest in the percentage of fatalities in the State of Illinois.

I may add that this is a matter that should be seriously considered by all who are concerned in the reduction of accidents in our mines. From my observation and experience, it is very difficult to adopt rules whereby this hazard can be controlled in a universal way, keeping in mind at all times that this is a personal matter and concerns the individual in its entirety for his safety.

Falls of Roof and Sides

There is another factor over which much thought has been devoted, and in which we are all concerned. Down through the years and up to the present time, no apparent gain has been made in reducing accidents from falls of roof and sides. More accidents occur and more lives are lost from this source than from any of which we have a record.

From 1882 to 1930,—3,029 lives were lost due to falls of roof and sides—a percentage of 46.8 of the entime number of men lost during that period of time.

During the year 1931—54 lives were lost, which constitute 60 percent of the entire number killed for that year as compared with 46.8 percent for the forty-eight years preceding it.

This is a class of work over which the average mine official has no control directly and is something which should be given very serious consideration. I believe the number of accidents due to falls of roof and sides could be very materially reduced if more time and care were taken by the men directly involved.

It seems strange that men working in the same place during the entire time they are in the mine should so frequently meet with accidents from roof and side falls. There is no reason why accidents should happen so repeatedly if the men would examine

their places oftener for dangers, and if, when found, they would immediately safeguard these places. This is a matter where personal responsibility for one's own safety should be considered. It is not to be expected that a man will be there all of the time warning the men of any danger they may be subjected to, although it is often remarked and said that men are not given the opportunity to properly safeguard themselves. This is frequently spoken of in mines where mechanized loading has come into use and men are paid by the day instead of the ton. In the State of Illinois this practice is very severely condemned when the attention of our Inspectors is called to it.

When we think of the terrible mortality which takes place due to falls of roof and sides, we should give more attention to the prevention of these accidents and have the bad practices which may be in vogue by the miner or mine official immediately corrected.

The conditions I have just briefly spoken of, I believe, are practically the same all over the United States for the same period of time and for the year just ended.

From my observation and experience I am fully convinced that a large number of the fatalities which happen in our mines can be avoided. If we would keep in mind the great sources from which most of our accidents come, i. e.,—explosions, explosives, falls of roof and sides, and haulage,—and concentrate our efforts on these causes and their prevention, I believe better results could be accomplished.

Conclusion

There are many schools of thought, if we may call them such, that are regarded as a panacea to cure the many ills in mining operations for the prevention of accidents. The Bureau of Mines has been very much concerned in devising ways and means to this end by educating miners and mine officials in advanced mine safety training. Others are inclined to believe that stricter supervision will obtain results—and many other methods have been advocated, however, most of these plans are largely theory, and, in my opinion, do not bring the reward they should be entitled to.

The miner, as a rule, is a very independent thinker, and very often these methods will arouse the hostility of the average practical miner. If we expect to accomplish anything worth while, it seems to me we must be more concerned in personal interest in safety. The average miner who is thoroughly trained in mining coal and the attendant dangers that go with his work knows more than any man can teach him. Experience is our greatest teacher and there is no question of a doubt but what the average experienced miner is better informed of the dangers he encounters in his working place every day of his life than anyone I know of.

It seems to me that if we can bring into the heart and mind of a man so engaged a realization of the responsibility that he owes to himself, his wife and family, and the terrible consequences of an accident—what it would mean to him to be incapacitated for life and thereby be denied the right to earn a living and provide for those who are dependent on him,—we will, I believe, accomplish more than by any other method I know of at this time. While I do not wish to, and can not disparage the good that any system of information or instruction is to a man for his well being, nevertheless, the personal ap-

peal is of more importance than any other.

If we can impress on a man the full realization that every time he takes a chance with his life or limb his family is standing beside him and as a result of his indiscretion will suffer more than he will—if we can bring into that man's life the understanding that his health and strength are the only capital he has in this mundane sphere and that when his capital is destroyed and made useless he is in a very pitiable condition on account of his being unable to earn his way through the world, I feel sure that we will strike a responsive chord in his heart which will make him STOP, LOOK AND LISTEN! and realize more fully than ever before what an accident will mean to him.

These are some of the factors that have entered into the cause and prevention of accidents in the state of Illinois.

DISCUSSION OF MR. JOHN G. MILLHOUSE'S PAPER
Given Before the
MINE INSPECTOR'S INSTITUTE OF AMERICA
on
"FACTORS THAT HAVE CAUSED AND PREVENTED ACCIDENTS IN ILLINOIS"

By JOHN LYONS
Safety Engineer Bell & Zoller Coal and Mining Co., of Zeigler, Illinois

Mr. Millhouse has reviewed 50 years of progress in accident prevention work in Illinois mines. He has pointed out to you a number of factors which has assisted very materially in the reduction of accidents. These things are:—

1. Improved methods and systems of mining.
2. Better ventilation.
3. Closer co-operation between coal operators.
4. Better co-operation between employer and employee.
5. Higher standards of workmanship among the miners.
6. Better trained and equipped bosses.
7. Improved supervision.
8. Closer personal contacts between employer, employee and the State Department of mines and minerals.
9. Teaching of First Aid and Mine Rescue work in State Mine Rescue Stations.
10. Employment of company safety inspectors.
11. Improved mechanical and electrical equipment.

My company, namely the Bell and Zoller Coal and Mining Company, recognize these factors and they have had, and are having, our earnest attention. During the past three years we have shown a substantial improvement in our frequency and serevity rates. While it is very difficult to state positively the particular things which have brought this about, we can state our opinions. We believe that the following things have been of very material assistance:

1. 100 percent First Aid training.
2. Safety rules.

3. Investigation of accidents.
4. Mining classes.
5. Prizes for meritorious work.
6. Safety posters.
7. Monthly safety magazine.

With your kind indulgence I would like to tell you briefly some of the details of these things.

We operate two large mines at Zeigler in Franklin County, Illinois, and mine what is known as the No. 6 Seam. The coal averages about 10 feet thick of which about 30 inches is left to form a coal roof. The operating conditions at both of these mines are similar. Each mine hoists an average of 7,000 tons daily. Our No. 1 mine is 100 percent mechanical loading, using Joy loading machines and conveyors, and the coal is shot with Cardox exclusively. Our No. 2 mine is strictly hand loading. Rock dusting is done at both mines and the U. C. C. Methane Indicator is used in testing our returns.

100 PerCent First Aid Training

Under the direction of the U. S. Bureau of Mines and the Illinois department of Mines and Minerals, we put on a First Aid training campaign which lasted four months. This was started in December, 1929. During this period 1435 men completed the course. During these meetings a portion of the time was taken up in Safety talks by State Mine Inspectors, Instructors and myself, and we discussed very freely the fatal accidents that had occurred at our mines, together with the causes and suggestions as to how they could each have been avoided. We believe these meetings were a very good help.

Personal talks were made by our Vice-President and General Superintendent to our foremen outlining the policy of our company with regard to Safety. These talks were followed by letters urging co-operation in the Safety movement.

Safety Rules

A set of Safety and Operating rules were drawn up and printed in booklet form. These rules especially outlined safe practices. These rules have been added to as they have been found necessary. Some of these rules are especially based on experiences, for example: In all mines where breast type cutting machines have been used, accidents have frequently occurred where helpers have been struck by falling face coal, very often with fatal results. In 1929 two fatal accidents occurred at our No. 1 mine from this cause. A rule was adopted which required that all faces undercut by breast machines must have sprags set not more than 6 feet apart beginning not more than 6 feet from the starting rib. Other rules of importance are the requiring of props in rooms to be set not nearer than 30 inches to the rails. Also the setting of Safety props on all Joy loading faces. The requiring that all tripriders shall have their trouser legs secured at the ankles. Violations of these rules were checked and if found they were reported in writing to the foreman in charge and all higher officials.

Investigation of Accidents

Reports are made to the Vice-President, General Superintendent, Superintendent and Mine manager, of all serious accidents, and if possible the responsibility for the accident is placed. We believe this has been quite a deciding factor in lining up our foreman in the Safety work.

Mining Classes

We have for the past two winters conducted instruction classes covering

the courses required for competency as Mine Examiners and also Mine Managers.

This has included technical and practical instruction. In the use of the safety lamp and the anemometer, the students were taken underground and instructed in testing for methane and measuring air in the mine.

Accident Rating of Bosses

In 1929 we began to make rating lists showing the standing of the bosses with reference to the number of days lost due to accidents in proportion to the Total man-shifts worked. This rating is based on the formulae of adding to the total man-shifts worked, the total days lost due to accidents and dividing the total thus obtained into the original number of man-shifts worked. The bosses are placed in competitive groups. We also rate our mines on the same formulae. The mines of the Crescent Coal Company located at Peoria, Illinois, and the Centralia Coal Company located at Centralia, Illinois, both of which are subsidiaries of our company, are included in this rating system. Annual prizes are awarded to each boss having the best rating in his group. Additional prizes are given to each boss employed at the mine having the best rating for the year. The rules which govern these contests were gotten up by a committee of bosses made up of one boss from each mine and this committee meets every six months to revise the rules if they are found necessary.

Safety Posters

We use the National Safety Council safety posters extensively, pasteing them on the side of pit cars and on concrete piers underground, locating a good strong light on the posters. In our safety poster case on the surface, we use a 22"x28" specially hand drawn poster which is changed each week. These are made up from descriptions which we send in to the artist. Some of these are made to describe in picture and word some safety rule. For instance, in our rule requiring that props be set not less than 30 inches from the rails, we had the artist show a man measuring the distance between rail and prop with a pick handle on which was marked 30 inches, also the words, "Set your props not less than 30 inches from the track." Sometimes these posters are made to describe in word and picture, how some particular accident may have happened at one of our mines.

Safetygram

We also publish a Safety Magazine which we call the "Monthly Safetygram." It is made up of 16 to 20 pages measuring 5½x8½ inches in size. Approximately 5 pages are used for articles on Safety; 7 pages for tables showing number of accidents from different causes, parts of body injured and occupation of injured. Also the accident ratings of each boss and mine is shown. About 4 pages are used for brief personal items concerning our employees and two full pages to what we call, "How it happened." Approximately 12 to 16 accidents in which time was lost are picked from among our mines, that have occurred the previous month, and these are described in detail. This magazine is compiled in the office of our Vice-President, and the front page is taken up by an Editorial written by him.

As to Improvement

Mr. Millhouse seems to infer that mechanical loading mines have more accidents than hand-loading mines.

We do not find this to be correct at our Zeigler mines. We admit that during the first year of our mechanical loading we did have an increased number of accidents; however, results over a period of time are proving that less accidents are occurring in our mechanical mine than in the hand-loading mine. Our severity rates for the year 1931 show as follows:

	Man-shifts worked	Total days lost on account of accidents	Yearly rating
Zeigler No. 1 Mine	121,956	1577	.987
Zeigler No. 2 Mine	134,409	7621	.946

Under the U. S. Bureau of Mines system of calculating seventy rates the figures would be for No. 1 mine 1.61 and for No. 2 mine 7.87.

No 1 mine is mechanized, and No. 2 mine is hand-loading. Our Centralia mine which is also mechanized, went through the months of January, September, October, November and December 1931, without a lost time accident. The average ratings of our bosses at No. 1 mine, also the mine, in 1929 was .971. In 1931, it was .987. The man-shifts worked per lost time injury was, in 1929—367. In 1931 it was 1079. In December 1929, this same mine with a total of 16,871 man-shift worked had 53 lost time accidents. In December 1931, with a total of 7,839 man-shifts worked, we had only 1 lost time accident. We have not had a fatal accident at our No. 1 mine since December 5, 1930, and have produced 1,291,799 tons of coal up to date, as compared with our former average of 310,355 tons per fatality over a ten year period.

During this same period, the tons per fatality at our No. 2 mine were 1,329,943. This mine operated from August 6, 1928 to September 28, 1931 without a fatal accident during which period a total of 3,756,525 tons was produced. This mine was awarded the Joseph A. Holmes Certificate for this outstanding achievement.

In addition to the factors already menioned, I cannot conclude without mentioning that the State Inspection Department have also played a good part in our accident prevention program to date.

FIFTY YEARS OF COAL MINING

The following article, being the second and concluding portion of "Fifty Years of Coal Mining," completes the paper of which the first four instalments appeared in our 1931 Year Book. This article was made available to our members through the courtesy of Explosives Engineer, to whom we are indebted for their permission to submit it to you. (See footnote end of article).

PART V

By OSCAR CARTLIDGE

Illustrations by A. B. Chapin

The Benton Coal Company had been operating not longer than a year when we had an explosion. This, I think, was as violent as any explosion of which I have knowledge. All mining was being done by hand, and there were only a few rooms, entry development having been the main objective. Since the field was new and the coal was quite dusty, we had put on shotfirers whose duties were to charge and fire the shots at night after all

other men had left the mine. The miners on the day shift drilled the holes, but the shotfirers had the authority to reject any hole which, in their judgment, was placed improperly. Also, it was a rule at the mine that all narrow places had to be sheared to the full depth of the hole.

The shots which caused our trouble were in a 9-ft. entry from which we were taking about 7½ ft. of coal. A shearing cut, only half way down from the top, had been made on the right-hand rib. A hole had been drilled on the opposite rib, and two others had been drilled near each rib at the bottom. If the top shot had been fired first, all would have been well. But we learned that our shotfirers, to get through the night's work hurriedly, had been in the habit of connecting all fuses in a place with lamp cotton soaked in coal oil. Touching the string with a light, they hurried to fire the next place, relying on the burning string to ignite the several fuses. On the night of the explosion, the top fuse in this narrow place failed to catch, and, therefore, did not liberate the lifting shots below. Both of these shots went off, blowing the tamping and devastating the entire mine. A loaded car, holding about four tons of coal, which had been left at the shaft bottom, was blown up the shaft and was left hanging in the tipple. One hundred feet of the main shaft's lining was dislodged and piled, together with pipe, wire, and similar material, in a jumbled mass at the bottom. The nice job of timbering which I had done in the main entries was entirely blown down and covered with roof falls to a depth of 10 ft. to 15 ft. The escapement shaft timbers were blown out at the bottom of the air shaft for 30 ft., the stairway going with it.

One Shotfirer Killed

Edward Laughron, the mine examiner, and I hung a rope to the bottom landing and slid down it the last thirty feet to get into the mine. We found the two shotfirers in the pump room near the bottom of the main shaft. One was dead; the other survived, although he was terribly burned. Several years later, he was killed by a fall of slate in another mine.

To get the men out, a long rope with a sinking bucket tied to the end was lowered to the bottom of the escapement shaft. After a man had been placed in it, nearly a hundred willing citizens grasped the rope and walked out across the level field. In preparing to take the men out, Mr. Laughron and I traveled the shaft seven round trips each. If anyone thinks it an easy task to climb a 630-ft. stairway seven times in one night, let him try it. I will venture a guess that he will be a trifle stiff the next day.

No fires were started by the explosion, luckily for us. When Laughron and I made a search to discover the cause, we found the unburnt lamp wick tied to the fuse in the upper hole. When confronted with this evidence, the surviving shotfirer confessed. They had been doing this for some time, but how they escaped disaster as long as they did is a mystery.

Peculiarities of the Explosion

A strange thing was observed in this mine after the explosion. There had been considerable gas issuing from the coal in all the working places, yet during the three months it took to reclaim the mine there was not an atom of gas to be found anywhere—even before the stopping and

overcasts were replaced and the air currents were circulating again. It would seem that the terrific heat had burned the coal free from all gas that was close enough to the outside to be forced out by the roof pressure; or the pressure exerted against the coal was so great that the dust particles stopped up the pores of the coal. Too, a vacuum may have been created when the explosive force passed, which sucked out the gas for a distance of several feet behind the face.

I have always regretted that I did not secure data on how far we penetrated into the coal after starting up before gas was observable, but I do know that shortly after mining was resumed gas was again in evidence. Just why the gas did not continue to issue forth after the blast is a matter for our more scientific friends to deliberate.

Another peculiarity I noticed was that while in some places things were completely wrecked, in others nothing was disturbed; yet evidence of the explosion was plainly observable by the coke deposits on the timbers and coal.

In those days it was permissible for a miner to have in his working place one keg of powder, which he was required to keep in a tight wooden box that had to be kept locked. The box had to be not less than 50 ft. from the working face. On our inspection, we found only one box that had not been destroyed by the powder it held. This one was resting apparently undisturbed exactly as the miner had left it; the lid was on and was securely padlocked. Mr. Laughron pried it off, and there was the metal powder keg spread out in a complete lining for the box. The powder had exploded with force enough to tear the keg to pieces, but it had not even loosened a board on the box.

When first breaking off from the bottom with the main entries, we used blasting barrels with squibs to explode the powder. Every once in a while, instead of the powder detonating with the usual loud report there would issue from the shot a long, drawn-out hissing noise, and no coal would be loosened. This had me puzzled for some time, but I finally concluded that the ½-in. barrels which our men were using were too large. I substituted barrels of ⅜-in. diameter and no further trouble was experienced from that source. It does not seem possible that a heavy charge of powder could burn in a hole and that the gas could escape through a pipe only ½ in. in diameter and yet not be able to do the same thing through one only ⅛ in. smaller—but such was the case.

Detecting Gas in the Workings

Mr. Laughron was an old English miner and was very expert with a Davy safety lamp. Nothing I could say would make him believe there was any other lamp in the world as good for detecting gas. He would admit in a pinch that my Pieler or the new Wolf lamps, which were just then becoming popular, would give a little better light, but that was of no importance to him. The light given off by a Davy was ample so far as he was concerned, and when it came to the detection of gas in a working place those "new-fangled contraptions" were not in it.

One day when the mine was idle, Neddie (as we called him) and I were going through the workings. As usual, he had his trusty Davy with him. In our rounds, we found a deep room neck which had about 2 ft. of gas resting snugly against the roof. Since merely words would not shake his faith in his Davy, I resolved to try

the effect of an object lesson. That year J. T. Beard had introduced a gas indicator, which consisted of two uprights, attached to which were a series of horizontal platinum wires so spaced that gas in percentages from one-half of one per cent up to two and one-half per cent was evidenced by the glowing of the respective wires. This attachment was inserted inside the gauze of the common Davy when it was to be used.

I had prepared a lamp with one of these indicators and had it with me that day, so I had Neddie remove his jacket and fan the gas out of the room neck into the main air current. With his Davy, we then again inspected the place, which was in about 40 ft., and he pronounced it clear of gas. I then lighted a carbide lamp which we had with us and took it into the room, thereby substantiating to Neddie's entire satisfaction the impossibility of failure with a good Davy. After these demonstrations, I adjusted my Beard indicator and tested the place with it, proving before Neddie's astonished eyes with this more delicate instrument that there was in every part of the room one and one-half per cent or more of methane. He had not fanned out the gas with his jacket; he had only mixed it with the air, which is just what I had suspected would happen. This demonstration somewhat shook his faith in the Davy, but he still continued to make it his chief reliance in his examinations—arguing that where he could not find gas with it there was no danger anyhow.

Many New Mines Opened

Mines in Franklin County were developing fast. Besides the United Mining Company, with two mines at Christopher, the Zeigler District Colliery had two, and T. C. Keller, at Sesser, in the northeast corner of the county, was vieing with Col. W. P. Rend, six miles south, to see which could reach coal first.

Mr. Keller's property, known as the Sesser Coal Company, had the deepest shaft in the county—705 ft. to the coal. In contrast to the sinking conditions around Christopher, where considerable quicksand and water is encountered, the Sesser shaft was perfectly dry. This was a decided advantage in sinking, but later considerable trouble was encountered from dry rot attacking the shaft timbers. Up to that time, wood was the universal shaft lining in that section of the country.

The Sesser Mine was exceedingly well equipped, and Mr. Keller holds the honor of being the first man to install a Smith box-car loader. This loader was so constructed that a box car placed on it would be tipped on end at a severe angle so that the coal from the screen chute would run to the low end. After the first end was loaded, the car would be reversed gently and the other end filled, the tilting being actuated by compressed air. This loader was designed to prevent breakage of coal, but the high cost of installation restricted its general use.

Colonel Rend's mine was also designed to handle large tonnages and had every facility known to the business. Being south of Sesser, it was not as deep by nearly 200 ft. to the coal. Colonel Rend had just sold his holdings in the Hocking Valley and in West Virginia at a reputed profit of over $2,000,000 and had decided to get in on the ground floor in the Franklin County big coal. His oldest son, Joseph, was general manager, and Jack Ohle was the superintendent. The Colonel had purchased several thousand acres and was expecting to

develop it on a large scale, but he suffered such reverses at the outset that only one mine was ever operated on this tract, although he later purchased a mine in Williamson County.

The Colonel was a unique character. A handsome, well-groomed Irishman with a decided "burr" to his speech; he was a born orator and was inclined to be rather liberal in his dealings with the miners' union. The other operators of the district were displeased with this procedure because they believed the miners were getting all, and a little more, than they were entitled to. For that reason, he was not as popular with the operators as he otherwise would have been, and they gave him but little opportunity to talk in their frequent conferences.

His mine, as I mentioned before, was burdened with misfortune. In the first place, the coal at this point was only 6 ft. to 7 ft. thick, which left little, if any, top coal to protect the roof. Mining was more expensive than in the average Franklin County mine, and two major explosions only a month apart caused him a great financial loss and much mental agony, for his was a sympathetic nature and he was easily touched by human suffering.

A Period of Disasters

The Southern Illinois district, as well as other coal fields in this country, was visited by an unprecedented series of terrible explosions at about this time. Many new mines were being developed, and there was rivalry between the operators to see which could get out a maximum tonnage in the shortest time. This high pressure on the superintendents and foremen caused them to take chances which otherwise they might not have taken. Then, too, none of us had much knowledge of the properties and actions of gases and coal dust, and there were not a few who argued strenuously that coal dust would not explode.

"Uncle Dick" Newsom was one of these. He held to the theory that coal dust was not explosive, but that water was the great enemy to be feared. Many times have I heard him orate on this subject. He contended that water was composed largely of oxygen, and that oxygen, when mixed with the mine air and gases by evaporation from the heat of a "blown-out" shot, was the real cause of all our troubles. He was bitterly opposed to the watering of the mines to prevent explosions and always condemned its use. "Uncle Dick" at that time had no corrective to offer in the place of water, as rock dusting was not then generally known, although in Europe some preliminary testing of its effects were being made.

The years 1908, 1909, and 1910 were a nightmare to those of us in Southern Illinois. During the previous year, Sherman Burris, then superintendent of No. 3 Mine of the Superior Coal Company, at Gillespie, had been appointed state inspector of the Ninth District. This district included eight counties in the southern end of the state, Franklin being one of them. At that time I was chief engineer for the Benton Coal Company and the Hart-Williams Coal Company. New mines were being sunk fast. The Dering Coal Company had completed its No. 18 shaft at West Frankfort; the Old Ben No. 11, at West Frankfort; the Hart-Williams Coal Company, at Benton; the White Ash Coal Company, near DuQuoin; the Marion County Coal Company, at Centralia; Horn and Diamond was sinking a shaft at Smotherville; the Centralia Coal Company had a large operation under way at Centralia; the Southern Illinois

Coal Company, one at West Frankfort; and the W. T. Ritchey Coal Company was developing one at Pinckneyville. Franklin County had increased its output 94.4 per cent over the year 1907, and the financial depression of that period seemed to be disappearing fast.

The state law required that when requested to do so by the district inspector, a county should employ an inspector as his assistant. Mr. Burris demanded an assistant for Franklin County and recommended me to the County Board. I was appointed, and, having arranged with my employers to put in half time at the mines, I accepted. This was the beginning of a political career which, in the following four or five years, was to see me elevated to the highest positions of honor my state had to offer in the mining industry—going successively from county inspector to state inspector and then to general manager of the state's mine rescue stations. This was not through accident, for I had had for years one definite objective and that was to be a state inspector.

From my earliest boyhood Uncle Walton Rutledge had been my hero, and I resolved that I would attain to what, in my boyish mind, was the acme of success—an inspector of mines. Throughout all the years I never lost sight of this for one moment. Looking back now, I can see that the height to which I aspired may not have been the highest pinnacle, but it goes to prove my theory that if a young chap with average ability will set before him an objective within reasonable limits and will work steadfastly to accomplish it, he will invariably succeed.

But, to get back to what I was saying about the winters of 1908 and 1909, the Dering No. 18 Mine at West Frankfort had an explosion, killing four men. There was one at Benton Coal Company in which six men were killed; at Zeigler two explosions took the lives of twenty-nine men; one at Grayson killed three men; at Colonel Rend's Mine at Rend, two explosions only thirty days apart, accounted for seven more lives; and the fire at Cherry added a fearful climax, with a toll of 267 deaths out of the 481 employed. These were all explosions of terrific force, which, in addition to the loss of life, did immense damage to property. At the Rend Mine, the first explosion, November 5, blew down all the doors and stoppings, destroyed the ladderway in the escapement shaft, and blew a loaded car containing four tons of coal from the bottom of the 450-ft. shaft up into the tipple, where it was left suspended.

A Risky Hoist

At this explosion, I made a big hit with "Uncle Dick" Newsom. Both main and escape shafts were complete wrecks, and to get below (nearly 600 ft.) we had to use an old steel wire rope and a sinking bucket, both of which had been nearly worn out in sinking the shaft. This outfit was suspended in the escape shaft and connected to an improvised hoist. It was an exceedingly dangerous arrangement, used only in an emergency to recover the bodies of the four men who had lost their lives in the explosion, and to put out the fires generated by it.

Inspector Burris had asked the mining board for assistance, and Thomas Little and Thomas Moses, inspectors, had been sent to help in the rescue work. After the bodies had been taken from the mine, permanent repairs were started at the main shaft, and the temporary hoist was aband-

oned except when it was absolutely necessary to go below. Governor Deneen had ordered the mining board and the inspectors to investigate and report on the explosion, and in a few days they all arived at Benton. I knew it would be very risky for all of those men to descend into the mine by such flimsy means, so as soon as I heard they were on the way, I slipped out to the mine and posted a notice to the effect that I considered the temporary hoisting arrangement too hazardous for the lowering of men into the mine and forbade its use for that purpose, signing it over my official title as county inspector. Fifteen or more of the men arrived at the mine and changed clothes in the office preparatory to going below. They then proceeded to the escapement shaft, with "Uncle Dick" in the lead, and the first thing they saw was the notice I had posted. "Uncle Dick" looked at the frayed and rusted rope hanging in the shaft, then he looked at me and said, "Oscar, did you put up that notice and do you mean to say we officials cannot go into this mine?"

"Exactly that, 'Uncle Dick'," I said, "and if you do, you'll do it over my lawful protest." He looked me in the eye a full second, threw up both hands, and said, "Come on, boys, let's go." And they all started back to Benton.

In about three weeks, when the shafts were in shape to enter safely,

After the Rend explosion, December 14, 1908. From left to right: William Morris, Thomas Little, Jonah Flavel, Thomas Moses, William Bennett, and Sherman S. Burris.

they all returned, but "Uncle Dick" knew I had deliberately saved them a most dangerous trip, and, although he never said anything about it, he always thereafter treated me with unusual consideration.

At this inspection, which was made November 30, 1908, "Uncle Dick" appointed Thomas Moses as clerk to keep a record of the observations for purposes of the report. Mr. Moses was then inspector of the Fifth Inspection District, residing in Westville. About 1912 he was made general superintendent of the Illinois mines of the U. S. Steel Company, and about 1928 he was elected president of the H. C. Frick Coal and Coke Company in charge of all the mining interests of the steel corporation. Tom, as we called him, is a whole-souled, most likable fellow—a born leader and a mining man par excellence. He knows men and understands how to handle them and undoubtedly is making a most successful executive for the great corporation which he now heads.

Trouble at Zeigler

This was the year of the great mine fire and subsequent explosions at Zeigler. About ten o'clock on the evening of November 4, my telephone rang. It was from the Leiter Mine at Zeigler. They said the mine was on fire that it had been fought without success until all their available force was incapacitated from the smoke and gases; that sixty of their best men were in the hospital; and they asked me if I would raise a crew and come over to help them.

I said that I would go but wanted to know how they expected me to get men in the union town of Benton to fight a fire at a non-union mine. Mr. Gordon, the general manager, was doing the talking at the other end, so he said for me to do the best I could and that he would send one of their own trains over to get us. I immediately got busy trying to get men to go with me, but I could not find a single miner who would make the trip. However, James Seymour, general manager of the Benton Coal Company; Barney Cosgrove, mine manager; and Edward Laughron, mine examiner, for the same company, and one other man whose name I cannot now recall, volunteered to go.

The "train," consisting of only a locomotive and coal tender, arrived in Benton at three o'clock that morning. We climbed aboard and started on our journey of 14 miles to Zeigler. The night was bitterly cold, and we almost froze to death before we got there. Arriving about four o'clock, we found that almost every man at the mine was sick and exhausted, and that they had, through sheer physical disability, been forced to give up the struggle against the flames.

Tom Watts, superintendent of the Zeigler District Collieries Company, and several others had arrived from Christopher (six miles to the north) and I at once proceeded to organize a crew to see what could be done. We found that we had ten men, all officials from neighboring mines, except Charlie Smothers, assistant mine manager at Zeigler, and a big colored laborer named King. We decided that it would be useless to try to fight the fire further, so we divided the force into two crews of five men each to see if we could seal it off. We learned that a trap door, about 1,200 feet in, between the third and fourth left entries on the south side, had caught fire in some unknown manner and that the flames had traveled out toward the main entries several hundred feet when the efforts to extinguish them had ceased. They had run in a pipe line and had tried to drown out the fire with water. In our opinion,

the only safe thing to do was to try to seal off these two entries and thus confine the fire to a limited area.

We all got into the main hoist and went to the bottom of the main shaft, from which point I took one crew (consisting of Edward Laughron, Mr. Gordon, James Seymour, and Tom Watts) to the mouth of the entries, leaving the other crew in charge of Barney Cosgrove, at the shaft bottom. It was our objective to see if the conditions were such that we could erect stoppings in these two entries, and if so, the crew at the bottom was to bring in supplies while we did the work of stopping off the fire.

PART VI

Arriving at the designated point, we found everything clear and sent word out at once for the necessary supplies to start the work. In a short time, Smothers and King arrived on a locomotive with some boards. While we were unloading at the third entry, some of us moved back to the fourth to locate a suitable spot for our next stopping and while we were standing at this spot we saw an intensely blue sheet of flame, about 2 feet thick, playing near the roof at the point where we had left Smothers and King. I saw Smothers fall on top of the locomotive, and some of us ran in and dragged him to the inside.

The Zeigler Mine is laid off on a large scale, the coal being 12 feet to 14 feet thick, and the third and fourth entries have a pillar between which is about 75 feet thick, as nearly as I recall at this time; therefore, the flame did not reach the fourth entry. There we were, shut off from the main shaft by burning gas and the escapement shaft nearly a mile away over the circuitous route we had to travel, with four overcasts to cross and nobody familiar with the inside workings except General Manager Gordon.

We started for the escape shaft, taking turns at carrying Smothers. We had no knowledge of King, the huge negro, but we later learned that he had been able to escape the flames and make his way to the main shaft, where he and the rest of the men had succeeded in reaching the surface safely.

We had proceeded what seemed to us an interminable time, when suddenly we heard a mighty roaring sound coming in our direction, and we knew an explosion was upon us. We threw ourselves to the side of the road, burrowing as low as we could and clinging to the mine track, while a mighty rush of wind, sticks, stones, dust, and what-not passed over. Fortunately, the flames from the explosion had died out before reaching us and no one was injured. We arose and started with all haste on our way, expecting another explosion at any moment, but none came. Mr. Gordon said that he knew where there was a regulator in a stopping between two entries, which, if we could find it, would cut off nearly half the distance—so we told him to lead us to it.

Almost a Panic

The intense strain and excitement had somewhat unnerved him, and when we got to the place where he thought the regulator should be, it wasn't there. By this time, all of us were in an unstrung condition, and the realization that we were lost in the mine almost created a panic. I suggested that it might be possible that the regulator was a little farther in than Mr. Gordon supposed, so I ran up to the next stopping to see—and, sure enough, there it was! I turned to notify the men and saw every one of them except Seymour madly retrac-

ing his steps down the entry. We shouted them back and crawled through the regulator door. Then Mr Gordon could not remember the way toward the escape shaft.

I had a Davy safety lamp with me, which I held up in the air current. I thought that by the inclination of the flame we could determine which way the air traveled and could thus orient ourselves, but the flame stood perfectly straight, there not being a particle of air traveling. We learned later that the explosion we had experienced had been of such terrific force as to blow down part of the brick fan house at the top of the air shaft, stopping the fan. This accounted for the lack of air current where we were.

"What is that noise?"

We started out blindly, and, by some fortunate circumstance, we chose the right direction, as evidenced by our arriving at the overcast which carried the major current over the main entry to the upcast. This was at a point about 500 feet from the upcast shaft. We breathed a sigh of relief, thinking our troubles were about over.

Seymour and I were in front of the other men, whose turn it was to carry Smothers, and we waited for them to come up so that we could help get the dead man over. Suddenly Seymour, who was leaning against the concrete wall of the overcast, said: "What is that noise?" We listened and could hear the roaring of a huge fire in the main entry almost at the very overcast itself. We frantically urged the others on, and, climbing over the overcast, made a mad dash for the air shaft. Just as we arrived, a rescue crew from the surface reached the shaft bottom to look for us, firmly convinced that we had all perished in the explosion. They assisted us up the ladder-way to the surface where we all thanked God for release from a night of horror, wherein we had at least on four different occasions miraculously escaped death.

We had been on top hardly an hour when the fire reached the escape shaft and was burning the timbers therein. Realizing it was useless to try to fight the flames further, we covered both shafts with temporary seals, which were ordered made permanent for ninety days by State Inspector Burris when he reached the mine later in the day. Joseph Leiter had been at the mine the day before the fire and was on a train bound for Chicago when a telegram informing him of the disaster overtook him. He returned immediately to Zeigler and assumed charge of the situation.

Two 5-in. drill holes were put down over the overcasts, and water and live steam were forced into the mine in great quantities. Only a short time before, I had read a treatise by Doctor Snelling, in which he mentioned the possible smothering of mine fires by burning sulphur and forcing the fumes into the affected area. I wrote to Mr. Leiter suggesting that he try sulphur. As soon as he read my letter, he ordered two carloads sent by express from St. Louis.

In the meantime, a large brick furnace had been erected. This had an evase chimney on top through which the sulphur was to be fed. A long tunnel led from the furnace, and at its opposite extremity was located a small high-speed force fan which was expected to pick up the gases generated by the burning sulphur and force them down the airshaft to the fire. The furnace was fitted with grate bars and a front door, and, to provide ventilation, two 7-inch pipes were inserted at each side of the door. When the sulphur arrived, Mr. Leiter

telephoned to me and I broke all records getting to the mine.

If you have ever tried to burn sulphur, you know how hard it is to ignite. The sulphur was in stick form, and the chimney had been nearly filled—perhaps a half ton. They were trying to ignite it when I arrived, but with no success. Turning to one of the mine officials, Mr. Leiter said, "Have you any coal oil?" When he was told that there was a supply, Mr. Leiter said, "Bring over two barrels." The oil was brought, and Mr. Leiter ordered it poured over the sulphur and a torch applied. Flames from the burning oil shot skyward, and the sulphur started to burn. Air sucked in to the grates through the side pipes and reversed with great sheets of flame shooting forth, causing us to scatter in all directions.

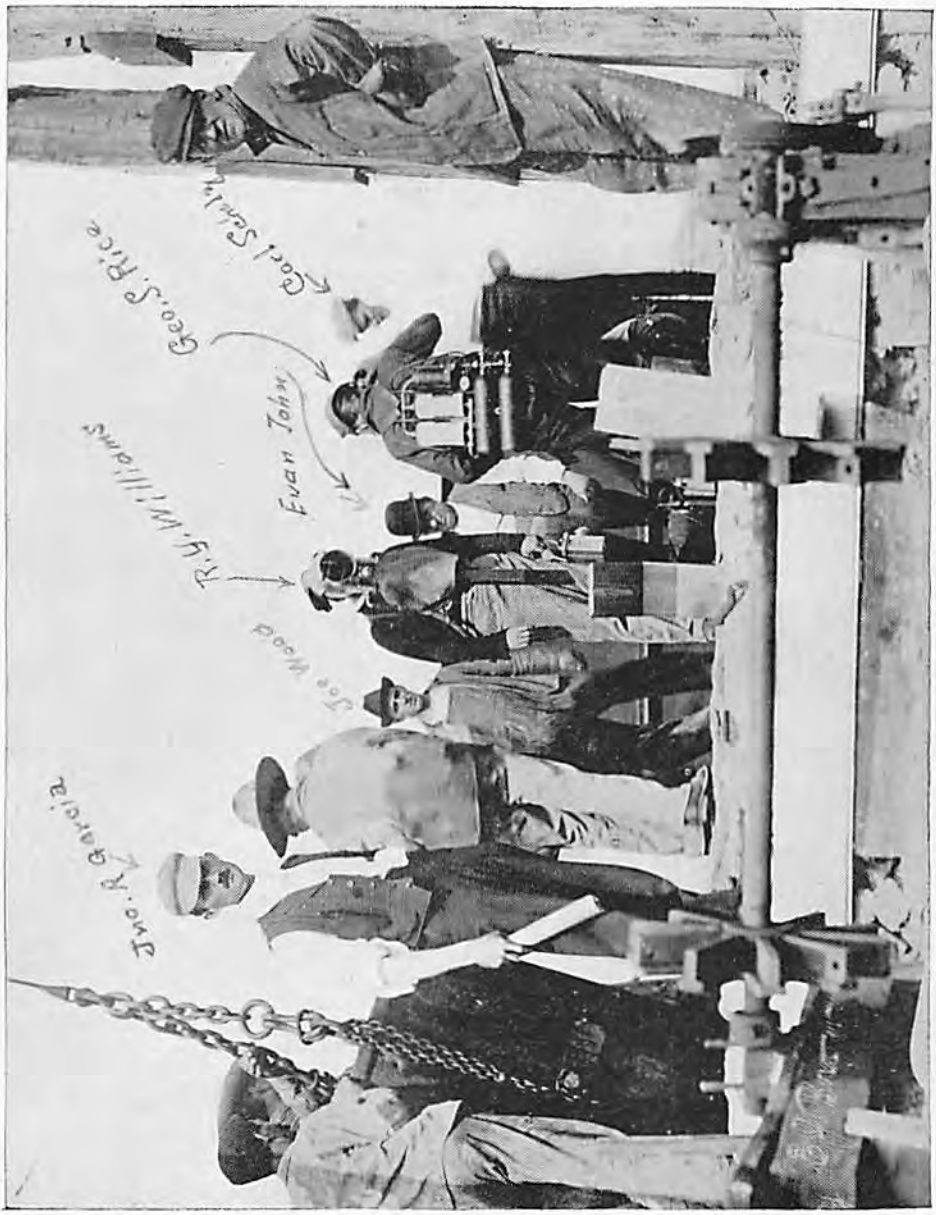
The sulphur melted and flowed in a red-hot stream, like lava, over the fan, burning out the bearings and completely clogging the works for the time. It took several hours to burn out the first charge of sulphur and afterwards, when the effort was renewed, it was found that a couple of shovels of sulphur at a time was ample to provide all the gases the fan could handle.

This method was tried for several days, but it was apparent that to force such a heavy gas back into the workings of so large a mine was beyond the ability of such a small fan, and the effort was abandoned. However, when we got a chance to observe its effects after the mine was reopened we could see plainly where the sulphur had extinguished burning timbers around the overcast. I could say much about the subsequent opening of the mine, the several explosions, and the final recovery under the direction of Sherman Burris, but that is history.

Mr. Leiter Provided His Mine with Fire-Fighting and Rescue Apparatus

The mine had been opened in 1902 by Mr. L. Z. Leiter, partner of Marshall Field. He purchased 7,500 acres of land in the southwestern part of Franklin County and had in mind the erection of vast coke ovens on the property, but for some reason, that part of the plan was never realized. His son, Joseph, took an active interest in the development of the mine, and at his father's death, assumed full control. The plant was very elaborately equipped for its day, and Mr. Leiter caused considerable derisive merriment among the other southern Illinois operators by having inscribed on the cornerstone of the engine house the numerals 2002, implying that the mine was 100 years ahead of the times.

I believe that Mr. Leiter was the first man in the United States to provide his mine with rescue apparatus and a building especially designed for fire-fighting and rescue work. In 1908, he imported from Germany eight Draeger rescue outfits and erected a building in which to service them and other equipment for fighting fires and doing rescue work. At this mine, too, the first successful coal-loading machine was tried out. It was the invention of W. E. Hamilton, now residing at Columbus, Ohio, and it really loaded coal. It was the "daddy" of the Colodor, now in successful operation in the mines of the Pocahontas Fuel Company, of West Virginia. I spent some time at the mine watching it perform; but it aroused such determined resistance from the miners that its use was finally abandoned. Mr. Hamilton was about twenty years ahead of the times.



George S. Rice and R. V. Williams, wearing Draeger helmets, ready to go down Dering No. 18 air shaft. Others in the group are: John A. Garcia, Joe Wood, Evan John, and Carl Scholz.

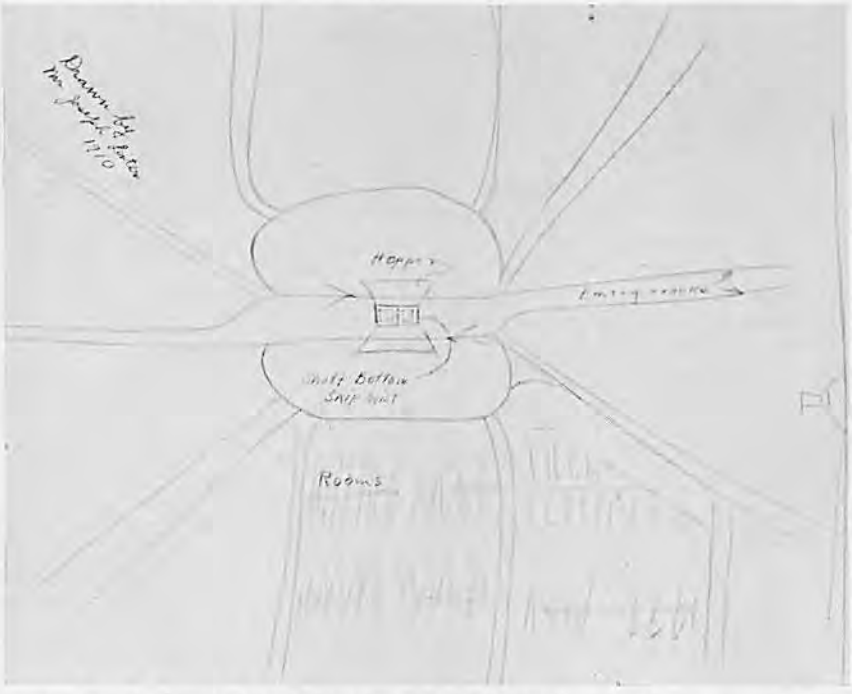
In those days, roads were terrible and automobiles were practically unknown. I recall when one of our Benton citizens purchased a Hupmobile. For several years, it was the only power-driven vehicle in the neighborhood. Mr. Leiter kept a team of English Cobb horses at the mine to take him to and from Christopher, the nearest passenger station to Zeigler.

It was a novelty to see them with their bobbed tails and silver-mounted harness hitched to a surrey and driven by a servant in livery.

Mine Restored

After several months of fighting fires and explosions, Mr. Gordon, who was from Kentucky, resigned as general manager and a man named Vickers was given his position. Mr. Vickers had just passed through the great Marianna Mine disaster in Pennsylvania, and I suppose it was because of his experience there that he was chosen. However, in a short time he resigned and went back home. Several explosions had occurred, fire was still raging below, and it looked like an almost impossible task to recover the mine.

L. T. Putman, now general superintendent of the Raleigh-Wyoming Mining Company, West Virginia, was then chief engineer; J. K. Orr was chief clerk and assistant to the general manager; John Core was mine foreman; and a Mr. Blank acted as superintendent. Mr. Blank left with Mr. Gordon, and a Mr. Wilson succeeded him. I do not know much about Mr. Wilson, but Mr. Core was an exceedingly able man and he had a man named Powell for mine examiner who, also, was of more than average ability. Because of the good work Sherman Burris had done as inspector, he was tendered the position of general manager. He was ably assisted by Messrs. Core, Putman, and Powell, and they succeeded in restoring the mine without the loss of another life —a remarkable fact for which Mr.



Mine No. 2, The Zeigler Coal Company, Zeigler, Illinois, as conceived in the mind of Mr. Joseph Leiter, and drawn by him for the author in 1910

Burris deserves great credit. At this distant date, it is not clear to me whether Mr. Burris was employed by Joseph Leiter or by Bell & Zoller, but it is my belief that it was the latter, for it was about this time that the mine was leased to Bell & Zoller Company.

Appointed State Mine Inspector

Mr. Burris, upon accepting the Zeigler job, had resigned as state inspector—and then my lifetime ambition was about to be realized. The previous September I had taken the examination from state inspector as prescribed by law, and of thirteen applicants for the honor I was the only one who passed successfully. My appointment to the next vacancy was thus assured, and Mr. Burris' designation made it pactically certain that I would succeed him.

I was at Zeigler on May 7, 1910, when a telephone call from my wife gave me the news that a letter had come from the governor saying that the position was mine. Up to this time Governor Deneen had never seen me, for I did not (as was the usual procedure) get together a delegation and personally solicit the appointment. In fact, I didn't have to, as I had behind me the backing of "Uncle Dick" and the Mining Board. However, in later years I became very well acquainted with the governor and watched with interest his career, which included two terms as governor, followed by his election as United States Senator.

As a small boy I remember when Terence V. Powderly was at the head of the Knights of Labor. The K. of L. was followed by the American Federation of Labor and the United Mine Workers of America, with such men as John Mitchell, John P. White, John P. Reese, William Green, and John L. Lewis as leaders.

In connection with the leasing of the Leiter Mine to the Bell & Zoller Coal Company hangs a tale untold. Joseph Leiter was a man of remarkable courage in the face of danger, and during the attempt to recover the mine he was in the habit of putting on one of the Draeger helmets and going below. Wearing a contraption of that kind was but one degree safer than if he had slipped a water bucket over his head. He had married a Washington lady named Williams, and she, alarmed for his safety, had come to Zeigler with him. One day I overheard Mrs. Leiter flatly tell her husband that he had risked his life for the last time if she had anything to say about it, and that she was leaving. He could choose between her and the mine, or words to that effect. He didn't hestitate a moment, and early the next morning, they left. I don't think he has seen the mine since that day.

Mr. Leiter had plans in formulation for a second and larger mine, which probably would have materialized if he had stayed with the company. Sitting in his office one day, he outlined to me a scheme for the development of this mine. It included a slope down which railroad cars could be delivered directly to the bottom, and a bottom layout that resembled a huge spider in general appearance. The accompanying sketch was drawn by Mr. Leiter to illustrate his ideas.

Vagen-Badens Helmet Proved Unsuccessful

Speaking of rescue helmets reminds me that it was about this time that Tom Watts (who was, as I have said, superintendent of the mines of the Zeigler District Coal Company) was prevailed on by a high-pressure

salesman to purchase a trial helmet then much used by firemen in the cities. It was known as the Vagen-Baden, and consisted of a large leather headpiece with windows in front. The neck of the contraption came well down over the shoulders, where it was supposed to fit tightly enough to preclude the entrance of extraneous deleterious atmosphere. Air for breathing was supplied through a hose, and the other end of it was attached to a small hand-pump.

Tom had a fire sealed off in a section of the mine, so he concluded that there was the opportunity and place in which to give the helmet a trial. He sent for me to come over, and several others and I followed him to the place of operation. A hole large enough to pass a man through was made in one of the fire walls, and Tom, with helmet in place, crawled through. We had taken the precaution to tie a rope around his waist, which was a lucky thing for Tom, for no sooner had he got inside when he went down all in a heap, overcome by the poison gases from the fire. We dragged him out and applied the pulmotor, and he was soon none the worse for the experience. However, that was his last attempt to put out a mine fire with Vagen-Badens.

Explosion at West Frankfort

The explosion at Dering No. 18, at West Frankfort, on February 16, 1909, was accompanied by some spectacular phenomena, only equalled, to my knowledge, by that of the Cardiff Coal Company in Livingston County. The latter catastrophe occurred March 13, 15, and 16, 1903, during which time five different explosions occurred, killing nine men and demolishing the plant so completely that the mine had to be abandoned permanently. George S. Rice was general superintendent of this mine at the time.

When the West Frankfort explosion occurred, he was chief engineer for the newly-created Bureau of Mines, and he and R. Y. Williams, mining engineer for the Bureau, took an active part in the recovery of the property.

Four shotfirers were in the mine firing the regular round of shots, which had been prepared by the miners beforehand, as was the customary practice. A blown-out shot created a dust explosion so terrific as to fill the entire mine and kill the four men. I was notified of the disaster and hurried from Benton, six miles distant. A blanket of coal dust, which was about 100 yd. wide, covered the ground in an easterly direction as far as the eye could see.

The first explosion occurred at 5 p. m., and was repeated at intervals of about two hours throughout the night. Flames shot 150 ft. into the air, and the heat was so intense that it melted the glass windows in the steel tipple. There was no possible chance to enter the mine, so we sealed the airshaft and then tried to cover the main opening, but scarcely did we get it well under way when it was thrown aside by a blast from below. We finally succeeded in placing the seal by starting on the windward side with steel rails, laid side by side, which we covered with sand as they were put in place.

John A. Garcia, then chief engineer for the Dering Company, arrived the next day and took charge. He called Carl Scholz, George S. Rice, R. Y. Williams, Sherman Burris, Evan John, and me for consultation. We decided to let the shafts remain sealed for three months. At the end of this time, Messrs. Rice and Williams descended to the bottom of the airshaft in a sinking bucket, wearing Draeger

helmets which they had brought from Urbana. They found that the fire was still smoldering, and the mine was flooded with water. I have always admired the courage of Rice and Williams in going down that deep shaft with nothing between them and certain death except a practically untried device of doubtful reliability. Subsequent experiments with self-contained breathing apparatus showed that the helmet type, as then constructed (which depended on an inflated rubber-band fitting closely the contour of the face to exclude the outer atmosphere), was unsafe and has since been adbandoned in favor of the mouthpiece and nose clip.

PART VII

The Cherry debacle, which occurred in November, 1909, was not an explosion; it was the result of a fire at the bottom of the shaft, which was caused by baled hay coming in contact with a torch used for lighting the passageway, the electric lighting system having been out of order for about a month. The mine belonged to the St. Paul Coal Company, and had a daily production of 1,500 tons from two veins. W. W. Taylor was general manager, and Joseph Steel was superintendent.

At the time of the accident there were 481 men at work, 259 of whom lost their lives. This was far the most appalling single accident ever to occur in Illinois, and it resulted from a series of incidents trivial in themselves, but terrible in their cumulative results.

Quoting from a report made by David Ross, secretary of the Bureau of Labor Statistics: "Immediately after dinner on the 13th of November, 1909, a car loaded with baled hay intended for the use of mules in the lower seam, was let down the main shaft. Upon reaching the landing of the second seam, which was the destination of the cages in the main shaft, the car and its contents were taken off, transferred by means of a runabout, and started into the narrow passageway leading to the airshaft, from which point, in accordance with the practice, it was to be sent to the seam below. A like operation had been performed successfully on all other occasions, but on this particular one it failed.

"Fate, utilizing all the agencies of human frailty, was evidently busy arranging the scenes for a great tragedy, and circumstances, seemingly simple in themselves, combined to create a situation involving the imprisonment and ultimate death of more men than ever before occurred at one time in the history of the state. Associated with all great calamities are some simple, curious, and mysterious causes. The burning of baled hay, the initial cause of the Cherry disaster, has never been fully explained nor clearly understood. Under ordinary circumstances, compressed hay will not burn. It has frequently been exposed to intense fire and heat with the result that only the broken ends on the surface were scorced and blackened.

Open Lights Probably Started It

"The facts, as developed by the testimony in this case, are that the car, containing six bales of compressed hay, in its journey to the airshaft had stopped immediately at the side of, or directly under, one of the burning torches temporarily used to illuminate that portion of the underground workings. Its detention at that point was of short duration, but long enough to permit the hay catching fire, a condition that some suppose was made possible by its be-

coming saturated with oil dripping from the lighted torch. Open lights in the connecting passageways and about the shaft buntons had been used for several weeks prior to the fire. Before that time, electric lights were employed. Some delay was experienced in filling the order to replace the destroyed electrical wiring, the new supply having reached the mine on the morning of the fatal day.

"From the moment the burning hay was discovered until the car containing it was finally dumped down the airshaft, not more than thirty minutes elapsed. The cager and his assistant and the others who aided, acted like men who had confidence in their power to control the situation. That the feeling existed that there was no real danger from the fire, and that it could be extinguished without peril to life, is indicated by the testimony of men who, in passing it on their way to the surface, stated that they could have put it out easily with their coats. One of them, when asked why he did not do so, said he had an important appointment in Peru and that he must take the 1:30 cage, otherwise he would have to remain in the mine until the cage for men at 3:30 p. m. In the meantime, the struggle with this new agency of death in the mine continued, until the fire fiend closed the last avenue of escape and the country was startled with a report of the greatest mine horror of modern times."

Aside from the large number of lives lost on this occasion, the fact that twenty-one men "walled themselves away from the fire and smoke by closing up an entry and living therein for seven days," being rescued alive at the end of this period, is of unusual interest. George Eddy, the mine examiner, had collected these men and was leading them to the shaft bottom when they were cut off by the smoke. They began to hunt for a place in the mine where there was a living atmosphere, but the black damp kept crowding them farther back into the recesses of the mine. They decided that their only safety lay in walling themselves in, which they did by building packs of slate and dirt across the first and second west entries. There they remained with nothing to eat. They dug some holes into which ran a little water, but it was so brackish that it was hardly drinkable. They had a light from Saturday until Tuesday, when their oil gave out, and during the rest of the time they were in total darkness.

Again quoting Mr. Ross: "Here they dwelt in darkness and despair, writing notes to their loved ones whom they had given up all hope of ever seeing again. At the end of a week's time, they were getting in such a weakened condition that they knew they could not hold out much longer, so they agreed that the four who were the strongest were to make a last attempt to get out, even though they should die in their efforts. This was on Saturday evening, November 20.

Rescued at Last

"It was in this attempt, as they struggled toward the escapement shaft, finding better air than existed before, that they encountered the rescue party consisting of David Powell, superintendent of the Braceville Mine; Father Hanney, of St. Mary's church, Mendota, Illinois; Captain Kenny, of the Chicago Fire Department; and three other firemen."

To George Eddy and Walter Waite belong the credit for saving their own lives and those of the other nineteen men whom they had held together and protected from the creeping black

damp which slowly enfolded them. Their forethought in guarding themselves with pack walls and the bravery they displayed during the long vigil in darkness and in despair are almost without parallel.

The direct result of the Cherry disaster was the passing of remedial legislation in Illinois covering several things which had heretofore been neglected. Up to this time, strange as it may seem, there were no laws governing the use of electricity in the mines, and no provision for the prevention and subjugation of mine fire; nor were there any compensation laws. The governor appointed a commission of nine men to revise the state mining laws, which commission met during the fall and spring of 1910-11 in Chicago. Thomas Weeks, James Taylor, and I were designated to sit with them in an advisory capacity. The men on the commission whose names I can now recall were H. H. Stock, Glen W. Traer, John H. Walker, Duncan McDonald, and John L. Lewis. I have forgotten the others.

Benefits of Disaster

The legislature of 1910 passed the Mine Rescue Station Act, and, the next year, the law requiring fire-fighting equipment at coal mines. It, also, provided for the appointment of an employers' liability commission whose duties were to investigate the problems of industrial accidents and inquire into the most equitable and effectual method of providing compensation for losses suffered as aforesaid. In 1911, the General Mining Law was passed—a great improvement over what had heretofore existed. In that year were also passed the first laws in the state governing the drilling of oil and gas wells; also, the first statutes restricting the kinds and grades of powder to be used.

It is of interest to note, in passing, that the first Sirocco, or multi-blade, high-speed fan ever installed in the West was erected by the McLean County Coal Company in 1909. This fan replaced a 22-ft. slow-speed unit, and the improvement was so marked that thereafter the large slow-speed fan was doomed to be discarded.

Francis S. Peabody and R. Dawson Hall

Early in my work as an inspector, I was called to Peabody No. 3 Mine, near Marion. My investigation disclosed inadequate ventilation. I also found the main roadways to be obstructed by dirt on the sides so that they were unsafe to walk through. After ordering changes made to comply with the law, I waited a reasonable length of time and then went back to the mine, only to find that nothing had been done. I immediately went to Chicago to see Francis S. Peabody, president of the company. I told him that his mine was not up to standard. After hearing all I had to say about it, he said, "Mr. Cartlidge, I had no idea that my mine was in the condition that you describe. It will be remedied at once."

On my next visit to the mine, I found it to be in excellent shape, and thereafter Mr. Peabody was one of my staunch supporters. At that time, he controlled thirty-six mines. I always found him to be a gentleman of the very highest type.

One of the first men I had the pleasure of coming in contact with during my regime as inspector was R. Dawson Hall, now engineering editor of Coal Age. There are few men with a better knowledge of mining in all its phases, and a most likable character with it all. I know of no man whom I admire more.

On one occasion I was attending a meeting of the Mine Inspectors' Institute, at Indianapolis, shortly after the first battle of the Marne. Mr. Hall and I were walking over town together, and I said it would always be a mystery to me what turned back the Germans after getting almost to the gates of Paris, and Mr. Hall said it was because they ran out of gasoline. Transportation of supplies was by motor trucks, and the advance had been so fast that the Germans could not keep up a supply of fuel to serve the vehicles, while, of course, the French had destroyed all in the immediate vicinity. I wonder what Mr. Hall thinks of this theory now.

Destruction by Cyclone and Flood

About the middle of April, 1912, a cyclone passed over the mining town of Bush, which belongs to the Western Coal and Mining Company. The office, store, and numerous houses were destroyed and fifteen lives lost. It happened about six o'clock in the evening, the time when most of the families were eating their suppers. One entire row of houses was completely destroyed and it is a wonder that only fifteen were killed. A huge warehouse, two stories high, was lifted from its foundation and deposited on the ground 10 ft. to the east, undamaged. Nothing was left of an amusement hall, containing two pool tables with a billiard board between them. On this floor the billiard table rested undisturbed, but the pool tables that were on either side were gone and not even a remnant of either was found.

One year later, April, 1913, the mine of the Gallatin Coal and Coke Company at Equality, Illinois, was destroyed by floods from the Ohio River backing up into the Saline until the mouth of the mine was submerged. This disaster, accompanied by some phenomena of peculiar interest, is well described by Mr. Frank Rosbottom, mine inspector.

Quoting him: "This mine is one of the old operations of the state, having been sunk in 1882. It has never been operated on a large scale, 600 tons having been its greatest capacity. Altogether there have been taken out a little more than 200 acres of coal of the No. 5 seam, which is about 5 ft. thick at this place.

"The opening to this mine, which is a shaft 90 ft. deep, was on the L. & N. Railroad, just at the west corporate line of the city of Equality, and about 1,000 ft. from the Saline River.

"On driving the opening entries of the mine, it was found that apparently the coal went to the outcrop to the east, and as the river was on the north, it was not thought advisable to work in that direction; consequently, the mine was all worked from one side, namely the north, with cross entries leading to the east and west. The works extended north about one mile and were about a half mile in extent, east and west, as the greatest distance.

"The level of the mouth of the shaft was about 1 ft. above the 1884 flood, which was the greatest ever known in this part of the state, and which was thought would never be equalled again.

"About March 28, it was pretty well known that all previous water records would be broken here, so they began to make efforts to protect the mine. They had a large crew of men dig trenches down to the clay and fill them with moist clay, tamping it in. Above the level of the surface they had a heavy timber retaining wall built on either side of this trench, 6 ft. apart, filling in between with clay and tamping it in. By April 1, the

mine was surrounded by water and it became necessary to boat all materials for the building of these levees a distance of several hundred feet.

"April 2, the cribbing in the shaft gave way on the east side at a point above 20 ft. below the surface, letting in considerable water and carrying away part of the levee. They made renewed efforts, and with the assistance of the citizens, who turned out almost to a man and did splendid work, they succeeded in getting this break stopped.

Cribbing Gives Way

"On the morning of April 3, the cribbing in the shaft, which was old, gave way on the west side just above the rock, which is about 28 ft. below the surface. This caused what had been an old slip to give way, taking into the shaft the levee on this side and with it the surface to a distance of 10 or 12 ft. west of the mouth of the shaft. Again everybody responded, and again, after untiring and heroic efforts on the part of the entire citizenship, they succeeded in stopping this break. It seemed that for the next two days the only effort needed was to keep the dykes above the rise of the water, which was a very difficult task now because they were more than 300 ft. long, and all material had to be brought in small boats.

"They secured bags of sand and succeeded in keeping above the water by dint of great effort. Sunday morning, April 6, when the water was almost at its greatest height, they began to feel that they could and would succeed in keeping it out, when it was discovered that a very small stream was running in through the clay from the south side at a depth of possibly 10 ft. blow the surface of the water. They began strengthening the dykes on this side with bags of sand, but before a great while they could see that this little stream was increasing in size. It steadily grew larger until at 9:28 a. m., with a mighty inrush of what looked like the entire river, the water broke through under the levee, carrying it, and everything for a hundred yards around, into the shaft. The velocity of the water was so great that it carried pit cars and other objects that were near the pit head into the mine, and the suction pulled the end out of the engine and boiler room and the blacksmith shop.

Air Blows Out

"In an hour and twenty-two minutes after the water had begun running into the mine, it completely filled the shaft, thereby trapping in all the air that was in the mine. The mine goes to the dip in all directions, being 13 ft. lower at the air shaft than at the hoisting shaft and 48 ft. lower in some of the northeast entries than at the main shaft. After the water had filled the opening at the main shaft and had filled the mine until the air could not escape at the airshaft, it continued to run in for five hours, all the time compressing the air that was behind it and trapping in more as the pressure and weight of water increased.

"At 3:50 in the afternoon of the 6th after the water had been compressing the air for five hours, the air rebounded with a force that was almost beyond comprehension. It threw out mine cars, cages, huge concrete blocks, sheave wheels, engines, and completely destroyed the entire top works. Water, stone, dirt, and machinery were thrown into the air to an estimated height of 500 ft. The sheave wheels, which had gone down the shaft together with head frame, were blown out and fell over a hundred yards from the pit head, com-

pletely burying themselves in the hard earth.

Twenty-two minutes after this first outburst, a second one came, and, eight minutes after, was followed by a third, either which was of considerably less force than the first. The second outburst threw water to a height of possibly 150 ft., and a picture was made of it while in action by one of the local photographers. The third outburst, which rose to a height of probably 75 ft., was followed by numerous others each in turn growing less and less until they were only huge air bubbles. This bubbling continued for more than a week before the mine filled. The shaft now stands to within 2 ft. of the level of the surface and presents the appearance of an old well caved in around the top until it is about 40 ft. across."

Members of the Illinois Mine Rescue Commission, photographed at LaSalle Station. From left to right: Oscar Cartlidge, manager; Prof. H. H. Stock, secretary; Wm. McMillan, assistant superintendent; Miss Harriet Ried, stenographer; Charles Bennett, member; Hector MacAllister, member; Thomas English, superintendent.

At about this period in our history we see the virtual passing of the air puncher mining machines. In 1913, the No. 3 Mine of the Superior Coal Company at Gillespie replaced its punchers with electric chain machines. In 1914, the No. 14 Mine of the Consolidated Coal Company, of St. Louis, at Staunton, and No. 18 Deering Coal Company, West Frankfort, replaced its punchers with chain machines operated by electricity, and this lead was soon followed by most of the larger operations.

PART VIII

The passage of the Illinois State Mine Rescue Commission Act in 1911 made provision for the building of three rescue stations, the locations to be selected by the commission. It also provided for a manager to have charge of all rescue and first-aid operations, "Uncle Dick Newsom was appointed to this position, and the business of selecting sites for and building the stations was begun. Locations were selected at LaSalle, Springfield, and Benton, and the first mine rescue and first aid work sponsored by a state was under way.

But before I enter into that part of these memoirs, I wish to tell something of the "inside history" of the organization and development of some of the manufacturing concerns that have had the most to do with the mining equipment business in this country.

No doubt, the pick and shovel and wedge and sledge, for ages the only tools used by man, were gradually developed as he learned through experience that these simple aids to the bare hands lightened and facilitated his tasks. Next came the invention of the wheelbarrow, which is attributed, I believe, to the most versatile of all men—Leonardo Da Vinci, who was forty years old when Columbus first saw America's shores.

With these tools to his hand, the early miner became expert in getting the coal, but necessarily his output was low. Then some genius thought of putting a box on wheels to travel on boards laid lengthwise for a track. However, men pushed the cars to and from the working places. Next, dogs were used for this purpose—then ponies, mules, and horses. Strips of 2-in. by 4-in. wood were nailed to the boards to keep the cars from leaving the track. With the next step, flanges were added to the wheels, for this permitted the use of iron and steel rails in their present form. Finally, mules gave way to locomotives operated by compressed air and electricity. These improvements provided means for more rapid transportation.

Drills and Powder Introduced

With the rapid development of haulage facilities capable of handling large tonnages, it became incumbent on inventors to provide quicker ways to bring down the coal, so drills and powder were introduced. These were followed by undercutters, shearers, conveyors, and loaders. The latter series, in turn, demanding better methods for sizing and cleaning, resulted in great improvements in surface equipment.

At first, coal workings were confined to outcrops where coal could be had without getting far underground, but as the demand for coal grew, men kept going farther and farther under the overburden. Then, means for holding up the roof and for lighting and airing the places became imperative. At first, natural ventilation was depended on; then fires were kept going at one opening during working hours. In some localities, outcropping

seams were absent, and shafts were put down. These were ventilated by furnaces and later by fans. At first it was assumed that the larger the fan, the more air it would displace, and fans were constructed up to 30 ft. or more in diameter. High-speed fans of small diameter replaced these, and crude curtains and dirt stoppings gave way to automatic doors and overcasts in the more modern mines. Lighting was by candles, oil, and carbide, and later by electricity.

By far the major portion of these developments took place during the period of which I write, and to two men in particular it would seem the laurel wreath, for having done the most to bring this evolution about, should be awarded. These men were George Harrison, inventor of the compressed-air machine, known as the "puncher"; and Francis M. Lechner, who made the first bar machine and who was, also, the first to use the chain for cutting coal.

In the "seventies," Mr. Lechner, then living in Stark County, Ohio, near Waynesburg, invented a machine which used the principle of cutting a horizontal kerf about 42 in. wide and 3½ in. high in the lower part of a vein of coal. The cutters were attached to a rotating bar which was fed underneath the coal at a speed of 2 ft. a minute. The cutter-bar, as it was called, was driven around by chains from the power shaft. These served to pull out the cuttings, or "bug-dust," as cut. The reverse movement brought the sliding frame back to its original position, and the machine was moved over the width of its cut until the entire room, or entry, had been undercut. Following this, the miners drilled and blasted down the coal into lumps of suitable size to load into mine cars by hand.

Mr. Jeffrey Becomes Interested

Mr. Lechner visited Columbus, Ohio, with the design of this machine, and obtained the financial assistance of Joseph A. Jeffrey, cashier, and Mr. Sessions, president, of the Commercial Bank, to the extent of building a trial machine. These gentlemen were personally interested in the Central Coal Mining Company, of New Straitsville, Ohio, and after a demonstrating machine, very crude in its construction, was built, it was taken to that mine for a test.

William Job was superintendent of this mine, and Charles Welch was the service man in the operation of the original machine. Later, Dave Jones, a coal miner employed at that mine, became the machine operator. These men served for several years thereafter in servicing trial machines through the western states. Mr. Welch was employed at the Jeffrey shop until his death. I believe that Dave Jones is now on the retired list of the Union Pacific Railway. He was for a number of years superintendent of coal mines at Cambria, Wyoming.

At the original test of this machine at New Straitsville, E. S. McKinlay, who was at the time interested at Shawnee, Ohio, in mining coal and making pig iron, with the Licking Iron Company, visited the mine to inspect the operation of this machine and was attracted by its possibilities. He learned the situation regarding the development, went to Columbus, and interviewed Messrs. Jeffrey and Sessions. This interview resulted in a contract for McKinlay to promote the business, covering the territory west of Ohio. He undertook the work at once and began negotiations with some coal operators in St. Louis, principally E. J. Crandall, of the Abbey Coal Company, located at Col-

linsville, on the Pennsylvania Railroad.

Mr. Crandall investigated the machine and co-operated with Mr. McKinlay in organizing a syndicate of ten coal operators, with as many mines—one on each line of the railway leading out from East St. Louis. This syndicate gave Mr. McKinlay a conditional order providing for his bringing the test machine from New Straitsville, together with a small "Norwalk" air compressor which had been exhibited first at the Centennial Exposition at Philadelphia in 1876, and taking this equipment to the Abbey Mine and demonstrating the action of the machine. The coal operators were satisfied with the work performed and the result was their placing orders for ten large air compressors and three Lechner mining machines each, thus forming the initial equipment for the ten mines.

Difficulties Arise

This order was sent in promptly to the Lechner Coal Mining Company, at Columbus, Ohio, and was placed in the hands of Mr. Lechner. The company had no shops of its own and Mr. Lechner, who was a blacksmith, gave construction details (without drawings) to six local machine shops in Columbus. The machines were sent out to the mines as soon as they were completed. When regular work commenced, occasional breakages occurred and orders for replacements were sent to Columbus. It was then discovered that it was practically impossible to duplicate parts made by the several shops without guiding records, detail drawings, and proper reference. After continuing in this manner for several months the coal operators became dissatisfied. The Columbus management laid the production blame on Mr. Lechner, although his inventive genius was recognized. Consequently, he resigned as general superintendent and was succeeded by Benjamin A. Legg, who systematized the work for future machines and made some valuable improvements. The disappointment and loss of his position caused Mr. Lechner to become seriously ill, and he was unable to attend to business for several years.

Soon after the machines had been installed in the St. Louis district, Mr. McKinlay visited Colorado and negotiated a trial installation for a duplicate of the St. Louis equipment. This plant was purchased and set up by Mr. McKinlay. It was operated at his own risk for six months in one of the mines of the Colorado Fuel and Iron Company near Trinidad. The demonstration was so successful that the coal company decided to purchase the small plant from Mr. McKinlay. They made an offer of $20,000 for the exclusive rights to operate the Lechner machines in three counties in southern Colorado, so that that company might control the use of the machines. Mr. McKinlay at once communicated this proposition to Mr. Jeffrey, who would not believe that anybody would pay $20,000 for such a proposition. Finally he was persuaded that the offer was legitimate and he made the trip, with the result that the deal was closed. Later, similar sales were made covering the exclusive rights for Montana, Washington, and parts of Wyoming. Through these deals, considerable money was made available for carrying on the business. The Lechner Company was taken over by the newly-organized Jeffrey Manufacturing Company and new and modern shops were erected at Columbus.

The Stanley Header

A new type of machine was then being developed in England, and Mr. McKinlay believed it would be a valuable adjunct to the undercutters for

driving the narrow work. This machine was called the Stanley Header, and arrangements were made with Mr. Stanley for the purchase of a machine. It was agreed that two men were to operate the machine on trial for a given length of time. This machine was shipped to a lignite mine seven miles east of Colorado Springs, Colorado, on the Denver and New Orleans Railway.

During the test, officials of the Colorado Fuel and Iron Company inspected the machine, and Mr. Osgood, the president, was so favorably impressed that he joined with Mr. McKinlay in completing the Stanley contract. At that time, Mr. Osgood had other coal mines in Iowa and he controlled the Diamond Prospecting Company, which later was taken over by the Sullivan Machinery Company.

Mr. Osgood wished to have the Stanley machines manufactured in Chicago and to secure control of the patents for America, so he began negotiations for the purchase of McKinlay's half interest. While this was under consideration, Mr. McKinlay met Mr. Lechner in Columbus and he told Mr. McKinlay of another machine which he had invented and which had progressed to the point of being tested out in a Hocking Valley Mine. Knowing the success that Mr. McKinlay had had with the original Lechner machine, Mr. Lechner urged him to take up the promotion of this one. It was the chain-cutting machine which is now in universal use.

After seeing the machine at work in the mine, Mr. McKinlay arranged for the development and sale of the new machine. An order was placed for two of them and in due time they were in operation. The initial work of this machine so satisfied Mr. McKinlay that he closed out his interest in the Stanley Header and took up the Lechner business. As with the cutter-bar machines, duplication of parts was difficult and purchasers became dissatisfied. Immediately, company officials insisted that a production engineer be employed and the controversy that ensued brought on a receivership.

This action placed Mr. McKinlay in a position where his contract and investment were in jeopardy, so he called on Mr. Jeffrey to purchase the assets of the Lechner Company, which had been fixed by the receiver at $7,500. Mr. Jeffrey took the position that the chain machine would never be successful, and if it were it would mean the entire loss of his investment in the cutter-bar equipment, so he refused to have anything to do with it

Air Puncher Machine Comes Out

During this time, competition had come through the invention of Mr. Harrison, who had interested Mr. George D. Whitcomb in his compressed-air "puncher" machines. These machines sold at a much lower price and could be operated in places where the cutter-bar and chain machines could not be used. From about 1880 to 1900 this machine had a great following, but as the chain machine was gradually improved it finally displaced the other almost entirely.

The Link-Belt Company came out with an electrically operated "puncher," and Mr. Goodman, who was working for this company, took a great deal of interest in it. About this time the proposed sale of the Lechner chain patent became known. Mr. Goodman had been following this invention closely and he persuaded his company to purchase it. Mr. Goodman then negotiated for the Lechner patents and organized the Goodman Manufacturing Company, which took over the business.

The superiority of the chain over the cutter-bar being soon established to the disadvantage of the Jeffrey Company, it became necessary for the Jeffrey Company to controvert its success by bringing out a new design. This resulted in the introduction of the chain breast machine in its present form.

During this time, the Stanley machine had been having considerable success through the efforts of the Sullivan Machinery Company. However, the contract for the use of the patent rights required that a large number of machines be made or a large minimum royalty be paid. These conditions, together with the competition from the chain machines, caused the Sullivan Company to accept a proposal from the other interested companies to join equally with them in the use of the chain patents. This proposal was brought about largely because of the invention by Jonas L. Mitchell, a Sullivan employe, who introduced the "shortwall" machine.

Mr. McKinlay, in later years believing that the principle of the Stanley Header was correct, and being an inventor, set out to design a machine that would bring the coal down and would also load it at the same time. The result is a machine that is now in successful operation in one of our largest mines.

The Mr. Mitchell above referred to was an uncle of "Mike" Mitchell, for years connected with the Sullivan Company as salesman and district manager in the St. Louis territory. "Mike" is one of the finest men ever connected with the mining machinery business and is known to everybody in the Middle West.

PART IX

About this time, R. Y. Williams, engineer in charge of the United States Bureau of Mines Station at Urbana, was appointed director of the newly-created Miners' and Mechanics' Institute. This work was to be under the supervision of the trustees of the University of Illinois, and was for the purpose of establishing and maintaining "a form of educational betterment work." It was designed to "promote the technical efficiency of all persons working in and about the mines and other industrial plants of the state, and to assist them to overcome better the increasing difficulties of mining and other industrial employment."

Some coal stripping was going on in the Mission Field, near Danville, and, in the course of Mr. Williams' travels, while promoting his new work he had had the opportunity to make a study of it. He came to the conclusion that, where conditions were favorable, this was the profitable way to mine coal; so he said that we ought to get into it. I was of the same opinion, and I told him that I knew where such a body of good coal was located. We went to look it over. The tract was about midway between Marion and Herrin, and consisted of 60 acres on which the coal outcropped along the western boundary.

Some years before, a country mine had been opened up on this land, under lease, but no coal had been mined for nearly three years, and the owner of the property assured us the leasing rights had been forfeited because of failure to operate.

At the place where this small mine was opened, the overburden was about 10 ft. thick, but 2 ft. of this (directly on top of the coal) was limestone. Mr. Williams was convinced that nobody could strip 2 ft. of limestone successfully, so we gave up the idea of becoming partner "coal barons."

Stripping coal was then in its infancy, that at Danville being the only

attempt of its kind in the state. Shovels of 1½-yd. capacity were monsters of their kind, and Mr. Williams was probably right in thinking that 2 f. of limestone was an insurmountable barrier to our success.

Some time after, I met William Johnson, general manager of the Saline County Coal Company, Harrisburg, and "Bill," too, had come to asked me if I could get him a driller to do the prospecting. I did, and holes bored at 100-yd. intervals over the entire field.

We found that the coal underlaid about two-thirds of the farm, with an average thickness of 6ft., and an average cover of 16 ft. But the remarkable thing about it was that the limestone which was the detriment

The first mine rescue team in Illinois (probably the first in the United States) standing near one of the state mine rescue cars. This team was trained by the United States Bureau of Mines at Pittsbugh. Note that the team is equipped with old-type Draeger helmets.

the conclusion that stripping coal was preferable to underground mining. He wanted to know if I could find a good tract for his company. I told him about the land that Williams and I had turned down, and he wasn't scared at the prospect of having to struggle with a thin streak of limestone.

He wanted to know what it would take to buy the property, and I told him that it had been offered to us at $80.00 an acre. "Bill" then said if I could get a six-months' option in which to prospect, he would allow me $20.00 an acre extra for my trouble. I hustled over to see the landowner and secured the option. "Bill" then

to Mr. Williams and me was just a strip along the western outcrop, and did not extend 100 ft. into the hill.

Ready to Make $1,200

Johnson drove over one Sunday to give the property a last looking-over and I went with him. On our way home, "Bill" said they would come back the next day to close the option. As the deal stood, my commission would net me about $1,200.00, so I was feeling pretty cheerful about that time.

Just as I was getting out of the car in front of my home, Roy Brinkley, a salesman for the Western Powder Company at Alton, approached

us. He wanted to know if we were aware of the lease of the coal on our proposed operation, and Johnson hastened to tell him that we did, but the lease was "no good."

"Well," said Roy, "you had better look into it before spending any more money, for I have purchased the leasehold, and it is good. The owner has never had the lease cancelled, and Doctor Honnold and I intend to develop the property."

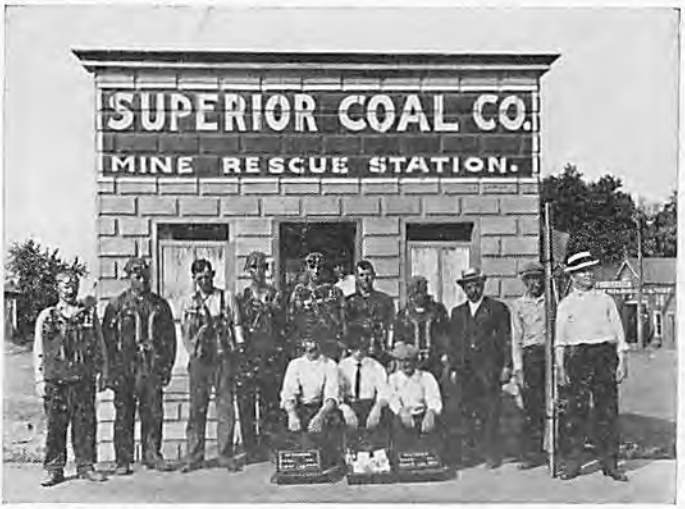
Johnson rushed back to Harrisburg to consult his attorney, and the lawyer, after investigating, told him he might as well forget it. The lease was as good as gold. Away flew my twelve hundred bucks, together with "Bill's" strip mine and the $2,000 or more he had spent for prespecting. Doctor Honnold, Mark Woodley, and Brinkley opened up the property and soon were putting out 600 tons of excellent coal a day.

I was amused one day when Doctor Honnold told me how they beat "Bill" Johnson to it. He didn't know he had cleaned me of $1,200.00, and never will, I suppose, unless he happens to read this narrative.

Beginning Mine Rescue Work

The mine rescue commission had as secretary, Prof. H. H. Stoek, who formerly had been editor of Mines and Minerals, and at that particular time was head of the department of engineering at the University of Illinois. Professor Stoek was an indefatigable worker and a man of high ideals. The chairman of the commission was Dr. Joseph A. Holmes, the first director of the newly-created U. S. Bureau of Mines, Doctor Holmes was a man ideally fitted for this work, both from the standpoint of education and experience. He and Professor Stoek were my very good friends, and I co-operated with them in every way possible to make the rescue and first-aid experiment a success.

The reader must bear in mind that this work was new in this country and there was little to guide us. The Germans and the English had been



The first-aid and mine-rescue teams of the Superior Coal Co., Gillespie, Ohio, photographed in front of the station. The three men standing at extreme right are T. English, "Uncle Jim" Boston, and John Ross.

doing some experimental work and had produced three types of self-contained breathing apparatus, namely, Draeger, Westphalian, and Fluess. None of these had attained to a state of perfection because of mechanical imperfections, althought in principle they were correct. All depended on compressed oxygen, carried in small cylinders, for respiration, and each of them was provided with containers loaded with potash or caustic soda through which the expelled oxygen from the lungs was passed under pressure for the purpose of absorbing the carbon dioxide.

H. N. Elmer represented the English Fluess machines in North America, and the Draeger Company had its representative in Pittsburgh. There was keen rivalry between them, and both types of apparatus were adopted extensively. Later, J. W. Paul and others brought out machines in this country that were great improvements over those on which we had to depend.

Getting a New Car

The state mine rescue commission, as provided by law, had to appoint a manager who was to be in charge of all the work. "Uncle Dick" Newsom was tendered the position, and he accepted. The commission then proceeded to select suitable locations for the three rescue stations, and to procure by purchase or otherwise three rescue cars.

Stations were erected at LaSalle, Springfield, and Benton. One car was donated by the Chicago, Milwaukee,

The first-aid team of the O'Gara Coal Co., Harrisburg, Illinois, from a photograph made in September, 1914

and St. Paul Railroad; another by the Chicago and Northwestern; and the third was purchased by the commission, from the Pullman Company.

One day I was walking on Dearborn Street, in Chicago, when I met Doctor Holmes.

"Come with me!" he said.

So I obediently followed without asking where. He led me to the railroad station, purchased two tickets, and we embarked on a trip I knew not where. Our train stopped at Pullman and Doctor Holmes said we would get off. We went to the Pullman works and it was then that he closed the deal for the car. It was my first trip to Pullman, and I then got my first insight into the wonders of Pullman-car construction.

The work of erecting the stations was hardly well under way before "Uncle Dick" was forced to resign because of failing health. Most of the state's positions were then under Civil Service rules, and an examination date was set for manager of the rescue work. In the interim, Hector McAllister, a member of the commission, was appointed acting manager.

On the day of the examination, sixteen others and I appeared for the test. This was the most important mining position in the gift of the state, and the best men in the industry were there to compete for it. The examining board consisted of William Morris, Carl Scholz, Professor Stock, Doctor Holmes, and I cannot now be sure although I think Dr. J. J. Rutledge was another.

Manager at Last!

When the smoke of the battle had cleared away, it was found that I stood first on the list, with Evan John second, and John Dunlap third. In a few days, I received notice from the Civil Service Commission that I was first in line for the appointment and that the governor had tendered the position to me. I immediately assumed charge of the work and was then enlisted in an unknown and untried experiment by a great state.

At once, I proceeded to perfect the organization so well begun by "Uncle Dick," and at the end of the three years I was in charge I had the satisfaction of knowing that Illinois was far in advance of any other state in the Union in mine rescue and first-aid and in efforts to safeguard the life and health of her mine workers.

Our three stations were fully equipped with everything in the way of rescue and first-aid supplies. Also, we had training rooms which were equipped inside to represent, as nearly as possible, the inside of a coal mine. Each station had in permanent residence two well-trained experts who devoted their time to instructing all who applied, in first-aid and rescue methods. These lessons were quite severe, consisting, as they did, of actual work with self-contained breathing apparatus in irreparable gases, and in actual first-aid bandaging, resuscitation, and the like.

Our three cars were in charge of trained men who went out through the state teaching these same methods to the miners in their home towns. First-aid associations were organized in districts over the state, and district and state competitive contests were annual events.

One of the first things I did after assuming charge of this work was to run over to St. Louis to see my good friend, A. J. Moorshead. He was the first man in Illinois to recognize the fact that an employer owed it to his workers to safeguard them in the performance of their duties. He was far in advance of our other operators in

On October 14, 1913, a safety meeting of the Madison Coal Corp, was held at Mine No. 9, Dewmaine, Illinois. A. J. Moorshead, president and general manager, is marked No. 1 in the picture. Among the others are included: James Taylor (2), Thomas Little (3), John Rollo (4), W. W. Williams (5), Robert Thompson (6), Hector McAllister (7), Prof. H. H. Stock (8), John Goalby (9), John Dunlop (10), John Duncan (11), Charles A. Sine (12), Oscar Cartlidge (13), R. Y. Williams (14), Frank Rosbottom (15), Martin Bolt (16), and Jonah Flavel (17).

this respect, and was ably supported by his district superintendents and his chief engineer, G. E. Lyman.

Mr. Moorshead contributed the first money for prizes to what I believe was the first annual first-aid contest ever held by any state. He erected fine brick buildings at each of his mines and supplied them with full equipment and first-class instructors. It was largely through the co-operation and example of Mr. Moorshead, Thomas Moses, and John P. Reese that our work was so successful; a work that, at the time I relinquished it, had as its graduates in mine rescue and first-aid, every third man in the industry.

We also had hundreds of high-school students throughout the state who had taken our courses, receiving credit in their regular course of studies. It was a noble and most interesting work, but, alas, and alack! all good things have their difficulties; and, since this is a true narrative, I was, after three years' service, legislated out of office. For the frst time in over thirty years, our state elected a Democratic governor (he being carried into office by the Woodrow Wilson landslide).

Because I was under Civil Service, there was no possible chance of the opposition ousting me for inefficiency. Failing in this, a bill was introduced and passed abolishing the position. There is no doubt that I could have rallied my friends to my support and prevented this action, but I was weary of the continual nagging, and, to tell the truth, I could never quite get over the belief that "to the victor belong the spoils," so I put up no resistance and quietly dropped out.

Enter Jack Ryan

One day, before this happened, I was sitting in my office when a stockily-built and quite handsome Irishman walked in. This young chap was in charge of the U. S. Bureau of Mines station at Urbana, having succeeded R. Y. Williams. After the usual salutations, he said:

'Mr. Cartlidge, I have great respect for your sound judgment and I want to ask your advice. You know that I

have a job with the Bureau and if I stay with it, I will be advanced from time to time as circumstances and my ability permit. George Deik and I are thinking seriously of throwing up our jobs and organizing a company that will specialize in acquiring and selling mine safety appliances. What do you think of our prospects, and do you think I should give up a sure thing and take a chance in an untried commercial venture?"

Without hestitation, I said to him: "Johnny, you are still a young man and even if the proposed venture does turn out to be a disappointment it will only be a temporary set-back and you can get another job. I think you would do well to accept the opportunity."

You have guessed it! The young man was none other than our John T. Ryan, and the new company was the Mine Safety Appliances Company.

Mining Progress Now Rapid

The period of our history, 1910-1920, inclusive, saw the greatest development in mining. Mules were rapidly giving place to electric motors for haulage, and electric drills were displacing hand air air-powered machines for boring shot holes. Steam was still favored for hoisting and for fan power, electricity being regarded by most as still too uncertain to be relied upon solely for these two most important functions. Mr. Moorshead had advanced so far as to rely upon electricity to operate the fans at his mines, as early as 1913, but he was playing safe by having steam-driven auxiliary engines connected to the opposite sides of the same fans.

Underground double-entry systems gave way to triple, and even more, main entries, and coal preparation became an exact science. It is a far cry from the first tipple erected by Colonel Roberts for the Egyptian Coal Company to the Westmoreland Coal Mining Company's cleaning plant at Irwin, Pennsylvania. We thought a lot of our little three-track tipple, with its facilities for making five sizes of coal, but it was a mere pygmy compared to some of the giants of recent times.

The Westmoreland tipple, erected by the same company, accomplishes the sizing and cleaning of 600 tons of coal an hour, and it can size and wash by Menzie's Hydro-separators, 380 tons an hour. A dozen or more sizes, from run-of-mine down to ½-in. washed, may be prepared, and all of these different sizes can be shipped separately or combined in any manner required by running them over a mixing table in the tipple.

There are Marcus screens with picking tables, Arms vibrating screens, loading booms, hydro-separators, sludge-recovery tanks, storage bins, fireproof construction, and very large tonnage handled, with the least possible amount of machinery, at a minimum first cost, and with a very low operating and maintenance expense.

Undercutting and overcutting machines, shearers, loaders, drills, motors, conveyors, water, air and sand cleaners electric hoists, high-speed fans frictionless mine-car wheels, and improved explosives are some of the many advances made during this period.

With the ascendency of the Democrats in the state's politics, J. E. Jones was made inspector in my old Benton District. Later, he became safety director for the Old Ben Corporation, where he has since achieved a national reputation for his mine-safety work.

James Boston, who is in charge of the safety work for the Superior Coal

The Gillespie First-Aid Team, winners of the first prize in an early contest held at Canton, Illinois. In the rear, left to right: Oscar Cartlidge, W. D. Ryan, and James Boston.

company, is another who has a long and enviable record as one of the most successful safety directors in this country.

The miners and operators were, in the main, at peace, and we had many outstanding men on both sides. Closer supervision, better explosives, rock-dusting, and better ventilation had greatly reduced the number and seri-

ousness of underground disasters, and the war had brought on an era of unprecedented prosperity.

Further Adventures

I went to Ottawa as general superintendent of a silica company, but in a year I was appointed consulting engineer for the Chicago Fire Brick Company, remaining at Ottawa six years. This company controlled several plants in Ohio and Indiana, and we erected a small one at Marseilles, Illinois, and a very large one at Wellsville, Missouri. W. J. Gilbert is president and general manager of this company. I regard it as a great privilege to be able to number him as a friend.

Everything went fine with the firebrick business until after the end of the war, when the bottom dropped out and firebrick couldn't be given away—much less sold for cash money.

My friend, H. M. Wilson, offered me a position with the Associated Companies, and I went to Pineville, Kentucky, but I was not long there until I was made general superintendent of the Kresge Coal Company, with headquarters in Knoxville, Tennessee. I remained there until Carl Scholz organized the Raleigh-Wyoming Coal Company in West Virginia for G. M. Hyams, of Boston.

I was assistant to the general manager, and was in charge of the field work, with headquarters in Charleston. Two large tracts, of about 9,000 acres each, were being developed—one at Edwight and the other at Glen Rogers. The latter was named for H. N. Rogers, whose money was behind the venture. The mine at Glen Rogers was in the Beckley seam, a very fine grade of smokeless coal, which was 630 ft. below the surface at the point where the shafts were sunk. Because there was an immense volume of water in the sandstone cover in this vicinity, great difficulty was experienced in sinking. We succeeded in overcoming this by drilling advance holes ahead of the sinking, and grouting the water cracks with cement, which was forced into the interstices under a pressure of 200 lb. a square inch. At times, cracks were encountered that were too large for simple grouting, and hay, beans, oats, corn, or any other material that was at hand (which would swell) was forced in to fill up the space.

On one occasion, the void was so big that it took an entire carload of baled hay and almost as much of corn and beans before its capacious maw was satisfied.

Our average volume of water before grouting was about 2,000 gal. a minute, which is quite a stream of water. However, we got the shafts down to coal and opened up on a very large scale, as it was the hope of the management to develop the mine that would be modern in every respect.

Because of the many difficulties encountered in sinking, and the enormous expense incurred in getting materials to the mine over the mountain before railroad facilities were available, all was not attained that had originally been projected. However, both Glen Rogers and Edwight are very fine examples of the more recent coal manufacturing plants.

Now a Consulting Engineer

It is not the object of this history, however, to consider things and events of recent times except to show pictorially some of the developments in tipples and machinery that have evolved as a natural result of the increased demand for more and cheaper coal. Suffice it for me to say that the mines of the Raleigh-Wyoming Coal Company were not fully developed be-

fore the company sold out to the Old Ben Coal Corporation. Since that time I have continued to reside in Charleston endeavoring to make a living as a consulting engineer.

It has been a real pleasure for me to cast a reminiscent eye back over the years, and I trust that my readers have had an equal degree of pleasure with me. As I said in the beginning, it is impossible for a man to recall at one time all the events in an active life; neither can he bring back to memory all the faces of friends and associates who have shared this life with him. I can recall at this late date numerous incidents that I had not thought of in the earlier chapters of these memoirs.

To the "old-timers" who have read this story and know about the things I have described, I extend heartiest greetings. I have had a long and fairly interesting life, and now, as the shadows lengthen toward the day's end I can truthfully say that God has been very good to me. I have never done any man a wrong knowingly, and if I have an enemy I do not know it.

Advice to old men is wasted, and perhaps to young men also, but in closing I cannot help but say to every young miner who aspires to better things: Work hard; study hard; be temperate, considerate, faithful, and honest; and trust in God for things that you yourself cannot control. If you do these things, success is sure to be yours.

NOTE: This as well as the preceding chapters in the 1931 Year Book may be secured in book form from the author:

OSCAR CARTLIDGE
1593 Lee Street
Charleston, West Virginia,
at a cost of $1.00 per copy postage prepaid

CONSTITUTION AND BY-LAWS

Adopted June 24, 1913.
Amended Nov. 12, 1926
Amended Nov. 8, 1929.

ARTICLE I.
NAME AND PURPOSE

The Illinois Mining Institute has for its objects 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 arreas on August 1, of the current year, after having been sent two notifications of dues, to 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. Funds received from life members are to be invested and only the income from these funds may be used in the regular operation of the institute.

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 President 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 officers and executive board members shall be elected by ballot, annually, at the regular November meeting and shall hold office for the ensuing year.

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 sign all orders for payment of money by the treasurer, and with the executive board shall 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, countersign all orders for money which have been signed by the president, and shall purchase necessary supplies under the direction of the executive board.

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 the president, and countersigned 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, act as program committee for each meeting, determine what is to published in the proceedings and shall perform such other duties as may be referred to them by a 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.

ILLINOIS MINING INSTITUTE

LIFE MEMBERS

BROOKS, C. W.....1629 Monadnock Block, Chicago, Ill.
BUCHANAN, D. W., Pres.....Old Ben Coal Corp., Chicago, Ill.
BUTCHER, FRED E.....First National Bank Bldg., Danville, Ill.
CLARK, FRED K.....Box 997, R. 5, Webster Groves, Mo.
COWIN, G. D., Pres.....Bell & Zoller Coal & Mining Co., Chicago, Ill.
GARCIA, JOHN A.....332 S. Michigan Ave., Chicago, Ill.
GREEN, ARTHUR C.....Goodman Mfg. Co., Chicago, Ill.
HARRINGTON, GEO. B., President.....
Chicago, Wilmington & Franklin Coal Co., Chicago, Ill.
JENKINS, S. T.....Goodman Mfg. Co., St. Louis, Mo.
JONES, JOHN E.....Old Ben Coal Corp., West Frankfort, Ill.
JOYCE, A. R., Vice-President.....Joyce-Watkins Co., Chicago, Ill.
LEACH, B. K., Vice President.....Egyptian Tie & Timber Co., St. Louis, Mo.
McFADDEN, GEO. C., Asst. Vice Pres., Peabody Coal Company, Chicago, Ill.
PELTIER, M. F., Vice President.....Peabody Coal Co., Chicago, Ill.
RYAN, JOHN T., V.-P. & B. M., Mine Safety Appliances Co., Pittsburgh, Pa.
SCHONTHAL, B. E., Pres.....B. E. Schonthal & Co., Inc., Chicago, Ill.
SCHONTHAL, D. C., Pres.....West Virginia Rail Co., Huntington, W. Va.
TAYLOR, H. H., Jr.....Franklin County Coal Co., Chicago, Ill.
THOMAS, T. J., Pres.....Valier Coal Co., Chicago, Ill.
THOMPSON, J. I., Vice-Pres.....Koppers Rheolaveur Co., Pittsburgh, Pa.
WEIR, PAUL, Vice-Pres.....Bell & Zoller Coal & Mining Co., Centralia, Ill.
ZELLER, HARRY, Vice-Pres.....West Virginia Rail Co., Huntington, W. Va.

HONORARY MEMBERS

MOORSHEAD, A. J.....968 Westchester Place, Los Angeles, Calif.
MURRAY, HUGH.....Equality, Ill.
ROLLO, JOHN.....Murphysboro, Ill.
TIRRE, FRANK.....7126 Northmoor Drive, St. Louis, Mo.

ACTIVE MEMBERS

ABERLE, JOS. F.....Consolidated Coal Co. of St. Louis, Mt. Olive, Ill.
ABRELL, JOHN, Supt.....Peabody Coal Co., No. 7 Mine, Kincaid, Ill.
ADAMS, R. L., Chief Engr.....Old Ben Coal Corp., Christopher, Ill.
ADAMS, WILLARD C.....
Koppers Rheolaveur Co., 1301 Koppers Bldg., Pittsburgh, Pa.
ALLARD, A. F.....United States Fuel Co., Danville, Ill.
ALVERSON, RALPH, G. S.....Harrisburg Coal Mining Co., Harrisburg, Ill.
ANDERSON, J. C.....United Electric Coal Co., 511 Adams Bldg., Danville, Ill.
ANDERSON, J. S., Dist. Supt.....Madison Coal Corp., Edwardsville, Ill.
ARGUST, W. C., Div. Supt.....Peabody Coal Co., Taylorville, Ill.
ARMSTRONG, E. R.....Collinsville, Ill.

ARNOLD, MARK R.....
810 W. Washington Blvd., A. Leschen & Sons Rope Co., Chicago, Ill.
AUSTIN, W. J.....332 S. Michigan Ave., Hercules Powder Co., Chicago, Ill.
BAGWILL, GEO.....State Mine Inspector, Harrisburg, Ill.
BARKER, CHAS, Supt.,
Peabody Coal Co., 104 W. College St., Harrisburg, Ill.
BARLOW, J. E.....Goodman Mfg. Co., 1122 S. 11th St., Springfield, Ill.
BARTLETT, A. G.....West Frankfort, Ill
BATTEY, R. B.....C. B. & Q. R. R., 547 W. Jackson Blvd., Chicago, Ill.
BAYLESS, I. N., A. G. M.....Union Pacific Coal Co., Rock Springs, Wyo.
BEALL, C. W.....Beall Bros. Supply Co., Alton, Ill.
BEDA, P. W., Vice-Pres., Old Ben Coal Corp, 230 S. Clark St., Chicago, Ill.
BELTZ, J. S., C. E.....Jeffrey Mfg. Co., Columbus, Ohio
BERGER, E. L., G. S.....Bell & Zoller Coal & Mng. Co., Zeigler, Ill.
BIGGER, I. S.....514 South Blvd., Cape Girardeau, Mo.
BLANKENSHIP, G. F.....Egyptian Iron Works, Murphysboro, Ill.
BOEDEKER, SIMON A.....7127 Cambridge Ave., University City, Mo.
BORELLA, PETER.....C-W-F Coal Co., Orient, Ill.
BREWERTON, W. A.....100 W. Monroe St., Chicago, Ill.
BREWSTER, B. B.....10 Algonquin Lane, Webster Groves, Mo.
**BROOKS, C. W.....1629 Monadnock Bldg., Chicago, Ill.
BROSKY, A. F., Associate Ed., "Coal Age".....
10th Ave. at 36th St., New York
**BUCHANAN, D. W. Pres., Old Ben Coal Corp., 230 S. Clark St., Chicago, Ill.
BURKHALTER, C. H.....
Ohio Brass Co., 20 N. Wacker Drive, R. 1116, Chicago, Ill.
BURNETT, FRED, Supt.....Peabody Mine No. 18, West Frankfort, Ill.
BURNETT, WM. J., Jr.....705 W. Boulevard, Marion, Ill.
**BUTCHER, FRED E.....First National Bank Bldg., Danville, Ill.
CADY, GILBERT H.....State Geological Survey, Urbana, Ill.
CAINE, K. E.....Joy Mfg. Co., Franklin, Pa.
CALLEN, A. C., Prof.....Transportation Bldg., Urbana, Ill.
CAMPBELL, GEO. F.....Old Ben Coal Corp., 230 S. Clark St., Chicago, Ill.
CAMPBELL, H. E., P. A.....
Peabody Coal Co., 20 N. Wacker Drive, Chicago, Ill.
CARROLL, D. J.....1355 Hood Ave., Chicago, Ill.
CARTER, DALE, Supt.....Mine No. 2, Bell & Zoller, Zeigler, Ill.
CARTWRIGHT, HARVEY..Indiana Coal Operators Assn., Terre Haute, Ind.
CASH, J. C., Mine Mgr.....American Eagle Colliery, Ameagle, W. Va.
CAWVEY, C. E., E. E.....Union Colliery Co., Dowell, Ill.
CECIL, C. H.....Bethlehem Steel Co., 400 N. Michigan Ave., Chicago, Ill.
CENTRAL MINE EQUIPMENT CO.
736 E. Big Bend Blvd., Webster Groves, St. Louis, Mo.
CHAMBERLIN, W. M.....521 Black Ave., Springfield, Ill.
CHRIST, ROBT. J., Div. Supt.....
Peabody Coal Co., 1836 Lowell Ave., Springfield, Ill.
CHRISTIANSON, C.....Sullivan Machinery Co., Mt. Vernon, Ill.
CLABAUGH, ALBERT.....Spivey Bldg., East St. Louis, Ill.

**CLARK, FRED K.
Hulbert Oil and Grease Co., Box 997, R. 5, Webster Groves, Mo.
CLARKSON, C. E.....Clarkson Mfg. Co., Nashville, Ill.
CLARKSON, JOHN L.....Nashville, Ill.
CLEMENTS, LOUIS.....Brewerton Coal Co., Danville, Ill.
COLLINS, G. H., Dist. Mgr.....Illinois Power & Light Corp., Duquoin, Ill.
COLQUHOUN, ALEX, Asst. Div. Engr.....Peabody Coal Co., Taylorville, Ill.
CONWAY, LEE, M. E.....Consolidated Coal Co. of St. Louis, Staunton, Ill.
COOLEY, H. B.....332 S. Michigan Ave., Allen & Garcia Co., Chicago, Ill.
**COWIN, G. D., Pres.....
Bell & Zoller Coal & Mining Co., 307 N. Michigan Ave., Chicago, Ill.
COX, R. L., Sales Manager.....Jeffrey Mfg. Co., Columbus, Ohio
CRAGGS, WM. C., Supt.....Peabody Coal Co., Mine 43, Harrisburg, Ill.
CRAWFORD, J. G., Gen. Mgr.....
Valier Coal Co., 547 W. Jackson Blvd., Chicago, Ill.
CURRIE, ADAM.....1121 St. Vincent Ave., La Salle, Ill.
DAKE, WALTER M.....Joy Mfg. Co., Franklin, Pa.
DAVIS, A. J.....Insurance Exchange, Osborn & Lange, Chicago, Ill.
DAVIS, WM. H.....568 S. Boyd St. Decatur, Ill.
DAWSON, HUGH.....500 W. Monroe St., Herrin, Ill.
DAY, SAM, Supt.....Clarkson Coal Mining Co., Nashville, Ill.
DETWEILER, M. H. Mgr.....Zeigler Coal & Coke Co., Zeigler, Ill.
DE VAULT, G. P.....Box 98, Edwards, Ill.
DEVONOLD, D. H.....Peabody Coal Co., 20 N. Wacker Drive, Chicago, Ill.
DE WITT, C. S., P. A., C-W-F Coal Co., 332 S. Michigan Ave., Chicago, Ill.
DONAHUE, ED.....111 W. Fifth St., West Frankfort, Ill.
DONIE, P. L.....Little Betty Mining Corp., Linton, Ind.
DOONER, P. J.....1341 N. Third St., Springfield, Ill.
DOUGHERTY, JAS.....312 Pine St., Zeigler, Ill.
DOWIATT, P. J., Jr.....P. J. Dowiatt & Sons Coal Co., Georgetown, Ill.
DUBOIS, JAS., Supt.....Hegeler Zinc Co., Danville, Ill.
DUFF, MILTON J.....
2227 S. Jane St., Phillips Mine & Mill Sup. Co., Pittsburgh, Pa.
DUNCAN, A. W.....Duncan Foundry & Machine Works, Inc., Alton, Ill.
DUNCAN, GEO. D.....Duncan Fdry. & Machine Co., Alton, Ill.
DUNCAN, GEO. D. Jr.....Duncan Fdry. & Machine Co., Alton, Ill.
DUNCAN, W. M.....Duncan Fdry. & Machine Co., Alton, Ill.
DUNN, JAS., G. S.....Old Ben Coal Corp., West Frankfort, Ill.
DUNN, THOS. J.....Old Ben Coal Corp., Christopher, Ill.
EDE, J. A.....LaSalle, Ill.
EDGAR, R. L.....Watt Car & Wheel Co., Barnesville, Ohio
EDWARDS, JOHN.....U. S. Fuel Co., Georgetown, Ill.
ELSHOFF, CARL, Pres...Mine B Coal Co., 1039 N. Vine St., Springfield, Ill.
ENGLISH, THOS. .....
Inspector at Large, Dept. of Mines & Minerals, Springfield, Ill.
EQUITABLE POWDER MFG. CO.....East Alton, Ill.
ESSINGTON, T. G.....231 S. LaSalle St., Chicago, Ill.
EVANS, JOHN E. .....311 Connecticut St., Westville, Ill.
FALETTI, PETER.....State Mine Inspector, Dalzell, Ill.

FENTON, J. R., V.-P.
J. K. Dering Coal Co., 332 S. Michigan Ave., Chicago, Ill.
FIRMIN, W. H. Joyce-Watkins Co., Metropolis, Ill.
FIRTH, B. H., Supt. Lumaghi Coal Co., Collinsville, Ill.
FISHWICK, HARRY, Pres. U. M. W. of A., Springfield, Ill.
FLASKAMP, F. A.
Broderick & Bascom Rope Co., 4203 N. Union St., St. Louis, Mo.
FLEMING, J. B. First National Bank Bldg., Benton, Ill.
FLYNN, EDWARD Duquoin, Ill.
FOSTER, JOHN R., Supt.
Chicago, Wilmington & Franklin Coal Co., West Frankfort, Ill.
FRASER, JOHN K. State Mine Inspector, Carlinville, Ill.
FRASER, THOMAS Hydrotator Co., 12435 Euclid Ave., Cleveland, Ohio
FULKE, FRANK L. Frank Prox Co., Terre Haute, Ind.
**GARCIA, JOHN A. 323 S. Michigan Ave., Chicago, Ill.
GASTON, HARVEY, Supt. Saxton Mining Co., Terre Haute, Ind.
GAUEN, C. F. 1821 Railway Exchange Bldg., St. Louis, Mo.
GEBHART, B. R. Illinois Coal Bureau, 307 N. Michigan Ave., Chicago, Ill.
GILGIS, W. L., Pur. Agent
Superior Coal Co., 1417 Daily News Bldg., Chicago, Ill.
GLENWRIGHT, J. W. Atlas Powder Co., Springfield, Ill.
GODBY, J. K. 230 Park Ave., American Brake Shoe Co., New York, N. Y.
GORDON, O. M., Treas.
Bell & Zoller Coal & Mining Co., 307 N. Michigan Ave., Chicago, Ill.
**GREEN, ARTHUR C. Goodman Mfg. Co., 4834 S. Halsted St., Chicago, Ill.
GREEN, KENNETH
129 First Ave., Pennsylvania Elec. Repair Co., Pittsburgh, Pa.
GREENE, D. W., G S. West Virginia Coal Co., O'Fallon, Ill.
GRIMMETT, O. C. C-W-F Coal Co., Benton, Ill.
GRISSOM, FRANK Alcoa Ore Co., Belleville, Ill.
HABERLE, M. Peabody Coal Co., Riverton, Ill.
HALBERSLEBEN, PAUL, G. S. O'Gara Coal Co., Harrisburg, Ill.
HALES, W. M. 605 W. 116th St., Chicago, Ill.
HALL, GEORGE 1809 S. Lincoln Ave., Springfield, Ill.
HALL, HECTOR H. Bell & Zoller C. & M. Co., Zeigler, Ill.
HALL, DAWSON R. 340 Burns St., Forest Hills, Long Island, N. Y.
HALLER, EMIL Consolidated Coal Co. of St. Louis, Mt. Olive, Ill.
HALLS, H. H. U. S. Fuel Co., Danville, Ill.
HAMILTON, CHAS. F., V.-P.
Pyramid Coal Corp., 230 N. Michigan Ave., Chicago, Ill.
HAMPTON, I. H. 1000 Milton Rd., Alton, Ill.
HARDY, JOHN W. 1220 W. Main St., Taylorville, Ill.
HARDY, WM. Peabody Coal Co., Taylorville, Ill.
**HARRINGTON, GEO. B., Pres.
Chicago, Wilmington, Franklin C. Co., 332 S. Michigan Ave., Chicago, Ill.
HARRIS, JOE Joy Mfg. Co., Franklin, Pa.
HARTWELL, LEN, Supt. Pyramid Coal Co., Pinckneyville, Ill.
HARVEY, HADLEY 1414 S. E. First St., Evansville, Ind.
HASKINS, LEE, Supt. Mine No. 1, Bell & Zoller, Zeigler, Ill.

HAWLEY, E. W.....20 N. Wacker Drive, American Powder Co., Chicago, Ill.
HAYDEN, CARL T., G. M.....
O'Gara Coal Co., 332 S. Michigan Ave., Chicago, Ill.
HAYWOOD, ALLEN.....U. M. W. of A., Taylorville, Ill.
HAYWOOD, HARRY.....Indiana & Illinois Coal Corp., Witt, Ill.
HAYWOOD, W. T.....Witt, Ill.
HEBLEY, HENRY F.....
Allen & Garcia Co., 332 S. Michigan Ave., Chicago, Ill.
HEINRITZ, M. W.....3335 W. 47th St., Chicago, Ill.
HELBING, ERNEST.....Franklin County Coal Co., Herrin, Ill.
HELM, GUIDO.....Consolidated Coal Co. of St. Louis, Mt. Olive, Ill.
HELSON, J. R.....Joyce-Watkins Co., Metropolis, Ill.
HESSLER, JOHN.....Fort Harrison Mining Co., Terre Haute, Ind.
HINDSON, HARRY C.....616 Garden St., Peoria, Ill.
HODGES, FRED T.....126 E. 14th St., Danville, Ill.
HOLMES, JOHN K.....520 Junction Ave., Danville, Ill.
HOOK, GEORGE.....Beck & Corbitt Co., First St., & Ashly, St. Louis, Mo.
HOPE, JOHN.....Peabody Coal Co., Danville, Ill.
HOWARD, HUBERT E., Pres.....
Pyramid Coal Corp., 230 N. Michigan Ave., Chicago, Ill.
HUNTER, THOS.....1032 W. Washington St., Springfield, Ill.
HUTTON, WM.....847 S. English Ave., Springfield, Ill.
JEFFERIS, J. A. .....
Illinois Terminal R. R. System, 1221 Locust St., St. Louis, Mo.
JENKINS, G. S., M. E.....
Consolidated Coal Co. of St. Louis, Railway Ex. Bldg., St. Louis, Mo.
**JENKINS, S. T. ..... Goodman Mfg. Co., 322 Clark Ave., St. Louis, Mo.
JENKINS, W. J., Pres.....
Consolidated Coal Co. of St. Louis, Railway Ex. Bldg., St. Louis, Mo.
JOHNSON, E. H.....307 N. Michigan Ave., Safety Mining Co., Chicago, Ill.
JOHNSTON, J. M., C. E.....Bell & Zoller C. & M. Co., Zeigler, Ill.
JONES, ARCH M.....904 Olive Plaza Bldg., St. Louis, Mo.
JONES, D. W., Supt. .....Valier Coal Co., Valier, Ill.
JONES, HARRY W.....417 E. Big Bend Blvd., Webster Groves, Mo.
**JONES, JOHN E.....Old Ben Coal Corp., West Frankfort, Ill.
JONES, JOHN Z.....U. S. Fuel Co., 306 Chandler St., Danville, Ill.
JONES, WALTER M.....Box 404, Joy Mfg. Co., Centralia, Ill.
JORGENSON, F. F., G. M.....Consolidation Coal Co., Fairmont, W. Va.
**JOYCE, A. R. V.-P.....Joyce-Watkins Co., 400 W. Madison St., Chicago, Ill.
JOYCE, PETER, Asst. Director.....
Dept. Mines & Minerals, Capitol Bldg., Springfield, Ill.
KENNEDY, H. M., Pres.....
Kennedy-Webster Electric Co., 300 W. Adams St., Chicago, Ill.
KIDD, WM. E.....Peoria, Ill.
KILLEN, L. S., Asst. Treas.
Truax-Traer Coal Co., 332 S. Michigan Ave., Chicago, Ill.
KLEIN, GEO.....Klein Armature Works, Centralia, Ill.
KNOIZEN, A. S.....Joy Mfg. Co., Franklin, Pa.
LA MENA, C. J.....Allen & Garcia Co., 332 S. Michigan Ave., Chicago, Ill.

LANGTRY, W. D., Pres.
Commercial Testing & Engr. Co., 360 N. Michigan Ave., Chicago, Ill.
**LEACH, B. K., V.-P.
Egyptian Tie & Timber Co., 1821 Ry. Exchange Bldg., St. Louis, Mo.
LEDNUM, E. T., Mgr.
E. I. du Pont de Nemours & Co., 332 S. Michigan Ave., Chicago, Ill.
LEE, CARL.....Peabody Coal Co., 20 N. Wacker Dr., Chicago, Ill.
LEIGHTON, M. M.....State Geological Survey, Urbana, Ill.
LEMING, ED., Supt.....Union Colliery Co., Dowell, Ill.
LETE, ACHILLE.....17 N. Main St., Danville, Ill.
LEWIS, A. D.....1142 W. Lawrence Ave., Springfield, Ill.
LINDSAY, GEO., Supt.....J. K. Dering Coal Co., Eldorado, Ill.
LOHR, C. P.....401 Bank of Commerce Bldg., St. Louis, Mo.
LONG, JOSEPH A.....Jeffrey Mfg. Co., Terre Haute, Ind.
LOTT, GEO. M., D. M.
Jeffrey Mfg. Co., 332 S. Michigan Ave., Chicago, Ill.
LYMAN, G. E., G. S.....Madison Coal Corp., Glen Carbon, Ill.
LYTLE, GEO. F...Universal Lubricating Co., Schofield Bldg., Cleveland, Ohio
MABRY, H. E.....1625 Washington Ave., Alton, Ill.
MALKOVICH, MIKE.....P. O. Box 321, Benton, Ill.
MAC-MURDO, P. W.....Peabody Coal Co., R. R. No. 5, Springfield, Ill.
MALSBERGER, A. H.....Dupont Powder Co., Springfield, Ill.
MANCHA, RAYMOND.....Mancha Motor Co., St. Louis, Mo.
MARBLE, G. E.....General Electric Co., 230 S. Clark St., Chicago, Ill.
MARDIS, EARL J.
American Steel & Wire Co., 208 S. LaSalle St., Chicago, Ill.
MARSH, I. D., Supt.....Alcoa Ore Co., Belleville, Ill.
MARSHALL, HARRY.....1325 S. College, Springfield, Ill.
MASELTER, J. E.....General Electric Co., 1009 Spruce St., St. Louis, Mo.
MAYOR, E. S., Supt.....Crerar-Clinch Coal Co., Duquoin, Ill.
MEISTER, V. S.....The Jeffrey Mfg. Co., Terre Haute, Ind.
MELKUSH, ONEY.....Peabody Coal Co., R. R. No. 5, Springfield, Ill.
MEYER, BRUNO F., Dist. Supt.
Consolidated Coal Co. of St. Louis, Staunton, Ill.
MILLER, A. O.....Bureau of Mines, Vincennes, Ind.
MILLER, FRED.....Franklin County Coal Co., Herrin, Ill.
MILLER, JAS. B.....1946 N. Broadway, St. Louis, Mo.
MILLETT, JOHN, Secy.
Miners Examing Board, 211 S. Seminary St., Collinsville, Ill.
MILLHOUSE, JOHN G.
Director of Mines & Minerals, Capitol Bldg., Springfield, Ill.
MITCHELL, D. R.....Transportation Bldg., Urbana, Ill.
MOELLER, A. C.....1212 Plaza-Olive Bldg., St. Louis, Mo.
*MOORSHEAD, A. J.....910 Geargina Ave., Santa Monica, Calif.
MORRIS, NELSON.....Harrisburg, Ill.
MOSES, HARRY M.....U. S. Coal & Coke Co., Gary, W. Va.
MOSES, THOS., Pres.
H. C. Frick Coal Co., 1315 Carnegie Bldg., Pittsburgh, Pa.
MULLEN, E. C.....2525 W. 21st St., Chicago, Ill.

MULLINS, T. C., Pres.
Northern Illinois Coal Corp., 310 S. Michigan Ave., Chicago, Ill.
MUNRO, CHAS. 8259 Langley Ave., Chicago, Ill.
MURRAY, ED. U. S. Fuel Co., Westville, Ill.
*MURRAY, HUGH Equality, Ill.
MC ARTOR, GEO. Herrin, Ill.
McAULIFFE, EUGENE, Pres.
Union Pacific Coal Co., 1416 Dodge St., Omaha, Nebr.
McAVOY, G. W. Evansville Supply Co., Evansville, Ind.
McBRIDE, W. P.
American Car & Fdry. Co., Ry. Exchange Bldg., Chicago, Ill.
McCLEISH, W. J. Safety Mining Co., Benton, Ill.
McCLOUD, DON B. Duquoin, Ill.
McCULLOCH, LAWRENCE 429 S. Tenth St., Vincennes, Ind.
McCULLOCH, WM. A. Evansville Elec. & Mfg. Co., Evansville, Ind.
McELHATTAN, D. F., Saf. Engr. Peabody Coal Co., Duquoin, Ill.
**McFADDEN, GEO., A.V-P.
Peabody Coal Co., 20 N. Wacker Dr., Chicago, Ill.
McFADDEN, JOS., Supt. Peabody Coal Co., Mine No. 24, Danville, Ill.
McFADDEN, NAT., Div. Engr. Peabody Coal Co., Taylorville, Ill.
McGURK, SAM, Supt. Mt. Olive & Staunton Coal Co., Staunton, Ill.
McKENNA, THOS. U. S. Fuel Co., Danville, Ill.
McLAREN, A. B. Marion, Ill.
McLAREN, W. S. Binkley Coal Co., Linton, Ind.
McPHAIL, ROBT., Mine Mgr. Peabody Mine No. 18, West Frankfort, Ill.
McREAKEN, C. W., Div. Supt. Peabody Coal Co., Marion, Ill.
NEAL, DAVE Consolidated Coal Co. of St. Louis, Mt. Olive, Ill.
NELSON, I. C. Beall Bros., Supply Co., Marion, Ill.
NIELSEN, A. M., G. S. Truax-Traer Coal Co., Carbondale, Ill.
NOE, A. C. Geological Dept., U. of C., 57th St., Chicago, Ill.
NOYES, J. A., 400 N. Michigan Ave., Sullivan Machinery Co., Chicago, Ill.
NUCKELS, C. E.
221 W. Third St., Post-Glover Electric Co., Cincinnati, Ohio.
O'BRIEN, EUGENE J. 3220 Oak Hill Ave., St. Louis, Mo.
O'BRIEN, FRANK 114 S. McKinley St., Harrisburg, Ill.
OHLE, JOHN Franklin Hotel, Benton, Ill.
OLDANI, JOHN V.
Department of Mines & Minerals, 717 N. 14th St., Herrin, Ill.
OLDHAM, R. J., Supt. Centralia Coal Co., Centralia, Ill.
O'NEIL, CHAS. Dupont Powder Co., McCormick Bldg., Chicago, Ill.
ORD, MARK 1622 N. Gilbert St., Danville, Ill.
O'ROURKE, JOHN 303 W. Lindell St., West Frankfort, Ill.
OVERSTREET, J. W., Gen. Mgr.
National Armature & Elec. Works, Bluefield, W. Va.
PATRICK, R. M., D. M.
The Atlas Car & Mfg. Co., 4271 Washington Blvd., St. Louis, Mo.
PATTERSON, FRANK Mine Rescue Station, Elorado, Ill.
**PELTIER, M. F., V.-P. Peabody Coal Co., 20 N. Wacker Dr., Chicago, Ill.
PFAHLER, F. S., V.-P. Superior Coal Co., Gillespie, Ill.

PHILLIPS, THOS. W., Supt.....
Superior Smokeless Coal & Mng. Co., Tahona, Okla.
PICKARD, A. E.....Mt. Vernon Car Co., Mt. Vernon, Ill.
PLIMPTON, J. A.....333 N. Michigan Ave., Pa. Crusher Co., Chicago, Ill.
PLUMLEE, ARTHUR.....Cambria, Ill.
POLING, J. W.....
Evansville Elec. & Mfg. Co., 600 W. Eichel Ave., Evansville, Ind.
POWELL, JAS. Supt.....Superior Coal Co., Gillespie, Ill.
POWERS, F. A.....Dooley Bros., Peoria, Ill.
PREVAL, H.....Peabody Coal Co., Springfield, Ill.
PRINGLE, MARK.....U. S. Fuel Co., Georgetown, Ill.
PROFFITT, R. P.....
3300 Locust St., Timken Roller Bearing Co., St. Louis, Mo.
PRITCHARD, W.....Goodman Mfg. Co., St. Louis, Mo.
PRUDENT, ED.....Bell & Zoller C. & M. Co., Zeigler, Ill.
QUADE, JOHN C.....Peabody Coal Co., Harrisburg, Ill.
REED, FRANK H.....State Geological Survey, Urbana, Ill.
REES, EDWIN.....1808 S. College St., Springfield, Ill.
REIS, C. A., G. M.....Green River Fuel Co., Mogg, Ky.
REITHER, E. C.....4925 Liberty Ave., Pittsburgh, Pa.
RHINE, F. E.....Duncan Fdry. & Machine Co., Alton, Ill.
RICHARDS, JAS.....214 N. 12th St., Carterville, Ill.
RICHART, F. W.....General Electric Co., Carterville, Ill.
RIHACEK, G. J.....307 N. Michigan Ave., Safety Mining Co., Chicago, Ill.
ROBERTSON, C. E.....
Westinghouse Elec. Co., 20 N. Wacker Drive, Chicago, Ill.
ROBINSON, L. R.....Robinson Ventilating Co., Zelienople, Pa.
ROCK, DAVID I., G. S.....U. S. Fuel Co., Danville, Ill.
RODENBUSH, JOHN, Supt.....
Chicago, Wilmington & Franklin Coal Co., West Frankfort, Ill.
ROGERS, THOS.....Mine Rescue Station, Herrin, Ill.
ROLLO, JAMES.....Egyptian Powder Co., Herrin, Ill.
*ROLLO, JOHN.....Murphysboro, Ill.
ROMAN, F. W.....332 S. Michigan Ave., Hercules Powder Co., Chicago, Ill.
RONK, R. K.....Dorthel Coal Co., Hanna City, Ill.
RUSSELL, W. H.....Madison Coal Corp., Glen Carbon, Ill.
RUTLEDGE, J. J.....22 Light St., Bureau of Mines, Baltimore, Md.
**RYAN, J. T., V.-P.....Mine Safety Appliance Co., Pittsburgh, Pa.
RYAN, W. D.....3209 Washington St., Kansas City, Mo.
SANDOE, C. J., V.-P.....
West Virginia Coal Co., Boatmens Bank Bldg., St. Louis, Mo.
SAYLOR, H. N.....1844 Railway Exchange Bldg., St. Louis, Mo.
SCHOEN, WM. H. Jr.....926 Farmers Bank Bldg., Pittsburgh, Pa.
**SCHONTHAL, B. E.....59 E. Van Buren St., Chicago, Ill.
**SCHONTHAL, D. C., Pres.....West Virginia Rail Co., Huntington, W. Va.
SCHONTHAL, JOSEPH.....59 E. Van Buren St., Chicago, Ill.
SCHREIER, G. A.....1508 E. Main St., West Frankfort, Ill.
SCHULL, B. H., Supt.....Binkley Mining Co., Clinton, Ind.
SCHULL, FRANK.....Binkley Mining Co., Clinton, Ind.

SELETTO, JAMES.....Box 173, Ind. & Ill. Coal Corp., Witt, Ill.
SEVER, L. G., Asst. to Pres.....Mt. Vernon Car Mfg. Co., Mt. Vernon, Ill.
SHAFFER, ARTHUR G.....702 W. St. Louis St., West Frankfort, Ill.
SHIMER, F. L.....C. I. P. S. Co., Marion, Ill.
SIMPSON, J. H.....1946 N. Broadway, St. Louis, Mo.
SLINGLUFF, W. H., D. M.....
American Cable Co., 400 W. Madison St., Chicago, Ill.
SMITH, C. B.....Dearborn Chemical Co., 310 S. Michigan Ave., Chicago, Ill.
SMITH, C. M.....214 Transportation Bldg., Urbana, Ill
SMITH, ED. S.....Mine Rescue Station, Rosiclare, Ill.
SMITH, GEO. M., Mine Supt.....
Peabody Coal Co., 1800 Whittier Ave., Springfield, Ill.
SMITH, G. R.....513 N. Franklin St., Danville, Ill.
SMITH, HARRY.....Consolidated Coal Co. of St. Louis, Mt. Olive, Ill.
SMITH, HARVEY E.....Franklin Hotel, Benton, Ill.
SMITH, L. D., V.-P.....
Chgo. Wilmington & Franklin C. Co., 332 S. Michigan Ave., Chicago, Ill.
SNEDDON, JAS.....Valier, Ill.
SOMERS, BYRON, Supt.....Truax-Traer Coal Co., St. David, Ill.
SOUTHWARD, G. B.....841 Munsey Bldg., Washington, D. C.
SOWERS, C. V.....U. S. Fuel Co., Danville, Ill.
SPAHT, A. W.....Old Ben Coal Co., West Frankfort, Ill.
SPICER, C. B.....56 Aberdeen Place, Clayton, Mo.
STAREK, R. B.....Old Ben Coal Corp., 230 S. Clark St., Chicago, Ill.
STARKS, J. W., Supt.....Peabody Coal Co., Taylorville, Ill.
STEDELIN, JOHN W., V.-P.....Marion County Coal Co., Centralia, Ill.
STEIGER, A. E., G. S.....Pyramid Coal Co., Pinckneyville, Ill.
STELLING, H. C.....Union Carbide Co., 30 E. 42nd St., New York, N. Y.
STEVENS, E. F.....Union Colliery Co., Union Electric Bldg., St. Louis, Mo.
STEWART, ROY, Mine Supt.....
Peabody Coal Co., 816 E. Main St., Marion, Ill.
STINTON, W. S.....7726 Gannon, University City, Mo.
SUTOR, DON M., Mgr.....
Sullivan Machinery Co., Railway Exchange Bldg., St. Louis, Mo.
SYERS, JACOB.....Western Powder Co., 825 Jefferson Bldg., Peoria, Ill.
TARRACH, A. C.....Rout 2, Box 86, Stauton, Ill
**TAYLOR, H. H., Jr. .....
230 S. Clark St., Franklin County Coal Co., Chicago, Ill.
THOMAS, JEFFERSON .....
825 Jefferson Bldg., Western Powder Mfg. Co., Peoria, Ill.
THOMAS, R. H.....U. S. Fuel Co., R. R. No. 8, Danville, Ill.
**THOMAS, T. J., Pres .....
Valier Coal Co., 547 W. Jackson Blvd., Chicago, Ill.
**THOMPSON, J. I., V.-P.....
Koppers Rheolaveur Co., Kopper Bldg., Pittsburgh, Pa.
*TIRRE, FRANK.....7126 Northmoor Dr., St. Louis, Mo.
TOWAL, JAS. .....Benton, Ill.
TREADWELL, H. A., G. S.....
Chicago, Wilmington & Franklin Coal Co., Benton, Ill.

TROEGER, L. D.....Consolidated Coal Co. of St. Louis, Mt. Olive, Ill.
VEACH, F. M.....Consolidated Coal Co. of St. Louis, Mt. Olive, Ill.
VLASAK, JOS. Supt.....
St. Louis & O'Fallon Coal Co., Edgmont Station, East St. Louis, Ill.
VOLTZ, GEO. P., Engr.....
Peabody Coal Co., 2025 S. Sixth St., Springfield, Ill.
WALDRON, LEWIS.....Peabody Coal Co., Springfield, Ill.
WALL, GEO. T., Supt.....American Eagle Colliery, Ameagle, W. Va.
WALSH, HOWARD T.....
Sullivan Machinery Co., 400 N. Michigan Ave., Chicago, Ill.
WANLESS, W. H., Div. Supt.....934 Public Service Bldg., Springfield, Ill.
WATERMAN, C. W.....402 Wisconsin Ave., Oak Park, Ill.
WATTERS, C. C.....West Virginia Rail Co., Huntington, W. Va.
WEART, EVERETT T.....
John A. Roebling's Sons Co., 205 W. Wacker Dr., Chicago, Ill.
WEIR, JAMES.....Benton, Ill.
**WEIR, PAUL, V.-P.....
Bell & Zoller Coal & Mng. Co., 311 E. Broadway, Centralia, Ill.
WEISSENBORN, F. E.....4266 Arsenal St., St. Louis, Mo.
WEST, JETT J., Trav. Auditor.....
Peabody Coal Co., Box 224, Marion, Ill.
WHITE, JAMES.....Peabody Coal Co., Shelburn, Ind.
WHITE, JOHN.....606 E. Main St., Collinsville, Ill.
WILCOX, D. D., G. S.....Superior Coal Co., Gillespie, Ill.
WILCOXSON, R. J.....P. O. Box No. 56, Sangamon Coal Co., Springfield, Ill.
WILDMAN, W. Y.....
Illinois Coal Traffic Bureau, 307 N. Michigan Ave., Chicago, Ill.
WILKEY, FRED S., Secy.....
Illinois Coal Operators' Labor Assn., 307 N. Michigan Ave., Chicago, Ill.
WILKISON, T. A.....Loogootee, Ind.
WILLIAMS, GARNER, V.-P.....
Cabin Creek Consolidated Coal Co., Kayford, W. Va.
WILLIAMSON, J. E.....410 W. Tremont St., Hillsboro, Ill.
WOODARD, WM., Electrician.....U. S. Fuel Co., Georgetown, Ill.
WRIGHT, D. D.....912 N. Van Buren St., Marion, Ill.
YOUNG, C. C., Div. Engr.....Peabody Coal Co., Marion, Ill.
YOUNG, W. P., G. S.....Crescent Mining Co., Jefferson Bldg., Peoria, Ill.
**ZELLER, HARRY, V.-P.....West Virginia Rail Co., Huntington, W. Va.
ZINKGRAF, J. W., Dist. Mgr.....
Chicago Pneumatic Tool Co., 1931 Washington Ave., St. Louis, Mo.

*Honorary members.
**Life members.

In Loving Remembrance

of our good friends and fellow members:

WILLIAM ORTMAN	February 22, 1931
S. W. FARNHAM	March 12, 1931
H. C. PERRY	April 13, 1931
A. J. SAYERS	October 11, 1931
G. E. KARSTROM	March 24, 1932
JOSEPH D. ZOOK	May 28, 1932
EDWARD CAHILL	August 4, 1932

who left the world better for their
having lived in it.

ADVERTISING SECTION

To Our Members:

Please go over this section very carefully and take note of our very good friends, who are helping us to issue this Book. Do not forget them when you go shopping.

Hulburt Oil & Grease Company

PHILADELPHIA, PA.

Specialists in Coal Mine Lubrication

The WEST VIRGINIA RAIL CO.

Twenty-six Years of Service to the Coal Mining Industry

RAILS
FROGS AND SWITCHES
STEEL TIES
REINFORCING BARS
SPECIAL SHAPES

District Sales Agents, B. E. Schonthal & Co., Inc.
59 East Van Buren Street, Chicago

Mills and General Office
HUNTINGTON, WEST VIRGINIA

MINE-VENT

Unexcelled Acid, Powder-Smoke, Fungus and Abrasion Resisting Fabrics—Readily Coupled

"Mine-Vent" Flexible Ventilation Pipe and patented demountable couplings for Auxiliary Ventilation.

"ABC" Non-inflammable Jute and Cotton Duck Brattice Cloths (eight grades)

AMERICAN BRATTICE CLOTH COMPANY

WARSAW, INDIANA

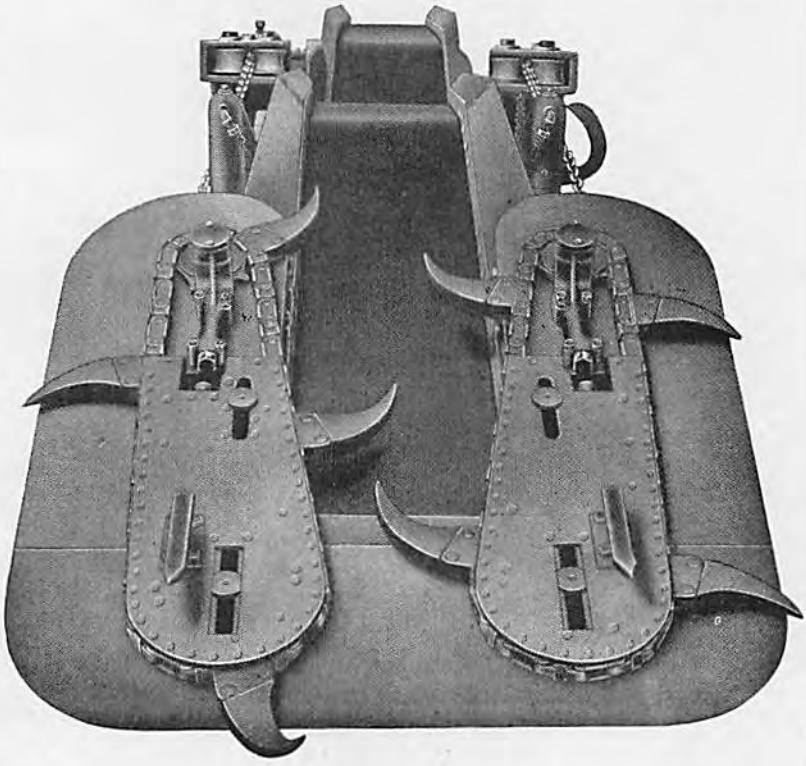
Patented "Mine-Vent" Coupling

Forms a strong, airtight joint. Simply pull tubing around spring steel ring and then snap ring into groove of coupling. The ring, in expanding, holds tubing securely in place.

CLARKSON LOADER

Strong and Powerful

Loads Out Those Tight Shots Perfectly



Clarkson Manufacturing Company

NASHVILLE, ILL.

THE ILLINOIS MINING INSTITUTE

HAS OUR SUPPORT AND BEST WISHES FOR A PROSPEROUS CONTINUATION

Robt. Holmes & Bros., Inc.

Builders of Holmes Coal Mine Equipment for Over 50 Years

Send For Our Latest Catalogue

DANVILLE, ILLINOIS

COALMASTER

Last year at this time we said that Coalmaster Drill Bits were used by more coal companies in Illinois than any other bit.

This year we can say that we have not only maintained but have increased this leadership in Illinois and have also established undisputed leadership in Indiana.

We mention this march of progress as evidence of Coalmaster superiority.

To put your mine on a more economical drilling basis and to obtain more satisfied drillers—Use Coalmaster.

Central Mine Equipment Company

Saint Louis

GREETINGS

to the

ILLINOIS MINING INSTITUTE

The Davies Supply Co.

NATIONAL STEEL PIPE BYERS WROT IRON

Fittings—Valves

Plumbing and Heating Materials

6601-6633 Grand Avenue CHICAGO, ILLINOIS

FLEXIPIPE

Furnishes air anywhere. Used extensively in development work and in connection with mechanical equipment for driving entries long distances without the necessity of crosscuts.

Write for reasons why Flexipipe is the standard auxiliary ventilating system in coal mines.

BEMIS BRO. BAG CO.
MANUFACTURERS

The Original makers of FLEXIBLE Air Tubing

412 POPLAR ST.
ST. LOUIS, MO.

And the Safety Depends Upon the Hoisting Ropes

To develop the maximum capacity of their hoisting machinery; secure satisfactory and dependable service; and avoid the annoyance and expense of frequent replacements, discriminating mining superintendents insist upon Roebling Wire Rope because of its dependability and long life in service.

JOHN A. ROEBLING'S SONS COMPANY
Trenton, New Jersey

ROEBLING WIRE ROPE

MOUNTED BOTTOM CUTTERS THAT CUT ON THE BOTTOM

Cuts 8 in. above to 8 in. below rail tops.

Open or Government Approved . . Cutterarm Locked at All Times
Cutterarm Swing May be Reversed Instantly . . . Self-Propelled
Low Maintenance . . . Self--Contained . . . Three-Point Support
Easy to Operate . . . Stays on the Track . . . Quickly Accessible

POWERFUL RUGGED SAFE

GOODMAN MANUFACTURING COMPANY
HALSTED ST. at 48TH.
CHICAGO - - - ILL.

Locomotives - Loaders - Coal Cutters

PITTSBURGH—WILKES-BARRE—HUNTINGTON—BIRMINGHAM—ST LOUIS—DENVER

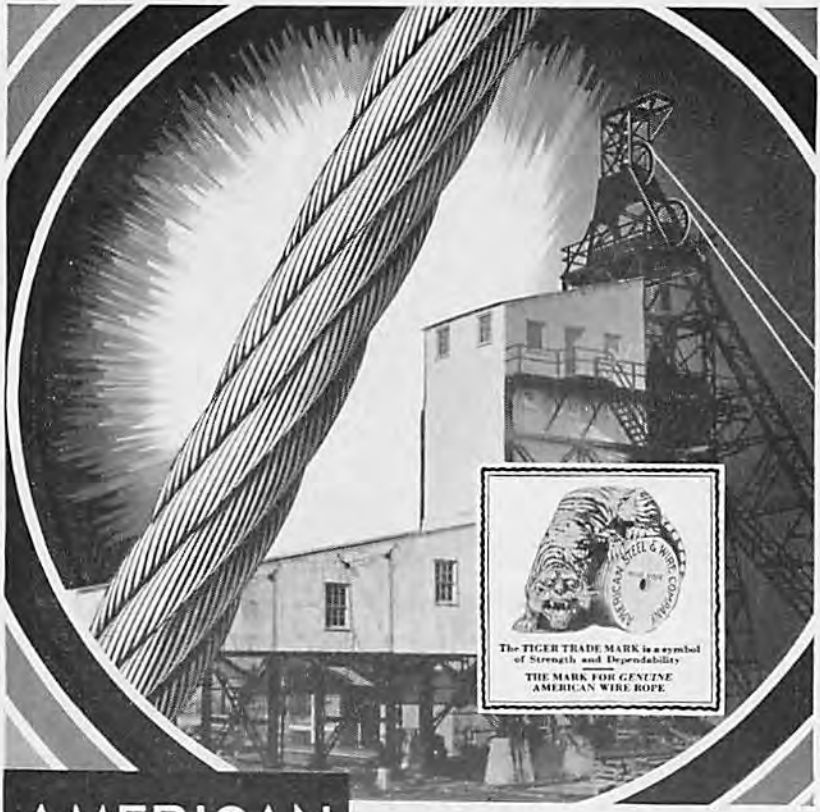
"Mancha's Electric Mule"

[Reg. U. S. Pat. Office]

Type "Standard A"

MANCHA LOCOMOTIVES
SERVE LOADING
MACHINES EFFICIENTLY

MANCHA STORAGE BATTERY LOCOMOTIVE CO.
4850 So. Halsted St. Chicago, Ill.
Offices in or Near all Mining Districts of the World



AMERICAN
STEEL & WIRE COMPANY
WIRE ROPE

IN THE LIGHT OF EXPERIENCE

Of vast importance to the life and progress of our Nation is the welfare of the Coal Mining Industry. Many factors have played a part in grooming this giant industry to its present high degree of efficiency.

The American Steel & Wire Company is proud of its contribution toward that attainment—the development of Wire Ropes to withstand the punishment and fatigue which bring destruction to ordinary ropes.

In the light of experience, mine-operators have secured the most satisfaction, the most "service per dollar" out of American Steel & Wire Company Wire Rope.

We have a complete line of Wire Rope, Electrical Wires and Cables, Amerclad Mining Machine and Locomotive Cables, Rail Bonds, Aerial Tramways, Trolley Wire, Tiger Wire Rope Clips and Sockets.

AMERICAN STEEL & WIRE COMPANY

Subsidiary of United States Steel Corporation

208 S. La Salle St., Chicago

From tipple to Sump - NITROSE stops corrosion

Wherever metal equipment is exposed—NITROSE fights off Corrosion. On the cage, cars, machines, rails, motors—on top or below—experience has proved that NITROSE offers the best and cheapest protection against rust, alkalis, chemicals, gas and sulphur fumes, damp air, cold or heat.

Not only does NITROSE stand up where paints fail—it **actually costs less** because of the labor it saves. Only one coat is needed except in extreme cases. Requires no mixing, no stirring; no chipping, scraping or sand-blasting to prepare the surface. Simply wire brush the loose scale and apply. Can be applied equally well on hot, wet, oily or cold surfaces.

Investigate this liquid armor that spreads like paint. For 17 years it has proved its claims to maintenance men in every industry. Write today! Get the details that will save you maintenance, repair and replacement bills.

Made only by

The NITROSE Co.
1500J Peoria Life Bldg.
PEORIA, ILLINOIS

NITROSE

The SAME GAS That Puts PEP in

Puts Pep in Your Sales and Increases Operating Profit!

If you are interested in lower operating costs you are interested in a mining method that will assist your sales department to move more coal.

CARDOX utilizes carbon dioxide (the pep in pop) to dislodge a coarser mine run output that resists the rough treatment of mining, sizing, transporting and handling through dealers' yards.

CARDOX is helping the dealer to make more money through reduced degradation. Consequently he is demanding CARDOX "mined" coal.

Your Salesmen Need That CARDOX Pep!

Safety Mining Company

307 North Michigan Avenue . . . . . Chicago

BRATTICE CLOTH

QUALITY

SERVICEABILITY

NON-INFLAMMABILITY

U.-W. Brattice is specified by particular buyers and superintendents who want the best.

It costs no more than ordinary Brattice.

Non-inflammable jute in 4 grades
in 36, 48, 60, 72, 84 and 96-inch widths.

Also:—

Non-inflammable cotton
Airtight-waterproof jute
Airtight-waterproof cotton

WRITE FOR PRICES.

The Upson-Walton Co.

CLEVELAND

Buffalo - Chicago - New York - Pittsburgh

Lubricating Oils

A grade for each type of service

Gargoyle Dark Lubricating Oil HH

for Joy Loaders

Voco Mine Car Greases

for plain and roller bearing pit cars

Gargoyle Steam Cylinder Oils

for steam engines and pumps

Gargoyle D.T.E. Oils

for turbines and air compressors

VACUUM OIL COMPANY, Inc.

3504 Washington Blvd.
ST. LOUIS, MO.

or

59 E. Van Buren Street
CHICAGO, ILL.

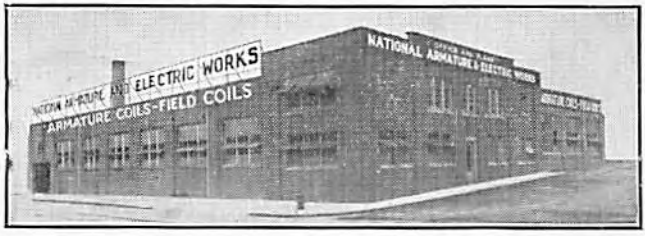
National Armature

and

Electric Works

J. W. OVERSTREET, General Manager

BLUEFIELD, W. VA.



Manufacturers of
Electrical Coils

WE INVITE YOUR INQUIRIES

Egyptian  Products

For information, write, wire or telephone to

EGYPTIAN IRON WORKS

MURPHYSBORO, ILLINOIS

Standard Switch Materials

Reid Safety Frogs—Cast Steel and Semi-Steel—guard rails cast integral with frog—all one piece—no bolts or rivets to become loose.

Riveted to Plate Frogs—Switches, Crossings, Turnouts complete, Switch Stands, etc.

Shaker Screen Driving Equipment

Ball Face Self-aligning Eccentrics, Arms, Shafts, Boxes, Hangers.

Mine Cars Complete

Equipped with Timken Bearings, Hyatt Bearings, Solid Roller Bearings, or Plain Type Wheels.

Journal Boxes, Axles, Bumpers, Body Irons, Draw Bars, and Wheels.

Light Push Cars For Miners' Tools

Equipped with Bicycle Type Wheels.

Boiler Castings

Grate Bars, Grate Bar Clips, Finger Bars, Stoker Links, Fire Box and Door Liners, etc.

Castings

In the rough—semi-finished and finished—

Semi-Steel
Cast Steel
Brass
Bronze

We have our own foundry, machine shop, and pattern shop.

In every coal mining country under every condition, you will find Joy - M & C equipment — it has world wide recognition.

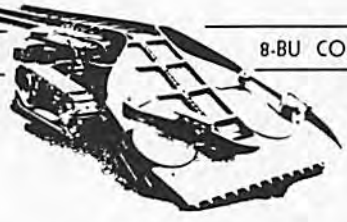
In America, Joy production in 1932 exceeded the combined tonnages of all other mechanical loaders.

Abroad, M & C Cutters and Conveyors have been giving unexcelled service for years.

Combined, Joy - M & C offer the utmost in economical coal production by modern methods.

Joy Engineering service is another valuable asset and is at your disposal constantly. Guaranteed results based upon your conditions. Call upon Joy for help in solving your problems.

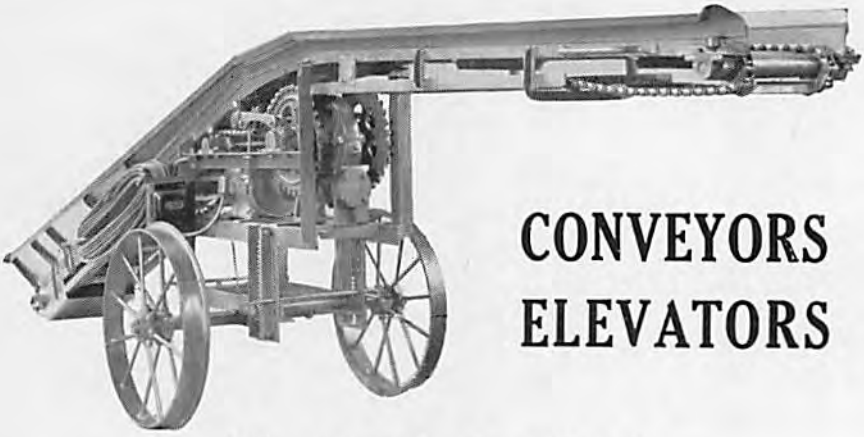
THE JOY



8-BU COAL LOADER

The JOY Manufacturing Company

FRANKLIN · · · · · · · · · · PENNSYLVANIA



CONVEYORS
ELEVATORS

- Mine car wheels and axles
  Roller Bearing Wheels
  Plain Bearing Wheels
  Timken Roller Bearing and other type wheels

- Electric furnace iron wheels are made of greater strength
  Close grain and deep chill

- Castings for all purposes
  Show greater tensile and transverse strength with the Electric Furnace method

- Conveyors
  Elevators
  Cages
  Tipple equipment of all description

DUNCAN

Foundry & Machine Works, Inc.

COMPLIMENTS OF

Beall Brothers Supply Co.

MANUFACTURERS OF

COAL MINERS' TOOLS
and
MINERS' SUPPLIES

C. W. BEALL, Manager

FACTORY:
Alton, Illinois

BRANCH HOUSE
Marion, Illinois

Coal and Water Analysis Power Plant Engineering Since 1908

1. Coal Analysis.
2. Oil Testing.
3. Boiler Water Tests.
4. Boiler Testing and Surveys.
5. Power Plant Designing.
6. Equipment Acceptance Tests.
7. Power Plant Reconditioning.
8. Reports on Manufactured and Purchased Power Costs.

Write for the following bulletins which are available for your information and use. Copies will be mailed to you upon request.

A-1. Questions and Answers pertaining to Boilers, Stokers, Boiler Tests and Draft.
B-2. Questions and Answers for those interested in the buying and selling of coal.
C-3. Coal Ash and its Fusion.
D-4. Research on Mixing Garbage and Coal with relation to Clinker Formation.
E-5. Spontaneous Combustion of Coal.
F-6. Tests on Model Heating Plant.

COMMERCIAL TESTING & ENGINEERING COMPANY

Executive Office:
Chicago, Illinois
360 N. Michigan Ave.

Charleston, W. Va.
Toledo, Ohio

KOEHLER
Flame Safety Lamp

U. S. Bureau of Mines
Approval No. 201

The Standard Device for testing atmosphere for the presence of explosive gas

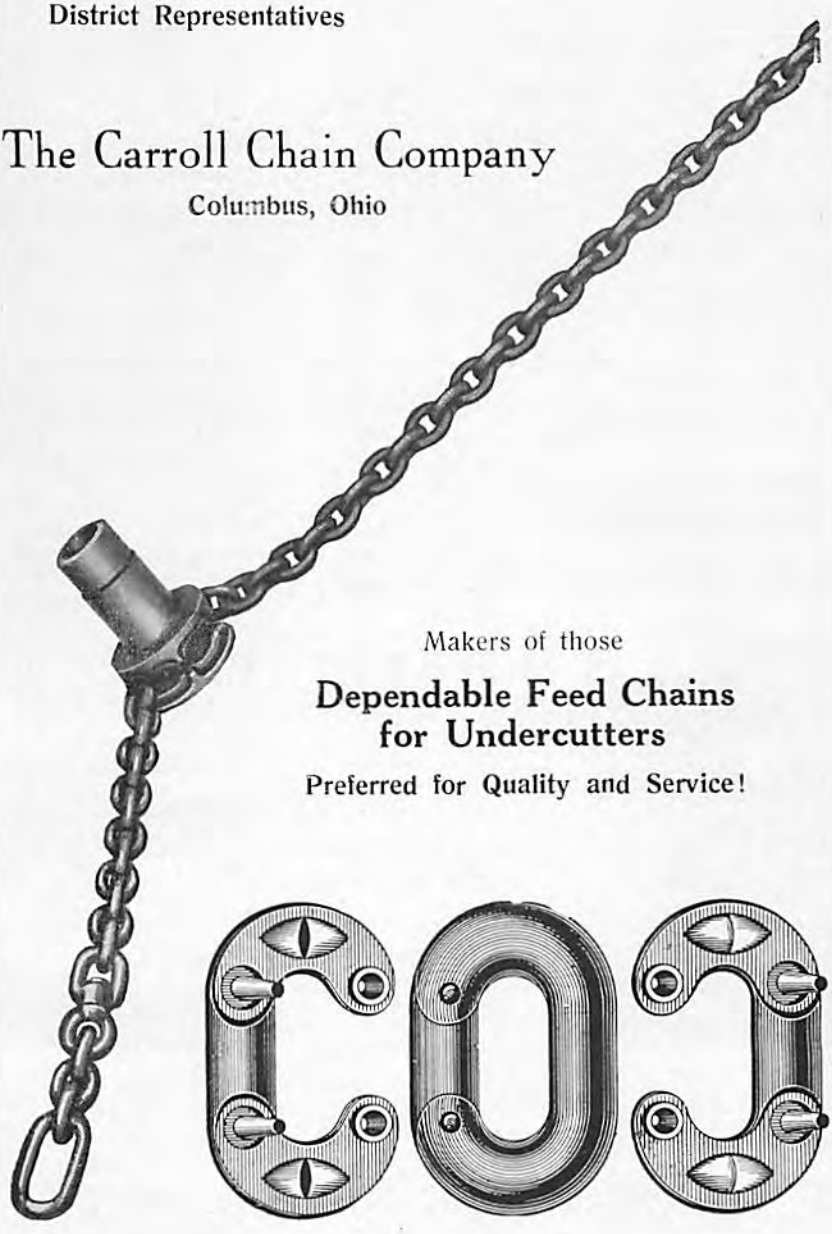
Distributed by

Portable Lamp & Equipment Co.
405 Penn Ave.
Pittsburgh, Pennsylvania

B. E. SCHONTHAL & CO., Inc.
59 East Van Buren Street
Chicago
District Representatives

The Carroll Chain Company

Columbus, Ohio



Makers of those

Dependable Feed Chains for Undercutters

Preferred for Quality and Service!

Treated Mine Timber

We have complete facilities for framing shaft timbers and timber sets before treatment at our plant at Metropolis, Illinois.

Timbers used in permanent locations in mines should be treated against decay. One authority says: "The use of treated ties in main haulage ways for maintenance and construction, means an annual saving of $500.00 to $600.00 per mile of maintained track per year."

JOYCE-WATKINS COMPANY

400 W. MADISON STREET, CHICAGO

Sixty-Five Years of Dependable Insurance Service

CRITCHELL MILLER WHITNEY & BARBOUR

1535 INSURANCE EXCHANGE

CHICAGO

PHONE WABASH 0340

Compliments of

Henry A. Petter Supply Co.

Supplies and Equipment

PADUCAH, KY.

Reduce Your Haulage Cost

By Using

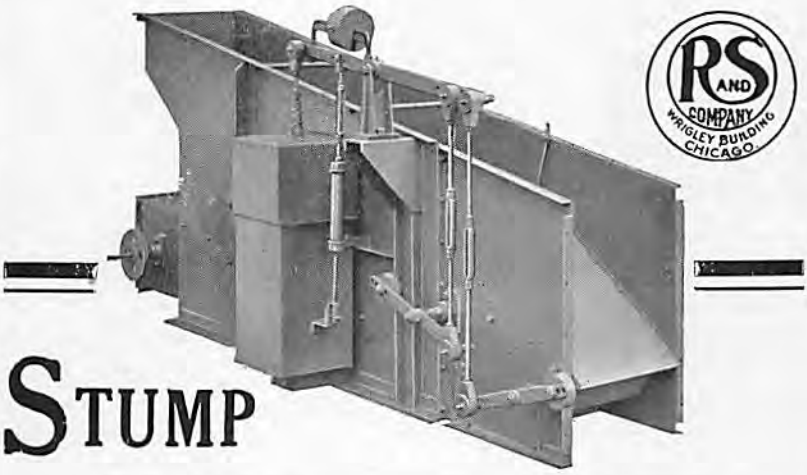
Enterprise Mine Cars

ENTERPRISE Cars are individually designed to suit the mine's conditions and thru unique features provide the largest attainable capacity for any given overall dimensions.

ENTERPRISE Cars are equipped with roller bearing wheels and sold with a guarantee that every part of the wheel—tread, flange, spokes and bearings will give satisfactory service for at least five years.

ENTERPRISE WHEEL & CAR CORPORATION

Bristol, Va. -Tenn.—Huntington, W. Va.



STUMP

AIR-FLOW COAL CLEANER

THE Barnes Coal Company, at Bakerton, Pennsylvania, have just put into operation the first complete coal-cleaning plant designed for the Stump AIR-FLOW process.

Included in the installation are Rands Ro-Sieve Screens and a Marcus screen in the tipple.

Now in daily operation, this plant has already far exceeded its specified performance. Designed for a capacity of 450 tons of uncleaned coal and 360 tons of cleaned coal per hour; it is now exceeding this planned output—and is turning out CLEAN COAL.

The actual records on this plant's operation strongly confirm the advantages claimed for AIR-FLOW, i. e.—Savings in first and maintenance costs, reduction in required ground space, air and power consumption together with greater capacity and better results.

You are invited to make tests of the Stump AIR-FLOW coal cleaner at our testing plant in Harvey, Illinois.

Or if you prefer, ask to have our representative discuss with you AIR-FLOW costs and results. In either case, write for our Bulletin No. 144, which describes the AIR-FLOW in detail.

Clean your stove, nut, pea and slack the STUMP AIR-FLOW WAY

ROBERTS AND SCHAEFER CO.
ENGINEERS AND CONTRACTORS
WRIGLEY BLDG., CHICAGO
3885 Beachwood Blvd. PITTSBURGH, PA.
514 Ninth Ave. HUNTINGTON, W. VA.

Standard Stamping & Perforating Co.

3131-37 W. 49th Place

CHICAGO

—

PERFORATED METALS

for

Coal Mines . . . Stone Quarries

Feed and Hammer Mills

. . . and many other purposes

Let us figure on your screen requirements

—

SERVICE . . . QUALITY . . . PRICE

Improved Net Profits!

That's what the Coal Mining Industry in Illinois and Every Other State is striving for in 1933.

There are many factors in a business which have a direct bearing on Net Profits. Some of these factors can be definitely controlled—others, not so easily.

One of the Definite Factors which can be controlled, and which does directly effect Net Profits, is the Accident Frequency Experience of any company. A Reduction in Accidents will positively reduce Operating Costs.

For example—take the experience of Madeira, Hill & Company in Pennsylvania. In two years time, following the introduction of M-S-A SKULLGARDS, this company reduced its Compensation and Medical Costs, due to Head Injuries, $7,500.00. Think of it!

Would M-S-A SKULLGARDS mean "Improved Net Profits" at your mines?

Mine Safety Appliances Co.

Braddock, Thomas and Meade, Pittsburgh, Pa.

"EVERYTHING for MINE and INDUSTRIAL SAFETY"

Equitable Powder Mfg. Company

East Alton, Illinois

ALTON BLASTING POWDER—For thirty-seven years the name "Alton" on a keg of blasting powder has been a guarantee of quality of the powder, and an assurance to users of excellent service. Alton B Blasting Powder is manufactured in all the standard sizes.

ALTON PELLET POWDER—This new form of packing B Blasting Powder is designed for greater convenience and safety. It is packed in wooden boxes and in paraffin paper cartridges like permissibles, and has all the conveniences of permissibles.

ALTON PERMISSIBLES—Recommended when the mining conditions do not permit the use of granular or pellet powder. We will be glad to furnish expert advice on the grade of Alton Permissibles best adapted to your coal.

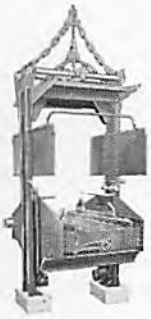
"PROTECTO" SPOOL ELECTRIC BLASTING CAPS—Greatly reduces the danger of transporting and handling electric blasting caps. This new method of packing offers an important safety feature that every user of explosives should consider. The package is designed to facilitate priming by avoiding the difficulties with tangled wires. "Protecto Spool" Electric Blasting Caps are made in two strengths—No. 6 and No. 8.

ALTON BLASTING SUPPLIES—A complete stock of all blasting supplies used with explosives is carried in our magazines. Immediate delivery can be made of Blasting Caps, Safety Fuse, Blasting Machines, etc.

Alton Explosives . . . made in Illinois

EAGLE

BUILDS



Also
Mine Cars of Wood or Steel ....Roller or Plain Bearing Trucks.....Weigh Pans..... Shaker Screens ..... Steam Hoists.....and other proven Tipple Equipment.

THE
OLSON CAGE

Eagle Iron Works
Des Moines, Iowa

COAL CLEANING

Use the Air-Sand Dry Cleaning System

Adapted to Handle All Sizes of Bituminous Coal up to 6 In. Without Water

An American Process Developed in America for American Conditions

AIR SAND

Write Us for Descriptive Literature and Results on Middle West Coal.

HYDROTATOR COMPANY

12435 Euclid Avenue **Cleveland, Ohio**

Coal Mine Supplies ..

A COMPLETE SERVICE

Manufactures

Trolley Wheels
Trolley Harps
Trolley Splicers
Locomotive Bearings
Journal Boxes
Bronze Castings
Oilless Bronze
Loader Parts
Mining Machine Bearings
Steel Castings

Distributors

American Brake Shoe and Fdy. Co.—Brake Shoes
American Manganese Steel Co.—Welding Rod
Chain Belt Co.—Conveyor Chains
Diamond Chain Mfg. Co.—Roller Chains
General Electric Co.—Locomotive Parts
General Cable Corp.—Super Service Cable
Hauck Mfg. Co.—Loco. Tire Heaters
Midvale Co.—Steel Loco. Tires
Penn. Electrical Repair Co.—Field & Armature Coils
Rockbestos Corp.—A. V. C. Cable
S. K. F. Industries—Ball Bearings

PROMPT — LOW COST — QUALITY

Evansville Electric Manufacturing Co.

600 W. Eichel Ave. **Evansville, Ind.**

C. A. CLARK, Pres.
JOHN FUHRER, Sec.-Treas.

B. K. LEACH, Vice-Pres.
C. F. GAUEN, Asst. V.-P.

EGYPTIAN TIE & TIMBER COMPANY

514 Rialto Bldg.

St Louis, Mo.

Mine Timbers, Cross Ties, Lumber and Piling

DOOLEY BROTHERS

Manufacturers of

SUPERIOR MOUNTED ELECTRIC
COAL AND ROCK DRILLS

PEORIA, ILLINOIS

Write us for our bulletin No. 5 giving prices and description of our different type drills.

MINING MACHINE BIT STEEL
MINE SUPPLIES

IN 1933, DEPEND UPON

SULLIVAN TRADE MARK

COAL MINE EQUIPMENT AND SULLIVAN SERVICE

✣ ✣ ✣

The Sullivan District Warehouse at Mt. Vernon is maintained for the convenience of Illinois mines. Prompt shipment of machines or spare parts is handled by rail, express or truck.

Insure your Sullivan equipment against mounting operating costs by replacing worn parts promptly with GENUINE SULLIVAN PARTS.

The Sullivan Line Includes:

COAL CUTTERS
Longwall
Room and Pillar
Track Machines
Shearers
Channelers

AIR COMPRESSORS
Mine Car (electric)
Portable (gasoline or electric)
Angle Compounds

HAMMER DRILLS
Tunnel Drills
Sinkers
Pick Hammers

DRILL SHARPENERS AND CUTTER BIT ROLLER SHARPENERS

HOISTS
Air and Electric for Car pulling and Scraper Loading

DIAMOND DRILL CONTRACT SERVICE

Catalogs Sent on Request

SULLIVAN MACHINERY COMPANY

General Offices: 400 No. Michigan Ave., Chicago.

DISTRICT OFFICE
Railway Exchange Bldg.
St. Louis

DISTRICT WAREHOUSE
Mt. Vernon,
Illinois

. . . WITH the turn of 1933 the total Annual Capacity of Rheolaveur Washing Plants in the United States exceeded 17,750,000 tons as against 16,000,000 tons one year ago.

KOPPERS-RHEOLAVEUR COMPANY

KOPPERS BUILDING PITTSBURGH, PA.

Sales Office
823 Peoples Gas Bldg.,
Chicago, Ill.

Sales Office and Laboratory
Coal Exchange Bldg.,
Wilkes-Barre, Penna.

Reg. U. S. Patent Office

Koppers-Rheolaveur

Obtains

Exclusive United States Coal Rights

for

BIRTLEY DEDUSTERS

and

WARING DUST COLLECTORS

Eight years experience in designing plants to handle a great variety of coals has developed these units from the conventional types by introducing new principles which are technically and commercially sound. They are successfully solving the difficult problems of handling damp coal or coal alternately damp and dry. This equipment has already proven its worth and dependability at a number of British and Continental properties.

We are now preparing a descriptive booklet giving principles, uses and performance. Would you like one of the first copies?

KOPPERS-RHEOLAVEUR COMPANY

KOPPERS BUILDING PITTSBURGH, PA.

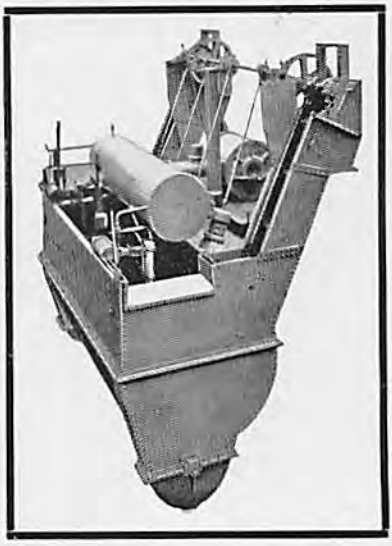
Sales Office
823 Peoples Gas Bldg.,
Chicago, Ill.

Sales Office and Laboratory
Coal Exchange Bldg.,
Wilkes-Barre, Penna.

The Rhéolaveur CURRENT WASHER COAL ORES

Reg. U. S. Patent Office

* * * * *



Coal Washing
by the
Norton *Automatic System*

The 5 * * * * * features of the Norton Automatic Washer—automatic refuse discharge, "stop-start" pilot valve control, improved air chamber design, stream line washer box and complete accessibility are attracting the attention of engineers and operators throughout the world.

The Norton washer requires less supervision, less manual labor and produces more accurate results at lower maintenance costs in money and time than any other. McNally-Pittsburg also manufactures the Norton Dust Extraction and Collection system.

Coal Preparation Specialists

McNally-Pittsburg engineers work exclusively on coal preparation problems and McNally-Pittsburg complete personnel and shops spend full time designing, building and erecting complete tipples. Use this organization for all or any of your production requirements.

THE McNally-Pittsburg MFG. CORP.

2007 ENGINEERING BLDG., 205 W. WACKER DRIVE, CHICAGO, ILLINOIS
GENERAL OFFICES AND WORKS, PITTSBURG, KANSAS

Your Inquiries are Invited

on

SOLVAY Calcium Chloride

for

Dustproofing Coal

Detailed information and cost estimates furnished on request.

Solvay Sales Corporation

222 W. Adams St., Chicago, Ill.

Insurance Brokers — Average Adjusters

OSBORN & LANGE, Inc.

Insurance Exchange

CHICAGO

15 William Street, New York — Bank of Nova Scotia Bldg., Montreal

---

Direct Facilities for placing Insurance in all home and foreign markets

---

Fire — Automobile — Tornado

Casualty — Bonds

Lake, Ocean and Inland Marine

Comprehensive Coverages

Check

these G-E Money-Saving Equipments

Here are just a few of the many devices designed by General Electric to help you reduce operating costs.

Save with dependable, trouble-free G-E motors. Thousands of installations prove the confidence that has been placed in these modern drives.

Save by modernizing with G-E control to provide maximum safety and protection. Perfectly matched motor and control combinations promote economy and efficiency.

Save by lighting those hard-to-light places with the G-E Handy floodlight. It's inexpensive and easy to install.

Save with arc welding. The G-E arc welder will save broken machinery from the scrap heap and get it back into service in record time.

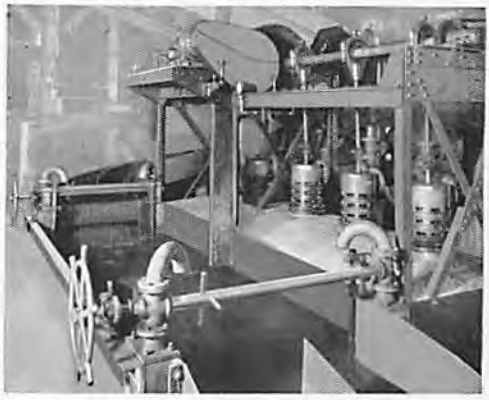
Save on cable. G-E mining cable, with its tellurium-compounded rubber jacket, is tough. It stands the gaff of the severest service.

Consider also the advantages of G-E equipment as applied to modernized ventilation, pumping, power generation and distribution, and to the many devices of mechanized mining. Let G-E engineers help plan your cost-cutting campaign. General Electric Company, Schenectady, N. Y.

200-591D

GENERAL ELECTRIC

Wet! The Link-Belt Simon-Carves System employs principles that have greatly increased the efficiency of wet washing, and the thorough separation of refuse from coal. With it, washing in one box, without presizing, is common practice. Degradation is almost entirely eliminated because the coal is water-borne throughout. It is the first and original American-Baum Washing System, employing air as the pulsating medium.



Wet and Dry Cleaning "by Link-Belt"

THERE is a need for both the wet and dry systems of cleaning coal—each serves best under certain conditions. Link-Belt employs both, and recommends each wherever it best applies.

No standardized formula or rule can be laid down for the use of one or the other, or both of these methods in combination. The selection of the correct cleaning equipment depends upon the characteristics of the coal, the requirements of the market, and the general condition peculiar to the vacinity of the installation.

There is no substitute for sound engineering judgment based upon years of actual experience. Put your coal cleaning problem up to Link-Belt—and get a practical, workable solution. What Link-Belt has learned in 35 years of service to the Coal Industry is at your command.

Dry! The Link-Belt Dry Cleaning System is highly efficient and employs new and sound principles in this form of cleaning. The dry table used is a tried-and-proved unit that has given exceptionally satisfactory service wherever installed. Primary and secondary treatment is accomplished on the same unit. This reduces the loss of coal in the refuse.

LINK-BELT COMPANY

4619-A

CHICAGO, 300 West Pershing Road

St. Louis Kansas City, Mo. Philadelphia Pittsburgh Huntington, W. Va.
Wilkes-Barre Denver Seattle Toronto

Makers of

P-G STEEL GRID RESISTANCES

For Locomotives and Mining Machines

P-G MINE DUTY SELF STARTERS

For Fan and Pump Motors

P-G AUTOMATIC TRANSFER SWITCHES

For Gathering Locomotives

Distributors of

CENTRAL FOUNDRY CO.
Universal Cast Iron Pipe and Fittings

UNIVERSAL LUBRICATING CO.
Tulc Oils and Greases

P-G CARBON BRUSHES
for All Types of Motors

The Post-Glover Electric Co.

221 W. 3rd St., Cincinnati, O.

Representative
MR. C. W. MUNRO, 8257 Langley Ave., Chicago, Illinois.

United States Rubber Products

INCORPORATED

Manufacturers

Belting - Hose - Packings

The "US" Line of Wires and Cables
"US" Royal—Mining and Locomotive Cable

UNITED STATES RUBBER PRODUCTS
INC.
440 W. Washington St. Chicago, Ill.

Revere Electric Co.

757-759 WEST JACKSON BLVD.
CHICAGO

DISTRIBUTORS OF

Electrical Supplies

Special Mining Tape
Mfg. by
Hazard Division of the Okonite Co.

MINING CABLE - MAZDA LAMPS

HERCULES EXPLOSIVES

DYNAMITE
HERCOMITE
GELATIN
GELAMITE
PERMISSIBLE POWDERS
BLASTING POWDER
PELLET POWDER
ELECTRIC BLASTING CAPS
ELECTRIC SQUIBS
ELECTRIC IGNITERS
BLASTING CAPS
SAFETY FUSE
BLASTING MACHINES

HERCULES POWDER COMPANY
INCORPORATED

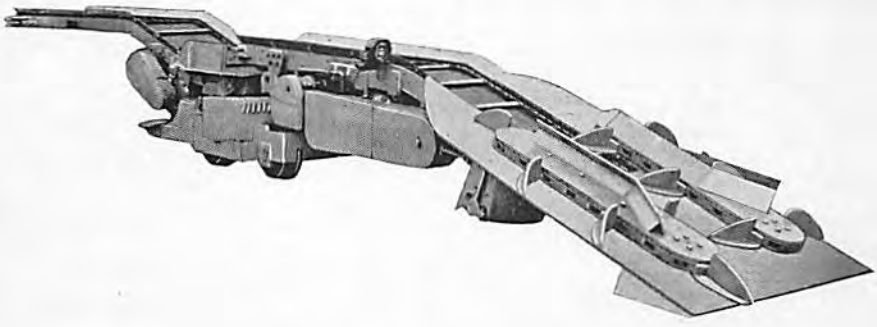
WILMINGTON, DELAWARE

McCormick Bldg.
Chicago, Ill.

Railway Exchange
Bldg., St. Louis, Mo.

Utility Loader--

RELIABLE - EFFICIENT



B. E. Schonthal & Co.

59 East Van Buren Street
CHICAGO
Sales Agents

Not just another Loader . . . BUT

1. Low Initial Cost
2. Low Maintenance
3. Spring Cushion Trough
4. Capacity 4 tons per minute
5. Cleans 30 ft. room from track
6. Easy Access
7. 28 ft. over-all length
8. 5 ft. 6 in. loading head
9. Minimum height, 34 inches

Utility Conveyor & Mine Equipment Co.

ST. LOUIS, MO.

ATLAS competence to serve the Great Mining Industry of Illinois is based on—

Knowledge of the requirements in the mines.

Manufacturing skill and experience.

Manufacturing plants located to give prompt service with fresh Explosives.

Research to discover and develop new products and methods.

Atlas maintains complete facilities for the manufacture of both Blasting Powder and High Explosives to serve Illinois Mining needs.

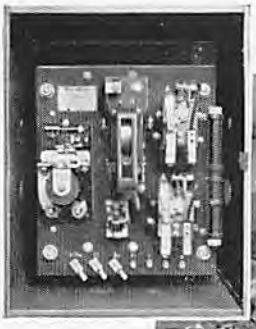
Blakstix is the most recent contribution by Atlas to the advance of coal mining. Its superiorities for the economical production of more lump coal are outstanding. A trial is convincing.

A Proper Explosive for Every Blasting Requirement

Atlas Powder Co.

JOPLIN, MISSOURI
ST. LOUIS, MISSOURI

Right—the new Westinghouse Heavy Duty Timestarter (cover removed). It is protected from rock falls by a rugged, dust-proof steel cabinet.



Below—A Goodman shaker conveyor powered by Westinghouse SK Motor and Control.

Protect BLACK TONNAGE* *with the NEW TIMESTARTER*

THE new Westinghouse heavy-duty Timestarter (underground magnetic control) brings you the following exclusive advantages that reduce mining costs:

Wear-Proof Contactor Operation—The Cold-Arc Contactor, used on the Timestarter, has withstood over 6,000,000 contactor operations under actual service load to prove that its arc box, shunt and bearings are wear-proof!

No More Idle Machines Due to Low Voltage—The Time-tactor, another feature of the Timestarter assures positive motor starting regardless of low-voltage conditions. Hence production keeps moving even though the line voltage may drop far below normal.

Greater Safety and Increased Tonnage—On the Timestarter, the TI relay automatically "sizes" overloads and treats them according to intensity—a radical improvement in overload protection.

With these improvements to assist the industry's leading underground motor . . . the Westinghouse SK . . . you are assured a greater return on mechanization investments.

*

PROFITS

OPERATING COSTS

*Black Tonnage—that portion of your production which is profit.

Westinghouse

Westinghouse Electric & Manufacturing Company, Chicago, Illinois

Sales Office
20 N. Wacker Drive Bldg.

Service Dept.
2211 W. Pershing Road

NOW--

A series of authoritative articles on the lubrication of mining equipment

These lubrication monographs describe tested and proved methods of lubricating various classes of mining equipment. They show why certain practices are expensive and often dangerous. They give facts and figures to prove why other lubrication methods are efficient and economical.

Lubrication engineers who are among the best in the country, are preparing these monographs. Each article, each statement, each recommendation is based upon authentic information and tried and proved methods.

You can get these monographs FREE, one each month, by sending your request to the Standard Oil Company (Indiana). Do it now so that you will receive all of these articles.

STANDARD OIL CO.

910 S. Michigan Avenue, Chicago, Illinois

DECATUR - EVANSVILLE - INDIANAPOLIS - PEORIA - QUINCY
JOLIET

SLIGO

IRON STORE CO.

St. Louis, Mo.

Steel Bars, Bands, Plates, Sheets, and Structural Shapes, Cold Rolled and Tool Steel, Bolts, Nuts, Rivets, Washers, Cap Screws and Small Tools

Distributors for Leading Manufacturers

NICHOLSON FILES
UNA ARC WELDERS
BUFFALO BLOWERS
STARRETT'S TOOLS
CERTAIN-TEED ROOFING
PREMIER WELDING RODS
CUSHMAN LATHE CHUCKS
LENOX HACK SAW BLADES
WILLSON SAFETY GOGGLES
NORTON GRINDING WHEELS
ARMSTRONG TOOL HOLDERS
WHEELER PROTECTIVE APPAREL
LITTLE GIANT POWER HAMMERS
REPUBLIC WROUGHT STEEL PIPE
TOLEDO PIPE THREADING TOOLS
J. H. WILLIAMS AND CO. WRENCHES
MORSE TWIST DRILLS AND REAMERS
RACINE POWER HACK SAW MACHINES
O. AMES, SHOVELS, SCOOPS AND SPADES
SIDNEY SCRAPERS AND WHEELBARROWS
REGO WELDING AND CUTTING EQUIPMENT
GREENFIELD SCREW PLATES, TAPS AND DIES
WILSON COLOR-TIPT ELECTRIC WELDING RODS
TEMPLETON, KENLY AND CO. INDUSTRIAL JACKS
YALE AND TOWNE CHAIN HOISTS AND TROLLEYS
BLACK AND DECKER ELECTRIC DRILLS AND GRINDERS

SLIGO SERVICE SLIGO

KW
SERVICE

With the KW BATTERY CO., service is more important than sales. Users must get good results from KW batteries for they have the unqualified privilege of exchanging for new batteries whenever in their opinion performance is no longer 100 per cent.

Obviously we can prosper only by making KW batteries so good that these exchanges are many months apart. The financial strength of the KW Company and the extensive use of KW service by large operators both are conclusive evidence of the excellence of KW service.

∴

KW BATTERY CO., Inc.

Chicago - New York - Pittsburgh

DU PONT
REG. U.S. PAT. OFF.

The du Pont Company manufactures 28 kinds of permissible explosives, some one of which is suited to every type of coal seam or method of mining encountered in the state. Popular brands of du Pont permissibles which have given excellent service in Illinois coal mines are Monobel No. 9 L. F. —low velocity permissible running 160, 1¼"x8" cartridges per 50 pound case; Monobel No. 11 L. F.—high velocity permissible running 185, 1¼"x8", cartridges per 50 pound case; and Duobel No. 4 L. F.—low velocity, low density permissible counting 205, 1¼"x8" cartridges per 50 pound case. These powders or others on our list will help you solve your coal mining problem.

The du Pont Company maintains a force of technical men who are experts in the use of permissibles for coal mining. Their services are free to our customers. They will be glad to call on you and give you their suggestions that might help to increase the profit in your operation.

E. I. du Pont de Nemours & Company, Inc.

332 South Michigan Avenue
CHICAGO, ILL.

Joplin National Bank Bldg., Joplin, Mo.

1176 Arcade Bldg. St. Louis, Mo.

TIREX CABLES

Assure an Unfailing Supply of Power for All Types of Portable Electric Equipment

Simplex Wire & Cable Co.

Manufacturers
79 SIDNEY ST., CAMBRIDGE, MASS.

Branch Sales Offices
CHICAGO, 564 W. Monroe St. SAN FRANCISCO, 390 Fourth St.
NEW YORK, 1328 Broadway CLEVELAND, 2019 Union Trust Bldg.
PHILADELPHIA, 1227 Fidelity Philadelphia Trust Bldg.

F. D. Farnam & Company

209 North Desplaines Street

CHICAGO, ILLINOIS

Phones Haymarket 2170-2171

ASBESTOS: Crude and in all finished forms.
PACKINGS: Steam, hydraulic, etc.
MICA: Cut, uncut and ground.
GASKETS: Folded and cut to any shape.
REFRACTORY CEMENTS
MECHANICAL LEATHERS
VERMICULITE and SILLIMANITE

If Any of Your Requirements Come Under Any of These Headings We Have Them
Prices and Samples Upon Request

MODERN

excavating machinery for any job

The unequalled experience gained by Bucyrus-Erie over 11,000 excavators tested and proved by service in over 50 countries throughout the world—has resulted in a perfection of design and workmanship that means trouble-free operation, maximum production, and lowest possible unit costs.

Today this company offers the most complete line of all sizes and types of excavating machines from which you may select exactly the right machine for your work.

Small Revolving Shovels, Draglines, Cranes, Clamshells, Dragshovels, Etc. Readily Convertible.

A—½-yard steam
16-B—½-yard gasoline, Diesel, electric
1020—½-yard gasoline, Diesel or electric
21-B—¾-yard gasoline, Diesel or electric
B-3—⅞-yard steam
GA-3—1¼-yard Gas-Air
32-B—1-yard gasoline, Diesel or electric
37-B—1½-yard gasoline, Diesel or electric
42-B—1½-yard electric or steam
43-B—1¾-yard gasoline, Diesel or electric
45-B—1 to 2½-yard Diesel dragline clamshell

Mine and Quarry Loaders and Strippers

50-B—2-yard electric or steam
52-B—2¼-yard Diesel or electric
75-B—2½-yard electric shovel
100-B—3-yard electric shovel
120-B—4-yard electric shovel
170-B—5-yard electric shovel
200-B—6-yard electric shovel
375-B—8-yard electric shovel
750-B—12 to 18-yard electric shovel

Large Draglines

Class 80—2½-yard steam or electric
Class 111—3½-yard Diesel
Class 200—5-yard steam, electric or Diesel-electric
Class 375—8-yard steam or electric

Bucyrus-Monighan walking draglines, 1 to 10-yard sizes; Dipper, Hydraulic, Elevator and Placer Dredges; Loadmaster, the handy gasoline crane; Railway Cranes; Tunnel shovels; Tower Excavators; Unloading Plows; Spreader Plow; Red Arch Dragline Buckets.

BUCYRUS-ERIE COMPANY
South Milwaukee, Wis.

BUCYRUS ERIE

18-yard 750-B stripper with counterbalanced hoist

CP

MINE EQUIPMENT

"LITTLE GIANT" COAL DRILLS, mounted, unmounted (Electric, Pneumatic)

"LITTLE GIANT" PERMISSIBLE ELECTRIC COAL DRILLS, mounted, unmounted

MINE CAR COMPRESSORS, Electric Motor Driven

SINKER DRILLS

AUGER DRILLS

ELECTRIC AND PNEUMATIC DRILLS for Car Repair and Maintenance Work

Little Giant 700 Type Mounted Coal Drill

The Little Giant "One Man" Mounted Coal Drill

The famous "472" Little Giant Electric Coal Drill can now be furnished with the improved post mechanism shown in the illustration. Operator places drill on turntable and lifts to desired drilling height while a ratchet automatically engages the notches in the post as the drill is raised. When the operator stops lifting, the ratchet and notch hold the drill in place while a hand set-screw is tightened. One man does it all—EASILY!

Chicago Pneumatic Tool Co.

6 East 44th Street NEW YORK, N. Y.
3655 Iron Street CHICAGO

RYERSON Steel and Tools

for the Coal Mining Industry

When the mines need steel for maintenance or new construction, quick service is essential. Whether it is a large quantity or only a bar, a sheet or a few bolts, your order to Ryerson is shipped immediately. No waiting—no delay. Ryerson service also includes portable electric tools, jacks, hack saws, pipe threaders and other metal working tools.

Beams and Heavy Structurals

An unusually large stock of the heavier structural sections including special wide flange structural shapes.

Cold Finished Steel Bars

Flats, rounds, squares and hexagons in various analyses. Triple inspected for accuracy, straightness and finish.

Channels, Angles, Tees and Zees

A complete range of both structural and bar sizes in all standard sections; also galvanized angles, ship and car channels, etc.

Boiler Tubes and Fittings

Boiler tubes, ferrules, flanges, hangers, lugs, crabs, hand holes, braces, nozzles, patch bolts and other allied products are in stock.

Rails, Splices, Spikes, Bolts, Etc.

Standard new rails with all accessories—splices, spikes, track bolts, etc.—are in stock for immediate shipment.

Welding Rod and Equipment

Special rods adapted to welding the various materials and also equipment for both acetylene and electric arc welding.

Plates

Steel plates U.M. and sheared, high carbon plates, Firebox steel, copper bearing, Armco Ingot Iron and diamond floor plates stocked.

Tool Steels

Special grades of tool steel for every shop requirement are carried in stock. Also tool steel sheets, tool holder bits, etc.

Allegheny Metal

—The unstaining, unrusting, untarnishing nickel chrome alloy that is being adopted for many purposes in all lines of industry. Large and complete stocks.

Chain, Grab Hooks, Etc.

Standard grades and sizes of chain; special chain for cranes and steam shovels, grab hooks and similar products can be shipped at once.

Heat Treated Alloy Steel Bars

Various grades of alloy steel bars heat treated and ready for use, in a wide range of sizes, including Nikrome, Ryco, etc.

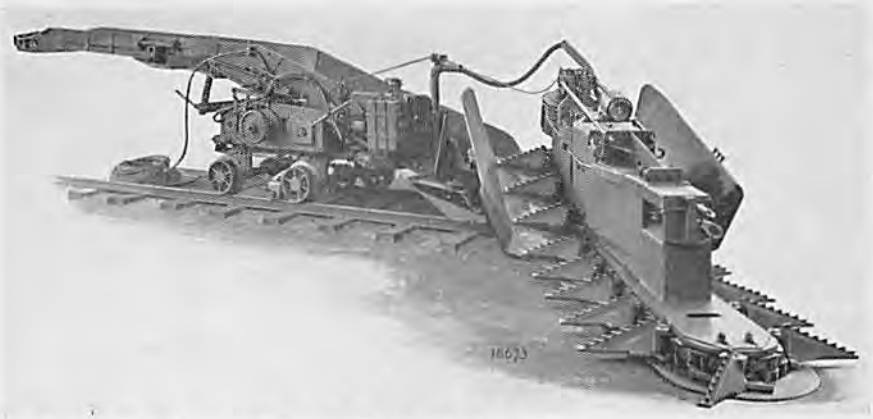
Machinery and Tools

Ryerson Machinery Division can meet all your requirements for machine tools, metal working equipment and small tools. Write for descriptive literature.

JOSEPH T. RYERSON & SON, INC., Chicago, Milwaukee, St. Louis, Cincinnati, Detroit, Cleveland, Buffalo, Boston, Philadelphia, Jersey City

RYERSON

STEEL-SERVICE



JEFFREY 44-D

HIGH CAPACITY AND MORE LUMP COAL

The New Jeffrey 44-D Machine is a high capacity—two tons per minute—Track Type Coal Loader. It is not necessary to tear up track laid for the cutting machine and then relay it after the room is loaded out.

Features of the Jeffrey 44-D are:

Loading in coal with minimum height 46" above rail.

Minimum breakage.

Swinging Discharge Boom—Can be swung 45° each side of center line. Permits loading on a curve in room necks or cross cuts with boom always over car. It is also hinged and supported on springs to allow vertical movement, which prevents jamming of large lumps against roof.

Easily maneuvered—in both loading and tramming. Especially applicable where roof is bad and timbering close.

Easy accessibility of all parts.

Centralized Control—convenient for operator.

Two 15 H. P. Motors—with interchangeable parts.

Maintenance and power costs are low—due to simplicity and extreme flexibility.

COMPLETE DETAILS ON REQUEST. WRITE TODAY.

The Jeffrey Manufacturing Company

953-99 North Fourth St., Columbus, Ohio

BRANCH OFFICES:

Chicago	Pittsburgh	Birmingham
New York	Scranton, Pa.	Denver
Philadelphia	Huntington, W. Va.	Salt Lake City

JEFFREY MANUFACTURING COMPANY, LTD., OF CANADA

Head Office and Works, Montreal; Branch Office, Toronto

JEFFREY

Coal Mine Equipment

HAZARD LAY-SET

for MINING SERVICE

THERE'S A HAZARD ROPE FOR EVERY MINING SERVICE

- Stripping Shovels
- Drag Lines
- Aerial Tramways
- Haulage Ropes
- Boom Hoists
- Shaft Ropes
- Mining Machines
- Slope Ropes
- Special Ropes

Mining profits come largely from uninterrupted operation. Hazard Lay-Set Preformed wire rope is the rope for mining service because it wears longer and gives much more tonnage per rope depending upon the nature of service and character of equipment on which the rope is used. Lay-Set can do this because its every wire and strand is set, or preformed to the exact lay it assumes in the finished rope. Being so, Lay-Set's wires and strands are free to do their work without internal stress or friction.

Preforming gives Lay-Set rope other advantages than long life. Lay-Set Preformed rope is easy to handle—spools perfectly—reduces wear on sheaves—runs straight—is not cranky or kinky—is safer to use—saves time, labor and expense.

Specify Lay-Set for your next rope.

HAZARD WIRE ROPE COMPANY
WILKES-BARRE PENNSYLVANIA

San Francisco Fort Worth Pittsburgh Chicago Tacoma
Birmingham New York Denver Los Angeles Philadelphia

H. CHANNON COMPANY

FOUNDED 1875

North Wacker Drive and Randolph St.

Chicago, Illinois

MINE

MILL

RAILROAD

and

INDUSTRIAL SUPPLIES

WHOLESALE ONLY

INDEX TO ADVERTISERS

ANNUAL BOAT TRIP

and

SUMMER MEETING

ILLINOIS MINING INSTITUTE

JUNE 9-10-11, 1933

S. S. CAPE GIRARDEAU

Leave St. Louis 11 p. m. June 9
Arrive St. Louis 10 a. m. June 11

A SPLENDID PROGRAM IS BEING ARRANGED
MAKE YOUR RESERVATIONS EARLY

B. E. SCHONTHAL, Secretary
59 EAST VAN BUREN STREET
CHICAGO