PROCEEDINGS OF THE ILLINOIS MINING INSTITUTE

FOUNDED FEBRUARY 1892



1933

Sent to: Jack A. Simon December 10, 1964

R.W. Lowe. Sachester, Illinois

PROCEEDINGS of the ILLINOIS MINING INSTITUTE

Founded February, 1892



1933

Summer Meeting on Board S. S. Cape Girardeau June 9-10-11

and

Annual Meeting SPRINGFIELD, ILLINOIS November 3



CHARLES F. HAMILTON
President, 1933

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 W. Stedelin

H. H. Taylor, Jr.

John G. Millhouse

Fred S. Pfahler

David I. Rock

C. J. Sandoe

H. H. Taylor, Jr.

T. J. Thomas

OFFICERS 1934

President
H. A. TREADWELL
Benton, Ill.

Vice-President
C. J. SANDOE
St. Louis, Mo.

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

EXECUTIVE BOARD

W. J. Austin
P. W. Beda
Fred S. Pfahler
Paul Halbersleben
Charles F. Hamilton
Dr. M. M. Leighton
Geo. C. McFadden
John G. Millhouse
Fred S. Pfahler
E. F. Stevens
H. H. Taylor, Jr.
T. J. Thomas

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 Institute inactive
- 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 Peahler, 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.
- 1932-33 Chas. F. Hamilton, Vice-Pres., Pyramid Coal Co., Chicago, Ill.

CONTENTS

	Page
SUMMER MEETING AND BOAT TRIP	
President Charles Hamilton, presiding	. 9
Effective Accident Prevention, by John Lyons	. 13
Today's Trend in the Utilization of Coal, by John Lucas	20
Compatitive Fuels by R R Cabbart	96
Coal Cleaning as Applied to Preparation by Willard C. Adams	33
Cleaning Coal by the Air Flow R. G. Lawry	38
Coal Cleaning Methods in Illinois J. W. Wilson	40
Coal Cleaning as Applied to Preparation, by Willard C. Adams. Cleaning Coal by the Air Flow, R. G. Lawry. Coal Cleaning Methods in Illinois, J. W. Wilson. The Dedusting of Coal, by E. M. Myers.	. 42
KINK BOX	
The Use of Dynamic Braking for Emergency Stopping of Hoist After	
Failure by Friction Brake, by David W. Jones	- 47
Adjustable Clevis for Quick Takeup on New Ropes, by John Stamper	. 48
Safety in Sharpening and Delivering of Drill Bits, by Lee Haskins	. 48
Reinforcing Electric Drill Posts, by Fred Burnett Stellite Machine Bits, by Thomas Garwood	49
Stellite Machine Bits, by Thomas Garwood	. 49
Sand Drying, by Charles Boyett	. 50
Track Signals Prevent Delays, by W. C. Craggs	. 50
Safety Signals to Prevent Collisions, by Thomas Garwood	. 51
Haulage Safety, by A. L. Reed	. 51
Hoisting Engine Repairs, by Henry J. Kinsman	. 52
Sand Drying, by Charles Boyett Track Signals Prevent Delays, by W. C. Craggs. Safety Signals to Prevent Collisions, by Thomas Garwood Haulage Safety, by A. L. Reed Hoisting Engine Repairs, by Henry J. Kinsman. Repairing Blower Tubing, by Thomas Garwood.	. 52
Question Box, Effective Blasting Means Increased Profits and Safety, by	. 53
Effective Blasting Means Increased Profits and Safety, by	
by C. J. Sandoe	54
Gathering in Relation to Mine Haulage, by David W. Jones Lubrication Cost for Loading Machines, by G. S. Jenkins	. 56
Lubrication Cost for Loading Machines, by G. S. Jenkins	60
Mine Fan Economy, by J. E. Jones	65
Mine Fan Economy, by J. E. Jones	69
by Henry F. Hebley	- 11
ANNUAL MEETING	
Morning Session.	87
Welcome to City, by Hon, John W. Kopp, Jr., Mayor of	
Springfield, Illinois Response of President Hamilton to Mayor Kopp	87
Response of President Hamilton to Mayor Kopp.	88
Report of Secretary	89
Report of the Executive Committee	89
Report of Auditing Committee	90
Report of the Membership Committee	90
Report of the Naminating Committee	93
The Physical Constitution of Illinois Coal and its Significance in Regard to Utilization, by Gilbert H. Cady.	12.5
Regard to Utilization, by Gilbert H. Cady	95
The Coal Code, by Paul Weir	112
The Production of Coal for the Market by the Dedusting	
Process, by Thomas Garwood The Relationship of the Industrial Surgeon and the Employer of Men, by J. B. Moore, M. D.	199
Some Personal Observations in Russia by Ralph Rudd	131
Some Personal Observations in Russia, by Ralph Budd. The Illinois Coal Industry, by John E. Jones	142
CONSTITUTION AND BY-LAWS	
LIST OF MEMBERS	157
IN MEMORIAM	167
ADVERTISING SECTION	168

SUMMER MEETING AND BOAT TRIP

June 10, 1933

Annual Summer Meeting and Boat Trip of the Illinois Mining Institute held on S. S. Cape Girardeau, leaving St. Louis Friday, June 9, 1933, at 10:30 P. M., and returning to St. Louis Sunday, June 11, 1933, at 8:30 A. M.

MORNING SESSION

Meeting called to order at 9:45 A. M., Saturday, June 10th, by President Chas. Hamilton.

Chas. Hamilton: It is indeed a great privilege to greet the members of the Illinois Mining Institute and guests on this their 15th boat trip. And it is also gratifying to see 93 in our party after a year that is probably unprecedented in many ways; for it might have been expected that a smaller number would have sought out such a trip as this.

It may not be untimely to say a few words on the question of what is being considered in Federal Legislation in regard to our industry. Soon after the inauguration of President Roosevelt it became evident that some legislation was to be passed regarding coal, Of course, the Illinois operators were much interested and it was decided to hold a joint meeting with Indiana. After two meetings there were five or six fundamental points on which the coal men of the two states could agree. Then some ten or twelve operators from Illinois and four from Indiana had a conference with Secretaries Ickes and Perkins at Washington.

As you all know the political control of the coal industry has always been in Southern corporations, and they had Washington convinced that Illinois and Indiana companies had no facilities for preparing coal and should not be considered in the coal picture.

We had a conference on Thursday and we stayed until Monday. This was an informal meeting at which Secretary of Interior Ickes and Secretary of Labor Perkins were present and the Industrial Control Bill was discussed. After the Illinois-Indiana draft of the bill was presented, it was gratifying to have Washington say that in the bill there were the most rational points that had been suggested to that time.

Later it was determined that Mr. Buchanan should send out a call for a nation-wide meeting of coal operators in Washington on June 4th. These telegrams were sent to about fifty-six people and the response was very gratifying. When the Eastern and Southern interests were advised of the points in the bill they got busy and tried to block the labor feature. The meeting took place on June 4th and there were about 90 coal men there. It was very adroitly handled by Mr. Buchanan and others from Illinois and Indiana. General Johnson, who is a graduate of West Point, remarked that he was in a very embarrassing position, as he was going to talk on something that did not But that he wanted the coal industry to provide a code of ethics for the other industries to follow. His first points were the question of hours per day, and days per week, and mine wages; also selling prices f. o. b. cars the mine, and the licensing of operators. When the bill was considered by the Senate Committee, these points were incorporated in the bill.

The proposed set-up for this code would be General Johnson and four departments, Accounting, Legal, Industrial and Labor, with a man at the head of each department, and in the coal industry on one side will be an operator and on the other some

one connected with mine labor. And of course the heads of all departments will send their reports in to General Johnson.

A committee of 19 was appointed to write the code for the mining industry. It is quite probable that there will be a majority report and a minority report. It is also likely that they will not agree with the conasom out and to a place of the conasom out and to a place of the conaction of the coal industry.

We will now have the roll call by our Secretary.

ATTENDANCE

ILLINOIS MINING INSTITUTE FIFTEENTH ANNUAL BOAT TRIP

St. Louis to Hannibal, Mo., and return-June 9-10-11, 1933

ADAMS, J. A	O'Gara Coal Co., Harrisburg, Ill.
ADAMS, W. C	Koppers Rheolaveur Co., Pittsburgh, Pa.
ANDERSON, J. C.	United Electric Coal Co., Danville, Ill.
ARGUST, W. C	Peabody Coal Co., Taylorville, Ill.
ARMSTRONG, E. R	Equitable Powder Mfg. Co., Collinsville, Ill.
AUSTIN, W. J	
BARTLETT, A. G	Burton Explosives, Inc., West Frankfort, Ill.
BEALL, C. W.	Beall Bros., Alton, Ill.
BENNER, DALE D	Alcoa Ore Co., Belleville, Ill.
BIGGER, I. S.	Vacuum Oil Co., Benton, Ill.
BLAKE, ARTHUR	Peabody Coal Co., Marion, Ill.
BLANKINSHIP, G. F	Egyptian Iron Works, Murphysboro, Ill.
BREWSTER, BURT B	Consulting Engineer, Webster Groves, Mo.
CADY, GILBERT	State Geological Survey, Urbana, Ill.
CARGAL, GORDON	Jeffrey Mfg. Co., Herrin, Ill.
CHRISTIANSON, C	Sullivan Machinery Co., Mt. Vernon, Ill.
CLARK, FRED KHu	lburt Oil & Grease Co., Webster Groves, Mo.
CLARKSON, JOHN	
DAWSON, HUGH	Bethlehem Steel Co, Herrin, Ill.
DRINKWATER, JAS. D. S	Link-Belt Co., Chicago, Ill.
DUNN, JAMES	Old Ben Coal Corp., West Frankfort, Ill.
ENGLISH, THOMAS	State Mine Inspector, Springfield, Ill.
FISHER, STEVE M.	Superior Coal Co., Gillespie, Ill.
FLEMING, JACK	Mine Safety Appliance Co., Urbana, Ill.
	ilmington & Franklin, West Frankfort, Ill.
GARCIA, JOHN A	Allen & Garcia Co., Chicago, Ill.
GIVEN, IVAN A.,	"Coal Age" New York, N. Y.
GREENE, D. W.	West Virginia Coal Co., O'Fallon, Ill.
HAMPTON, I. H	Beall Brothers, Alton, Ill.
HALL, L. W	
HALLER, EMIL	
HAMILTON, CHAS. F	Binkley Coal Co., Chicago, Ill.
HARDY, WM	Peabody, Coal Co., Taylorville, Ill.

HARTWELL LEN	Described to the pure of
HARVEY HADLEY	Pyramid Coal Co., Pinckneyville, Ill.
HASKING LEE	Ohio Brass Co., Evansville, Ind. Bell & Zoller Coal & Mining Co., Zeigler, Ill.
HEISON IIM	Bell & Zoller Coal & Mining Co., Zeigler, Ill.
HUNTED THOMAS	Helson Timber Co., Metropolis, Ill.
IEEEEDIC I A	Sec'y. U. M. W. of A., Springfield, Ill.
IOHNSON EDWIN II	Illinois Terminal R. R. System, St. Louis, Mo.
IONES APOH M	Safety Mining Co., Chicago, Ill.
JONES JOHN F	John A. Roebling's Sons Co., St. Louis, Mo.
TENKING C T	Old Ben Coal Corp., West Frankfort, Ill.
KLEIN CEOPCE	Goodman Mfg, Co., St. Louis, Mo.
KNOIZEN A C	Klein Armature Works, Centralia, Ill.
LAWDY D. C.	Joy Mfg. Co., Franklin, Penn.
LAWRI, R. G	Roberts & Schaefer Co., Chicago, Ill.
LUCAS JOHN	Jeffrey Mfg. Co., Terre Haute, Ind.
LUCAS, JUHN	Old Ben Coal Corp., Chicago, Ill.
MADDY H. B.	Bell & Zoller Coal & Mining Co., Zeigler, Ill.
MAISPERCER A II	Equitable Powder Mfg. Co., East Alton, Ill.
MARSHERGER, A. H	DuPont Powder Co., Springfield, Ill.
MARSH, IAN D	Alcoa Ore Co., Belleville, Ill.
MARSHALL, HARRY	State Mine Inspector, Springfield, Ill.
MEVED DOLLING	Safety Mining Co., Benton III.
MEYER, BRUNO	
MEYER, CARL	
MILLER, JAMES B	
MILLHOUSE, JOHN G	Director Mines & Minerals, Springfield, Ill.
McFADDEN, NAT	Peabody Coal Co., Taylorville, Ill.
MORRIS, NELSON	O'Gara Coal Co., Harrisburg, Ill.
NELSON, I. C.	Beall Brothers, Alton, Ill.
NOYES, J. A.	Sullivan Machinery Co., Chicago, Ill.
OHLE, J. L.	Hotel Franklin, Benton, Ill.
PFAHLER, F. S	Superior Coal Co., Chicago, Ill.
PFAHLER, SAM	Superior Coal Co., Gillespie, Ill.
PICKARD, A. E.	Mt. Vernon Car Mfg. Co., Mt. Vernon, Ill.
POWERS, F. A	Dooley Brothers, Peoria, Ill.
RHINE, FRANK	Duncan Fdry. & Mchy. Co., Alton, Ill.
ROSAN, H	T. E. Joiner & Co., Chicago, Ill.
	General Electric Co., Carterville, Ill.
SANDOE, C. J	West Virginia Coal Co., St. Louis, Mo.
SCHONTHAL, B. E.	West Virginia Rail Co., Chicago, Ill.
SCHULL, B. H	Binkley Mining Co., Clinton, Ind.
SCHULL, F. M.	Binkley Mining Co., Clinton, Ind.
SMITH, C. M	University of Illinois, Urbana, Ill.
SCHMIDT, W. E.	Superior Coal Co., Gillespie, Ill.
	Peabody Coal Co., Taylorville, Ill.
STEIGER, A. E	Pyramid Coal Co., Pinckneyville, Ill.
	Vacuum Oil Co., University City, Mo.
	Sullivan Machinery Co., St. Louis, Mo.
SYERS, JACOB	Western Powder Mfg. Co., Peoria, Ill.
TAYLOR, H. H. Jr	Franklin County Coal Co., Chicago, Ill.

TOBIN, HOWARDCoal Stripping Co., Pinckneyville, Ill.
THIES, HENRY Portable Lamp & Equipt. Co., Pittsburgh, Pa.
THOMAS, JEFFERSONWestern Powder Mfg. Co., Peoria, III.
TIRRE, F. F. Business Bureau, St. Louis, Mo.
TREADWELL, H. A
VLASAK, JOSEPHSt. Louis & O'Fallon Coal Co., East St. Louis, Ill
WATERMAN, C. W. McNally-Pittsburg Mfg. Corp., Chicago, Ill.
WILKEY, FRED S. Sec., Ill. Coal Oper. Ass'n., Chicago, Ill.
WILSON, J. C. Ohio Brass Co., Mansfield, Ohio
YOUNG, W. P

Chas. Hamilton: There have been removed from our roll during the past year, Joseph Viano who passed away at Coal City, December 12, 1932, and John Rollo, who passed away February 6, 1933. Let us all stand for one minute as a tribute to their memory.

It has been the thought that we would try to get our business out of the way at this morning session. We have two announcements which I will ask the Secretary to read.

(Secretary Schonthal read invitations from Springfield and Mt. Vernon that the fall meeting of the Illinois Mining Institute be held in their cities).

Thos. Hunter: I make the motion that the next meeting be held in Springfield, Illinois.

Fred Pfahler: I suggest that Mr. Hunter withdraw his motion, and I make the motion that the Executive Board decide where the Fall meeting be held.

John Garcia: I suggest that the members be allowed to voice their opinions.

Thos. Hunter: I would like for the meeting to come to Springfield and if the Executive Board decides to do so, I am sure we will all be glad to have all the members in Springfield.

Pickard: We would like to have you come down to Mt. Vernon, if you can see your way clear to do so. Millhouse: I believe it has always been the policy of the Illinois Mining Institute to distribute the meetings as much as possible. It was only two years ago that we had the meeting in Springfield, and I feel we should visit around quite a bit. I have been led to believe that if we went to Southern Illinois, a very successful meeting could be held there. I have thought that Benton would be an ideal place to hold the meeting. I believe it would be an honor and a compliment to the next incoming President to hold the meeting there.

Harry Treadwell: I know that the fellows from down at our end of the State would appreciate it if the meeting was held there. Also the men down there would sacrifice that privilege for the benefit of the Iistitute. However, I think the naming of the location should be given careful consideration by the Executive Committee.

(Mr. Pfahler's motion as to the Executive Board deciding the Fall Meeting place was seconded and carried unanimously).

Chas. Hamilton: It is now my privilege to turn the meeting over to W. C. Argust.

W. C. Argust: The first thing on the program is a paper on accident prevention by Mr. Lyons, Safety Engineer for The Bell & Zoller Coal & Mining Company. We will now be glad to have Mr. Lyons present his paper.

EFFECTIVE ACCIDENT PREVENTION

By JOHN LYONS

Safety Engineer, Bell & Zoller Coal & Mining Company

Zeigler, Illinois

As most of you know, our company operates two large mines at Zeigler; one at Centralia, and two at Peoria. While I have visited all of our properties, my work is largely confined to our Zeigler mines, and it is the experience of these two mines that I refer to mostly in this paper. However, our safety and accident prevention work has been standardized by our Vice President, Mr. Paul Weir, and applies to all of our mines in general.

For many years, these mines, like many others were interested in big tonnage and if accidents did occur they were just a part of the daily routine and apparantly could not be prevented. Too often in the occurrence of these accidents, it was passed up as a mistake on the part of the injured man and very little was thought about what the boss or company could have done to prevent the accident or to prevent a repetition of a similar accident. It was believed that to put "Safety" first would cut down production. This attitude was reflected from the higher officials on down to the foreman.

Records of production and cost of coal were kept, but no records of accidents were kept with the exception of those required for State and compensation purposes. Under this atmosphere, serious and fatal accidents were very frequent especially at our No. 1 mine. From 1920 to 1930 inclusive, this mine did not operate a single year without a fatality. As a matter of fact the average number of fatalities per year for that period was 3.27. The tonnage per fatality

was 310,355 and in our worst year of 1929, we produced only 181,046 tons per fatality. During this year this mine was partially mechanized, and the mechanical loading was generally given the credit for the many accidents of that year. As a matter of fact 50 per cent of these accidents occurred in hand loading sections.

Our Zeigler No. 2 mine during the same eleven year period, produced 1,329,943 tons per fatality, and between August 7, 1928 and September 27, 1931, hoisted 3,756,525 tons without a fatality. In recognition of this the mine was awarded the Joseph A. Holmes Safety Association Certificate.

It is singular that two mines, operated by the same company in the same seam and locality should have such a wide difference in their accident records. However, although No. 2 came through so well without fatalities, lost-time accidents were frequent and plans were made to reduce the number of accidents.

Mr. Alex Miller, Associate Mining Engineer of the U.S. Bureau of Mines, visited our properties during the latter part of 1929 at the invitation of our Vice-President, Mr. Weir, and spent several weeks with us, going through the mines, coming in contact with the management and the miners. It was his opinion that the management did not have the right attitude towards Safety and that the management must be sold on Safety before we could sell it to the men. Mr. Weir became thoroughly sold on Safety First principles and he conducted frequent

meetings with our foremen and made it plain that the first consideration must be Safety and that they would be held responsible for accidents to men under their charge, and would be discharged if accidents occurred through their neglect. He also laid down plans for an accident prevention campaign. These talks were followed up by many personal letters to all foremen and other officials on the subject.

In January, 1929, a complete record was started which would show the cause of each accident, part of body injured, the occupation of the injured, number of days lost on account of the accident, and under what boss he was working at the time of the accident. Detailed reports were made on each serious accident. From these reports we have been able to determine unsafe practices and conditions which were responsible for accidents and knowing these we have, where possible, endeavored to remove the causes. have also adopted a standard system used by the U.S. Bureau of Mines and the National Safety Council whereby the "Frequency Rate" on lost time accidents can be computed; that is, it will show just how many lost time accidents occur during every million man-hours worked. Also the "Severity Rate" which shows just how many days are lost due to accidents for every 1,000 man-hours worked. In this system standard charges are used to designate the severity of an accident. For example-6,000 days are charged against the mine at which a fatal or total disability accident occurs, and other standard number of days for less severe accidents.

In this system, it is possible to compare our own mines with others throughout the States using this system, and it readily shows whether we

are making progress or falling back.

Records are also kept on each foreman which show the number of manshifts worked, number of accidents, number of days lost due to accidents on his section each month, and his rating. In connection with these ratings, we gave monthly prizes to those having the best safety record. Later this was made into a yearly prize. We also placed our mines on a competitive basis with each other, money prizes going to each boss working at the mine having the highest rating. This year, we have reduced the foremen's prizes some and plan to give to each employee who goes through the year of 1933 without losing one day on account of injury, a souvenir pocket knife. We have an annual Safety Banquet at which the foremen's prizes are awarded by our higher officials. Safety talks are given and plans given out for the next year's campaign. A set of rules made up by a committee of bosses, govern the prizes mentioned.

In selling Safety to our men we used the 100 per cent First Aid training classes as a basis under the supervision of Federal and State teachers. We explained to the men the company's attitude on Safety and discussed accident prevention. Talks on this were also made by our State Inspectors. In these classes we had excellent response from the men.

Having laid the basis for the campaign, the next thing was to keep it going and keep everybody Safety minded. Among the helps to this end we used a system of Safety education through our Safety Bulletin Board, using posters which were specially drawn for us, showing safe practices and describing in pictures safety rules, and showing how injuries had occurred at our own mines. We also use a lot of the National Safety Council Posters throughout

the mine, pasting them on concrete walls or piers where strong lights show them up. We also paste them in the wash houses and on pit cars, changing them frequently, thus at almost every turn men are reminded of Safety.

We conducted mining classes for two years covering the mine examiner and mine manager courses. For two years during the month of December, we have conducted campaigns for a "No Accident Month" each of which, although not a perfect month, showed decided improvement over months of the year and had a lasting effect on months that followed. During these campaigns we erected an electric Safety Calendar which had a light socket for every day in the month. At the end of the day, if we had a lost-time accident, we put in a Red light. For no accidents, we placed a blue light. This created so much interest that we have used it ever since. It is just another idea of keeping the Safety thought before everybody.

We publish monthly, a small magazine called the "Safetygram" in which we print under the head of, "How it Happened" a description of the lost-time accidents that occurred at our mines during the month, also the bosses' monthly safety rating. A copy of this book is given to all of our men.

During the last year we have introduced the Safety Toe Shoes which we sell at cost, also Safety Hats which we sell at half-price to the men, the difference being absorbed by our company. To the men in our shops we supply goggles free. At our No. 2 mine, 20 per cent of the men are wearing the hats, and about 35 per cent the Safety Toe Shoes. It should be understood that the wearing of the hats and shoes are perfectly vol-

untary on the men's part.

We operate our own Rescue Station, being equipped with six sets of "Gibbs" two hour breathing apparatus. Teams are trained regularly in the use of these apparatus and rescue procedure.

We rock dust throughout the mine entries and use rock dust barriers for the isolation of each pair of panel entries. All our returns are checked for methane content by the use of a U. C. C. methane indicator. Measurement of the quantities of air passing from each return is made at the same time. We endeavor to keep the methane content from exceeding one-half of one per cent in any split as recommended by the U.S. Bureau of Mines. We very seldom exceed this standard. Monthly reports covering these tests and air measurements are made to the Vice-President, General Superintendent. Superintendent and Mine Manager.

As Safety Engineer, I am employed full time in safety work. I make monthly and yearly accident reports, also make special reports on all serious accidents. After such accidents a special investigation is made to determine the cause and place the responsibility for the accident. persons who witnessed the accident as well as the injured man, if possible, are interviewed. The scene of all data pertaining to the accident is collected. If the accident is attributed to neglect or carelessness of the foreman, he is penalized. This report is made to the Vice-President. General Superintendent and Mine Manager, and is a very important factor in the work of accident prevention. Through these reports the management is advised of the results of our Safety work at all times. When accumulated over a period of years, accident reports show just what causes our injuries and before we can

reduce injuries we must know the causes.

Considerable time is spent inspecting roadways for unsafe conditions due to roof and track, etc.; working places for lack of timbering, unsafe practices such as working under top, working between car and face, props set too close to tracks. We have a definite rule that props shall not be set nearer to the rail than 30 inches. Reports of dangerous or unsafe practices found are made to the Superintendent, Superin-General tendent and Mine Manager. This is another important phase in accident prevention work. If the recommendations of the Safety department are not sustained by the "big boss" the work of the Safety Engineer amounts to nothing. If the management sustains him he must then see that his own recommendations are carried out and enforced by the foreman and should report violations to the man-This work can be done agement. in such a manner that the foreman instead of considering the Safety Man as a detective, always trying to get him in bad, is really looking for dangerous practices and conditions and that his attentions drawn to same will help him to keep accidents from occurring. In this line of work we are getting fairly good cooperation. and one of the main reasons for this is that the Safety department does get the backing of the higher officials, and the foremen know it.

I quote here some of the Safety Standard or Rules we have adopted. Some were adopted through accidents having occurred, others because they presented potential hazard.

- All track switches should be equipped with bridle bars.
- All track switches of 60 lb. steel or over, or any switch where it is necessary for the motor to make a drop with his trip, should

- be provided with double bridle bars.
- Switch throws should be placed on all switches other than room switches.
- The ground around switch throws should be kept clear of gob, etc., for a distance of at least 15 feet each way.
- At all places where man-trips load or unload throughout the mine, the trolley wire shall be properly guarded to prevent men coming in contact with same.
- 6. Trolley wire feeder jumpers that cross overhead from one side of the track to the other, if not already insulated, shall be properly insulated to prevent any person coming in contact with live wire, regardless of height.
- Live trolley wires or cables, whether insulated or bare, which pass through wood brattices or door frames, must be insulated from the wood by using porcelain insulators.
- 8. Where men are cleaning up falls on entries with live wire around car that is being loaded, the trolley wire should temporarily be guarded to prevent contact with same, by being covered with old fire hose or other suitable insulating cover.
- Drillers should not be allowed to drill places while cutting machines are undercutting same.
- 10. No cars shall be switched in any room while such room is being undercut or drilled, except where there is a switch inside of room that can be lined and blocked so that runaway cars cannot run into place where men are cutting or drilling.
- No person other than motorman and triprider, handling man-trip shall ride the motor of such mantrip.

- 12. Lights shall be placed on all main haulage entries at such distances that the rails may be seen at all times between one light and the next.
- Where top coal has fallen on main haulage entries exposing slate roof, the same shall be cross-barred.
- Hand grab bars shall be placed on the ends of all pit cars for the tripriders.

 Axe handles used underground should be cut to 20 inches in length.

Sufficient argument for the adoption of Rules 5 and 8 may be found in our State Coal Mine Reports from 1920 to 1930. The report shows that 30 men lost their lives through coming in contact with the trolley wire in Illinois mines.

The following statistics show at a glance that the accident prevention work has been effective:

29	Z Mine No.	Fatals	Lost time acci- dents	Days lost	Ton- nage for year	Tons per lost time acc't.	Man hours wkd.	Lost time Freq. rate	Sev.
30	1	8	430	52,552	1,448,364	3,368	1,264,136	240.15	43.74
1	1	3.	240	20,562	940,483	3,919	947,288	253.98	21.80
2	1	U	113	1,577	936,785	8,290	975,648	115.82	1.61
	1	0	71	1,089	698,870	9,843	738,448	96.15	1.47
)	2	U	275	8,710	1,329,483	1,834	1,366,160	201.29	6.37
1	2	0	202	2,078	959,246	4,749	1,147,568	175.99	1.81
2	2	1	94	7,621	859,849	0.147	1,075,272	87.42	7.87
	1 2	**	98	3,956	716,790	7.314	1.007,224	97.29	3.92

Our last fatality at Mine No. 1 occurred December 5, 1930. Since that date we have produced 1,912,834 tons, compared with our former average of 310,355 tons per fatality over the eleven year period quoted. In recognition of this improvement we have just received the Joseph A. Holmes Safety Association Certificate. Our last fatality at No. 2 was September 28, 1931, and to May 31, 1933, we have produced 1,336,352 tons.

We are not able to show results on a dollars and cents basis, because during the period covered in this paper, we carried compensation insurance. It is fair to assume that due to the reduction in fatal accidents alone at our No. 1 mine, and excluding savings through the reduction of non-fatal accidents, we have prevented 6.5 fatal accidents since December 5, 1930 to date, On the average cost of fatality of \$4,150. The savings due to this decrease in fatalities alone would be \$26,975,00.

The reduction of accidents attained

by this company proves what can be done when definite effort is expended in the right direction for Safety. We do not believe that our system is perfect, but believe better results can be obtained and we are striving for this always.

W. C. Argust: Gentlemen, this is a splendid paper and we want plenty of discussion on it. We expect to call on a number of you to discuss this question.

John Millhouse: I know we have had a very interesting paper read to us on accident prevention. Mr. Lyons has brought out two points that all of us should take into consideration, and that have some food for thought for those who try to prevent accidents.

I know from my own experience from mining men and mines, and unless you show them that they are going to profit by working safely, you are not going to have much success in preventing accidents. The average miner has it in his mind that this accident prevention is just another way of trying to save the company money.

I have in my mind one particular case that came to my attention. This is where prizes were offered to the men that could shoot the best grade of coal with the least powder. That is one way of blocking accidents.

Another instance was the Union Colliery Company policy whereby there were rewards in a money way for men that would get by over a certain length of time without any lost time accident

But even in the best regulated mines, we have accidents. We had a splendid example of this at Moweaqua, Illinois a short time ago. It was a mine that was never thought to contain gas, but was thought to be safe.

I want to tell you men that we must have something more than an idea to offer; we must offer them some return to get them interested in accident prevention. I have seen and heard a lot of men talk on accident prevention, and I regret to say that we have a lot of companies that are not sold on the idea, but we do have a lot of companies that are.

John Garcia: Mr. Lyons, I am interested in that idea of grab bars on the pit cars. Do you have them?

Lyons: Yes, we have grab bars on all our pit cars. It gives the trip riders a chance to hold on.

J. E. Jones: The paper was very interesting indeed. I have had the privilege of being in some of the meetings of the Bell & Zoller company.

I am very much interested in Mr. Millhouse's talk concerning the shooting of coal. I believe that a great deal can be done in safety by a proper placing of shots. You men do not need to be reminded that in a

5,000 ton mine you must shoot down 5,000 tons of coal in two or three hours. The man who prepares those shots does not fire them. So, two or three times as much powder is used as is necessary.

We have a commission to improve the mining laws in Illinois, and statistics show that the State of Illinois has the best mining conditions of any state east of the Mississippi, and yet our fatality rate is as great as the worst state we have. These fatality rates are in view of the fact that we only take 60% of our coal, while Pennsylvania, West Virginia and Kentucky take 90 to 100% of the coal. So we are attempting to have legislation passed so as to shoot that coal as it should be shot, one shot at a time, and for the person that prepares that shot to also shoot that shot.

Fred Pfahler: I enjoyed the paper to a considerable extent. I was much interested in one particular point of the paper; the fact that when they first made a canvass for going into accident work, was that the management was not sold on the safety work. The first thing we did when we went into this work was to sell the management.

Mr. Millhouse knows that we made some records to be proud of.

I note the Bell & Zoller man quotes giving prizes for the men making a good safety record. I am not in favor with this plan. We have so far stuck to giving medals for good safety records. I believe that the success of safety work lies entirely in the management selling themselves to the men.

Frank Schull: Mr. Millhouse possibly was a little bit over-enthused over what we did in the shooting at Panama. It was a fertile field to make a change in.

I appreciate the paper that was read here very much, but I figure that the least explosives used, the safer it is.

Our screenings at Panama were very high. I took it up with the company to put out a little prize. They agreed and we started the big drive, the first prize to go to the man mining the most tons of coal per pound of powder used. We got our face bosses interested and eventually reduced our screenings to 28.2%. The men became very much enthused over trying to show better results for the prize money.

We later did this same thing on our accidents. We were working on the same system as the paper just read describes. When we first started, at one of our meetings a man got up and said that it was impossible to bat 1,000, but it was not long until that same man was batting 1,000.

I really think that if a face boss on a section has his men properly sold on the idea, the men are not thinking of it being sold to them.

We are really geting some place, but I can just get credit for laying out the plans, and must give the men and the face bosses credit for carrying them out.

James Dunn: I would like to know when you cut your screenings to 28.2% did the miners change their system of drilling? Also did they snub the coal more than they had before?

Frank Schull: We did three things to reduce our screenings to this figure: first we changed our system of drilling; second we hand snubbed; and third we cut down on our powder.

James Dunn: I don't know as I have much to say. As Mr. Lyons is a neighbor of ours, I have been in very close touch with his work. I have read Mr. Lyons' safety report

every month, and have always found it interesting.

However, I am a little bit the same as Mr. Pfahler, as to commercializing on safety first. I belong to the "Old School", and I can't quite get it into my head as to why we should pay a man for doing his duty.

We have watched other companies, and we do not wish to criticize them, either for the payment of prizes for safety or for shooting coal. I may change my mind some day about paying face bosses and mine managers for their safety work.

H. A. Treadwell: For the past five years we have carried a report, by the month, and the record of each foreman, and have classified the accidents as to causes, etc.

There was one thing in Mr. Lyons' paper that interested me very much, and that was in their getting about 30% of their men to wear hard-boiled safety hats. We are not going into this because we do not know how to go about it.

In mechanical mining we have increased our foot accidents a lot. I think that the safety-toed shoe is a big thing in mechanical mining.

Lee Haskins: I am like Mr. Pfahler in regard to selling the management on safety. When we started into this work our management was not sold. The first thing we did was to start selling these boys on safety.

Mr. Lyons is a fellow that eats, sleeps and lives Safety First. We started in to sell our boys, and it was not very long until we got results.

In answer to Mr. Treadwell's statement that they do not know how to start to sell the men the hard boiled hats. I do not know of any way of making a man wear safety hat and shoes. We started out by having the bosses wear these hats and shoes. And they demonstrated the use of these hats and shoes, and we are in-

creasing the sale of these all the time.

H. A. Treadwell: How do you handle the sale of these hats and shoes?

Lee Haskins: We carry these in stock. We sell the shoes at cost but sell the hats at a loss.

Mr. Lyons: We carry about four dozen pairs of shoes in stock, and about three dozen hats. The hats cost us \$1.50 each and we sell them for 75 cents each.

C. J. Sandoe: This has been discussed a great deal, but there is one question I would like to ask Mr. Lyons. Do you notice any difference in places that are self-insured and those that are insured in some company?

Mr. Lyons: Where a company is carrying its own insurance, I believe a safety program would pay much better. But where you have your insurance carried by some other company, no doubt an effective safety program would lead to some credit on your insurance rates.

H. H. Taylor: We always carried our own insurance up until some time in 1930, and we all felt that there would be a general let down in safety when we changed. But our record after we bought our insurance was better than it was when we carried our own. Now we are back carrying our own, and our record is much better.

Garcia: I want to pay my respects to Mr. Lyons and the Bell & Zoller Coal Company for the Bulletin they put out on accidents, and their description of how the accident happened. I am sure we all learn something from this.

W. C. Argust: I am sure that we could go on for some time with this discussion, but owing to the fact that we have another paper to read, we must continue with the program.

I am sure we all enjoyed Mr. Lyons' paper, and I am sure that all the operators are interested in cutting down their accidents.

The next paper we have this morning is by Mr. John Lucas.

TODAY'S TREND IN THE UTILIZATION OF COAL

By JOHN LUCAS

Combustion Engineer, Old Ben Coal Corp.

The present day trend in the burning of coal is undergoing rapid changes due to influences largely outside the coal industry itself. While these changes are universal in scope, this paper will deal only with those conditions which affect the natural market of Illinois coals, and although a host of conditions have had important bearing on the welfare of the Illinois coal industry, this thesis will confine its discussion to those conditions which have taken place in the art of using coal.

Up to a few years ago, Illinois coal had little serious competition in the steam market from outside fields, and competitive fuels were practically unknown. In Chicago the steam plants were almost entirely equipped with chain grate stokers, using Illinois screenings, and the skillfully prepared lump, egg and nut from our own mines was a popular domestic fuel. The many well prepared sizes produced enabled Illinois coals to dominate a wide market and gain a reputation which is one of their greatest assets today.

During recent years, constant and rapid changes in the utilization of coal has taken place in all types of plants from central station units down to warm air furnaces. Some of these changes are favorable to the Illinois coal industry and some are not. Various sizes of coal have had to be developed and new and rigid standards of preparation have had to be inaugurated.

Three important changes which have seriously affected the market for Illinois coals are:

- (1) Introduction of new types of fuel burning equipment.
- The passing and enforcement of new and more stringent smoke ordinances,
- (3) Competitive fuels,

Beyond question the change in fuel burning equipment has resulted in making a pound of coal do considerably more work than formerly. The average overall efficiency of boiler units is at least ten per cent higher than it was ten years ago. Furthermore, prime movers have become more efficient which also makes a pound of coal go farther. A central station of today will make a kilowatt hour on half the coal required for a station of the vintage of 1920. Railroads will average twice as many ton miles on a given amount of coal as they were able to ten or fifteen years ago. It is claimed that during this period about twice as much tonnage has been lost to increased efficiency than to competitive fuels. Although this loss has been felt, the efficient use of our products is highly desirable as it prevents greater inroads by other types of fuel and keeps King Coal on his throne.

The practical commercial limits of efficiency in the transformation of fuel into power are being rapidly approached at the present time. The best central station units are extremely close to their theoretical limit. Railroads cannot possibly de-

crease their coal consumption per ton mile except with tremendous expenditures.

In order to clarify this paper we will roughly group plants into three divisions; namely:

- Industrial—Define the industrial plant as one having boilers of 200 horse power or over.
- (2) Semi-industrial—This class of plants can be accepted as having boilers rated at from 50 to 200 horse power.
- (3) Domestic—The domestic heating plant consists of boilers and furnaces rated lower than 50 horse power.

The power plant fuel burning equipment is being manufactured, sold and installed by large organizations with capable men in all departments.

As a result of extensive research and observation such equipment is being improved in every respect, and the service departments maintained by these organizations are becoming more valuable to the power plants every day.

Automatic controls for regulating the drafts and coal feeds are rapidly becoming standard equipment.

Instruments for indicating and recording what actually takes place in the boiler room are considered a necessity in the industrial plants, partly because such knowledge results in more efficient operation and partly because the data obtained furnishes an accurate basis for cost determinations.

The trend in the boiler room itself is toward fewer and larger units. Instead of a long row of small boilers working at low pressure we now see a few large ones operating at high rating and producing high pressure superheated steam. Auxiliaries, such as bleeder heaters, superheaters, air

preheaters and steaming economizers are becoming the rule instead of the exception. Improved methods of handling fuel and refuse are gaining ground, and at the present time practically all units above 500 H. P. have some form of coal handling equipment. The smaller plants are using screw and bucket conveyors and the larger plants are putting in belt conveyors for handling fuel and hydraulic systems for removing refuse.

There is a general change in industrial plants from side feed stokers and natural draft chain grate stokers using small nut coal and the larger size screenings to underfeed stokers suitable for using two inch, one inch and a half, and three-quarter inch screenings, to force draft chain grate stokers suitable for using threequarter inch screenings and to pulverized coal burners capable of efficiently burning all small sizes of coal, including carbon. We can see that the trend in the power plant demand for coal is changing from small nut and larger sized screenings to smaller sized screenings and carbon.

semi-industrial plants changing from handfired shaking grates to underfeed, overfeed, and forced draft chain grate stokers, As handfired plants, they used egg, nut, and two inch screenings. After changing to stokers, they burn one and one-half inch stoker special and two inch, one and one-half inch, and three quarter inch screenings. According to my personal views, a special one and one-half inch screening which contained about ten per cent duff would prove satisfactory for a greater number of installations in the semi-industrial class than any other size of coal.

Domestic heating plants are steadily changing from handfired grates using prepared sizes to underfeed stokers using screenings, stoker special and pea. The last named size is especially suitable for the smallest type stokers using less than fifty Washed carbon pounds per hour. has also been used successfully on these small stokers. At the present time, baby coal burning equipment suitable for one and two family homes are receiving considerable attention of successful designers and manufacturers of power plant equip-These machines are miniature reproductions of nearly every type found in the industrial and semiindustrial plants, including the screw type underfeed, ram type underfeed, overfeed, force draft chain grate, and pulverized coal burners.

In studying the change in plants and the natural displacement of coal sizes, we again note that the demand for larger sizes is decreasing, whereas, the demand for smaller sizes is becoming greater.

The pea coal, displaced in the change from chain grate stokers in the industrial plants can be absorbed by the domestic stoker. The demand for pea and stoker special coal in the semi-industrial and domestic stoker is growing daily. Increased demand in these sizes necessitates the production of more carbon. We must depend on the powdered coal burner, which is becoming more popular every day, to create a sufficient demand for this size that it will command a fair price. Formerly, the high installation costs and the explosion hazard made the pulverized coal plant prohibitive except for very large units. Today, however, this equipment can be installed for practically the same cost as a modern underfeed stoker and all operation hazard has been eliminated.

The average engineer thinks of powdered coal for boilers larger than five hundred horse power. Some well known engineers consider that, at the present time, pulverized fuel installations are economical under boilers as small as two hundred horse power, and I know of satisfactory installations of such equipment under one hundred and fifty horse power boilers.

Smoke ordinances have been passed and enforced which guided users of Illinois coal to eastern coal. Our customers were definitely ordered to burn low volatile coal, install stokers or shut down their plants. Naturally. the domestic plants and a goodly part of the semiindustrial plants went to New River and Pocahontas mine run. have a condition where smoke ordinances were stringent and smokeless coal expensive; therefore, it is only natural that a wave of small stokers should develop. Although there are and have been for some time, well designed stokers under the control of properly trained men who insist on good installation, for the most part stokers of a size suitable for boilers smaller than 100 H. P. were "designed with kodaks" by men without even the slightest knowledge of the basic principles of combustion. Consequently, stokers which were sold with the stipulation that they would burn anything black were forced to use low-ash, high-fusionpoint Eastern Kentucky screenings due to poor inherent design, unwise application, and improper installa-Some of the legitimate stoker tion. organizations should be highly praised for the fight they have made to give the public economic heat by putting in stokers suitable for using coals near their respective districts.

I am completely in favor of economic stoker fired units, and wish to fight the legitimate stoker man's worst enemy — the one who discourages the plant owner by selling

him stokers with such features as rear end dead plates, narrow side dead plates and insufficient combustion space. Such equipment will struggle along for a while with midwestern coals and in the end will have to use low ash coal from the eastern fields. If at any time in the future the wage scale in the eastern fields approximates that of our own, such plants will be dead horses on the hands of their owners and will have to be replaced by better machines. The coal men are justified and are more or less getting behind the stoker organizations who are capable of giving the plant owner a good job.

Competitive fuels in general have had one effect on the Illinois coal industry. They have caused it to keep on the alert in order to give the customer satisfaction as the introduction of oil and gas burners have set up new standards in heating ser-We have studied the new fuel burning equipment coming into our territories and have prepared sizes of coal suitable for their use. We have assisted the industrial plants in obtaining fuel satisfaction by working in the boiler room and have aided the home owner by producing firing charts in the interest of economy and service for handfired units. Illinois operators have, at the present time, a wide reputation throughout the Middle West as having the greatest selection of sizes, the best preparation, and the most reliable customer service of all bituminous coal fields. In order to maintain this valuable asset, we must understand the problem of the plant operator.

If I were to choose one of the most important sizes of our product to improve, I would suggest a more nearly standardized one and one-half inch screening practically constant in the ratio of constituent sizes and ash content. You, gentlemen, know the factors involved in preparing such a product much better than myself: therefore. I will make no statements as to the practicability of such standardization. However, I know that if we could deliver one and one-half conforming close inch screenings enough to a set standard, that the variation could not be detected by the fireman's eve. a great many less complaints would be made and, consequently, less business turnover experienced.

Let any member of this conference imagine himself as being the fireman in a plant consisting of two 300 H. P. boilers set over dump plate underfeed stokers. He would be selling his services for a wage and would be chiefly interested in doing as little work as possible and in holding his job. If a car of coal comes in containing an excessive amount of bug dust in even a part of the car, he will have to burn a product containing a large amount of ash and a different ratio of sizes. In burning these fines he will have to handle more coal, poke the fires oftener, break up clinkers, remove more refuse and probably be called on the carnet for allowing the evaporation per pound of coal to diminish. In all probability he would tell the chief engineer that the coal was no good. Then when the purchasing agent asked the engineer how the coal was running he would answer, "Not very good, the last car was nearly all dust which caused the fireman more work. lowered the overall efficiency and increased our maintenance costs by causing more fly ash, incrustation of boiler tubes, deterioration of walls and burning of stoker tuyeres." After a number of such reports the purchasing agent would in all probability try a car of coal from another

We must also bear in mind that most complaints are made, not because the coal is really giving trouble, but because the last car was not as uniform as the previous one. Any change in the ratio of sizes or component parts can be detected by the fireman in many ways. Such changes necessitate more careful attention, give less efficient results and cause general dissatisfaction which results in the loss of customers. Occasional cars of coal consisting large percentages of nut sizes are received and plant operators are prone to use such cars as a standard by which to compare all shipments. Naturally, when such a car is immediately followed by a car containing an excessive amount of fines, the result is not good. Undoubtedly an improvement in the preparation of screenings looking toward a more nearly uniform product is worthy of very great effort.

The general shift in the demand for coal is from the larger sizes to smaller ones. Screenings are no longer a by-product and are becoming more important as a basic product with every installation of modern firing equipment. The trend is definitely toward bringing the price of all sizes to a mine run basis where all tonnage may be sold at a profit.

The increased efficiency experienced during the past twenty years cannot be duplicated in all time to come and we will never again witness the rapid loss in coal consumption due to higher efficiency as seen during the past decade. Consequently, the total demand for fuel must show a substantial increase more or less in proportion to the increase in demand for power and heat. The demand for the last named commodities has steadily increased and can be expected to continue doing so for many years to come.

The marked trend toward high wage scales and better prices in the eastern fields gives us hopes of being able to regain a portion of our lost market by increasing the price differential in our favor. Our strong and constant fight against competitive fuels in general has prepared us for reclaiming such tonnage by continually strengthening the cooperative spirit between the production department and the sales department of our respective organizations. Let us strive to give our oustomers the best product on the market.

C. N. Smith: I have enjoyed Mr. Lucas' paper very much. I have made a complete analysis of the trend to make greater use of the smaller sizes of coal. The fact that this trend is moving forward at a rapid rate is very encouraging.

J. B. Miller: For the last three or four years we have made a small unit that will burn any of the small sizes of coal. We have a small unit at the place that we have just developed that is used for heating water. This is maintained on a coal consumption of 24 pounds in 24 hours. The unit is very inexpensive and requires only 1/6 HP to operate. We have had the opportunity to compare this with gas, and we found we could heat hot water with coal, using one of these units, from 1/2 to 1/3 of what you could do it for with gas.

W. C. Argust: Are there any others who would like to discuss the utilization of coal?

Jefferis: There is not a coal salesman on this boat. The salesmen who go out to sell these smaller sizes of coal for the stokers are basing their prices on the cost to the big users. I think we should have this paper read when there are some coal salesmen on board.

I am not in favor of having so many sizes of coal. I can see no need of it. I do think we should have some means of getting the producers of the coal and the salesmen together. There should be some connection so that there would be a better understanding.

This paper is all right, but who is going to follow it up? I think we should have the coal salesmen come on this boat.

H. H. Taylor, Jr.: I think this paper was very timely. We talk a different language from the salesmen. I think it is very necessary to have a paper of this kind. We are interested just generally in the utilization of fuel, but this paper will help us to prepare fuel. Therefore, I say again that the paper was very timely.

E. H. Johnson: A few years ago I visited a plant in the East to see an operation that used small coal. I was only just mildly interested in this, but I was very much interested in what it was doing at some of the properties. They were producing a low ash coal, and naturally they would expect to have many clinkers, but by treating that coal with dedusting machines, they were taking out this fine stuff and throwing it away. Now that is along the line of what Mr. Lucas meant and it is very likely.

H. A. Treadwell: I had an experience last winter that I want to tell you, just to show you what rotten salesmen coal men are. I was at a place where there was a circuit judge, a lawyer, a superintendent of a factory, a general manager and myself. Everyone of those fellows had oil burners in his home. I was the only coal man there. I got to talking to those fellows about stokers, and there was not one of the bunch that knew anything about an automatic stoker.

The coal dealer, instead of buy-

ing a good grade of stoker coal, generally buys the cheapest grade. If we are going to get into this stuff, we are going to have to sell these men real coal.

Lucas: I want to agree with the last speaker. Practically every stoker man sells his stoker to burn the cheapest coal that it is possible to buy. The biggest fact is that stoker men are now working on a stoker to successfully burn the smaller sizes of coal.

Chas. Hamilton: I want to express the thanks of the Institute to Mr. Argust for the fine manner in which he has handled the meeting this morning. We will now stand adjourned until this afternoon.

AFTERNOON SESSION

Chas. Hamilton: With a great deal of pleasure, I am turning this afternoon session over to Mr. Harry Treadwell.

H. A. Treadwell: Gentlemen, this afternoon I think we have some very interesting papers, and we can make the meeting more interesting by all of us entering into discussions. I am sure it will be of benefit to all.

COMPETITIVE FUELS

By B. R. GEBHART

Director of Public Relations, Illinois Coal Bureau Chicago

At the Illinois Mining Institute Meeting, on Board the Cape Girardeau, Saturday, June 10, 1933.

Last month, as a result of suggestions made by several of our operating executives here in Illinois, I had the honor to be invited to give a paper on competitive fuels before the American Mining Congress at Pittsburgh. I don't know whether my sponsors wanted to get me out here on a boat so they could take a closer shot at what I said, or whether they really liked the paper. At any rate they asked if the same information might not be presented before the Illinois Mining Institute and I appreciate very much this opportunity to get before our own operating people a brief picture of the battle going on in the energy market of this country.

Your understanding and appreciation of the competitive fuel problem is important for several reasons. Chief among these is the desperate need for collaboration between production and combustion engineers to the end that Illinois coal may be given an improved form value which will adapt it more readily to successful use in newer and better coal burning equipment. The success of coal competition with oil and gas depends first upon its being made available at the lowest possible cost, and second, in such form that it can be utilized not only at a high degree of efficiency but with convenience and satisfaction. This problem cannot be separated as between the mine and the market. The old notions about producing cleanly graded coal according to the standards of the past, and even some of the standards of the present, loading it into cars and kissing it good-bye at the mine must be dismissed if coal is to hold its place in the sun,

Let us look briefly at the energy picture. Back in 1913, King Coal justified his majestic title by developing 84.3 per cent of the total annual energy supply of the United States derived from mineral fuels and water power. Since that time his throne has been unsteady. In 1920, coal's percentage was 77.2, and in 1931, the last year for which figures are available, the percentage had dropped to 56.5. Of this amount, anthracite coal was responsible for 7.9 per cent and bituminous coal 48.6 per cent.

During these years petroleum and natural gas combined jumped from 12.4 per cent in 1913 to 18.5 per cent in 1920, and to 35 per cent in 1931. The percentage of energy developed by water power has increased in about the same proportion, from 3.3 per cent in 1913 to 4.3 per cent in 1920, and to 8.5 per cent in 1931. The authority for these figures is the U. S. Bureau of Mines. A tabulation showing percentages as well as quantities in trillions of B.t.u.'s is attached as an appendix to this paper.

It seems necessary to have in mind this general picture of the changing relationship between the fuel sources of energy the country over, in order that conditions in our central western territory may be fully understood. The competition of fuel oil with coal in the Central West has been severe. For example, in our state of Illinois, the state having larger resources in recoverable coal than any other state east of the Missouri River, over 20 per cent of the owned homes are equipped with oil burners, and consequently are heated with fuel oil. This percentage is four times the national average and is higher than that for any other state. Conservatively, it is estimated that substitution of fuel oil for coal in its natural market territory during the last ten years has cost the Illinois coal industry more than ten million tons in annual production.

Natural gas, relatively a new com-

petitor in the Middle West, is charged with displacing during 1932, probably five million tons of coal from various sources. Last summer in a survey conducted by salesmen of Southern Illinois coal producing companies, it was found that in 59 cities located in the states of Illinois, Iowa, Minnesota, Missouri, Nebraska and South Dakota, natural gas had replaced coal in industrial plants to the extent of 4,622,250 tons annually. takes no account of the displacement for domestic use, which is rather difficult to compile. It was further determined that in 185 towns in these same states, natural gas competition either actual or impending, threatening the replacement of over four million additional tons of industrial coal now shipped to these towns annually from the Southern Illinois field alone.

If you were to plot a chart showing the production of energy in United converted States as B. t. u.'s, according to the various sources, coal, oil and gas, and water power, you would discover that the coal curve rises steadily until about 1918, when it started to break, and it has gradually descended ever since. In contrast, the curves for both oil and gas, and water power, have steadily risen to the present date, oil and gas most rapidly during the last fifteen years. As another mental picture, consider a chart showing the ratio of energy produced by coal as compared to oil and gas at ten year intervals. Prior to 1900 coal held the overwhelming majority, but in 1929, gas and oil had risen to more than half the total of coal, while we have seen from the figures already cited that in 1931 the relationship was still more unfavorable insofar as coal is concerned.

Since 1929, thousands of miles of natural gas pipe lines have been built from source areas to industrial centers in the United States. Over 5,000 miles of such pipe lines were laid during 1931 alone. The majority of this mileage directly serves the markets for Illinois coal. A map of the United States in which the total natural gas pipe line mileage constructed to date is superimposed resembles a spider web, so vast is the extent of natural gas distribution.

Most coal producing areas have a problem in the matter of competitive fuels throughout the market areas which they serve, similar to the problem we face in Illinois. Consequently, most coal men, both in the operating and sales departments of the business are familiar enough with the losses coal has sustained to competitive fuels, and with the availability and distribution of these fuels, so that I need not here dwell further upon this side of the picture. Rather than graveyard whistling let us study briefly what has been done and can be done about it.

In the first place, I believe it is necessary to dismiss from our minds any such ideas as that the price of fuel oil is going to go so high as to prohibit its use for domestic heating or industrial purposes, or that oil burners cannot continue to be successful, or that people will not pay the price for burners or for oil. The answer lies in the fact that while we have cherished these ideas, nearly three quarters of a million oil burners have been installed in residences in the United States. Another such idea is that the financial foundation of the gas pipe lines is insecure and liable to crumble, that the cost of gas transmission over long distances is too high to permit general use, that the pipe lines will break or the gas will freeze or explode, or that the price of gas can never get low enough

to disturb seriously the industrial coal market.

These notions have already been disproved in figures I have cited. The natural gas pipe lines are with us and it looks very much as though they were going to stay. The notions here described have in the past lulled coal men into a false sense of security and have resulted in a national loss in annual coal production to competitive fuels and water power of something in the neighborhood of 125 millions of tons.

In my opinion, excluding specialized application of fuels, there are only two points at issue as between coal on the one hand and oil and gas on the other. These are cost and convenience. Water power can be excluded for the present because the potential sources of what might be called hydraulic energy are definitely limited. Cost is relatively more important in industrial applications and convenience in domestic applications.

Both cost and convenience are affected by the method of use. It is here that the purveyors of oil and gas have had a ten year jump on the coal man. Bear in mind that oil in the tank and gas in the main are as helpless as coal in the bin unless mechanically efficient and adaptable devices are available for their regulated consumption. During the past ten years extensive researches have developed oil and gas burners and methods for their application to a high degree of excellence. velopment has been stimulated largely by oil and gas fuel interests. In contrast, I believe it can be safely stated that the coal man's chief interest has been efficient production of coal at the mine, while he has neglected the application of coal in the hands of the ultimate consumer. As a result, oil and gas interests have been successful in securing higher prices per million B.t.u.'s for their fuel than the coal people, and yet have made and are continuing to make tremendous gains in the energy market.

During recent years we in Illinois have been forced to change our attitude and seek methods for protecting our markets. Something had to be done about the threatened loss of additional millions of tons of industrial business to natural gas. A brief study indicated that the laid down cost of coal at plants in our market area was composed roughly of onethird coal cost f. o. b. mines, and twothirds freight. After trimming mine prices to the limit, appeal was made to the railroads to protect their freight revenue by trimming the haulage charges.

The western carriers petitioned the Interstate Commerce Commission for relief at certain specified destinations, and after a series of hearings, this relief was granted at points where natural gas competition actually existed. With this assistance from the railroads, we have cleared one of the hurdles in the matter of cost, which is most important in the industrial picture.

Continuing the battle, combustion were sent to engineers various threatened plants to devise ways and means of improving the method of coal application, thereby increasing efficiency and further reducing cost. As just one example, I can cite the City Light Plant at Rochester, Minnesota, where stoker and other plant adjustments accomplished an increase in actual evaporation of 1.25 pounds per pound of coal burned, which was equivalent to a reduction in the delivered coal price of approximately 50 cents per ton, or a reduction of nearly 40 per cent of the f. o. b. mine price.

The stoker, both in domestic and industrial sizes, offers an effective weapon to the coal man. Whether or not the domestic stoker in its present state of development is the last word in automatic coal burning equipment is not to be debated here. Excepting the use of powdered coal, stokers do offer the only tried method of controlled combustion of coal. Such a method is needed to compete with the burners provided for oil and gas.

In the domestic field stokers permit the retail coal merchant to offer a degree of heat service which is somewhat comparable with the fully automatic service provided by gas and Stoker hoppers still have to be oil. filled with fuel and ash receptacles removed, but these services are being prformed for a fee by coal merchants in many citis. Thus equipped with thermostatic regulation, the home owner is freed of all duties in connection with his heating plant and can enjoy the economy of coal with none of the labors hitherto associated with it. Perhaps in the near future we may have a completely automatic domestic stoker for bituminous coal which will fill itself from a main storage hopper and dispose of its own ashes. Some such machines are now on the market for anthracite.

The installation of smaller stokers has increased rather promisingly in the last few years. The Bureau of Mines is authority for the statement that 55 establishments reporting installed roughly 22.000 stoker units during the years 1931 and 1932. The total number of installations recorded at the Bureau up to and including February, 1933 was 33,541. While this by no means represents all installations, it does show some progress in the face of the more than 700,000 oil burners now in operation.

Other examples of recent activities here in our home markets may be of interest to you. Among other things, we have learned that comparisons of coal heating in conventional, I might even say traditional hand-fired coal plants, with heating by oil or gas in these same plants after they have been cleaned up, modernized, the houses or buildings insulated and the burners equipped with thermostats and automatic controls, are very much to the disadvantage of coal. The only fair comparison is between a thoroughly up-to-date mechanically fired coal plant, and oil and gas installations, under similar conditions.

The coal merchants in Chicago, assisted by the coal operators, determined that under equal conditions, heat could be provided with coal at approximately one-half the price of oil, and one-third the price of gas. Rather extensive advertising of these relationships has been carried during the past three years in Chicago news-The results have been ilpapers. luminating in several ways. For one thing, this almost unique effort of the coal man to tell the public in mass the true story of the advantages and economy of his fuel has been amply rewarded. In spite of the large number of oil burner installations elsewhere in Illinois, the figures now show that since the start of this campaign, there have been less oilburner installations per capita in Chicago than in any other major city in the United States.

After the advertising had been running for some time, the coal merchants were challenged by a building management concern to prove their advertised statements. A reputable commercial laboratory was employed to make a series of tests at two Chicago hotels which were equipped with oil burners. The oil burner people were invited to adjust their equipment to their satisfaction and the plants were operated for several

weeks under service conditions, accurate data being kept by the laboratory staff. The oil in these installations cost 4% cents per gallon. At the conclusion of the oil tests, the burners were removed and stokers were installed, on which midwestern coal costing \$5.15 per ton, delivered, was applied.

At the conclusion of the stoker tests, it was discovered that at one hotel the saving in the total heating cost, all items such as labor and depreciation being included, was 36.1 per cent in favor of coal, and at the other hotel 43.3 per cent in favor of Needless to say, this building management firm completed change over to stokers and coal and in three months time reported that they had actually saved 30 per cent of the total cost of the stoker installations as well as building changes necessary to accommodate the handling and storage of coal. I cite this example to illustrate the result of comparisons between coal burned in modern fashion and competitive fuels, under equal conditions.

These experiences taught us the necessity for educating the public as to the true possibilities of coal. The Illinois Coal Bureau published and distributed widely, a booklet entitled, "Debunking the Fuel Question," which goes into the matter of application and efficiency of different fuels under different circumstancess. I am sorry that time here will not permit fuller discussion of this phase of the subject, but I shall be glad to send a copy of this booklet to anyone interested.

As an illustration of the nature of our conclusions, we plotted the relative cost of heat in various fuels, based on the average of domestic prices in 300 middle western cities, the coal as it lies in the bin, the oil in the tank and the gas in the main. This study bore out the generally claimed relationship regarding the cost of heat in the diferent fuels, namely that with a dollar's worth of Illinois coal, twice as much heat is obtained as with a dollar's worth of gas. Introducing the element of efficiency, which is governed by the type of equipment in which the fuel is used, it is discovered that roughly the same 1-2-3 relationship obtains as between the cost of heat utilized from stoker coal, fuel oil and natural gas. In this case we applied a combined efficiency of 65 per cent to stoker fired coal, 65 per cent to fuel oil, and 75 per cent to natural gas.

The booklet also presents several actual examples. One compares \$5.50 Illinois stoker coal in Chicago with natural gas. This example shows that for pure natural gas to produce heat at equal cost, it would have to be sold at a retail rate of 26 cents per thousand cubic feet, which is about one-third of the current cost of mixed gas for domestic heating purposes in Chicago.

I hope that in the foregoing discussion I have at least given you an indication of what I mean by the desperate need for collaboration between our production and combustion engineers. Obviously, the job of educating the public as to the true value of coal compared with other fuels, is a job for the sales departments. But there is a bigger job. As we have seen, oil and gas have continued to grow in popularity and in use in spite of the superior economy of coal. The bigger job is one of research, both in the preparation and the use of coal, to the end that the public may be provided with the type of convenient heat and power service which it demands.

Some very exceptional work along this line is now being conducted in the laboratories of the State Geological Survey at Urbana and in the Mining Engineering Department at the University of Illinois. However, more immediate results can logically be expected from individual coal companies whose production and combustion men together study the rapidly changing needs of the market and prepare to meet these needs. Such work has been going on for years in the anthracite industry and the results should be a brilliant inspiration to all of us. Cooperatively, through the Anthracite Institute, and individually in their own laboratories, anthracite producing companies have developed and offered to the public vastly improved furnace and stoking devices as well as sizes and preparations of coal, specially and closely fitted to the needs of the devices.

Very recently many new things have been tried in the way of washing, screening and cleaning bituminous coal, particularly the smaller sizes for stoker and other mechanical application. But we have just made a It is going to be necessary to follow this thing through as one of the newest and biggest problems facing the Illinois coal industry. Our competing coal fields are alert to the need and are making daily progress in suiting their product more closely to the needs of the market. Whether our studies shall result in packaging coal at the mine, selling it on a guaranteed therm basis with a therm certificate accompanying each car, or whether coal shall eventually be pulverized or gasified at the mine, and transported to market through the pipe lines which we may inherit from the natural gas speculators, remains with you men to settle in collaboration with your combustion en-But the problem must be gineers. settled.

The laboratory must be called

into partnership with both ends of rich heritage of coal resources with the coal business if we are to deserve which nature has endowed this couna profit for taking advantage of the try.

QUANTITY AND PER CENT OF ANNUAL SUPPLY OF ENERGY IN THE UNITED STATES FROM MINERAL FUELS AND WATER POWER. Figures from U. S. Bureau of Mines.

19	13	1920		1931	
Trillions of B.t.u.'s	Per Cent	Trillions of B.t.u.'s	Per Cent	Trillions of B.t.u.'s	Per Cent
Anthracite 2,490	14.0	2,437	10.9	1,619	7.9
Bituminous Coal 12,535	70.3	14,899	66.3	9,906	48.6
Petroleum 1,593	8.9	3,295	14.7	5,385	26.4
Natural Gas 626	3.5	858	3.8	1,760	8.6
Water Power 588	3.3	971	4,3	1,721	8.5
17,832	100.0	22,460	100.0	20,391	100.0

H. A. Treadwell: I think there are two or three things that stand out to the coal producer. The first and most important to all of us is that 1910 coal produced 85% of the energy produced in this country, and now coal has been reduced until it is only producing 56% of all the energy. This shows an increase of gas, oil and water power from 15% in 1910 to 44% in 1932.

I can remember when we claimed that the operation of oil or gas was dangerous. We must forget this line of argument, and meet this problem with constructive thought. We also used to say, "Just wait until it gets cold and the gas and oil won't be there", but everyone now knows that is not the case.

B. B. Brewster: I have just finished a very intensive study on this subject for a company. They are producing a new designed boiler at this time.

Frank Tirre: I think we should have more discussion on this subject. I do not like to see a subject like this passed up. Down in the St. Louis field we are making a study of this subject.

Lucas: I might give some data that I have obtained from a concern that have changed over seven of their large generating plants to gas. These people are very particular to get everything there is out of any fuel they burn. The highest efficient plant they have out of these seven is running at 74% efficiency on gas. These boilers are all large. They figure on these same boilers their coal efficiency would run about 69%.

In burning gas under ordinary coal boilers, you require approximately 20% more combustion space, and the efficiency of such constructed boilers go down below 50% when gas is used for firing,

I talked with the engineer who had charge of their operation and kept the records, and he says that it requires a great deal more attention to burn gas than coal. But any time you talk to a gas man, he will never set down less than 75% efficiency for gas, and not more than 65% efficiency for coal.

H. H. Taylor, Jr.: Is it not easy to get 75% efficiency from coal?

Lucas: It is pretty hard, but there are some plants that are getting 92% efficiency. With powdered coal they are averaging about 85%, hand fired operations about 50% and stoker fired operations about 65%.

COAL CLEANING AS APPLIED TO PREPARATION

By WILLARD C. ADAMS Koppers-Rheolaveur Co. Pittsburgh, Pa.

The object of preparation is to increase marketability and to stabilize the value of a given coal by producing a uniform fuel of physical and size characteristics inherently suited to the consumers' particular use. It is expected to provide a fuel competitive in its natural markets with Gas, Oil and Coals that are uniform low ash fuels as mined.

The extent and methods of preparation that should be employed are primarily economic problems in which market requirements, the consumers' measure of value and monetary returns to the operator are the controlling factors.

The application of preparation must be adaptable to changes in market requirements and conditions if it is always to fulfill its purpose and be a true aid to selling at a profit.

Increased net realization cannot be expected on any application of preparation that does not add tangible values to the user, or on preparation methods that are not economical.

It has been definitely determined that sizing is an important factor in good preparation, as it governs to a large extent the behavior of a given coal when applied to a given use, or to specific conditions of combustion, or rates of combustion. Where the coal is to include two or more primary sizes, blending, in certain predetermined proportions suitable for a given service, is necessary to securing the best performance with a given coal.

Accurate separation of coal into

grades having small size range is a thoroughly established practice in the Illinois field. Proper methods of separation, which includes types of screens suitable for the upper sizes, and dedusting or aspiration for the very fine sizes, has been definitely determined in that field by experience. In a few instances, mixing facilities are provided whereby a uniformly blended coal of a specific sizing specification as may be best suited to a given use can be furnished.

The full benefit of cleaning in accomplishing the purposes of preparation cannot be secured for steam and domestic markets unless it is considered as an adjunct to sizing, mixing and loading, so that the various preparation facilities can be properly coordinated in design and operation. Without such coordination, there is a possibility that a cleaning system, even though producing the desired results in treated coal and refuse, would be considered a commercial failure on the basis of monetary returns, Quality and suitability is important, but so also are costs of such marketable products.

The removal of the impurities in coal will enhance its value to the extent of monetary savings and benefits that can be effected by reason of:

- The elimination of the purchase price, freight and handling cost of useless material.
- (2) A uniform fuel with increased heating value and less slagging, resulting in improved boiler efficiency and decreased boiler

maintenance, boiler outage, ash handling, fly ash and sulphur compounds in the flue gases.

(3) The elimination of bone, laminated and other objectional material in sizes that are judged and sold mainly on appearance.

On this basis, it would appear that a premium price for cleaned coal in all sizes could be expected, but while buyers are coming to realize that for practically every use better results can be obtained from coal if free from non-combustible material, it is difficult to arrive at a definite figure for expected increase of realization.

Existing preparation plants have, however, proven:

- That a uniform sized and cleaned product increases marketability with a resultant reduction in production costs due to increased running time.
- (2) That the mechanical cleaning has permitted the guarantee of quality to within recognized tolerances of sampling and analysis with a resultant decrease of complaints and cost of adjustments.
 - (3) That mechanical cleaning has in cases made possible greater seam extraction and mining efficiency.

In considering the removal of impurities from the complete range of sizes as mined, hand picking, based upon visual inspection and mechanical cleaning must be considered. The proper scope of each as applied to a given condition, should obviously be determined on the basis of efficiency, costs and coordinization. The mere fact that hand picking is already in use at a given operation, when mechanical cleaning is to be applied, should not alter this procedure.

The cleaning of the sizes larger than 6" must for the time being be considered as a hand picking job. There is not at this time a commercially proven- process available to handle this size.

It is generally advisable to feed the coal to be cleaned unsized, because of lower cost and to avoid excessive degradation that would result from handling, and the double screening necessary when cleaning by sizes.

In general, it has been the practice to limit the top size in mechanical cleaning to 4" or 4-1/2". The desirable range of mechanical cleaning, therefore, would be from 4" or 4-1/2" down, including all smaller sizes which, if cleaned, will aid to increase the net realization of the operation.

On the basis of direct cleaning cost, it may often seem advisable to include the 6"x4" with the above sizes to be mechanically cleaned. This may be entirely feasible with some coals, and doubtless a demand for its inclusion for beneficiation with the smaller sizes would bring about the necessary mechanical development in the equipment of the various cleaning processes.

The 6"x2" sizes of many seams, however, have a light gravity laminated coal, which must be removed to secure a product to pass a rigid visual inspection. This material in the 4"x2" size can be removed by a higher gravity separation than required for the 6"x4". In making the necessary separation for the latter, there would also be removed as middling some good coal of the 4"x2" This middling material would be crushed and re-treated to maintain recovery, but nevertheless, there would be a monetary loss due to unwarranted breakdown of the 4"x2" size. This loss could be avoided by hand picking the middlings, but would involve an additional labor cost. secure practical results on the Illinois No. 6 and similar coals with the 6"x4" included, would, for economy and

other operating advantages, probably necessitate making 1-1/2'' the lower size limit, and cleaning the Minus 1-1/2'' sizes in a separate unit.

Equivalent cleaning by hand as compared to most mechanical methods for any size below 3", is impractical, and the attempt to so clean, except for small tonnages, can definitely be considered as uneconomical if cleaning cost and results alone are considered.

Hand picking in any size results in a reject, which in cases amounts to 3% of the total tonnage of which from 60 to 65% is good, recoverable coal. This is either reprocessed by hand, and sold, or used on the basis of a very low value, or disposed of as refuse, and in either case represents a loss chargeable to method of cleaning.

It is good practice to crush these pickings to free the impurities and mix with the feed to the mechanical cleaning unit. The value of the coal so salvaged should be credited to the operation of mechanical cleaning if the costs of the latter are set up separately. It would seem, however, that comparisons in costs should be made on the basis of total preparation, in which case the salvage value from pickings would be taken into account automatically.

In mechanical cleaning, the practical problem is to make the desired separation at the predetermined specific gravity to be simulated in cleaning as complete as possible. Therefore, the most efficient cleaning process is one that will produce cleaned coal with a minimum of sink (refuse) and refuse with a minimum of float (combustible matter). The efficiency of a cleaning process is also indicated by the character of this float and sink in that the best results are shown by a high ash float in the

refuse, and a low ash sink in the cleaned coal.

The desirable cleaning process must properly clean all sizes as fed to a uniform marketable quality, whether that quality be judged by ash analysis, or by appearance, and in so doing it shall not permit unnecessary losses, or jeopardize the cleaning of other sizes. It must also lend itself to a plant operation that will be flexible, economical and efficient in preparing, handling and loading the products.

In considering the mechanical cleaning of the Illinois No. 6 and like coals of sizes below 4", the removal of the laminated material in the 4"x2" and possibly down to 1-1/2" will be found very necessary. Examination of the various gravity fractions of these sizes show this material to be of light gravity and it will be necessary, in effect, to operate at a lower gravity down to 1-1/2" or 2" than on the smaller sizes.

This is readily accomplished with a process having a separate primary and secondary cleaning. The primary is adjusted to give separation equivalent to the lower gravity necessary for removal of the undesirable laminated material. The heavier gravity material removed would pass to the secondary where separation would be made on the basis of the higher gravity suitable for satisfactory cleaning of the smaller coal. cleaned product from the secondary would be screened to segregate the plus 1-1/2" or 2 " as desired, and that material crushed and returned for recovery of the good coal it may contain. The undersize is not crushed, and is mixed with the product of the primary cleaning.

It is not sufficient to depend upon the inherent characteristic of a cleaning process that when treating a range of sizes produces the effect of separating the larger sizes at a lower gravity than the small coals. Such a method does not give proper control, and furthermore, in order to obtain recoveries, rock would have to be crushed with the middlings, unless hand picking is used. The deliberate introduction of unnecessary rock into a cleaning system is wrong practice.

Many coals, and among them the No. 6 Illinois seam, have flat, slabby impurities, the removal of which presents a problem, especially, to a process depending upon a vertical force or impulse for classification. When the flat side is exposed to such a force, there is a tendency to change its effective gravity, and the piece is raised from the rock bed and goes over with the coal. Recirculation of Middlings material reduces the probability that heavy, flat pieces will remain with the good coal. The inherent characteristic of a process and their effect on the removal of such objectionable material should be carefully considered in order that a clean product may be assured.

The shales which form a part of the impurities of the Illinois No. 6 seam, have a tendency to disintegrate and slack in water; therefore, with wet cleaning processes. consideration should be given, not only as to the time these materials remain, but also to what action it is subjected, while in the system. The character of agitation has been proven by tests to have a definite bearing on the amount of degradation within a given time. Under proper conditions, the amount of disintegrated material that enters the washing system is not a handicap to wet washing. It settles out rapidly, and is easily removed, and adequate spraying will remove all trace of it from the washed products.

The coal produced by some mining systems, notably stripping, carries a considerable amount of very fine fire clay. Floatation is the only process that will effectively separate the coals from such clays, in say Minus 100 Mesh. Processes treating an unsized feed depend on aspiration, or washing through a fine mesh for the removal of this screen entails material. Either method all of practically the loss minus 50 Mesh Coal. the removal of this fine mesh material generally improves the quality of the product by giving a better size characteristic for most uses in addition to ash elimination.

The general results in efficiency in cleaning by wet and dry processes indicate that a more complete separation can be obtained on all, or any size, by the wet process. The coal product will show less sink, and the refuse less coal loss.

The main advantage of dry cleaning is that it does not add moisture to the products as prepared for market. This added moisture, however, need not be detrimental in sizes above 5/16". Efficient screen dewatering can be expected to show the following surface moistures in sizes above 5/16".

4"x2" Moisture 2% 2"x¾" Moisture 2.75% ¾"x5/16" Moisture 3.75%

The problem, therefore, applies more especially to the cleaning of Minus b/16" coal. Dry cleaning of this size furnishes a dry product, and eliminates the problem of removal and recovery of wet sludge from the washing system. It has on the other hand, the problem of removing the dust from the air discharged from the cleaning system and maintaining satisfactory working conditions in the plant.

The dewatering of Minus 5/16" coal from a wet process can be accomplished by several different meth-

ods with approximately the following results:

- Dewatering elevator with a resultant moisture of 20%.
- (2) A dewatering high speed screen with wedge wire, or cloth mesh having openings of about 50 Mesh, with a product having moisture of 10 to 16%.
- (3) A dewatering elevator in combination with a centrifugal dryer giving expected moisture in product of from 5 to 7%.
- (4) A dewatering elevator, or screen in combination with heat drying. The moisture in the product would be under control down to a low practical limit of 3%.

A choice between two cleaning systems is a subject for very careful study and should be based on:

- The character of the expected products from the two systems.
- (2) The present and possible future requirements as to physical character of marketable coal.
- The comparative costs of cleaning.

It would seem in general that when the coal to be cleaned is plus 5/16", the wet system should be used. A logical and economical solution, when the coal down to zero or 50 Mesh is to be cleaned also, might be the wet system down to 5/16" in combination with a dry process for the sizes below 5/16".

The amount of makeup water required for a wet process is often considered a problem for operations in certain localities. It would seem that this difficulty is exaggerated by the thought of the streams of water that used to be discharged from the washing plants of years ago. Plants having feed with surface moisture about as expected in Illinois Shaft Coals are operating with makeup water requirements of from 14 to 15 gallons

per ton of 4"x0 product. A wet coal feed would reduce this by the amount of water brought in by the feed coal as surface moisture.

The value of the reject is a considerable item, and it is general practice in determining cleaning costs to charge this loss on the basis of mine costs. Proper consideration for the coveries will often result in savings as demonstrated by certain plants where the recoveries are considerably higher than indicated in one instance by an actual refuse ash of 70%, as compared with a theoretical of 66%. This is accomplished by freeing of coal from high ash impurities by crushing, and system of handling peculiar to the process.

A feed to a cleaning system that presumably has the fines removed, will still contain an appreciable quantity of under-size material due to normal inefficiencies of screening and degradation. Such of this material as is not recovered after cleaning, either due to inadequate auxiliary equipment, or to an inherent characteristic of a cleaning process that makes its recovery impossible, must be charged as a loss against cleaning.

Mention is made here of some of the features to consider when cleaning the No. 6 Illinois seam, but every coal has its own peculiarities and problems respect. The desirable cleaning process is the one that lends itself by reason of its inherent characteristics to the best solution of these problems.

The cost of operation for the various processes is subject to calculation, or based upon such information from going plants. Costs should include, maintenance, labor, power, supplies and cost of reject.

The supply item for a wet process includes water, and the amount of water in circulation has a very considerable bearing on economy of operation. It naturally affects pumping costs, but perhaps more seriously the items of capital investment and operating costs for sludge handling.

The commercial success of any cleaning system is still greatly dependent upon the over-all design of the plant. Only the proper sizing and loading of a cleaned product, and possibly drying of the minus 5/16" coal, if cleaned wet, can assure a fuel which will, for a given coal, furnish in a satisfactory manner the cheapest over-all heat or power unit, which is the fuel the consumer will use.

CLEANING COAL BY THE AIR-FLOW

By R. G. LAWRY Roberts and Schaefer Co.

Recently there has been a renewal of interest in cleaning coal by air. It has been brought about by problems which arise in washing, especially as applied to fine coal. One of the new developments in air cleaning is called the Stump Air-Flow. It is really an air jig.

The Stump process of air cleaning is comparatively new, the first experimental work having been started about a year and a half ago. Most of the testing work was done at the Bakerton Mine of the Barnes Coal Company. A brief description of the operating plant which resulted from this development work will be given later. It will be interesting, first, to cramine the construction and operation of the Air-Flow unit.

This is a sketch of the machine with a normal coal bed. The Air-Flow consists of an air tight box with a pervious deck offering resistance to the passage of air. The air enters at the back under the deck from a blowing fan. The raw coal flows on the deck which is placed on a slight slope. The air pressure is adjusted so that it will lift the coal and form a fluid boiling mass. This action causes a stratification of the particles in the bed according to their specific grav-The bed flows down the slope due to the air pressure lifting the coal, eliminating the friction. In front the top layer or clean coal flows off on a gravity chute. The lower and heavier layer of material to be rejected also flows off to a pocket with a hinged gate at the bottom.

The rejection of refuse is not at all in proportion to the thickness of the bed in the deck. This material moves much slower than the coal due to the friction and weight of the coal. To fix the position of the cutoff chute for the coal where it will separate the clean coal from the reject, makes it necessary to maintain the depth of the refuse bed. This is controlled by the refuse gate.

The flow of air through the machine is not constant but is interrupted by a revolving pulsator which cuts off the air twice for every revolution of the valve. This air pulsation accomplishes two things, first it raises the bed and allows the heavy particles to settle and second, it permits the automatic operation of the refuse gate by the dashpot. dashpot consists of a tank of water or non freezing liquid by the side of the machine. There is an air pipe extending up the center of the tank with the bottom connected to the air pressure chamber. Over the top of the pipe and in the water is an inverted "can" suspended rigidly by a rod from a walking beam.

The air pressure lowers the water on the inside, and raises the water on the outside, and also raises the upper part of the dashpot until there is a balance with the refuse gate which is hung from a rod on the other end of the walking beam. Adjustments are made of the rod lengths and also by means of sliding weights on the beam. These adjustments permit the correct opening of the refuse gate to control the flow of this material. The air pressure alone fixes the position of the gate but the pumping action due to the pulsator prevents blocking at the gate.

The automatic control is produced as follows: if the refuse bed thickens due to a slug of high ash feed, the pressure is increased due to increased air resistance. The higher pressure raises the dashpot and lowers the refuse gate, permitting an increased rejection until the bed is reduced to normal again. Likewise, if there is a sudden decrease of heavy material in the feed, the dashpot will lower and the refuse gate will close until the bed is built up again.

All of the Air-Flows now in operation are three product machines, making a middling product between the clean coal and refuse. A cutoff chute is placed between the coal chute and the deck which leads the middlings to a pocket similar to that for the There is also a gate to control the flow which is operated from the beam in the same manner as the refuse. In plant design the middle product can be retreated in case it is a mixture of coal and refuse, or when treating coals that produce a true bone or high ash coal, the product can be retained for special uses. For some coals where only a low rejection is possible, it is policy to retreat both refuse and middlings

together. I have here cuts and description of the Air-Flow used at the Barnes plant and elsewhere, also the latest Air-Flow box. A recent addition is a reciprocating feeder for the coal, and wire glass sides that enable the operator to see what is taking place at all times and to make rapid adjustments to take care of abnormal conditions. In this unit the slope of the pack is adjustable and it is self contained with the pressure chamber so air leaks are eliminated.

The Air-Flow is designed for cleaning sized coal, the usual size range being about one to three. In treating screenings the smallest size is about 1/4"x0. Of course this size is fixed by practical consideration as screening coal smaller than 1/4" or 3/16" is more expensive than is warranted. Very good ash reduction can be accomplished on the above size.

Combined ash reduction and dedusting is easily done on the Air-Flow. In our test plant experiments in cleaning, there has usually been more suction applied than was necessary. Enough work has been done to show that a very efficient removal of dust below 48 mesh can be accomplished, and that the air can be controlled to remove only finer sizes or more coarse material.

I have a drawing showing the Air-Flow cleaner built for the Barnes Coal Company at Bakerton, Pennsylvania. The coal at this mine is the lower Kittanning, commonly called Miller B. The plant handles 360 tons per hour of 3"x0 raw feed.

A flight conveyor brings the coal to the plant and the clean coal is returned to the tipple in another similar conveyor. From the 150 ton surge bin the coal is fed to six Ro-Sieve screens, making the sizes 3x¾", ¾"x¼", and ¼"x0. Each is cleaned as follows: The first size in three 18" Air-Flows; the second size in

three 18" units, and the last size in six 24" units. The middlings, and if desired the refuse, from the 12 primary units is retreated in five units on the floor below. The clean coal from all the cleaning boxes goes direct to the conveyor returning to the tipple. The final refuse is all delivered to a refuse bin for delivery to the gob pile.

The air supply for several Air-Flows is drawn from a plenum chamber served by a fan. At this plant there is one chamber and fan for the two largest sizes of coal; one for the smallest size, and one for all the recleaning units. A better technical arrangement would be one plenum chamber and fan for each size of coal.

The static pressure varies from three ounces per sq. in, for the 2" coal to five ounces or less for the 4" size. The air volume will vary from 5,000 cu. ft. per min. per 12" width of the deck for the 2" coal to 1,500 cu. ft. per min. for the ¼" size. The air volume is about 250 cu. ft. per min. per ton average for the above range of sizes. At the Barnes plant the dust is collected in two conical collectors. The air volume for this purpose is slightly more than for cleaning but at a pressure of only about 1½ oz.

Coal cleaning for commercial uses usually aims at a definite point of ash reduction with as small a bank loss as possible rather than the maximum possible ash reduction at the sacrifice of recovery. The Air-Flow process is essentially one of retreatment as by this means during the primary treatment the bulk of the low ash coal can be disposed of so that the retreating units can deal with a feed of high ash material. This method gives the best results.

COAL CLEANING METHODS IN ILLINOIS

By J. W. WILSON

McNally Pittsburg Mfg. Corp.

Presented by Mr. C. W. Waterman.

We want to express our appreciation to the Institute for the courteous request of is Program Committee, through the Institute's secretary, Mr. Schonthal, for the presentation of some views on coal cleaning in our State of Illinois. We are also outlining some equipment, admirably fitted for the economical and satisfactory preparation of coal.

In view of the limited time available, a detailed description of coal cleaning practice is hardly possible, but we believe that generally speaking, coal cleaning in Illinois largely centers around a wet washer system. Because of lack of time, the many and varied reasons for much of the present disturbance of the Illinois

small, raw coal market will have to be passed over and assumed, as you men are perhaps more familiar with those reasons than we. However, by way of pointing to a few major factors, we may recognize more fully why the cleaning of our coal is essential to the industry's complete recovery in this State. First, reducing price competition by increasing quality; second, reducing the ultimate cost to the consumer by lower freight cost per ton and a greater efficiency per pound of coal burned.

When we look back to the growth of the coal industry in Illinois and to the high place it once occupied in preparation, we can trace that prestige directly to the enterprise of the

operators of the period prior to the World War. Up to that time, the very best in preparation was the only consideration. Naturally, a considerable part of the preparation of small coal was done by coal washing. The art had not been practiced to the point it has at present, but a renewing of intent to get back to basic standards of preparation has brought a return to more serious consideration of such facilities. I am sure that if finances were available no doubt the entire state would be full of modern mechanical coal cleaning equipment and the small coal shipped. then, would bring back the high standard of quality together with the market, since lost to other field coals.

The decreasing demand for the larger sized coal and the increasing market for small coal will make possible a wider distribution for a good, well-prepared small coal.

In the 10 year period from 1907 to 1917, the tonnage washed in Illinois gradually increased from about 21/2 million tons (out of about 51,000,000 tons produced) in 1907, to about 4% million tons of washed coal in 1917 (out of about a total production of 86,000,000 tons). If 60% of this prodduct is considered as 3" screenings then, of the 50,000,000 tons of 3" screenings, almost 10% was washed. If the market at that time justified a cleaned product, obviously the present efficiency of fuel burning equipment makes it more essential than ever to prepare the present production.

With the ever increasing mechanical loading devices being used in the underground mines, it is absolutely essential to clean such loaded coal. The same general rule applies to all stripped coal.

This paper will discuss briefly only one type of wet cleaning, the Baum jig. This jig originated in Germany in 1900. Later in 1903, the system was introduced in Great Britain and today has obtained great preference in the British Isles. There are several manufacturers building Baum type units in England, but to date, only two types of this system are in use in our country, the Simon-Carves and the Ivorton Automatic. While the different types of Baum jigs vary considerably in some features, the underlying principle of separating is the same in all makes.

In this type of jig, pulsation of the washing bed is effected by air pres-By arrangement of air inlet and exhaust valves, air pressure is admitted to the off-side water column thus forcing upward current through the washing bed and on the exhaust cycle of the air, the washing bed is allowed to slowly settle. Thus stratification is taking place on both the upward and downward stroke of the pulsation. If the downward stroke is too violent (caused by "back suction"), the stratification process is much hindered and if the back suction is extremely violent, stratification on the downward stroke may be rendered nil and the wash box becomes in effect, an intermittent upward current classifier. There are some authorities who maintain that with the back suction properly controlled, more effective stratification is obtained on the down stroke than on the up stroke of the pulsation. In the light of these opinions, it is fair to presume that with a properly controlled back suction, the stratification on the down impulse may be made as effective as on the upward movement, thus making for maximum efficiency.

The principal advantages of the Baum type over the usual mechanical plunger type jig lies first, in the perfect and easily adjustable control of the pulsation and limitation of back suction to the point of most efficient operation. Second, the larger capacity per unit, it being possible to handle as high as 150 tons per hour or more in a single unit, and the multi-stage washing action made possible by the several washing compartments incorporated in each unit. In the standard two refuse discharge Baum jigs, we accomplish the same result as would be obtained by using two separate units, one operating to remove the very heavy or pure refuse, and the other operating at a lower gravity separation for removing the lighter refuse or middlings.

In many coals there appears in the nut or egg size (5" to 1") what are termed middlings. These individual pieces are made up partly of coal and partly of bone or other heavy refuse. With the Baum type washer, recovery of the coal from these middlings is made possible by the two gravity separation in the unit. As stated previously, it is possible to draw off the pure refuse through the primary refuse gate and elevator and the middl-

ings through secondary refuse gate and elevator. The middlings delivered from the secondary refuse elevator may be crushed down to about 1", thus freeing much of the coal from the refuse and returned to the wash unit for retreatment and recovery of the cleaned coal. In some cases, it may be desired to load a low grade, high ash coal, in which case the middlings product may be loaded out without retreatment.

In first cost, for a given tonnage, Baum type units are generally somewhat higher than the average wet process. However, when their higher capacities are taken into consideration, thus reducing necessary building structure, and with their extremely low maintenance cost, in the long run, they will wash coal at a less cost per ton than the average competitive wet system. After all the important thing is the consideration of the amount of coal lost with the rejects and the amount of refuse left in the cleaned coal. The efficiency of the Baum unit in this respect clearly justifies its slightly higher cost.

THE DE-DUSTING OF COAL

By E. M. MYERS

Dorman, Long & Co., Ltd., Bowburn, England

Presented by J. D. S. Drinkwater of Link Belt Co., Chicago

It has been known for a considerable time that in the mechanical cleaning of coal either by dry or wet processes, particles below 1/50th inch pass through the plant without being appreciably cleaned, and therefore constitute a handicap to the effective cleaning of the remainder. For this reason the removal of the "fines", or "de-dusting" as it has

become known, is now considered as an essential feature of modern coal cleaning plants, and indeed dedusting apparatus has been fitted into existing plants with very beneficial results.

The first attempts at de-dusting were made by using various types of screens, but even with the driest of coal, such methods were only partially successful, for if the dust contained only a small amount of free moisture, viz: 2% or 3%, the screen apertures rapidly became choked, thus seriously affecting the screening efficiency, while with very damp coals, this method became quite impracticable.

An alternative to screening out the very fine dust was to treat the coal over larger apertures of 1/8th inch or more, which would not become so easily choked, but this resulted in a considerable bulk of uncleaned coal being recovered which could not be re-mixed with the cleaned product, or even readily disposed of as a separate product. Furthermore, this fraction of the coal also contained quite a large amount of material that could have been cleaned in the plant.

It was obvious that the foregoing methods could not prevail, and that the ideal procedure would be to remove only that portion of the coal that could not be cleaned, i.e., particles below 1/50th inch. Accordingly pneumatic methods of dust extraction were introduced, and these have solved the difficulties previously met with, so that de-dusting by air separation is now a normal procedure in modern coal cleaning practice.

The removal of dust before cleaning coal by wet processes has an important effect on reducing the quantity of "slimes" produced in the washing water, and further, considerably enhances the ability of the washed coal to drain rapidly. In dry cleaning processes, preliminary de-dusting increases the efficiency of stratification of shale and coal, and as the dust always contains a higher percentage of moisture than the larger particles, the removal of this fraction eliminates one of the chief difficulties met with.

As previously stated, fine particles

below 1/50th inch (some observers place this limit at 1/25th inch) are not washed out but merely wetted. and this is a cause of a large proportion of trouble and loss, more especially when the shale, or adventitious dirt, associated with the coal is of such a nature that it easily amalgamates with the water. In the absence of de-dusting appliances there is a progressive accumulation of fine particles (coal and dirt) in the water. necessitating a quantity of "slurry" being generally run to waste, or alternatively, evacuated each week-end. As the quantity of solids in suspension in the water increases, it be comes difficult to effect proper separation of coal and dirt, while the moisture content of the "smalls" increases due to the greater difficulty of dewatering. In addition, washed products have a "slimy" appearance-unless large volumes of spray water are used-and this militates against sales.

By removing the slurry forming material in a dry condition, and only washing de-dusted coal, the foregoing difficulties are practically eliminated.

These facts are well illustrated by two plants under the author's control, both of which are dealing with similar coals. The washeries are of the "BAUM" type erected by Simon-Carves, Ltd., one being of 200 tons per hour capacity, while the other is of 125 tons per hour capacity. The former plant is four years old and has no de-dusting apparatus, while the latter was started in September 1932 and has a Simon-Carves dedusting plant incorporated. result of the experience gained with de-dusting at the latter plant, and the economies derived in the washery, arrangements are being made forthwith to equip the former plant with similar de-dusting apparatus, and this

applies also to a third washery of 160 tons per hour capacity. It should also be pointed out that the coke made from the washed de-dusted coal is superior to the coke made from the other coal, and this has also been a

contributory factor in arriving at the decision to install de-dusters. The figures quoted below are for the product below half-inch (round holes) all of which is used for coke production.

	Tons pe	r hour
(20	0 tons)	(125 tons)
Pe	ercent	Per cent
Ash content of material from slurry shakers	16.0	7.5
Ash content of "smalls" before addition of slur- ry and dust	2.2	4.5
Ash content of "smalls" after addition of slurry and dust	6.5	5,5
Moisture content		6
Ash content of dust(No	de-dustin	ng) 9.5

The figures are an average taken from daily samples over long periods and prove conclusively the beneficial effect of de-dusting. A further point that should be stressed is that coal which has been de-dusted before washing presents no difficulties in discharging from wagons, whereas in all other cases the coal is very prone to be sticky and requires more labor for discharging. This, of course, refers to the washed "smalls" below 1/2 inch.

The dust recovered by air separation is invariably lower in ash content than the same size of dust in the raw coal, or even the same size obtained by screening. This is due to a distinct density separation brought about by the air stream and this separation is very considerable in the case of raw dust with a high ash content.

De-dusting enhances the washery efficiency and enables uniform results to be obtained, so that the washing water can be used indefinitely, practically in a closed circuit because no thickening takes place.

Another important advantage of de-dusting is that the volume of effluent that it is necessary to discharge to maintain good washing results can be considerably reduced, and owing to the smaller quantity of water retained by the "smalls", the amount of "make-up" water can be likewise reduced.

Finally, the production of "slurry" and the difficulties associated with its handling and disposal are largely eliminated, while the small quantity that is produced is bright in appearance, low in ash, and much easier to dewater than is the case on plants where no de-dusting is practiced. As a result, the "slurry" can always be re-added to the "smalls" without detriment, as may be seen from the figures previously quoted.

Desirable Features in the Design and Operation of a Pneumatic De-Dusting Plant.

The first essential of any de-dusting plant is that it should be capable of removing the maximum percentage of dust below any desired size from damp coal in which the "fines" contain from 6% to 8% free moisture, and at the same time remove a minimum of oversize particles. The dust should be blown away from the air gaps, or louvres, so as to prevent clogging them, and also avoid the dust from falling through them to

build up in the dusting. In this way even saturated coal can be passed over the apparatus without the necessity of by-passing, and without rendering the plant inoperative due to blockages.

The raw coal should be very gently passed through the air separator to avoid breakage and prevent the formation of more dust, and during this passage the coal should be loosely retained to permit of thorough scrubbing by the air, without excessive pressure drop so as to ensure a high efficiency of extraction. Where possible, the air circuit should be a closed one and so designed as to give a neat and compact arrangement without unnecessary bends in the ducting which would give rise to deposition of dust and excessive wear due to the abrasive action of the dust. A further advantage of a closed circuit is immunity from dust nuisance without the provision of bag filters, although it is recognized that when dealing with damp coal it would be advantageous to pass a certain volume of the air to the atmosphere and admit fresh air to the circuit to prevent the deposition of moisture in the ducting. It is important that the design of the plant should permit of easy control and enable immediate variation in the size of dust recov-It should occupy a minimum of floor space and head room to enable it to be fitted into existing washeries without the necessity of re-elevating the de-dusted coal.

It is also important that the system resistance of the apparatus, including the cyclone separator, ducting, etc., should be kept as low as possible so that a minimum of power is absorbed by the fan which should be placed on the outlet side of the dust separator to avoid excessive wear which would otherwise occur if it were handling heavily dust laden air.

Finally the ducting and apparatus generally should be of rugged construction, the cyclone separator should be capable of giving a high efficiency, and the plant should be moderately priced.

There are many practical difficulties in the successful handling of coal dust, and it is important that a thorough examination of the dust likely to be produced should be made before finally deciding on the use to which it should be ultimately put.

In some instances the dust can be re-mixed wholly or partly with the washed "smalls" provided the resultant mixture is within the required ash limits. If the dust has a high ash-content it can be mixed with the small amount of "slurry" and burnt on Lancashire boilers. Alternatively, it can be used as pulverized fuel for it possesses the advantage of being practically free from pyrites or other hard material, so that the wear and tear on the pulverizers is greatly reduced.

In the case of washed "smalls" us 2d for coking, the addition of dust considerably lowers the moisture of the mixture, and, furthermore, provides the very valuable fusain fraction which considerably improves the resultant coke.

The description of the plant is as follows:

AVERAGE ANALYSIS OF DUST REMOVED BY THE PNEUMATIC PLANT AT THE WASHERY PREVIOUSLY MENTIONED.

(Capacity—125 Tons per hour)	Percent
Moisture	4.75
Ash	9.5
Sulphur	1.6 Dry basis
Volatile Matter	28.1

SCREEN TEST:			
Above 10 I. M. M			2.5
10 to 20 I. M. M.		**********	14.6
20 to 40 I. M. M.			
40 to 60 I. M. M			
60 to 80 I. M. M.			
80 to 100 I. M. M			
100 to 200 I. M. M			
Below 200 I. M. M.			5.8
EXAMPLE OF DE-DUST		De-Dusted Co	
	Raw Coal	Per cent	Percent
	Per cent	0.4	90.
(1) Below 50 I. M. M.	3.8	0.9	80.
(2) Below 50 I. M. M.	4.5		
Example of Variable S	ice of Dus		
		Fine Dust	04 (122 22 22 22 22 22 22
GRADING:		Per cent	Per cent
Above 1 m/m			13.4
1 m/m to 1/2 m			18.4
1 1/2 m/m to 1/4	1 m/m	9.5	23.5
1/4 m/m to 0		90.5	44.7
EXAMPLE SHOWING	ABILITY		DAMP COAL:
		Free Moisture	
		in aspirated	Size of Dust
		dust	
		Per cent	
(1)		8.5	Thru 1/16 inch
(2)		8.5	70% thru 1/50 inch
EFFICIENCY OF SEPA	RATION:		
Dust below 30		Recovered dus	
mesh in raw coal		below 30 mes	h Extractor

H. A. Treadweil: I wish to thank all you gentlemen who have prepared all these fine papers on coal cleaning.

3.36 tons

In the State of Illinois, we have in past years gone into the preparation of coal. A number of years ago there were quite a few wet washers. In recent years we have gone to hand cleaning of coal. However, in the last few years we have run into some serious competition. Therefore I feel that this mechanical cleaning is of vital importance to the Illinois coal industry.

87.5 per cent

2.94 tons

During hand loading we all know there was very little cleaning underground for coal under 3 inches. Our analysis and watching has proved to us that mechanical loading has not made our small sizes of coal any cleaner.

KINK BOX

H. H. Taylor, Jr.: We have had quite a good response on our requests for papers for the "Kink Box". I will read each paper, and the dis-

cussion, if any, on that particular subject will be held before going on to the next paper.

THE USE OF DYNAMIC BRAKING FOR EMERGENCY STOPPING OF HOIST AFTER FAILURE OF FRICTION BRAKE

By DAVID W. JONES Valier Coal Company Valier, Ill.

A friction brake is in general use for slowing down or stopping the moving drum of a Mine Hoist, by converting the energy of the descending load into heat. The wooden blocks of the brake resist the motion of the drum with a force due to sliding friction. The coefficient of friction, which is a unit of resistance, decreases as the speed is increased. In other words, for the same brake pressure applied, the coefficient of brake shoe resistance at 60 miles per hour is only one-half the coefficient of brake shoe resistance at 20 miles per hour. If a hoist is moving at a high rate of speed and the brake is not applied a sufficient length of time in advance, it can not be stopped before it reaches the landing, although there would be no difficulty in stopping through the same distance when traveled at a slower speed.

The usual Electrical Hoist with an oil operated brake requires power to prevent the setting of the brake by the force of gravity. An emergency control valve is operated by a sole-noid connected across the circuit breaker and in case of a power failure due to the opening of the circuit breaker the solenoid becomes inoperative and the oil valve closes by

gravity. This causes the brake to set immediately. But suppose for some unexplained reason the friction brake does not hold, due to lack of pressure, burnt wooden friction blocks or slippage due to unintended lubrication of some sort,—how can the hoist be stopped?

The Engineer can open the circuit breaker and thus operate the emergency control for the brake, but it would not be any more effective than the hand controlled brake against a fast moving brake drum having a very low coefficient of friction.

Dynamic Braking is the solution. If a properly designed resistance is automatically connected across the terminals of a Direct Current Motor when the emergency control is made effective by the opening of the circuit breaker, the energy of the revolving drum will generate electrical power by converting the motor into a generator, and this power will be absorbed by the resistance across the motor terminals. The energy of the revolving drum will be dissipated as heat from the electrical current in the resistance. This external electrical resistance must provide a greater load than the revolving motor can carry without slowing it down to a very slow speed.

Slowing down the speed of an electrical motor by the electrical force it generates is called Dynamic Braking. This form of control does not injure the motor in any way and is a positive means of retarding speed.

The heat dissipated is in a resistance external to the motor and if the resistance is freely ventilated a very large amount of energy can be absorbed in a comparatively short time.

ADJUSTABLE CLEVIS FOR QUICK TAKE-UP ON NEW ROPES

By JOHN STAMPER
Top Foreman, Mine 58, Peabody Coal Co.
Taylorville, Ill.

This device is made up like a pair of fish plates for track joints only they are much heavier and are longer.

These plates are made of two pieces of 1½"x6" plates 29" long, preferably of Norway iron. This de-

vice lets you take up the rope three times, 5" each time, before the clamps have to be disturbed and it works very well where step up drums are used because 5" is about the amount of take up needed to keep the ropes in balance.

SAFETY IN SHARPENING AND DELIVERY OF DRILL BITS

By LEE HASKINS Superintendent, Mine No. 1, Bell & Zoller Coal & Mining Co., Zeigler, Ill.

Mine No. 1 of the Bell & Zoller Coal & Mining Co., Zeigler, Illinois, is 100% mechanical loading mine, ing twenty-four sets of loading crews crews which requires twenty-four sets of drillers. Also the coal is shot with Cardox 100%. The Cardox shells being 2-1/2" in diameter requires a drill bit of 3" in diameter. After trying out about all the different makes of drill bits on the market, we decided to standardize on the Coal-Master Drill Bit which is a four-prong bit of heat treated steel and is of very hard material and cannot be

filed with a common file, therefore has to be sharpened on an emery stone. We first sharpened these bits on top in the blacksmith shop and delivered them on the night shift.

We are now doing this work down below. Having five motor generator set stations located in the five different sections of the mine, we installed a small electric emery stone grinder in each station and the man in charge of the station does the grinding of the bits as he has plenty of spare time to do this work,

When the bits are sharpened they

are put on the main line motors and taken to the main parting and there picked up by the gathering motor and taken to the driller at the face. These bits are strung on a wire and a brass check with the number of the loading

unit put on them so that there can be no mistake made in delivery.

With this system we have done away with a bit sharpener in the shop on top and the work is being carried on very satisfactorily.

REINFORCING ELECTRIC DRILL POSTS

By FRED BURNETT Superintendent, Peabody Coal Co., Mine 18, West Frankfort, Illinois

Practically all mechanically equipped mines are using electric drills and are experiencing some trouble with the drill posts, either bending or breaking. The question arises as to whether or not a larger and heavier drill post should be used instead of the smaller and lighter ones now in use.

Most of these mines have installed and standardized on a certain number or type of electric drill and to change to a different number or a larger and heavier drill post would cost additional expenditure of money. Of course, they could buy a number of extra drill posts of the type they are using, but this would entail extra expense.

A very simple method can be used in repairing and reinforcing the drill post, at practically no cost, which would effect a great saving to the mine costs, both in money and labor. When a drill post is sent out to be repaired, whether it is bent or broken, have the man who is going to do the repairing get the inside measurements of the hollow drill post and saw a piece of wood, preferably white oak, to these dimensions. After the drill post has been repaired, either by welding or straightening, place the drill post in the fire and let it get fairly hot, remove and immediately drive the wood into the hollow post. The drill post has been reinforced by a wooden filler, making it a good solid post, slightly heavier.

STELLITING MACHINE BITS

By THOMAS GARWOOD Orient No. 2 Mine, C. W. & F. Coal Co. West Frankfort, Illinois

You might remember our method of holding the bits for cutting machines while the stellite is being applied.

Instead of the bits being placed in an angle and the operator having to move his position and thus lose his technique, we have constructed a revolving table on which the bits are arranged around the edge and which can be rotated, bringing the bits successively into position for the application of the stellite.

SAND DRYING

By CHAS. BOYETT, Peabody Coal Co., Mine No. 47 Harco, Illinois

We originally hauled the sand for the electric locomotives into the sand drier in a wheel barrow. The demand for dry sand increased until one man with two stoves working 8 hours could not dry enough sand. He had to wheel it from the pile to the sand house and run it through the stoves and then send it to the bottom through a drill hole. When I caught our sand supply low, I built a track out of 20 lb. rails using steel ties over the top of the stove and out on the ground where the sand would be unloaded on top of it, with an easy grade up to the top of the stoves. Then I built a small hopper out of light sheet iron with a side dump that would hold as much as six ordinary wheelbarrows and to this I attached 4 old Ford Model T front wheels, using the rims for flanges to hold it on the track. The man can get his sand in the stoves so much faster and easier with the car than he could with the barrows, the stoves can be kept full getting the benefit of all the heating surface. More time can be spent keeping the stoves hot and keeping the drier sand out from under them. We use 15 tons of sand each work day.

TRACK SIGNALS PREVENT DELAYS

By W. C. CRAGGS Superintendent Peabody Coal Co. Mine 43 Harrisburg, Ill.

On haulage road at Mine No. 43, Peabody Coal Co., there are four haulage motors running over the same road. This road is exceptionally busy at all times and as the main road leads directly to the shaft, traffic on it is important.

The signal is a winking light. The lamp was already in place on entry where formerly it was used for illumination and it was only necessary to devise a means of winking when a trip was approaching the bottom or parting. The device designed for the purpose consists of a piece of strap iron spiked to a tie in the road bed.

a piece of brass strap is fastened to the iron in such a manner as to be pressed down against another piece of brass attached to a block of wood nailed to the next tie.

One can readily see the action of this device when a trip of cars pass over the rails at this point. The flange of the car wheels closes the circuit of the lamp as they pass over the device. During the interval when a wheel is not running over the switch, the contact is open. This making and breaking device in the circuit of the Lamp causes the light to wink and thus gives a signal out at the junction to the main road.

SAFETY SIGNALS TO PREVENT COLLISIONS

By THOMAS GARWOOD Orient Mine No. 2., C. W. & F. Coal Co. West Frankfort, Ill.

It is thought that our safety signal system used in connection with the underground haulage might be of interest to some of the men. We have of course the two tracks along our main haulage ways and into this at certain junctions have motors coming from opposite cross-entries. Having had motors arrive at the same time and in order to avoid collision at these points we connect our signal lamps so that, in giving any motor a clear signal, connections are so made that before the green light is made other red lights (signals to all other lines of traffic) are first in connection and it is impossible to give clear signals to two trips that might be travelling in the same direction or

cross into or over that track in use by the other motor. For instance a motor coming out of a west territory headed toward the bottom is given a green light. Red lights are positively on to motors north and east of this point on tracks leading to the bottom but green lights may be given to motors going inside to all points but the west entry. Should the motor be coming out of the east cross-entry all other lights are red and no light can be changed on any track since the inbound motors would have to cross his track. We don't have wrecks due to mixed signals when they are properly obeyed by the motor crew

HAULAGE SAFETY

By A. L. REED Chief Electrician, Mine No. 18, Peabody Coal Co. West Frankfort, Ill.

At our mine, all of our main line motor roads have steep grades both going in toward partings with empties and coming out toward the bottom with loads. We use the Monarch couplings, and as a safety measure, have provided each main line motor with two short lengths of wood, approximately 20 inches long, which have been fishtailed or V'd on one The purpose of these pieces of wood or sticks are for the motormen and tripriders to push clevis of couplings to one side, while motor is going down a grade, in bunching their loads or empties. It is necessary for the clevis of the coupling to be

pushed to one side in bunching a trip of cars, otherwise the clevis of coupling would ride on the bumper of the motor and derail the front car.

The haulage man, instead of using his hand to turn aside the clevis, used the stock of wood. This piece of wood is made from a 2x4, the V'd end being 4 inches wide, while the end the haulage man holds is narrowed down to about 2 inches and rounded, so as to give him a good grip.

This simple device has saved us many an accident to hands as well as many broken couplings.

HOISTING ENGINE REPAIRS

By HENRY J. KINSMAN
Master Mechanic, Franklin County Coal Co.
Royalton, Ill.

We have a pair of Hoisting Engines with cast iron discs. These engines were installed in 1919.

About 1923 we began to have trouble with the Crank Pins and up to December 12, 1925 we changed 3 Pins on the left-hand engine. Upon close examination we found the bore to be 0.012" out of round and a crack in the disc on the pillow block side extending about 2-1/2" deep and about 3" down towards the hub. This discovery taxed the man in charge, which fell to the writer. Obviously it was necessary to shrink a band on the disc to close the crack. Next, the hole being out of round and nothing on the grounds to rebore the hole with, the idea occurred to shrink the band on and make an oversize pin at draw. Next, where to get a band of that size. Fortunately a switch engine's driving wheel tire was measured and found to be what we wanted. A local machine shop turned it down to a shrink fit and the band was shrunk on. In the meantime the Pin was made at the mine, with a shank 2-1/2" in diameter, extending 14 inches past the proper length of Pin with about eight inches of threads; 6 threads to the inch, which were used to pull the pin into the disc. The Pin was made 0.005 inches larger than the smallest diameter and on the last 1/2 inch we had to use a ram to assist the screw in drawing it in. The local machine shop's cost including the old tire was \$91.82. The new Pin was made of an old sheave wheel shaft and our labor included, the total came to \$165.00 and we only lost two days work.

Although we ordered a new steel disc which arrived about five weeks later and cost \$425.00, we decided to do the same on the right-hand engine a few months later, on account of the time and expense of changing discs which would have taken about five days and cost \$350 for labor. These pins have been in for over seven years and show no sign of loosening.

REPAIRING BLOWER TUBING

By THOMAS GARWOOD Orient No. 2 Mine, C. W. & F. Coal Co. West Frankfort, Ill.

First we might mention the trouble of connecting blower tubing that has been cut short of original lengths. To overcome this we use short sleeves of galvanized iron with a groove rolled in one end. We then slip the tubing over this from both ends and tie a wire around it to hold the tubing in place. There is an eye

in the sleeve for hanging to some point in the roof, or rib. For the support of this tubing we use the "Yankee' drill and make 11/64" holes into which we insert a small wood plug and drive a nail. This nail is bent over and a wire stretched from them to hang the tubing from. This small push type "Yankee" drill is handy for this work.

QUESTION BOX

By J. E. JONES Safety Engineer, Old Ben Coal Corporation

5-A

Question: What do you do to keep idle electric equipment from "sweating"?

Answer: Cover with a canvas and put an electric heater of about 250 watt capacity to 1,000 horse power motor during winter months.

5-B

Question: What do you do to reduce burn-outs in electric motors?

Answer: Wind the fields and armatures in asbestos covered wire using mica or asbestos installation and asbestos tape; using high temperature solder.

Discussion notes: Armature and fields will stand 400 to 500° F. Formerly 212° F. was the limit and can be done for one-half the cost of cotton covered coils from the factory.

5-C

Question: Mantrips at night have been a source of danger because of the rush to save a few minutes after quitting time. Discipline is of some value but speed has gradually increased after each drive for safe handling of mantrips after quitting time.

Answer: A successful method now in use is for the generator attendant on the surface to lower the voltage to 175 (or that required as to distance) at once after the whistle blows. The maximum speed from this procedure is four miles per hour.

5-D

To reduce fire hazard from electric short circuit at night and on idle days the circuit breaker is readjusted for a lower amperage kickoff. The normal amperage kickoff is replaced at the starting time.

5-E

Question: Since night shifts began they have been blamed by the day shifts for most of that which goes wrong — especially misplaced equipment. Sometimes this is warranted but most of the time it is not. What have you done to place responsibility in this respect where it belongs, thereby lessening the waste of time and material?

The following papers by C. J. Sandoe, David W. Jones, G. S. Jenkins, John E. Jones, and G. G. Crowder—all members of our Institute—were presented at the 1933 meeting of the American Mining Congress at Pittsburgh and were published in "Coal Mine Mechanization" yearbook for 1933. We are grateful to the American Mining Congress for their full permission to give these papers to you herewith.

EFFECTIVE BLASTING MEANS INCREASED PROFITS AND SAFETY

By C. J. SANDOE

Vice President, West Virginia Coal Company of Missouri

Much is required of a modern coal operator in the way of constant study and experimenting to reduce the cost and improve the quality of his product so that he can more effectively meet the constant competition and pressure from other fuels. To this end in the mines of our company, we have been doing some studying and experimenting in connection with the blasting of coal. Much has been done along this line by students of mining generally and we have really only been taking advantage of their efforts. Properly speaking, our work has been limited to the application of methods devised by others to our own conditions and a study of the results to determine whether or not these methods are profitable. The subject of blasting of coal suggests immediately to the operator two important problems: First, that of protecting the employee from the hazards resulting from the same; and, secondly, that of improving the quality of the coal shot down for selling purposes in so far as the blasting may affect the coal.

In powder blasting, we are all familiar with obnoxious gases, fires, smoke, and the shattering forces that sometimes creep into the roof loosening the top coal and rock and the falls resulting therefrom. These are some of the ordinary hazards with which men working at the face are constantly confronted where powder is

used for blasting. These hazards actually are the cause of many of our most serious accidents. We are also familiar with the shattering effect of powder on the coal. A slight drop of a large lump of coal will sometimes collapse into screenings. We have all had complaints from the screenings in the cars at destinations. This is not all due to improper screening or preparation. Some is the result of the shattering effect on the coal from blasting, coupled with the jarring received in transportation.

The problems connected with blasting of coal have apparently always been a constant source of great worry to the operator, and much experimenting has been done to overcome these problems. Most of the study has been toward controlling the force of the explosion so as to concentrate the energy from the explosion in a certain spot or in a certain direction. Recently, I was told of a novel device that was patented in 1854 and had for its objective this very thing. In later years, an effort has been made to obtain the same result by heating water and creating a steam pressure. Still later, we have had the safety cartridge, the explosive cartridge, and several devices called blasting cartridges. None of these were generally used until the different grades of powder were put in pellet form. Permissible powder has been introduced to aid in heavy blasting.

There has also been developed among our present-day methods a plan of blasting through the expansion of gases. This method is known as Cardox blasting and it is to this method that I desire briefly to call your attention. In the course of our experience, I believe we have tried all of the proven grades of explosives. In November, 1931, we made our first test of the Cardox method of blasting coal at our St. Ellen Mine, near O'Fallen, Ill. In this test we were interested in the two problems mentioned-the safety factor, and the making of a better grade of coal. At this particular mine, we have a limestone roof and no large quantity of gas. After many obstacles in the way of interference, other than the actual handling of this particular method, we found that this method of blasting reduced our accident hazard and improved the quality of our coal. The latter improvement was revealed in our sales realization and this, I believe, is the ultimate test.

The coal at St. Ellen mine is loaded with the larger type mechanical loaders. Machines of this type add to the breakage in the coal where the coal has the slightest tendencey to shatter. Nevertheless, in using Cardox blasting with this type of machine, we have made a reduction in our 2-inch screenings of approximately 19 percent. The greater part of the reduction has been in the number four and five sizes and the greatest increase has been in the 6-inch lump which is increased approximately 13 percent. In the 6 by 3inch egg, there has been an increase of approximately 6 percent, while the 3 by 2-inch and 2 by 11/2-inch have remained about the same in percentage. This would seem to justify the conclusion that coal blasted through this method would handle much better than that blasted by powder. I might mention, also, that an improvement is noticed in the appearance of Cardox blasted coal. It seems brighter and cleaner. The impurities in the coal are usually along the fracture of the coal and with Cardox blasting the fracture seems to follow more generally natural lines and as a result the coal is more easily cleaned. Also, due to the reduction in the number four and five sizes, there is a marked improvement in the quality of the 1½-inch screenings.

As a factor in reducing our accident hazard, our limited experience has shown that Cardox blasting is most effective. Although I do not want to appear an extremist or partial toward Cardox blasting, it actually seems to me that as I study it and the results we have had, the use of this method is one of the greatest steps toward safety and health of the miners that has been introduced in the mines in a number of years. Obviously, it makes for the elimination of obnoxious gas and smoke in rooms where miners have to work. In the loading of coal with the large type mechanical loaders, there is very little coal dust held in suspension in the air, eliminating nose, throat, and lung irritations to the men working. The hazard of mine coal fires is done away with and with it goes the dangers connected with the sealing off of the same. The danger connected with the handling, transportation and storage of explosives in the mine is eliminated and the possibility of dust and gas explosions from blasting coal has been reduced to a minimum. Cardox blasting appears to have little effect on the roof and walls and since we have been using it we have had less falls at the face than before. Falls, I believe, account for the majority of serious injuries in the mines. Since using this method, we have really only had one accident resulting from

the Cardox blasting itself. This accident occured shortly after we began blasting in this manner. A shot-firer was struck on the leg by a flying shell because he was careless and did not obey rules. He was superficially bruised and lost only three days. Although the miners, at first, were slow to accept this system of blasting, they have rapidly come to appreciate its advantages and, I do not think I am exaggerating, when I say that our

men now prefer it to the other method of blasting. It is my firm belief that while the first cost of the Cardox method is more expensive than powder, our own experience has warranted its continued use in that we have increased our sales realization as a result through the improvement of the quality of our coal, the reduction of the percentage in minus 2inch coal, and by the reduction of the accident hazard.

GATHERING IN RELATION TO MINE HAULAGE

By DAVID W. JONES Superintendent, Valier Coal Company

Mine haulage designated "Gathering," covers the movement of cars between the main line haulage partings and the working places where coal is loaded into the mine cars.

The particular means by which mine cars are loaded determine the method of gathering required to give the most efficient operation.

Three general headings will classify the usual systems of gathering, as follows:

- (1)—"Gathering" mechanically loaded coal.
- (2)—"Gathering" conveyor loaded coal.
- (3)—"Gathering" hand loaded coal.

Gathering mechanically loaded coal may be subdivided into three types, as follows:

- (A)—Gathering with two battery locomotives for each loading unit.
- (B)-Gathering with two reel locomotives for each loading unit.
- (C)—Gathering with a single locomotive for each loading unit.

Relaying for Gathering Locomotives: Locomotives gathering for mechanical loading units require the assistance of relay locomotives to move the empties and loads between the main line partings and the immediate vicinity of the mechanical loading units. Locomotives gathering conveyor loaded cars and hand loaded cars do not require the assistance of relay locomotives.

Methods of Gathering Mechanically Loaded Coal:

(A)—Two battery locomotives gathering for a mechanical loading unit will provide a fast means of changing cars and give a high ratio of loading time to time required for car changes, when the haulage conditions and grades are not such as to cause reduction in locomotive speed due to battery exhaustion.

In determining whether one or two locomotives should be used in connection with a mechanical loading unit, consideration should be given to the maximum number of cars it is possible to load under the existing conditions within a given time by operating the machine continuously. If for instance, it is estimated that there is a possibility of loading, say, not more than 250 tons per shift under the most favorable conditions, it is ques-

tionable whether the second locomotive would be warranted in the operation. However, if there are no limiting features in connection with the loading conditions and the number of tons possible to load depended entirely upon the availability of empties for loading, the second locomotive would be worth the investment, providing an excessive outlay of capital is not required to supply the locomotive. The added expense in addition to the locomotive investment would be the labor of one motorman. One triprider could be employed in connection with the operation of two locomotives by remaining at the proper place to throw switches and couple the cars. Each of the locomotives would be operated by the motorman with the locomotive turned so that the motorman could couple the cars to locomotive and observe the adjusting and spotting of the car while under the conveyor in order to fill it full and evenly. Practically no saving can be made by employing two locomotives for changing cars when the face is located within 100 feet from the entry. If the locomotive travel in the room is as far as 150 feet, the traveling time required of the locomotive in and out of the room to set out the load and spot an empty for the loading machine is longer than the time required by the loading machine for maneuvering to clean up the working place and get set for efficient operation. When the depth of the room exceeds 150 feet, the time required for changing cars can again be shortened by laying track through a cross-cut and connecting the tracks in two adjacent rooms. The operation in this case would be about as follows:

Locomotive No. 1 has just finished loading a car under the loading machine conveyor, moves out to the entry and places the load on the entry inby the working room, then moves back to the room outby the working room and couples on to three or four empties. Locomotive No. 2 which has been standing in the cross-cut coupled to an empty follows locomotive No. 1 until it clears the cross-cut switch and then moves forward to spot an empty under the loading machine conveyor. Locomotive No. 1 has by this time re-entered the working room with empties and switches into the cross-cut in the place just left by locomotive No. 2. This completes the cycle and the loading machine was waiting for an empty only the time required for the first locomotive to move the short distance to the crosscut switch and the time required for the second locomotive to take its place under the loading machine conveyor.

(B)—Gathering with two reel locomotives for each loading unit.

If the conditions are not favorable for the operation of battery locomotives and it is necessary to use reel locomotives, similar methods of gathering may be employed, except the location of the trolley wire must be given special consideration to prevent interference of cables in the operation. The usual practice in hanging trolley wire is to place it on the crosscut side of the entry where it presents very little hazard for men, as well as cars, passing under it. However, under this arrangement when a locomotive is in a room the cable is stretched across the track and it is necessary for the triprider to stand by it constantly and see that it is not run over when the second gathering locomotive or the relay locomotive passes on the entry, setting in empties and pulling out loads as the case may be. Where there is sufficient height and the roof conditions are favorable. all cable interference among locomotives can be eliminated by placing the trolley wire on the

room-neck side of the entry. Under this arrangement the cable will not be across the entry track while the locomotive is in the room. Sufficient clearance should be provided for men and loaded cars to pass under the trolley wire. There is the constant hazard, however, that should the trolley wire fall it will lie across the room tracks. It is not advisable to extend trolley wire into rooms and for this reason changing cars inside the rooms by the cross-cut switch method is not possible, the same way as suggested for the use of battery locomotives where the depth of the room is bevond 150 feet. However, reel locomotives have greater speed and power per ton of weight than battery locomotives which permits car movements over greater distances.

(C) Gathering with a single locomotive for each loading unit:

When a mechanical loading unit is served by a single locomotive, it is the usual practice for the locomotive to be coupled to three, four, or as many cars as the motorman can handle quickly and safely. The triprider remains with the car next to the loading machine and signals the motorman to move forward or backward as required to load the car evenly or permit the loading machine to change position. It is not well to have more than five cars coupled for shifting in this manner as the motorman is not able to control the slack definitely enough to spot the empty being loaded in the proper place. When a loaded car is ready to be pulled out the triprider signals the motorman accordingly, and the load is then set out on the entry inby the working room and coupled to loads which have already been set out. The empty cars brought in by the relay locomotive are spotted in adjacent outby rooms and obtained there by the gathering locomotive when needed.

In rooms where the face is in a distance of 150 feet or more, the crosscut car change method can be used advantageously to save traveling time of the locomotive, and the operation would be about as follows:

The gathering locomotive will bring in four or five empties as explained above, the triprider signaling movements to the motorman to suit loading conditions. When a car is loaded it is switched in the cross-cut instead of moving it the full distance to the entry. If the gathering locomotive motorman starts out with, say, four empties, he will leave the fourth empty spotted under the loading machine, and while it is being loaded. move away light, couple onto the three loads in the cross-cut and set them out on the entry, then return with three or four more empties and couple to the car remaining under the loading machine conveyor. When loaded it will be set in the cross-cut as just explained. This arrangement has saved several trips back and forth to the entry with single cars and considerably reduced the waiting time for empties for the loading machine.

Relay Locomotives:

The relay locomotives required between the main line parting and the loading machines enable the gathering locomotives to work within a very close distance to the working face. It is desirable to have the distance traveled by the gathering locomotives as short as possible in order to give the loading machines the advantage of the maximum loading time. Of course, it is not possible for a loading machine to load continuously as a certain amount of time is required for shifting into desirable loading positions in order to properly clean up a place. These shifting times do not always occur during car-changing times and for this reason it is desirable to give the loading machine every advantage

by having an empty available for loading the maximum time possible. Whatever time is lost after the loading machine is in loading position can-The movements of not be recovered. the relay locomotives should be timed so that deliveries of loads to the main line parting are made and the haulage tracks cleared for the main line when it arrives at the parting with empties. The motorman of the relay locomotive should anticipate requirements and loading conditions of the mechanical loaders he is serving and obtain sufficient empties to keep the loading machines operating at maximum capacity. If he is serving two loading machines and they are both in favorable positions the maximum number of empties allowable should be available for both of his machines. If it so happens that both of his loading machines are moving into new places the minimum car requirements should be taken. Unless the motorman of a relay locomotive is capable of using good judgment in anticipating the car requirements of his loading machines, an efficient distribution of cars cannot be obtained, and many empties will be stored away and kept out of service, or the other extreme would be to have the loading machines idle without empties to load before the relay locomotive returns from his trip to the main line parting. results are obtained when the haulage men and the loading machine crews work in close contact and are familiar with all movements and prepared for unusual conditions. Usually the main line haulage locomotives are timed to be at partings at regular intervals. The relay motormen must then time their movements so that they can deliver empties to their loading machines and return with loads to the parting before the main line locomotive arrives at the parting with empties.

If several main line locomotives are

operating to the hoisting shaft, it is important to have them arrive there at regular intervals to permit uninterrupted hoisting. If a main line motorman is delayed at an inside parting waiting for relay motormen to clear the empty parting or place their loads on the load parting, it is quite likely that the operations on the main bottom will suffer serious confusion by one of the main line locomotives arriving off schedule and then having to wait in turn to enter with loads and receive empties. Whatever time a main line locomotive is idle by waiting on the main bottom for empty cars is reflected back to an inside parting where a relay locomotive is waiting for the main line locomotive to bring in empties,-and still farther inside the loading machines may be idle waiting for the relay to bring in empties after the last available car is loaded. If the main line haulage functions smoothly and the relay locomotives distribute empties efficiently, not allowing them to remain out of service where not required, the loading of cars will be uniformly and efficiently done. In other words, the production of any loading equipment will not be up to maximum unless the gathering is efficiently handled.

(2)-Conveyor Loading Units:

Gathering for conveyors or pit car loaders can be done efficiently by one locomotive and no relay is required. The number of tons to be gathered per locomotive and the number of units serviced must definitely be determined in order to make the operation economical. If for instance, a group of seven conveyors is to be served, the gathering locomotive must have sufficient time to pull the required number of cars from each loading unit to give the tonnage desired. If a group, say, of seven conveyors are served by one locomotive, a good system of haulage is as follows:

At least two working places must be assigned for each loading unit. The gathering locomotive will leave the main line parting with seven empties coupled ahead of it. The load standing under the conveyor in the last working room inby is pulled first by coupling it to the string of empties pushed into the room. This load is then pulled out of the room and spotted on the entry. The empties are again pushed into the same room and the last one spotted under the conveyor from which the load has just been pulled. The load in the next working room is pulled out and another empty spotted in the same man-This system of gathering proceeds until the last load has been spotted on the entry and the last empty spotted under the conveyor. The locomotive is then coupled to the seven loads which have been gathered on the entry and the motorman proceeds to the parting where he leaves his loads and obtains empties for another cycle of operation. The number of units to be served also depends upon their closeness to the main line parting as the main line haulage might be so timed that a gathering locomotive would make two trips to one of the main line locomotive.

(3)—Gathering Hand Loaded Coal: Gathering for hand loaders requires one locomotive for a pair of room panels and a total from 30 to 40 hand loaders are served by one gathering locomotive. The usual method is for the gathering locomotive to bring in say, 10 empties for 20 loaders, who work double, and drop one empty for each two men. The motorman then moves over to the second panel and starting with the last working place inby, pulls the loads out of the room and couples them on the panel entry. After, say, the 10 loads are gathered, the gathering motorman proceeds to the main line parting where he leaves the loads and returns with another 10 empties which he spots in the rooms from which he has just pulled out the loads. After this length of time has elapsed he is ready to start on the first panel again and pull out loads as previously explained which completes a cycle of operation from the time the empties left the parting until returned loaded from men on the hand loading territory.

In gather'ng for entries, it is necessary to spot an empty immediately upon pulling the load and this is done more frequently during the early part of the day in order to provide the time required for the men in the gang to cut and prepare the entry face after the coal has been loaded out.

LUBRICATION COST FOR LOADING MACHINES

By G. S. JENKINS Mechanical Engineer, Consolidated Coal Co. of St. Louis

In discussing this item, it becomes necessary to limit the scope of the discussion to some one phase of operation to keep from wandering into the numerous application of lubricants found in the industry of coal mining. On account of the widely varied types of locomotives—carwheels, motors—tipples, etc., these items will not be

discussed, and the lubrication cost will be limited to the cost per ton for lubrication on our loading machines.

This particular type is one widely used in the State of Illinois where the mobile type of mechanical loader alone is considered and loads approximately 31 percent of all the coal loaded in shaft mines in that state. Hand load-

ing accounts for 31 percent, and other types of loading machines and pit car loaders account for the remaining 38 percent. These figures are for the year 1932. From this it can be seen that the cost per ton for lubrication of these machines becomes one of the costs to be considered in the mining of coal.

The Consolidated Coal Company started using loading machines early in 1928 and at the present writing owns 26 of these machines and a saving of \$.001 per ton on 26 machine days operation means a saving of \$9. equivalent to \$45 per week if machines are operating 5 days On the same basis a saving of \$.005 would mean \$45 a day or \$225 on 5 days a week operation. Or to take it up to the yearly budget the saving will be \$1,000 on each million tons mined (per mil the lubricating cost is lowered).

During the past two years the Consolidated Coal Company has managed to lower its lubricating costs approximately 7 mils per ton and the saving involved is \$7,000 on each million tons produced, which at the present time represents quite an important figure.

In arriving at these figures the costs are divided into hydraulic oil cost and lubrication cost and the total of these two figures represents our "Oil Cost."

During our first years experience with loading machine we were showing an oil cost of from 1½ to 2 cents a ton, which we managed to get down to just over 1 cent a ton by 1931, and during the past two years have maintained an oil cost just over 3 mils per ton. This includes hydraulic oil and lubricant, and gives us a saving of \$7,000 on each million tons of coal produced.

During our early experience we experimented with several lubricants with various degrees of success, burning up numerous clutches and causing considerable delays, and finally decided we had to select some one lubricant and stay with it.

The lubricant we wanted was one that did not break down at the temperatures attained in the loading machines, one that was of sufficient heavy-duty to prevent undue wear in the transmission, and of such a nature as to properly lubricate the clutch plates and prevent burning; one that would not sludge, and yet still be cheap enough so that the leakage loss would not be prohibitive.

At that particular time there was a trend toward lighter lubricants, and as we were putting 10 new machines into operation at our Herrin Mine, we decided to give the theory a try, despite warnings that we might experience burned clutches and worn gears in a short time. Our experience was such that after several months we adopted the use of oil as the lubricant in all our machines. Our experience being that the lubricant temperatures were lower with oil than with grease and the viscosity of the oil at operating temperatures was higher than that of the grease.

As these 10 machines have been on our present practice from the beginning, and have at the present loaded approximately 100,000 tons each, we will limit the discussion for the present to these 10 machines as there can be no credits or deficiencies attributed to other lubricants.

As to the efficiency of the clutch lubrication, we haven't had a stuck or burned clutch at the present writing. Inspection of the gears in the transmission shows them to have no visible signs of wear and they have never been out of the machines.

There is no resinous residue on the clutch plates and several of the machines were flushed out during this year and no residue present. Other lubricants on the market would probably perform equally as satisfactory—perhaps more so, but our experience is such that we see no great advantage in further experimentation.

This brings up the question of the machines maintenance. Are We feel that properly lubricated? were they not properly lubricated after loading 100,000 tons a machine would begin to show signs of wear, and mechanically the machines are practically as good as new. Incidentally our maintenance cost per ton on these machines for their entire life is just under 1 cent per ton. This figure includes labor and materialabout 65 percent being material and the remaining 35 percent labor. The spread on the cost on these 10 machines is from about 3 mils for the lowest machine to about 2 cents for the highest one. As to the cost during the past 6 months, it is running under the average for the life of the machines-both as to labor The labor scale, of and material. course has been reduced from \$.761/4 per hour to \$.75 per hour; but this is negligible. Material, however, has dropped somewhat more. Our peak cost per ton was encountered during the first six months of service. This, however, was due to the operators learning to run and not knowing just how to handle the machines. Incidentally all repair parts used in maintaining the machines are genuine manufacturers parts, and the low maintenance figure is not accomplished by replacing with cheaper parts.

As to the method of lubricating the machines. It is done on the night shift—the night shift crew consists of 3 men, 1 repairman, 1 head greaser and assistant repairman and 1 greaser. The greasing truck is towed with a battery locomotive. While the repairman inspects the machine and

makes the necessary repairs and adjustments the other 2 lubricate the Should the machine need machine. further working on the repairman has the head oiler help him, while the oiler moves on to the next machine. We find that we have no trouble greasing the machines using this layout and at the same time have a competent man constantly on the job. In some mines the machines are greased during the operating day and this works out very satisfactorily. However, we are working the machines on a concentrated territory-10 machines in 5 consecutive panels, and the amount of traffic rather prohibits the transportation or the grease truck during the operating shift.

Regarding the lubrication. A new machine will give about 20 tons per pound of lubricant or about 150 tons per gallon of lubricant. The loss is accountable only to leakage as the lubricant actually consumed is negligible. The main points of leakage will be taken into consideration and the method in use in deciding when to try and remedy a leak.

We consider that 15 tons per pound or about 120 tons per gallon as being about all we can economically expect out of the machines, and as long as a machine approximates this we feel satisfied. Where a machine falls below this we check it over to find the source of the leaks.

One very satisfactory way of doing this is to run the machine up over paper and allow it to run. The oil shows very readily on this paper background.

One of the sources of leaks is the front clutch located under the gathering head and attached to the motor housing. This clutch is of the disc type and runs in a lubricant. The housing is split with ground joints and practically leak-proof. However, considerable leakage is experienced

at the opening through which the armature shaft extends into clutch housing. A leak at this point, can be stopped by repacking the joint, which requires about 30 to 40 hours labor at \$.75 per hour or from \$22.50 to \$30 worth of labor. We feel that a repair job should pay out in 100 shifts to be worth while; so considering the price of the lubricant, a leak at this point would have to amount to 3 to 4 quarts a day to make any net saving, otherwise the expense of repairing would amount to more than the lubricant you would lose during 100 shifts.

Another source of leaks is from the transmission case. This case is made up with ground joints and if care is exercised in taking it apart and replacing it, not to damage the ground joints, it is practically leak-proof except through the openings in the sides for Timken bearing supports. These supports are cap-screwed to the case and if care is taken to get cap-screws tight and wire them, this source of leak should be practically negligible. However, the caterpillar drive shafts extending through the side of the case, are supported by bearings which are ground, and capscrewed to the case. These caterpillar drive shafts are subjected to considerable punishment which tends to loosen the cap screw; so a frequent check of the bearing supports is necessary. We have found that sheet packing between the joints has helped considerable; lessening the tendency of the cap screws to become loosened.

Probably more lubricant leaks around the brass bushing of the drive shaft bearing than between the case and the bearing. These bushings carry all of the caterpillar drive and the punishment they receive makes them subject to considerable wear. As the lubricant level is carried well up

on the drive shaft there will be considerable leakage at this point as the bushings wear, especially when operating in a position where one side is higher than the other.

To replace this pair of bushings means \$6.70 material and 6 hours labor or \$11.20, which would neces sitate saving about a quart of lubricant a day to make a real net saving.

Probably one of the most common sources of leaks is the rear conveyor or side clutch. This assembly is partitioned and both halves require lubrication. The front half contains a disc clutch. It is imperative that this compartment be well lubricated to prevent the discs from sticking and burning; which would happen, should they run dry.

The most likely point for the lubricant to escape is through the bearings and into the rear compartment. There is considerable tendency in this direction as the oil level in the rear compartment is found to increase at the expense of the level in the fron compartment. The rear compartment is connected to a grease reservoir that extends over and around the swinging rear conveyor center shaft. This reservoir must be full to allow grease to remain in the side clutch rear compartment. The most likely place for lubricant to leak then is through this hopper reservoir.

The rear conveyor swings on a Timken bearing and the overhang is supported by rollers. These rollers must be carefully adjusted to maintain as true a balance as possible, and to keep any unnecessary wear off of the packing while swinging the conveyor. Any leak through this packing runs down the sides of the machine below the hopper. The vertical center shaft which drives from a position between the forward and reverse gears in the transmission also must be packed to prevent leakage

directly into the transmission case. To replace either of these packing rings requires the removal of the rear conveyor assembly, so both are usually packed while the assembly is off. This job requires \$1.30 worth of packing and about 30 to 40 hours labor. This means a saving of about 3 or 4 quarts of lubricant must be realized for a net saving.

The above examples are indicative of the manner upon which we determine the advisability of correcting oil leaks in the lubrication system.

As for the hydraulic system, we use red engine oil in this and get from 200 to 400 tons per gallon. averaging close to 300. We have tried ordinary "hydraulic oil" and find that the action is too sluggish and a heavier oil gives too fast an action. Just the contrary to what one would Regarding the new rubber expect. pressure hoses for the hydraulic system, our experience has been that they give increased life wherever they are not subjected to chafing-or come in contact with oil on the outside. Where those conditions are experienced we find the metal hose gives the longer life. One condition noticed is that where rubber hoses are put on the swing conveyor jacks-it slows them up slightly, probably due to the rubber hose having a smaller opening. However, this does not impede the production any and is easier on the machine.

One item that might be of interest to some is the lubrication of the motor bearings. If these grease cups are filled every night, the operator has a tendency to turn them down at intervals. This tends to get grease into the motor cases and leads to various troubles. We find that sufficient lubrication is obtained by filling the cups with high temperature grease and turning them down and leaving them empty, once every 12

shifts—this takes about .4 pound of high temperature grease per machine once every 12 shifts; and by buying this grease in 5-pound cans and lubricating the motors all at the same time a clean lubricant is insured and the additional cost in small containers is negligible.

If idle time is encountered we lubricate the machines on the night prior to the working day. As some leakage takes place while machines are standing idle this requires a slightly larger amount of lubricant, but insures a fresh and adequate supply on the working day.

Along this line some people advocate only filling the reservoirs to the lower level on the gauge. This is like running your automobile with your oil level at the low mark on the gauge. You will cut down your consumption, but you are taking a chance if a small leak starts during operation.

Another practice frequently encountered is throwing a few pounds of high temperature grease into the side clutch to prevent leakage around the vertical shafts. This stops the grease from leaking, but also probably stops adequate lubrication of some of the necessary parts.

It might be mentioned here that the lubricant consumption is more dependent on time the machine is running than the number of tons going over the machines. However, during a work day the tonnage loaded by different machines will probably not vary to a degree to very far affect the cost on a per-ton basis which is the customary method of cost accounting in the coal mining industry.

As a final check on our lubricating cost, an inventory of loader lubricant is taken each year and our yearly purchases checked against the consumption sheet turned in by the oiler and so far we have checked out all right. Of course, this means the last machine lubricated from a barrel is charged with the difference of the

lubricant used and the contents stamped on the barrel. This compensates for any mistakes in measuring.

MINE FAN ECONOMY

By J. E. JONES Safety Engineer, Old Ben Coal Corporation

Successful mine operation includes the application of as great a variety of scientific knowledge as does possibly any other type of industrial activity. Such knowledge embodies an equal amount to that required by any other industry on the face of the earth, but added to it is the need of artificially supplying underground those necessities taken as a matter of course on the surface. Chief among these is ventilation, and the chief single factor in ventilation is the mine fan.

Mechanical ventilation of mines is now wholly obtained with fans. There was a time when mechanical efforts in forcing the air down by the cylinder and piston principle were made, but these all disappeared with the advent of the fan. However, when one considers the fan as a set of cylinders and centripetal force as a piston to each cylinder, there is a connection of thought between the two.

There is probably no operating mechanism in or about a coal mine the principles of which are so little understood by the managements as those of the fan. The average management can intelligently direct any detail of any other department. With the fan, however, the limits of understanding are usually the mechanical maintenance and variation in speed. The fan is that piece of equipment which, above all others, the management accepts, bewildered as to its efficiency. The evolution of every bit of progress in and about a coal mine is at least partly attributable to

the "men at the mines" with the exception of the fan. The fan designer is neither assisted nor bothered by the mining men in his study and efforts. They accept what he has to offer, their only demands being original cost and that the fan delivers the quantity of air desired.

There is probably, also, no other operating mechanism in or about a coal mine that operates with greater regularity and gives less trouble than the mine fan. Its efficiency, therefore, has been taken by the management as a matter of course. After installation it is all but forgotten, a maximum of attention being given elsewhere, in spite of the probability that the fan and the mine are no longer properly mated, perhaps were never so, and in spite of the fact that the fan probably uses one-fourth of the power used at the mine.

In the evolution of mine fans the tendency in recent years has been from the large slow-moving fans to the smaller and speedier ones. From historical data of the Illinois Mining Institute Proceedings of 1929 we find. "It was late in 1891 . . . that Mr. James C. Simpson, general manager of the Consolidated Coal Company, invited the state mining board and inspectors, and other mining men of the state, to visit one of the company's mines in Staunton, and to spend the day in mining discussion and good fellowship. The nucleus of the meeting was the inspection of the recently installed newest type mine fan. This was a Guibal type fan, 30 feet in diameter (for mines Nos. 8 and 9). At the dinner given by Mr. Simpson on that day, it was proposed that an institute be organized, and the date of February 17, 1892, was fixed for the preliminary organization." The Illinois state coal report for 1893 shows that this fan, running 62 revolutions per minute, water gauge of 2.2, and volume of 163,000 cubic feet per minute, was belt-driven by a pair of engines 18 inches by 36 inches. The same report states that mine No. 7 of the same company had a 20-foot fan giving 92,000 cubic feet per minute at 72 revolutions per minute and 1.4 inches of water gauge. It further states that the Pana Coal Company installed an 18-foot fan and notes that other fans of various sizes were installed in that fiscal year. In the six years ending 1893, fan installations in Illinois increased from 176 to 286. Another period of increased fan installation began 10 years later with the opening of the Franklin With the excep-County coal field. tion of the 30-foot fan previously mentioned, there was no decided difference in the general sizes of fans installed, those in this most recently developed coal field ranging from 12 to 18 feet in diameter.

There has been much progress made in the design of fans. Available fan efficiency is far greater than has been generally realized. While the cost to change fans is considerable, it would pay the management of each mine to give greater consideration to the constant cost of fan operation for the full 24 hours per day, every day year after year, determining whether or not the cost of changing fans would be warranted.

In recent years there has been a decided change from steam to electricity as the drive for fans. While steam had a definite cost, this cost was not as evident as that for electric power, the latter being measured, paid for to some one else, and the cost definitely known. It is now realized more fully that a fan is a great consumer of energy, being the largest, if operated the entire 24 hours, of any other device in or at the mine. With this knowledge, made more startling because of the direct purchase of the power, there should be greater incentive to get the highest possible efficiency from fan operation.

The mine, in so far as ventilation is concerned, has a rather definite set of characteristics. The height of coal and other natural conditions are apt to remain nearly constant. The mine deisgn including the number of passageways for air travel will probably remain constant. It is probable that no natural or artificial condition will arise to materially change the resistance, other than increased distances for the air to travel as the mine expands, presuming, of course, that air passages will be kept in average opened condition.

As with any combination of work to be done and the mechanism to do the work, the greatest job is to build into the mechanism the characteristics best fitted to do that work. This is true with automobiles, airplanes, and whatnot. With a fan this, of course, is the job for the designer of the fan. As stated before, the fan and its characteristics are most elusive. However, they are subject to natural laws, the recent improved efficiency being nothing more than the result of a better understanding of those laws.

The fan designer needs to know the volume desired and the resulting pressure. He may ask if the mine will change rapidly in these requirements. Knowing the pressure and volume required, he can at once determine the energy in the air.

Efficiently operated fans are like automobiles or any other mechanical device in having an approach to correct balance between power input and work accomplished. An automobile designed to travel at 5 miles per hour and 80 miles per hour is inefficient as to the power input and work accomplished at such great variation. An automobile having an engine that operates the most efficiently at 40 miles per hour can be run with a fair degree of efficiency at a constant speed of 50 or 30 miles per hour, but if either 60 or 20 miles per hour is to be the constant speed, then it would be advisable to install the correct engine for that speed.

Similarly the correct size engine or motor can be installed, depending upon the work to be done by the fan. But, and here is where there is often confusion of ideas, any individual fan is just as efficient for the mine it ventilates irrespective of its speed. The highest efficiency of the fan depends upon two fundamental principles: First, the inherent qualities of the fan for efficient performance; and, second, how well the characteristics of the fan fit the characteristics of the mine.

It is not the purpose here to enter into a discussion of the theory of fan design. This is a problem for the fan engineer. It is the purpose, however, to call attention to the general apathetic attitude of the coal industry towards efficient fan performance. The chief faults are:

- (1) The original attempt to obtain a fan to fit the mine was without full or correct knowledge of air volume and pressure data, resulting in a fan that was a misfit, usually having the wrong idea that a larger fan is required as the mine develops.
- (2) The mine resistance has increased due to expansion to such

extent that the fan is inefficient for the present mine, and will further decrease in efficiency as the mine continues to expand.

- (3) Selecting a large expensive fan to operate efficiently during the temporary unstable period of a new mine rather than selecting a small inexpensive fan, the proper unit, to operate over the greater life of the mine when the operating requirements of the mine become more stabilized and the work to be done on the air becomes great. If a machine cannot be efficient all of the time, it is obviously preferable that the machine is allowed to be inefficient during the period that there is little work to be done rather than at that period when the amount of work to be done is great.
- (4) Old fashioned plain bearings are in too prevalent use. There is not the same consideration given to this factor as in the case of other equipment.
- (5) There is frequent loss of power between the motor and the fan. Constant speed motors stop loss of power in rheostats, short pulley centers and V belts lessen wind resistance and slippage losses.

As an example of the foregoing, a fan 16 feet by 5 feet, typical of the fans in general use in the southern Illinois coal field, in use at Mine No. 8 of the Old Ben Coal Corporation, was discarded in October, 1932, and a fan 8 feet by 4½ inches was placed in its stead. The comparative data follows:

	16' x 5' fan	8' x 4 1/2' fan
Blades	Forward curve	Backward curve
Speed	123 r. p. m.	318 r. p. m.
Volume1	13,856 cu. ft. per min.	117,300 cu. f. per min.
Static Pressure	3.56 in. of water	3.60 in. of water
Overall unit efficiency	40.3%	78.1%

This change has resulted in a monthly saving of \$552 in electric power cost.

The complete cost of this change, exclusive of motor and automatic starter, was \$5,785.11. This cost divided by \$552 (savings per month) equals 10½, which is the number of months that the saving in cost will pay for the complete installation. On the other hand, it takes considerable thought to scrap a \$27,500 fan and drive installation.

When one considers that such a monthly cost has been paid for many years, all because of not having the proper ventilating unit installed, it is time to profit by that experience and prevent, if possible, recurrences.

Fan engineers agree that the fan with backward curved blades will prove more successful when applied to mine ventilation than the fan with There are forward curved blades. two principal reasons: First, a properly designed backward curve fan can be made to develop a higher mechanical efficiency than a properly designed forward curve fan; second, the backward curve fan is a more stable ventilating unit in that it will maintain its high efficiency over a wider range of varying underground mine conditions than a forward curve fan. The forward curve fan for a particular job will be smaller than a backward curve fan for the same job, due to the fact that the volumetric capacity of the forward type is higher than the backward type. However, the slight difference in initial cost is greatly outweighed by the higher operating mechanical efficiency of the backward curve fan. It must be borne in mind that it is mechanical efficiency that determines cost of operation and not volumetric capacity or manometric efficiency. The reason for this difference in mechanical efficiency in the two types of fan is that the backward curve fan, by virtue of its larger wheel volume, passes air through itself at a lower absolute velocity than does the smaller forward curve wheel. In both cases the total work done on the air manifests itself, almost completely, in the form of pressure energy as the air leaves the fan out-Since each fan must store in the air the same amount of total energy in order to overcome the mine resistance, it is obvious that it is necessary for the forward curve fan to perform a greater amount of conversion of kinetic energy to pressure energy than the backward curve fan. A student of aerodynamics is well

Mine	Daily tonuage	Present fan size	Proper fan size	Times too large	Present fan-motor input kw.	Possible percentage power reduction	Possible saving per year at 1½ cents per kw. h.	Approximate cost of new fan	Percent return in investment per year
A	6,000	16' x5'	7.5'x3.75'	6.05	130.00	36.0	6,270.00	6,320.00	99.25
	7,000	16 x5	9 x4.5	3.50	123.00	22.0	4,130.00	8,550.00	48.30
C	4,500	12 x5	7.5 x3.75	3.42	112.00	27.5	4,700.00	6,350.00	74.00
D	10,000	12 x5	9.5 x4.75	1.68	233.00	16.5	5,850.00	9,850.00	59.50
E	4,000	16 x5	6.5 x3.25	9.25	118.50	48.5	8.770.00	4,525.00	194.00
F	4,000	16 x6	7.5 x3.75	6.05	59.10	33.3	3,000.00	7,770.00	38.10
G	4,500	16 x5	9 x4.5	3.50	64.80	32.2	3,190.00	8,800.00	36.30
H	4,200	16 x5	9 x4.5	3.50	270.00	27.5	11,320.00	8,800.00	129.00
i	4,000	16.5 x8	7 x3.5	12.60	157.00	53.5	12,800.00	4,900.00	261.00
J	7,000	14 x5	9 x4.5	2,70	149.00	44.2	9,770.00	8,310.00	117.50
K	3,000	12 x4	5.5 x2.75	6.90	60.00	71.0	6,500.00	3,270.00	199.00
L	2,500	15 x5	6.5 x3.25	8.20	26.20	73.0	2,920.00	4,510.00	64.70
M	3,500	12 x4	7.5 x3.75	2.70	60.40		4,750.00	6,350.00	74.50
N	4,000	10 x5	8 x4	1.96	68.70		5,140.00	8,300.00	62.20
0	1,500	14.5x5.84	3.5 x1.75	57.20	54.00		5,680.00	1.620.00	350.00
	R			8.60		43.5	******	******	120.00

aware of the fundamental fact that a fluid in motion, be it liquid or gaseous, when subjected to expansion undergoes the loss of a part of its energy due to "shock," which lost energy can not be recovered. It is, therefore, a corollary that the fan that has the least amount of this conversion to do can be made the most efficient fan, which is why the backward curve fan is the more efficient type.

The foregoing experience is typical of a few of the leading mines in the coal fields of the nation. To further illustrate the lack of application in keeping abreast with up-to-date fan science, the following tabulations are given for otherwise modernized coal fields, the data in part being collected by the writer:

Experience has taught us that although a fan is new and of modern design and operates efficiently at a mine of certain size, it is very improbable that this fan will operate efficiently at another mine. Rarely do two mines have identically the same ventilating characteristics.

As previously stated, it cannot be emphasized too strongly that the fan is usually the most wasteful consumer of power in or about a coal mine.

BUDGET CONTROL OF OPERATIONS

By G. G. CROWDER
Assistant to Vice President in Charge of Accounting
Peabody Coal Company

In discussing budgets in the mining industry, we find two schools, one using gross money or man-hours, and the other a unit or per ton basis. The gross money or man-hour quota basis is still in use in more companies at the present time. The per ton budget is an outgrowth of the former and overcomes or controls the variable of production, and to that extent is superior, and in addition can be made use of by finance and sales departments in addition to the operating and engineering departments. Inasmuch as everyone is familiar with the man-hour quota basis, we will confine our discussion to the working of the per ton method.

Budgets in practical use are devised to forecast results and eliminate rule-of-thumb practices. To be entirely successful and satisfactory they should be made so they can be used by all departments of a company. This is quite important and results in a smooth-working organization.

Budgets correctly prepared are used as follows:

First. By the sales department to sell with confidence varying tonnages, knowing exactly the cost of additional tonnage to give any mine more or full working time. The financial department at that time, knowing the factors of costs and selling prices in effect, can forecast immediately the resulting profit or loss.

Second. By the operating department to control their organization and obtain results expected from each mine as well as subdivisions of that mine on any day of the month.

Third. By the accounting department as a basis of this cost accounting as well as their general accounting system, thereby eliminating dual control and extra effort and expense which exists when a man-hour quota basis is in effect.

When using the man-hour quota basis, it is difficult to prepare and present in advance of operations sufficient concrete data to permit the sales and financial departments to lay their programs for 3, 6, or 12 months in advance. The proper per ton basis makes it possible to prepare a concise statement of each mine, showing production and cost per ton for any number of working days in a month. For illustration, we present the following anticipated cost for a mine:

cost of \$1.2737 and they had 30,000 tons in view at a price. The cost of this additional coal would not be \$1.2737, but the difference between 94,000 tons at \$1.1617 per ton and 64,400 tons at \$1.2737, or \$.9180 per ton.

 This chart enables the sales and financial departments to plan in advance what mines to work and how

Days	Series de	Labor and Supply Cost	Fixed Charges	Total Cost Per Ton
Worked	Production	Per Ton	Per Ton \$0,4069	\$1.7453
6	27,600	\$1.3384	.3379	1.5400
8	36,800	1.2021		1.4155
10	46,000	1.1200	.2977	1.3317
12	55,200	1.0653	.2664	
14	64,400	1.0263	.2474	1.2737
16	73,600	.9956	,2306	1.2262
18	82.800	.9742	.2170	1.1912
20	92,000	.9560	.2050	1.1617
22	101,000	.9410	.1960	1.1370
24	110,400	.9293	.1873	1.1166
26	119,600	.9184	,1797	1.0981

This form is quite condensed and has a two-day spread in working days. The labor and supply cost per ton includes all cost at the mine for which a superintendent is responsible. The fixed charges include taxes, insurance, depreciation, depletion, compensation insurance, and proportionate division office expenses.

This statement for those who work better with graphs results in a hyperbolic curve from which can be read each day of working time as well as fractions. (Exhibit No. 1.)

Now, what does this do for the sales department?

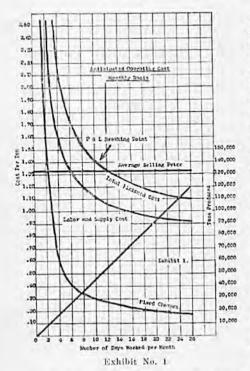
- 1. It shows the breaking point between profit or loss for each mine. You will note the point where the average selling price line cuts the total cost curve shows the number of days and tonnage needed to break even.
- 2. It shows them also the exact cost of any additional tonnage they might desire to sell over and above any certain tonnage then being produced, at a glance. For illustration, say a mine was working 14 days a month at a

many days for each one. Mines not only have high and low operating labor and supply costs but high and low idle day and supply costs as well as fixed charges. A scientific study of allotment of tonnage sold can be worked out without further effort than the application of this condensed per ton budget. This is the real test and results in a much better condition of a company as a whole.

These uses and others by the sales and financial departments can be had without causing the operating or accounting departments further effort once the budgets are prepared in this manner.

The operating department, as stated, uses this budget to control their organization and get the results they wish. It enables them to know on any date of a month with a given number of working days the cost they should have. For example, on the 20th of the month with 9 working days, it is equivalent to 12 days on a monthly basis, so the mine superintendent should have a labor and supply cost of \$1.0653. This can be car-

March Lane Mar	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Switzer ON PRODUCTION State of the Switzer Switzer can be switzer Switzer	And the second s	12 12 12 12 12 12 12 12 12 12 12 12 12 1	Table Section Library Section 1 April	
1	11 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	100	The state of the s	1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2		
	2		To take the first transfer of the first tran	1 2 3 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		
T 1-19 1111111111111111111111111111111111	7	5	To the total to the total tota			
	2	T and the state of	To take the control of the control o			
940011011111111111111111111111111111111	2	The second secon	Control Contro			
		The control of the co	Construction of the constr		March 1992 March	
. z Sereba (,	The state of the s	The state of the s	(Cont. Deposits (Cont. Deposit		Control (1997) Control (1997)	
a Berste F .	The state of the s	Fig. 1. Sec. 1	Out the second of the second o		Martin Martin Communication Co	
	Part Part Part Part Part Part Part Part	Control Street Contro	Control of the contro		Control Designation of	
terese f	The state of the s	The control of the co	Total de la companya		to the first of th	
Tata f	The second secon	And the state of t	Control Contro		And Decorations of the first f	
5, f		New Cook (Groups on Earth Transaction Cook (Groups Internation Cook (Groups Internation Cook (Groups Internation Cook (Groups Internation Cook (Groups Internation Cook (Groups Internation Cook (Groups	Committee of the commit		the Roser. The Park I have been been been been been been been be	
		A second local loc	Comment Towns Town Town Towns Towns Town		Medicine Committee Committ	
	1	Assemble (Special Control Cont	Comment of the Commen		The Transition of Part Teachers	
	1 4	Total Spiritual Control Spirit	Comment of the Commen		Wolf Lie Town	
	1, .1	Vandament Total Septem Unit to Bergin Total Septem United Total Septem S. Parency	Total		Topics of the same	<u> </u>
	1 .41	No City Control of the City of City Control of City Control of City of	Transport of the Control of the Cont			
		Transfer Transfer	1		Try l'den	-
The Mark Press			1		-	
Research Park		Total and	The second			
Total Spines		The Party of Salarian	Comfortant		Open Contrast	-
1			- Andrews		Party Property	
The Party of Light		There is party				
White Cad in Langua			Total Total Count Security		Taring Cales	-
- 1. Park			Entry (e) a		Test Date William 1	
			and a		Test for Laws	
			33.5			+
The state of the s			Tar facility of		Carlo Section	
Target County		The Course	Part letter		Total Confession	
1		Adding language	Litter		The Party of the P	
Dental Sent Side Turber		Cake Over Pappides .	Wide family frages		Part Printed Bloom	+
1		· 141 man 141			"applied faceshing	
and the part is a second secon			1		The later of the l	
The state of the s		the Case - Apple Investor	Total Charles		Cate that take	
7.44	PRODUCTION SUMMARY		SUMMARY OF COSTS			
70 140	1000	4	Tries to the second	To law his Tay	Contracts Contracted	-
i						Teles Teles
11		The Court	2 X X	7.	The Can Milana with	
Wild said		Top Labor Targe Depart	Exhib		Amagential	
15 Tange Park It. Ha	1	Section 1			**************************************	
		Task at Labor			The state of the s	-
Factor Paper		-			And the Parties and the Parties	
					+ 100 + 100 m	
		Tak All Pres'			On he hardets Tip & Been	
1	1	Tank Labor 2 Taylor			The state of the s	



ried further by breaking the total mine cost down into departments and sections so each foreman will know how he stands as well as the superintendent for his mine as a whole. The budget is made by the engineering and planning divisions from about a three-month experience to arrive at an average working day, idle day, and It is changed each time Sunday. there is a change in wage scales or general physical condition of the mine. Sufficient margin must be allowed for keeping the mine in approved working condition and frequent examinations, of course, made to see to this point. The main advantage of this per ton method is that it permits the superintendent to know exactly where he stands at any time during the month, and by knowing that he can plan and do his advance work as he has margin to do it on a systematic basis. It has been very interesting to notice the general condition of properties improve where this system has been put into effect. There are numerous hurdles along the way to prevent bad practices developing and continuing to the detriment of the property. Time does not permit of further explanation about the many steps of preparing this working per ton budget and the benefits to be derived by operating departments.

This particular method of budgeting was developed through the joint efforts of the operating and accounting departments, as all should be pre-There is absolutely no overpared. lapping or duplication anywhere in it, and the daily cost made daily is an integral part of the general account-The cost statement, a ing practice. reduced Exhibit No. 2, definitely controls all labor and equals the total pay roll, as well as all supplies. This, of course, takes in non-operating as well as operating charges.

One important diversion has been made (as will be noticed) in that all labor has been broken down into lines of control rather than departments of cost, like haulage, drainage, etc. For example, each section foreman's cost is subdivided to give his cost of coal to the parting, including the mining cost whether it be piecework or mechanical loading. electrician, mine manager, top boss also have sections on which costs are computed. There is a distinct advantage in this in that it shows the cost of each boss' department. It is quite simple to obtain the haulage, ventilation, drainage, mining machine repair, lubrication, and other costs if desired. The expense for both labor and supplies is accumulated daily and to date for a month by all these subfor further comparative divisions purposes.

Under this plan no foreman is al-

The Superior Smokeless Coal & Mining Co. The Superior Smokeless Coal &	1		Coas Coto Labor Para Lorente	Park Transport	F auto	
THE BANK OF PL Union Bank Of Prof. Cont. Bar Col. With Bar	Total To	Par EMERICAN ENGLISHED	* 0	1/10 1/10 1/10 1/10	The Superior	PAY ENDING
Crear Cut FL Ushen Deere Home Back Urleen Assert) Crear Bar Ushen Masser) Union Brightyn Fen Union Berief Famil Wiskey Deere	PY PL Bergling Turn FL Condensighmen Cot FL Usion Dues Back Usion Assem' Usion Assem' Usion Part Free Union Part Free Union Bert Free Find Cothectory Enail	N	E t B I 3	1707	e Coal & Mining Co.	<u> </u>
Cree Cut FL Usine Done Horse Back Urien Assem? Cree Bar Usine Bright Fee Usine Burlet Fund Write Union Burlet Fund Write Done	Cot FL Union Dues Back Union Assem Back Union Indigence Fire Union Indigence Fire Union Devide Fund Devide Fire Contenting Devide Devide Devide Devide Devide Devide Devide Devide	STATE STATE	S Total ENTRY FL	Empire		11
Out Work Union Burlat Front Writing Denke	Bar Under helfselper Free Work Under herfel Free Under Dereit Free Dereite Find Coffections Exact	** **	Cross Cut FL	Union Duce		1
Make Deske	Danks Face Collectors Excel	\$	Crose Bar	Union Initiation Fre		
55	Collections Exert			Dente		1 1
Collections		59	*			
Fishibit + 7	1 1 saderade	Part Life	*7		-	1 11

lowed to carry a semimonthly time book and no timekeepers are needed. The bosses write off a time sheet each day. This is printed up to simplify his work and keep distribution uniform. Captions are in line on the same as on the cost statement. A perfect balance between pay roll and cost distribution is obtained in an easy manner. Time sheets are posted direct to a duplicate pay statement. Exhibit 7, thereby eliminating all pay forms and reducing pay-roll department's time by the time used to prepare statements.

Supplies should be as closely watched and budgeted as labor. They should be charged into cost as used. This makes it necessary to accurately

account for them as received and used. This results in inventory records which permit of further studies in minimum and maximum quantities to be kept on hand. Supplies should be arranged to permit frequent checking to prevent inventory shortages which disturb the budget. This can be accomplished by arranging supplies in the bins or shelves in exactly the same order as the inventory records are kept. Space should be allotted each item so it will have a space at the front of the bin at which point a small identification card should be tacked. If the supplies are neatly arranged so they can be counted with the eye, then whole departments can be counted and

checked in a half hour and inventory variations will disappear and cease to be a disturbing element in budgeting.

This all necessitates a very close working arrangement between the accounting and operating departments, and if properly worked out the main accounting office can dispose of all expense ledgers and use the records compiled at the mines for cost purposes, for their financial records at the end of the month. Needless to say, by doing this general books can be closed 5 to 10 days earlier, which is a further advantage to the financial heads of the company.

Another distinct advantage in mak-

Mine Manager's Daily Time Sheet

						Date_				193_
			X	line .	No.					
_	1			_		Di	stri	buti	o n	1 1 1
	Check Number	NAME	W.k.q	Nate. Per Day	Esten-ion	More Manager Meter Seco	Salls how line Complete year From 4	Line liber Frankreise University Malu erreis	Nam Line Trey Arthre Dares A March	Dynes Sylvager & Desert
	-					П	Ш	Ш		
		Chief Electrician's	Time Shee	t						1
	C	chief Electricians		n	ate	_			193	- !
			Mine			_				
			Mine			Di	stril	butic	n	П
						17.	1	Allowa Allowa	100	111
	Chiefs Number	NAME	House Wikid	Terr Terr	Extension	Court Jack	phalms Parties P	Spell Ber		1
				1	1-	+	+++	TI		Tot
_				1	درار	*	The state	2	T	T
	11.	and the	The state of the s	1	7	+	++			11
222	3222			+	1	+	1	T		111
PROOF	1			+	+	1	I	111	11	+++
hrs. 69			-	-	1		111	111	+++	+++
hrs 65	-+-		-	1			111	111	+++	1
hrs. @	-+-			1		11	11	111	++	++
brs. @						11	11	++	++	1
brs. G			-				11-	1	++	H
hrs. Ø	-						1	+++	H	111
	-					1	11	+++	+++	111
	-		Total Honrs			1	111	+++	11	T
	-		Total Host		and a	+	++	+++	11	
			0	of Local	near 2	-	1		11	
Time Enter	ed by				11	1			11	
Time and	Rates Approved by-	Poter	sion Checked by	_	_	1	Circle		П	
Extended		Circle					_			
Remarks.						_	_			

ing use of the daily cost records prepared at the mines for the financial reports, it eliminates friction and misunderstanding between departments, for there is no change between the mines and the finished reports as far as labor and supplies are concerned.

This is no experiment. It has been in use 12 years in principle. Refinements are added as merited. Not long ago, the loading-machine manufacturers gave us the idea of figuring the cost of coal to the parting, which resulted in putting the mining cost into a sectional split-up under each boss. It has resulted in some savings in closer supervision of the mining or "face" cost.

The accounting firm who installs this system have applied the same principle to foundries, machine shops, retail coal yards, and numerous other forms of manufacture. It has been very satisfactory to us.

ADVANTAGES AND USE OF DEDUSTED COAL AND ITS PRODUCTS

By HENRY F. HEBLEY Allen & Garcia Company Chicago, Ill.

In Europe the removal of dust from coal was a practice brought about to improve the art of coal cleaning. American development however, grew from the demand for a special fuel, which would be more suitable for use in small automatic stokers.

When attempting to burn slack coal on domestic stokers, which are automatically controlled, either from the steam pressure line or the room temperature, it often occurs that the stoker is not in operation for a considerable period of time. During this interval, the fuel bed is prone to form a crust on the top, and on the resumption of the coal feed and the air supply, the crust forms an impervious crown on top of the fuel bed, causing a ring of "forge fire" in the furnace, with its attendant excess air and poor efficiency. mitigate this objection, minus 5/16" coal was treated in aspirators to remove the minus 48 mesh material. This procedure, especially when applied to free burning coals of the Midwest coal fields, tended to keep the fuel bed more porous. giving an even distribution of air. It is a characteristic of Illinois coals that the ash content increases with decreasing size; and as the ash is low in fusion point, the removal of the dust reduces the clinkering tendencies, and because of the absence of very fine dust, a minimum of material is lifted into the tubes, or flues, of the boiler. Apart from this freedom from operating annoyances, an eight day test comparing minus 2" screenings and dedusted coal, showed a 5% increase

in evaporation per pound of coal, in favor of the dust free coal.

When cleaning coal the possible advantages accruing from the removal of the dust prior to cleaning should be given consideration.

Improvement in Efficiency of Cleaning.

It is well known that the efficiency of coal cleaning equipment depending on the difference in specific gravity, both wet and dry, becomes less, as the size of the coal treated decreases. In this regard, the wet systems generally maintain their efficiencies to a smaller size than dry cleaning equipment, but with few exceptions. any improvement in cleaning accomplished on coal below 60 mesh, is negligible.

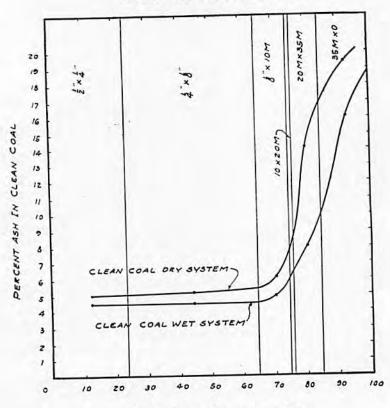
To illustrate this condition, Curve No. 1, based on data given by Mott has been drawn. Two samples of minus 1/2" coal, from the same mine and seam, were subjected to cleaning. One sample was washed in a wet system and the other was treated on a dry table. It will be noted that the wet system cleaned to 4.5% (inherent ash, 3%) down to 10 mesh, after which the ash content rose rapidly as the size decreased.

Similarly, the dry cleaning system cleaned to 5% but began to lose in efficiency below 1/8" in size. The removal of the fine sizes would have eliminated that portion of the coal which received scant improvement.

Improvement in Drainage of Washed Coal.

After coal has been washed the dewatering of the product must be as

MESH SIZES OF COAL IN FEED



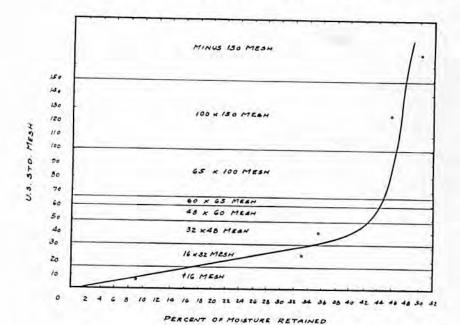
PERCENT OF SIZES IN FEED

CURVES SHOWING DECREASE IN CLEANING EFFICIENCY WITH DECREASING SIZES

Curve No. 1

efficient and rapid as possible. Sized coal above 1/2" leaving the wet sizing shaking screens, are little troubled with high moisture content as the voids are large and the ratio of surface to volume of individual coal pieces is small. However, the drainage of fine coal presents many difficulties.

Due to the large surface of the fine coal and the closeness with which adjacent pieces can be packed, capillarity in the coal mass makes gravity drainage practically useless. Also, due to the porous structure of Fusain, any considerable percentage in the fine sizes will effectually hold to moisture.



CURVE SHOWING DECREASE IN DRAINAGE DECREASING SIZES

Curve No. 2

Curve No. 2 shows the moisture retained in various sizes, after the coal sample had been subjected to gravity drainage for 24 hours. Thus, any coal below 48 mesh in size will show practically no reduction in moisture content. Other systems of dewatering are available such as high speed screens, centrifuges, suction filters, and heat dryers; but these are expensive both in investment and maintenance. Should there be soft shale or clay present, which disintegrates quickly when in contact with water, the drainage problem increases in difficulty.

Dedusting the coal prior to coal cleaning would have the advantage of removing the troublesome fraction of the feed and facilitate drainage. The characteristics of the coal may

be such that the dust removed may be low in ash content. If such is the case, the dry dust can be remixed with the cleaned fine sizes, increasing the yield and decreasing the moisture content.

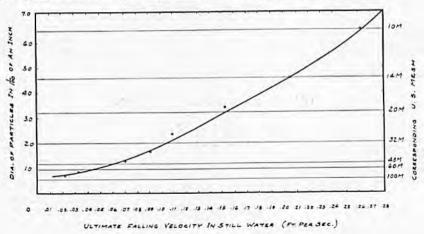
In the wet washing of coal, the appearance of the finished product is of importance. If the coal is dull and coated with fine particles of coal dust deposited by the washery water, it gives the impression of being dirty notwithstanding the fact that it conforms to the ash requirements. Rinsing sprays are used to overcome this objection, but unless generous quantities of clean spray water are used, the coal will continue to be lustreless. The elimination of the dust, however, leaves the coal brighter, as it leaves the dewatering screens and reduces

the quantity of "make up" water required.

Improvement in the Clarification of Washery Water.

In washeries where the water supply is restricted, or where the State Law forbids the discharge of contaminated water to creeks or rivers, it is necessary to install water clarification equipment. Where extremely fine sizes are present, and especially if clay or shale particles are in suspension, clarification becomes difficult.

To illustrate this condition, Curve No. 3, based on data from Needham has been plotted. It will be seen that below 60 mesh, the falling velocity is very small, even in still water. If any agitation of the water in the settling tank is experienced, the clarification is still further retarded. Due to the discharge of dirty water from the washery into the tank, there is always some disturbance and velocity present. The elimination of the fine dust before treatment, therefore reduces the water clarification problem, as the larger particles settle faster. The specific gravity of the wash water may then be kept more constant, and the washery results will be more uniform.



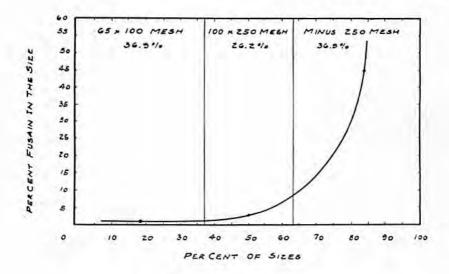
CURVE SHOWING DECREASE IN CLARIFICATION OF WATER WITH DECREASING SIZES CHEVE No. 3

Control of the Fusain in Coking Coal:

Until recently, it was thought that fusain (mother coal, or mineral charcoal) was a detriment to the manufacture of coke. It was distinctly non-coking, and tended to form a large percentage of coke breeze. However, the work of Wheeler and Mott has shown that fusain properly controlled may be mixed with coal of

a coking nature and the resulting coke will be quite satisfactory and in some cases improved.

As fusain is for the most part extremely friable, it is often found concentrated in the fine sizes. Curve No. 4, based on data given by the same authorities (Wheeler and Mott) shows clearly the rapid increase of the fusain percentage as the sizes de-



#X0" COKING SLACK #X65 MESH 81.3 % 65 MESH X 0 18.7%

TOTAL

CURVE SHOWING INCREASE OF FUSAIN CONTENT WITH DECREASING SIZES Gurve No. 4

100.00/0

crease. With coal of this nature, the removal of the fine dust and the remixing of it in the correct proportion will allow the coking mixture to be controlled. If mixed with washed coal the reduced moisture content thus brought about will enable an increased coke oven output to be obtained.

Use of the Products of De-dusting.

The foregoing description has dealt chiefly with the advantages to be derived from dedusting raw coal prior to delivering it to coal cleaning apparatus. However, with the exception of coals whose extracted dust is low in ash, and can be mixed back with the washed product, there is a

definite problem to be solved in the disposal of the extracted dust.

In contemplated plants where no coal cleaning equipment is to be installed, and the dedusted coal is to be prepared for domestic stoker use, the inability to find a market for the dust deters the operator from making the necessary installation. There are, however, various potential outlets for this by-product which will bear some consideration. When considering the uses of coal dust, the following outlets come to one's mind:

- (1) Briquetting of the dust.
- Transporting the dust in cars to pulverized fuel power plants.
- (3) Colloidal fuel.

- (4) Low temperature carbonization of the dust.
- (5) Burning the dust in furnaces without further grinding.

It is realized that in all these matters the question of economics is the ultimate governing factor, and each problem should be weighed on its merits.

Briquetting:

This method of disposing dust has been in use for many years, notably in Germany, Great Britain, Belgium and France. The briquetting of brown coal (lignite) in Germany has developed into a huge industry. This particular material fortunately does not need the addition of a binder, With bituminous coal, however, a binder is needed. This material consists either of coal tar pitch or asphalt, although, many other substances ranging from wood pulp sulphite stock to molasses have been tested and in some cases adopted. A coal tar pitch having a softening point between 140 degrees F, and 170 degrees F. gives satisfactory results.

In the manufacture of briquettes, a high proportion of fine dust will require a large amount of binder. The amount required varies from 6% for high volatile coals with small quantities of dust, to 10% for low volatile coals with heavy dust concentrations. Moisture content in coals to be briquetted should not be over 5%, and the ash content should be kept low, as it wastes the binder.

Generally, the cost of the pitch is the main item of expense, consequently the smallest amount consistent with the quality of the briquette should be used. Since so much has been published on the manufacture of briquettes, further study can be made by referring to the various publications dealing with this subject.

Pulverized Fuel Plants:

The burning of coal in pulverized form can be accomplished quite satisfactorily when the feed to the pulverizing mills is composed of dust collected from dedusting apparatus. In a test run on such material, it was found that the mills had no difficulty in grinding it, but trouble was experienced in unloading the coal dust from the car. However, there are available several designs of tank cars which have been developed for the efficient handling of finely powdered materials.

Colloidal Fuel:

Recently there has been renewed interest in the manufacture and use of coal-oil mixtures wherein finely ground coal dust is mixed with fuel oil, and a small proportion of lime rosin "soap" acting as a stabilizer. This mixture is used as a substitute for liquid fuel. It has the advantage of being able to be burned with a minimum of excess air and due to the presence of solids in the flame, a more intensely radiating flame is obtained. For a given volume, colloidal fuel contains a greater number of heat units than either coal or oil.

Due to the specific heat of the mixture being approximately 26% less than fuel oil, less heat is required for heating the fuel prior to

Test No.	2	4	6	12
Time in hours Pressure on fuel in lbs. per	2	2.25	0.66	3.17
sq. in	131.8 65.5	149.5 70.7	156.5 91.5	101.0 84.2

being fed to the burners. The following tests on the boilers of the U.S.S. Gem, burning colloidal fuel, consisting of—

30% coal

70% fuel oil

1% lime rosin stabilizer, were given by S. E. Sheppard.

Referring to the ability of the solids in the mixture to stay in suspension over a period of time, the following figures by L. W. Bates are of interest.

	Mixture	Settling Period	% Solids Settling	Use	Authority
	Poca. coal Navy fuel oil Stabilizer	6 Months	Trace	Marine Boilers.	Bates
	Coal & coke Mexican fuel oil Stabilizer	5 Months	2.6	Marine Boiters.	Bates
40% 60%	Coalfuel oil	9 Months	Trace	Marine	Bates

Tests have also been carried out by burning this type of fuel in the fire boxes of oil burning locomotives and the results were quite satisfactory.

Low Temperature Carbonization:

An enormous amount of research on low temperature carbonization of coal has been carried out during the past decade and is continuing. Many varieties of equipment have been constructed and tested. One of these, which shows promise, and which is directly applicable to the manufacture of domestic smokeless fuel from coal dust, is the C. T. G. (Chemisch-Technische Gesellschaft) system. It has the advantage of being able to coke aspirated dust 1/25" by 0" extracted from coal in dedusting units. It is claimed that excellent coke was obtained from a low grade dust containing 13.1% ash. A full description of this machine is given in the Proceedings of the Second International Conference on Bituminous coal, Vol. 1.

Production of Water Gas From PowerFuels:

It is well known that passing steam over heated carbon will form watergas, a gas very rich in hydrogen. The demand for hydrogen for various chemical and industrial processes has increased greatly in recent years, and as the water-gas method of hydrogen production is one of the cheapest, it is well worth consideration.

Normally the manufacture of water-gas is intermittent, there being alternately "blowing" and "steaming" periods.

With the Heller process, which has been installed in a semi-commercial way at the Berlin Gas Works in Germany, pulverized coal is sprayed into a cylindrical retort, where the fine coal dust comes into intimate contact with jets of superheated steam. The process is continuous in operation and provides another possible outlet for some of the dust at coal mines.

Combustion of Coal Dust Without Further Grinding:

There is another very promising field where the coal dust from dedusting equipment can be used without further preparation. It consists of burning the coal dust in the normal pulverized furnaces, modified to handle the raw coal dust. Over twenty installations have been put in at various Germany mines where dedusting or aspirating apparatus has been installed as part of the coal preparation equipment.

Most of the coal burning installations are giving very good results even though some are handling dust whose maximum size pieces are from .078 to 0.157 inches in diameter. Most of the furnaces are similar to the ordinary pulverized coal units, with the exception that inclined porous refractory grates are placed at the bottom of the furnace. The coal is blown into the furnace chamber in the usual manner, and that percentage of the dust which is small enough, burns in suspension while the heavier coal particles settle out of the gas stream and are deposited on the refractory grates.

As these grates are provided with

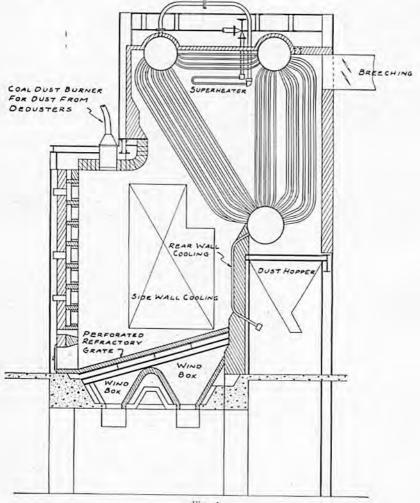


Fig 1

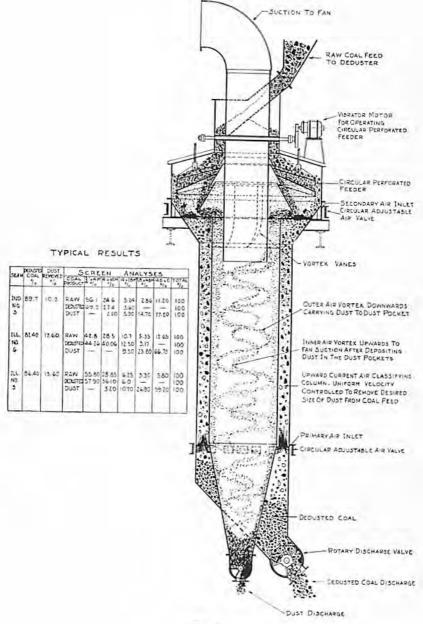


Fig. 2

the necessary air inlets, the coal, after being deposited, is supplied with sufficient air to complete the combustion of the coarser particles. The velocity of the air entering through the deck is such that all but the largest particles are lifted off the grate and burned in suspension. Fig-

ure 1 shows a cross sectional elevation of a boiler installation which is at present in operation.

The following test results taken from figures given by O. Haller are indicative of the operation that has been attained with some of these installations.

Description	Test No. 1	Test No. 2	Test No. 3	Test No. 4
Coal Burned	Med. Vol.	Low Vol.	Low Vol.	Low Vol.
Prox. Analysis Moisture Ash Vol. Mat. Fixed Carbon Cal. Value as Received	3.20 11.60 25.23 59.97 12460	2.17 6.53 11.41 79.89 13750	$1.69 \\ 8.60 \\ 21.05 \\ 68.66 \\ 13540$	1.73 7.17 12.57 78.53 13748
Screen— 1/8" by No. 76 No. 76 by No. 178 No. 178 by 0	38.38% 55.89% 5.73%	55.07% $25.68%$ $19.25%$	Dust from Aspirator	Dust from Aspirator
Boiler Steam Pressure Furnace Vol.	884 HP	315 HP. 200 lbs. 3430 cu. ft.	339 HP. 170 lbs. 1766 cu. ft.	339 HP. 170 lbs. 1766 cu, ft.
Grate Area Heat Release CO-2 Eff. %,	248 sq. ft. 12,000 13.5 81.0	11,300 13.3 80.0	18.000 15.1 79.93	18,000 16.6 83.0

ing load for the boilers would be desirous when burning the class of fuel and coal mine steam demands are notoriously fluctuating. This disadvantage, however, can be overcome by modern steam power plant design.

A study of the proximate analyses will indicate that low volatile coals containing as little as 12 per cent have been burned successfully. Coals similar to Pocahontas or New River seams with the volatile matter varying from 16% to 25%, should give no difficulty. As the ash must

be kept in its dry state, sufficient furnace volume and water cooled wall area is essential. Figure No. 2 shows a typical dedusting equipment which can be used for the removel of dust from the fines.

The object in submitting these notes has been to draw to the attention of those interested, the many and varied ways in which dedusted coal and its products can be utilized. If that object is in any degree realized, then the paper has served its purpose.

PROCEEDINGS OF ILLINOIS MINING INSTITUTE FORTY-FIRST ANNUAL MEETING

Friday, November 3, 1933

Held at Hotel Abraham Lincoln, Springfield, Illinois

MORNING SESSION

With a resounding rap of the gavel, the morning session of the forty-first annual meeting of the Illinois Mining Institute was called to order by President Charles F. Hamilton, who asked that those members of the Institute standing in the rear of the room and the lobby would please come forward and take seats. This request was graciously and promptly complied with, and with the restoration of quiet, President Hamilton opened the meeting with the following remarks:

President Charles F. Hamilton: Members of the Illinois Mining Institute, and Distinguished Guests:

It gives me great pleasure to open the forty-first meeting of the Illinois Mining Institute and to see so many members present, which voices the interest we all take in our Institute.

We are privileged this morning in having with us the Mayor of this beautiful and delightful city, who will welcome us to his surroundings. I take pleasure in presenting the Honorable John W. Kapp, Junior. (Applause.)

Welcome to city by Hon. John W. Kapp, Jr., Mayor of Springfield, Illinois:

Mr. Chairman and Gentlemen of the Illinois Mining Institute:

As Mayor of the City of Springfield, and on behalf of its citizens, I want to extend to you a most hearty and sincere welcome.

Springfield, as you gentlemen all know, is the capitol city of Illinois. We have located here the capitol group of buildings, the State House in particular, and I am only too sorry that today the Legislature is not in session so that you gentlemen could be with that august body, visit them, and see how the laws of the great State of Illinois are made.

We also have here the Centennial Building, in which building are located the Illinois State Museum and the Hall of Flags. I would like to call your attention to that great old Hall of Flags, in which is displayed a flag for every military organization that ever served under this great State. Some of you gentlemen who have had experience in a military way, or who have friends or relatives who have had military experience, will be happy to see that old flag under which you or they served.

The other building in this capitol group is the Supreme Court—a very interesting place to visit.

Springfield, gentlemen, as you know, is rich in history. We have here the home and also the newly reconstructed tomb of the immortal Abraham Lincoln. I would like to ask that you pay them a visit, especially the tomb, pause a moment there and again be inspired by the spirit of that great man,—a spirit which is so much needed during these trying times.

Now, gentlemen, if you will permit me for a moment to digress from a speech of welcome, I have in my mind a thought that I would like to give you men interested in the mining business. You have probably read in the local and metropolitan press in the last week or so a story of natural gas in the glass industry. First they subsidized the press and other gentlemen with sincere motives in order to get publicity. Now I can truthfully say that I have had a wide acquaintance with the coal and gas industries. When natural gas was first introduced into Illinois (except for my city attorney) I went by myself and appeared before the Illinois Commerce Commission, objecting to it as not being an organization which should be given a certificate of convenience and necessity for selling natural gas in this State. My reason for being there was that Springfield is almost entirely surrounded by the coal industry, and as it is primarily a coal city, I thought it would hurt Springfield in a civic way. I also had in mind trying to take care of our citizens in the way of getting for them cheaper gas. I am talking about the usual household-not the industries.

We appeared there by ourselves, objecting to this certificate of convenience and necessity being issued. No one appeared with us. wards, we made an attempt to try and induce the coal operators of the State of Illinois and the coal-carrying railroads to go along with us and help us in this fight about natural gas. Now I want to say to you gentlemen who are primarily interested in the coal business that you have a real fight on your hands. This was two years ago, and I think you are beginning to realize it now. I still have before the Illinois Commerce Commission one case in which I am attempting to say to the natural gas people that if they make a price to the industries for natural gas comparable to a price for coal, that we are satisfied, but if they make the price of natural gas to any industry cheaper than coal and then make the average householder pay more for it, we object to that.

My idea in saying this to you gentlemen is that that case is to be heard some time this month, and, if possible, I would like to have some sort of resolution passed by this august body to help me with my fight on natural gas as against coal. gentlemen know, from an economic standpoint, that the coal business of Illinois is of paramount importance, and I feel, with your help, we can see that natural gas will be sold at a price where you gentlemen will be able to live-where the coal miner will be able to live-where the railroad man will be able to live-and where all will be happy. I want to say to you that this is your fight now, along with the fight that I started. I do want to apologize to you for saying this, but it was in my mind. I feel that I want to co-operate with you in every way to help the mining industry of Illinois.

In conclusion, permit me to say that if there is any way in which I can help to make your visit here more pleasant, you will find me very, very happy to do so, as I would like to have you carry away from Springfield a pleasant memory of your visit here.

(Applause).

President Charles F. Hamilton: I wish to thank Your Honor for your gracious words of welcome, which I know are thoroughly appreciated by the members of the Institute, and also the thought which you have given them, which, in my judgment, should probably be discussed a little later, and will be introduced as "New Business." I wish that we were able to take advantage of the invitation to see the many historic places of interest in this city, but we have quite a lengthy program for the

morning session, as well as the afternoon, and the banquet this evening. However, if it is possible and we can find the time, we must ask you to show us all these buildings.

Your Honor, we will be very delighted to have you stay with us during our morning session, as well as our afternoon meeting and banquet.

Mayor Kapp: Thank you, Mr. President.

President Hamilton: The next order of business is the reading of the minutes of last meeting by the Secretary.

Mr. Schonthal arose to read the minutes of the last meeting, but before he started to do so, the Chair recognized Mr. George C. McFadden, who made the following motion: Mr. President, I move that we dispense with the reading of the minutes, as I think everyone here is well acquainted with the printed Proceedings. Motion seconded and carried.

Mr. Hamilton: The next order of business is the report of the Executive Board. As Chairman, I might say that one small meeting was held last November in Southern Illinois. where the general work for the year was discussed-and during the presseveral communications vear have been sent out on matters of interest to the Institute. Not in the way of alibi-ing, but as you all know. some of us have been busily engaged with matters of a Federal and State nature and possibly the business of the Institute has been somewhat hampered in that regard. However, I think the report will show that the Institute is in a very healthy condition both physically and financially, and to confirm that statement, I will ask the Secretary to make his report.

SECRETARY'S REPORT

Illinois Mining Institute, November 3, 1933.

To the Officers and Members of the Illinois Mining Institute:

There is very little for the Secretary to report this year, aside from the statements to be presented showing the cash position and membership situation.

We have been fortunate in being able to add to our financial position, and the operation for the year shows a comfortable profit.

Due to the many difficulties that all our members have experienced during the past year, we have not been able to maintain our position from the standpoint of numbers of members as we have in the past, but we hope that the future holds better things along this line. It is the hope of the Secretary that we might be able to get our membership during the coming year up to at least five hundred active members.

I wish to express my appreciation to all the members, the executive board, and the officers for their willingness to co-operate whenever this was needed.

During the year we suffered the loss of three of our members: Mr. Joseph Viano, Mr. David I. Rock (who was a member of the executive board), and Mr. John Rollo (who was an honorary member, having been a charter member of the original Institute formed in 1892). Letters of condolence were dispatched to the members of the bereaved families.

Respectfully submitted.

B. E. SCHONTHAL.

Secretary-Treasurer.

President Hamilton: Next in order of business is the report of the auditing committee:

ILLINOIS MINING INSTITUTE

Cash Statement, November 1, 1933

REPORT OF AUDITING COMMITTEE

\$981.75	
=00.00	\$481.75
	825.00
	225.00
	318.18 .14
	\$981.75

DISBURSEMENTS:

The foregoing is found to be correct.

Bonds Owned by the Illinois Mining Institute:

One-Chicago,	Burlington & Quincy Railroad Co	1,000.00
One-Missouri	Pacific Railroad Co.	1,000.00
One-Western	Union Telegraph Co	1,000.00
Two-U. S. Tr	easury Certificates, \$1,000 each	2,000.00

(At the reading of the item, "Profit from boat trip, 14 cents," there was much mirth and laughter.)

President Hamilton: Gentlemen, you have heard the report of the Secretary and the financial report. What is your pleasure? I would be glad to receive a motion that they be adopted as read and placed on file.

Mr. Joyce: I make a motion to that effect. Duly seconded and carried. (Unanimously adopted.)

President Hamilton: Mr. McFadden, have you a report to make on membership?

Mr. George C. McFadden: Mr. Chairman and Gentlemen: From what the Secretary reported, it would appear that the Membership Committee was not too successful in obtaining new members, but we feel reasonably sure, as a committee, that when this meeting closes today the endeavors

of the Membership Committee will have shown very good results in the number of registrations.

AUDITING COMMITTEE.

President Hamilton: Is there any unfinished business to come before the Institute?

Secretary Schonthal: None that I know of.

President Hamilton: We have now reached the time for new business. Is there any new business to come before the Institute?

Mr. John A. Garcia: There has been quite a little discussion among certain members, and rather earnest discussion at that, on the question of establishing a scholarship in Mining Engineering at the University of Illinois, to be sponsored by the Illinois Mining Institute. I would like to bring this question up for discussion at this time, to the end that our officers appoint a commit-

tee to discuss the subject and make a report on our River Trip next June. It is our idea that some lad from the mining camps be given an opportunity for an education at Urbana and that the movement be sponsored by the Illinois Mining Institute.

President Hamilton: The meeting is open to discussion on this suggestion.

Mr. H. H. Taylor, Jr.: Because of purposes of the Illinois Mining Institute is to promote education in coal mining within the State and because of the fact that I think we have a very able staff in a school right within our own State, I think that it is very proper that we start this very commendable scholarship fund, and I move that you appoint a committee to discuss the matter and report back in the near future, or, as Mr. Garcia suggested, on the annual boat trip.

President Hamilton: Any further discussion? There seeming to be none, the President inquired of Mr. Taylor if he understood that he made the foregoing as a motion, and Mr. Taylor replied in the affirmative, upon which the motion was duly seconded and carried.

President Hamilton: Mr. Taylor, just how many do you suggest I shall appoint on that committee?

Mr. Taylor: Three.

President Hamilton: It has been moved and seconded that a committee of three be appointed to inquire into and arrange for considering an appropriation for a scholarship or scholarships in Mining Engineering (to be available later) at the University of Illinois. I take the liberty of suggesting that the appointment of that committee be referred to the present Executive Board, so that the incoming president may have a hand in the selection of it, as this administration is about at an end.

Mr. Garcia: All we ask is that the Illinois Mining Institute take this matter up, and we leave it to your judgment, Mr. President, as to how the matter be handled.

President Hamilton: Any discussion on this subject? There being none, he said that the announcement of the personnel of the Committee on Scholarship would be made at the afternoon meeting and that a meeting of the Executive Board was called immediately after the adjournment of the morning session and before the luncheon. He then inquired if there was any further new business, and Dr. M. M. Leighton, being recognized by the Chair, spoke as follows:

Mr. President, and Fellow Members of the Illinois Mining Institute:

I have a matter I would like to call to the attention of the Institute, too. I have discussed this matter previously with your President and a few others. Therefore, I feel that it is proper to bring this matter to your attention.

You have in mind that three years ago the Illinois Mining Institute took the initiative in sponsoring the establishment of Mineral Research Laboratories at the State Geological Survey at Urbana. These Laboratories, by grant of the Legislature, were established, and they have now been running about two years. The results of their researches seem to be so successful as to make the suggestion that I am going to make proper.

The position that we took at that time was that it made no difference as to the housing of these laboratories—just so we got them. Our position was: "Give us temporary space in which we may be able to show whether or not such researches as we wish to make will be of value."

The time has now come when the

evidences of those researches are apparent, in several ways. Many of you have visited the Laboratories at Urbana and many of you have heard our reports on our investigations. The exhibit of briquettes made from fine coal without an artificial binder out in the hall is one tangible result. There are others that I will not take time here to describe.

The point is—that these Laboratories, which have been running now about two years—are overcrowded and there is no room for more equipment needed to carry out fully the lines of research. Our space is entirely inadequate.

Now, it so happens that there has arisen this Public Works fund of the Federal Government of several billions of dollars which is to be allotted to various sections of the country for those things that will help aid employment and also give stability to the present economic needs of our country.

I wish to call this matter to the attention of the Institute and raise the question as to whether or not consideration should be given to the matter of asking for an allotment that would provide adequate housing for the Mineral Research Laboratories.

In discussing this matter with your President, he suggested that I bring before the Institute this statement, and that, if this body saw fit, it be referred to the Executive Committee for further consideration, with the view of an appointment of a Special Mineral Industries Building Committee.

There are one or two things I would like to mention in this connection. I am sure that you will be interested to know that in connection with the reclassification of North American coals, which is under the sponsorship of the American Society for Testing Materials, that we have

been able to clear up a number of questions in regard to whether some of the Illinois coals should be classified as bituminous or sub-bituminous. It was only by having our own laboratories that we were able to study these questions and obtain scientific information which now answers these questions and makes it clear that Illinois coals should be classified as bituminous. In this work, our results were checked by the laboratories of the United States Bureau of Mines.

Now, these laboratories are in position to do that kind of thing, and while some of our work may not appear on the surface, it is being done wherever possible to support our coal industry, to extend the uses of Illinois coal and all the other mineral products in this State-and so I wish to leave this question to you, as to whether or not this matter should be given consideration by the Instituteas to whether or not a request should be sponsored by them, for an allotment of funds from Public Works in Washington for the building of our new Mineral Industries Laboratories on the campus of the University of Illinois, where these laboratories can have full facilities for their work.

President Hamilton: You have heard the very interesting presentation of a subject which I think is very proper to come before the Institute. May we not have a rather full discussion on it, or at least some action taken on it?

George F. Campbell: To bring this matter before us for discussion, I would like to move that the sense of this meeting is that we favor the proposition submitted by Doctor Leighton. I would like to move further that a committee of three be appointed to draft a resolution to be sent to the proper authorities in Washington for this purpose.

(Motion seconded and carried.)
President Hamilton: Is there any
further discussion?

Harry Fishwick: Mr. Chairman, I like the idea of trying to get an allotment from the Federal Government to build such laboratories as will properly house the Mineral Research Laboratories. If it is at all possible, I think we ought to have a committee who will take time to go down to Washington and interview Mr. Roosevelt and try and get the money that way rather than through the adoption and sending of a formal resolution. What do you think about that? We can send a resolution from this body. but go along further and do everything within our power to have this proposition put through. I think it would be well to spend a little money to try and put this thing over. We have some, and if we can put this matter over, I think we ought to do it.

President Hamilton: Mr. Campbell, you moved, I believe, that a committee of three be appointed to endorse this idea and draw up the proper resolution to foster it and carry it on to—at least we hope—a happy conclusion, and the motion was seconded and carried. Is that right, Mr. Campbell?

Mr. Campbell: Yes, that is right. President Hamilton: Any further discussion? If not, the motion is carried and the committee will be announced at the afternoon session. We are now ready for the report of the nominating committee.

Mr. Garcia: I would like to say that the Nominating Committee was made up of George F. Campbell, Paul Weir and myself. We had considerable difficulty in getting together because of Code meetings, but we have been mindful of the fact that the Illinois Mining Institute now represents the coal mining industry of

the State of Illinois and we have been very zealous in our selection of the men for this honor. We have tried to get a true perspective of the coal mining industry of Illinois and we have drawn up a slate and submitted it to your Secretary, with the earnest request that you gentlemen will endorse it.

REPORT OF NOMINATING COMMITTEE

Read by Mr. Schonthal.

November 3, 1933

To the Officers and Members of the Illinois Mining Institute:

We, the undersigned, constituting the Committee on Nominations, offer to this meeting the following list of officers and executive board for the coming year:

OFFICERS

President—H. A. Treadwell, Benton. Vice President—C. J. Sandoe, St. Louis.

Secretary-Treasurer—B. E. Schonthal, Chicago.

EXECUTIVE BOARD

W. J. Austin, Chicago.
P. W. Beda, Chicago.
Paul Halbersleben, Harrisburg.
Charles F. Hamilton, Chicago.
Dr. M. M. Leighton, Urbana.
Geo. C. McFadden, Chicago.
John G. Millhouse, Springfield.
Fred S. Pfahler, Gillespie.
E. F. Stevens, St. Louis.
H. H. Taylor, Jr., Chicago.
T. J. Thomas, Chicago.
Paul Weir, Centralia.

Respectfully submitted, JOHN A. GARCIA, Chairman.

GEO. F. CAMPBELL, PAUL WEIR.

President Hamilton: You have heard the report of the Nominating Committee. What is your pleasure? Mr. McCulloch: I move that the report be adopted as read. Seconded and carried.

Preisdent Hamilton: I believe that a motion will be in order at this time to instruct the Secretary to cast a unanimous ballot for the election of the officers as nominated. Motion was made, seconded, carried and the Secretary announced that the slate was unanimously elected.

President Hamilton: Any other business?

Mr. B. E. Schonthal, Secretary, read a communication from Mr. Eugene McAuliffe; also a wire from Paul Weir.

Mr. Hamilton: This closes the business session of our meeting and we are ready to launch into the program. It gives me great pleasure to call as Chairman of the morning session Mr. George C. McFadden, Vice-President of the Peabody Coal Company.

(Applause.)

Mr. George C. McFadden: Mr. President and Guests: I wish to call your attention to the announcement on the back of your program. My good friend Doctor Leighton has an exhibit on the outside and there will be someone in attendance there who will be able to give you any information you want as to the experimental work that has been carried on in the manufacture of briquettes by the Mineral Research Laboratories. A little later on, before we recess, I will announce where to get your luncheon and banquet tickets.

The first paper to be presented this morning is entitled: "The Physical Construction of Illinois Coal and its Significance in Regard to Utilization", by Dr. G. H. Cady, Head of Coal section, and Dr. M. M. Leighton, Chief, Geological Survey, Urbana, Ill.

The paper will be read by Doctor Leighton and will be illustrated with motion pictures. Gentlemen, you all know Dr. Leighton.

Dr. M. M. Leighton: (Applause.)

Mr. President and Gentlemen: Before beginning the reading of our paper. I might say we welcomed the opportunity to place on exhibit in the outer hall here the results of our work of briquetting Illinois coal fines without a binder. I may say in that connection that these are the results of an extra intensive study of the whole question of the compression and impaction of Illinois coal fines. In the case of compression, we found that that was to be discarded. In the case of impaction, we found that there is a decided promise that Illinois slack can be compacted under certain conditions of compaction. making the briquettes 21/2" in size, without the use of an original binder. The investigation has not yet been completed, as we wish to take up such questions as the permissible range of ash in coal slack; also the question of the impaction of dust in which there is a great overlay of fusain. which affects impaction-also questions on the fusain tests of these materials-but we wanted to bring this question to your attention at this time in order that we might receive from you any questions or any suggestions that might help us in rounding out this investigation in the most profitable way for the industry.

I wish to say before reading our paper that there was a typographical error in the title as printed on the program. It should have read: "The Physical Constitution of Illinois Coal and its Significance in Regard to Utilization."

THE PHYSICAL CONSTITUTION OF ILLINOIS COAL AND ITS SIGNIFICANCE IN REGARD TO UTILIZATION

By GILBERT H. CADY Illinois State Geological Survey

Presented by M. M. LEIGHTON Chief, Illinois State Geological Survey

Introduction

Within the last twenty years, and mainly within the last ten years, there has developed a new technique of coal investigation based on a study of coal as a rock substance rather than as a complex chemical compound. The discriminating information which Reinhardt Thiessen of the Bureau of Mines has assembled on the petrographic characteristics of a large variety of American coals indicates the most promising means of unraveling the tangled skein of coal composition.

The investigations by the Illinois Geological Survey of the physical constitution of Illinois coal in accordance with the procedure of the new technique of coal investigation has been underway for about three years, but the studies were expanded in 1931 when the Survey, through legislative grants, found it possible to enlarge its research activities. The present paper describes briefly the physical constitution of Illinois coal as revealed by microscopic study and suggests the practical value of the more accurate knowledge of the physical character of coal. An understanding of the nature of the physical constitution of coal is, we believe, the best basis for the study and interpretation of chemical attributes, and with the chemical data, provides a fundamentally sound basis for experimental research. Practical application rests largely with the engineer.

The Physical Constitution of Illinois Coal¹

General characteristics .- Illinois coal is predominately of one general type. that is, normal, banded, bituminous coal. It varies in rank from bituminous medium-volatile coal to bituminous high-volatile high-moisture coal, the coal of lowest rank being little removed from coals known as subbituminous. From the standpoint of rank there is, therefore, a relatively narrow and yet a definite range of variation among Illinois coals which permits of discriminating marketing on the basis of rank characteristicsnamely calorific value, moisture content, and carbon ratio.

Within each rank of coal, representing a stage of coalification, various types of coal are found, each type representing concentration of

¹ The microscopic investigations of coal by the State Geological Survey have been carried on largely by L. C. McCabe, who is also responsible for the photographs shown. Studies in mineral constituents of coal are being made by C. G. Ball. Macerated residues have been investigated by L. C. McCabe, J. M. Schopf, and O. J. Henbest. The thin and polished sections are prepared by W. S. McCabe. The author gratefully acknowledges his indebtedness to these associates for the technical data presented in this paper.

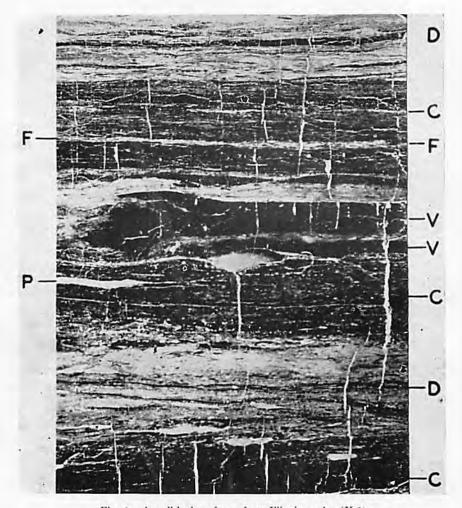


Fig. 1. A polished surface of an Illinois coal. (X 2)

- D. Durain, dull or splint coal with thin streaks of bright coal (vitrain). A relatively uncommon ingredient in Illinois coals.
- C. Clarain, bright but definitely laminated or striated coal. Most Illinois coal is clarain.
- F. Fusain or mineral charcoal, appears white in the photograph due to its tendency to reflect light. It is actually the blackest ingredient in the coal.
- V. Bright coal of uniform, unstriated appearance. The most conspicuous ingredient in the coal and the one largely responsible for its banded appearance.
- P. A small lens of iron pyrites ("sulfur"). It is difficult to distinguish from fusain in the photograph. The small thick lens about the center of the photograph is a lens of fusain.

certain kinds of coal-forming material. The three most widely recognized types of coal are normal banded bituminous, such as that common in Illinois, cannel coal, and bog-head coal. Normal banded bituminous coals are derived from forest swamp peats, and hence are predominately woody in origin, Cannel coals contain less woody material, consisting largely of windborne plant constituents, such as spores and pollens, deposited in open water areas in the coal swamp. Algal or boghead coals, as their name implies, are derived from algae, also in more or less open water localities in the coal swamps. No algal coals and but few cannel coals are known in Illinois.

The statement that Illinois coals are predominately of the banded bituminous or forest-peat type indicates that they consist of a closely matted aggregate of the various plant parts and plant secretions which contributed to the forest peat. The specific character of any coal of this generalized type is determined by the extent to which the different components contribute to its consitution.

The Banded Ingredients

The most obvious effect of differences in the plant parts that contributed to the coal material is the banded consitution of the coal (Fig. 1). The bands represent the cross sections of thin lenticular layers of different coal material as they appear on the joint and fracture surfaces. There are three main types of bands in Illinois coal seams and a fourth less common type: (1) The jet-black, brilliant, mainly structure-

less bands; (2) the bright more or less faintly laminated bands that make up most of the coal, and (3) the mineral charcoal or fusain. Occasionally (4) there are bands of distinctly dull coal which appear to be either highly mineralized bright coal or in the nature of splint coal which is not necessarily of high mineral content. These three common varieties, with the fourth uncommon variety, of coal material have been called by Stopes the Petrographic ingredients of coal. Although recognizable in other ranks of coals they are particularly characteristic of bituminous coals and are significant because each petrographic ingredient possesses a characteristic physical constitution inherited from its swamp forest origin and determined by the kind of plant materials of which it is composed.

To avoid the use of elaborate explanatory phrases, Stopes applied names to these petrographic ingredients. The brilliant jet-black coal was called vitrain; the bright, laminated, coal, clarain; the mineral charcoal, fusain; and the dull coal, which is not commonly present in Illinois coals, durain, which Thiessen² regards as the same as American splint coal.

Illinois coal is usually composed predominately of clarain; it contains variable amounts of vitrain up to possibly 25 per cent, fusain rarely in excess of 10 per cent, and durain rarely in excess of 5 and usually less than 2 per cent.

These figures interpreted in terms of tonnage for Illinois coals become imposing when it is realized that between 2-1/2 and 5 million tons of fusain, and 12 to 15 million tons of

Stopes, Marie C. "The Studies on the Composition of Coal". The Four Visible Ingredients in Banded Bituminous Coal. Proc. Roy. Soc., London, Vol. 90 B. p. 470.
 Thiessen. Reinhardt, Recently developed Methods of Research in the Constitution of Coal and their Application to Illinois Coals: Illinois State Geol. Survey. Bull. 60, pp. 117-147.

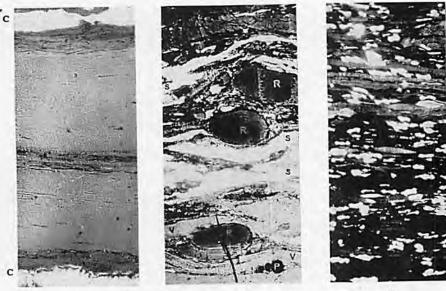


Fig. 2. Banded ingredients of coal as seen in thin sections.

- A. Vitrain band. This is translucent and uniformly bright orange red in color. The band (V) shown here probably represents a section cut lengthwise of the stem. It is bounded above and below (C) by a bright (yellow) band possibly representing outer waxy tissue (cuticle?). (X150).
- B. Clarain band. This is translucent, orange red (vitrain shreds, V), wine red (resins, R) and yellow (disintegrated spores, S) colors prevail. Certain round black areas are pyrite (P). The photograph shows very definitely the heterogeneous physical constitution of clarain. (X150).
- C. Durain band. This is largely composed of opaque material. Extreme thinness of the section is essential in order to overcome the density of the opaque material in durain. The small white dumb-bell shaped areas in the photograph represent microspores which lie as flattened spheres in the plane truncated by the thin sections. Their frequency is rather typical in this type of coal but larger spores as shown in Fig. 7, B, are even more characteristic of durain. (X150).

vitrain are produced annually by Illinois mines.

The vitrain bands contribute most to the banded appearance of Illinois coal. These are always present but vary a good deal in their width and frequency. In Illinois coals vitrain bands rarely exceed an inch in width and are usually less than one-half inch wide. It is only those that are about 1/16 inch or more in width that are recognized as distinct bands, but they are present as fine shreds or as micro-vitrain within the clarain.

Vitrain (Fig. 2A) is exceedingly brittle and resilient and breaks up into small irregular sharp-edged fragments both when the coal is shattered and upon drying out. Layers of vitrain are commonly crossed with fine shrinkage cracks filled with white crystalline kaolinite (Fig. 3), or calcite which is very closely restricted to the width of the vitrain band (Fig. 2A). In fine sizes of coal the kaolinite is largely broken from the vitrain. Vitrain has a low specific gravity (less than 1.30) due

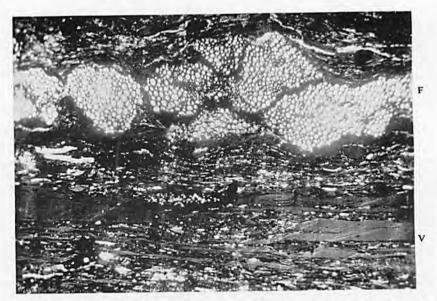
to its low ash content and a high luster. In high sulphur coals pyrite may be present in disseminated form or as joint facings. Vitrain is translucent and is red in thin sections. It takes a high polish on polished surfaces.

Fusain (Fig. 4), is the source of the sooty "dirt" which accompanies Illinois coal. Much of it is loosely attached and is shaken loose during preparation processes and concentrates in the small sizes. Much the larger proportion of the cust below 100-mesh recovered in the dedusting process is fusain. It is present in fine needle-shaped particles which seem capable of subdividing into almost indefinite fineness. It also has a relatively low specific gravity (less than 1.30) when pure, but adhering and impregnating mineral matter is common so that much fusain has an apparent specific gravity much above

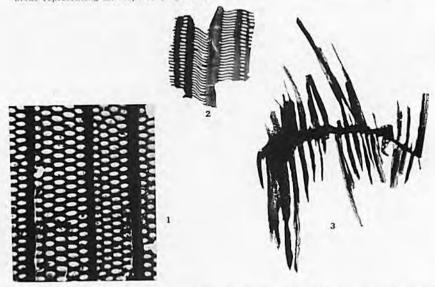


Fig. 3. Kaolinite in vitrain. (Natural s'ze)

A block of bituminous coal from Indiana broken in a vitrain band to show kaolinite (white) in the shrinkage cracks which are confined to this band. Such occurrence of kaolin and calcite has been observed in Illinois coals.



A. Fusain in thin section (F) showing its opaque character and distinct plant structure (X60). The cavities shown are commonly filled with mineral matter. The material below the fusain is clarain containing microvitrain strands (V) and numerous small white areas representing microspores (rig. 7A4).



B. Fusain fragments obtained by macerating Illinois coal No. 6, showing traces of several

varieties of plants.

(1) A fusainized wood fragment of a fern type of plant showing well preserved delicate structures. (X65).

(2) A fusainized wood fragment of a primitive pine type of plant. (X35)

(3) A fusainized wood fragment from a plant of the horse-tail group, showing a portion of a node or joint in a stem. (X50)

Fig. 4. Fusain.

1.4. Fusain is opaque in thin sections.

Clarain (Fig. 2B is relatively tough and is usually distinctly fine to micro-laminated. It usually comprises all the coal that is neither vitrain nor fusain. It grades with increase in the amount of micro-vitrain into vitrain, or as the opaque matter

increases, into durain, which has the general appearance of dull clarain, or as mineral impurities increase into "bony" coal. Clarain is less easily broken than vitrain and breaks more irregularly with less sharp edges. It is translucent and varies from red to bright yellow in thin sections.





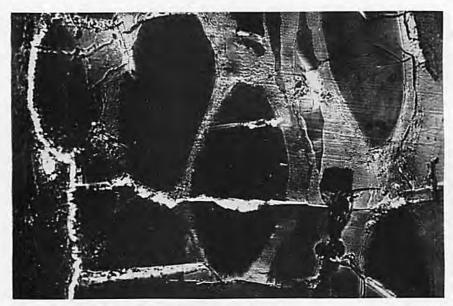
Fig. 5. Vitrain bands showing cell structure.

 Wood cells in a vitrain or anthraxylon band representing a transverse section of a stem. (X100).

B. Wood cells in vitrain (anthraxylon) representing a section of a stem cut approximately lengthwise of the stem. (X100).

Typical durain (Fig. 2C) is laminated like clarain but has a distinctly dull luster with a slight grayish tone. This grayness is more evident in photographs than in the coal itself (Fig. 1, D), although it can usually be distinguished in polished hand specimens. Microscopically, typical durain sections of usual thickness have an opaque groundmass usually containing red to bright yellow translucent areas representing spores. Megascopically durain has much the

appearance of "bone coal" and in fact some durain undoubtedly contains much mineral matter, but a high mineral matter content is not an essential concomitant of durain. In Illinois coals durain occurs in bands usually about a half inch, rarely over one inch, in width which are probably generally regarded as "bone". In general their actual character cannot be determined except with the microscope. Durain as has been stated, is



A. Resins in a band of vitrain. They are translucent, wine or mahogany red, elliptical areas embedded in an orange-red background characteristic of vitrain. The cell structure of the vitrain is not apparent. See also Fig. 2, B. (X200).



B. Resin droplets isolated by maceration from Herrin No. 6 coal. (X15). Resin also commonly occurs in needle-like rodlets readily visible without microscope.

Fig. 6. Resinous bodies.



A. Spore exines isolated by maceration.

(1) and (2) Smooth wingless spores commonly as large as the head of a pin. (1,X20) (2,X20).

(3) Winged spore with triradiate markings extending from center to circumference. These are the traces of the junction of the four spores originally grouped together in the sporangium. (X50).

grouped together in the sporangium. (X50).

(4) Microspores. These often occur in great numbers on the horizontal laminae of the coal. (X30). The white dumb-bell shaped areas in Fig. 2C are microspores as they appear in cross section.

Fig. 7A. Spore exines.

believed to correspond to the American "splint" coal.

It is no particular accomplishment to have pointed out the banded character of mid-western coals as this is one of their outstanding characteristics. However, until recently no one seems to have understood its significance or what might be done about it. Coal continued to be regarded simply as coal. It is an achievement of modern coal research to have aroused a more discriminating understanding of the

physical nature of coal, thereby raising doubts as to the adequacy of the earlier methods of description, analysis, and preparation. It must be obvious even to those inexperienced in methods of technical and engineering procedure that an awakened realization of the existance of definitely distinguishable physical constituents in our coal is to be preferred to the previous indolent attitude of regarding coal as a uniform material. At any rate we put ourselves in a position receptive of new

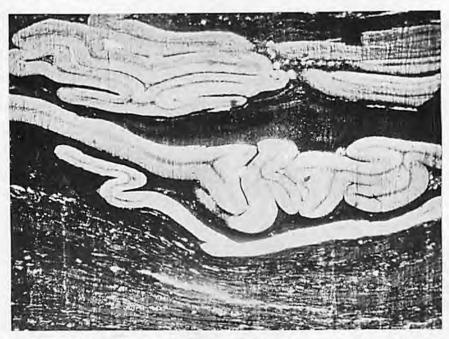
ideas in regard to the chemical and physical composition of coal and the possible effect of different methods of mining and preparation upon the finished product.

Plant Components of Illinois Coal

The nature of a banded coal is not fully expressed in terms of its banded ingredients. It is only as the constitution of these ingredients is understood that the nature of the coal and the possibilities of variation are The physical constituunderstood. tion is revealed by the microscope. Thiessen has provided us with two convenient terms as names of plant constituents and aggregates found in coal. Coalified woody substances he calls anthraxylon, whatever the rank of the coal. Non-anthraxylous material is grouped under the general

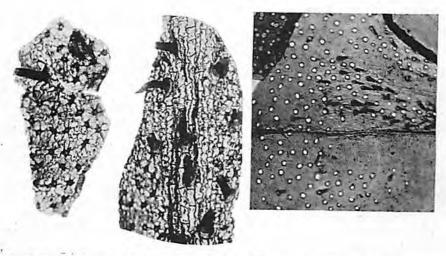
name attritus. Attritus is of two sorts, the translucent (or lucid) and opaque. Opaque attritus is characteristic of durain in splint coals. By this classification cannel and boghead coals are attrital coals. Thiessen also uses the term fusain in referring to mineral charcoal.

In general vitrain (Fig. 2A), is anthraxylous in constitution, that is, it is composed of coalified wood, but much vitrain of Illinois coals is composed largely of resinous bodies (Fig. 6). Clarain (Fig. 2B), is predominately attrital, although very bright clarain may contain much anthraxylous material and differ but little from vitrain. Durain (Fig. 2C) is opaque attritus. Fusain, like vitrain, is derived from wood but it is carbonized wood rather than coalified



B. Large thick walled megaspores closely crowded together as found in a thin section of No. 6 coal from Montgomery County. (X75).

Fig. 7B. Spore exines.



- A. Cuticular tissue isolated from coal No. 6 of St. Clair County by the maceration process.
 - (a) Cuticle with spiny protuberances (epidermal hairs). (X37).
 - (b) Cuticle showing one spine and star-like surface markings indicating the position of the stomata. (X37).
 - (c) Epidermis, possibly of an insect, with spines and the holes caused by their removal. (X50).



B. Thin section showing waxy shreds probably cuticular matter in clarain. (X75), Fig. 8. Cuticles.

wood, and so is not regarded as anthraxylon.

The recognizable plant constituents in coal are of three main sorts; (a) Woody materials, (b) resinous secretions, and (c) waxy secretions, organs, and tissues. The woody materials, when preserved, constitute the lenses and strips of vitrain, and when carbonized they constitute the fusain. Resins (Fig. 6) too are present in vitrain, but they occur also in the clarain as tiny rodlets and droplets, isolated, or in aggregates. Waxy bodies found in the clarain and durain represent the more resistant parts of the plants so that they appear with their original form more or less well preserved as spore cases or exines (Fig. 7), cuticles (Fig. 8), and as wax droplets. Vitrain may be either predominately anthraxylous or largely resinous. Clarain is variable; it may be largely anthraxylous or highly waxy. Durain like clarain, is commonly waxy (Fig. 2C. Since it is evident that the characters of the banded ingredients differ because each is composed of a more or less characteristic type of plant constituents, it is evident that the character of the coal varies with the variation of the amount of each of the banded ingredients.

In this brief summary it is possible only to suggest the nature of the physical constitution of Illinois coal and the possible variations in the coal due to local concentration of certain parts or secretions of plants. In general the important plant components which can be identified as contributing to the coal substance are as have been listed. All are more or less common to all plants, but there is obviously possibility of great variation in the extent to which each of these substances may contribute to the coal due to local conditions determining the concentration of each.

Mineral Constituents

Coal contains both inherent and extraneous mineral matter. croscopic studies we are concerned primarily with extraneous non-organic mineral matter, either that washed, blown or carried into the coal swamp at the time the coal was deposited or secondary mineral matter deposited from solution. In nary clean coal that is free of shaly partings-which are really not part of the coal substance-extraneous mineral matter consists largely of secondary mineral matter. This is chiefly pyrite or marcasite, calcite, and kaolin.

Pyrite and its occurrence in coal is generally known. In large masses it occurs as nodules and plates of earthy or stony pyrite, as impregnations, and as joint "faces". Occasionally it is found impregnating and apparently replacing fusain.

Calcite occurs in coal mainly as facings of joint cracks and occasionally as petrifications known as "coal balls" or as large irregular brownish masses of limestone whose shape suggests that they are petrified portions of woody stems or branches sometimes called "coal balls".

Kaolinite.—The third mineral listed and the one which in many Illinois coals is quantitatively of greatest importance is kaolinite. A sample collected for analysis from Franklin County No. 6 coal had the following composition as determined by the Illinois Geological Survey Analytical Laboratory:

Analysis of kaolinite from Franklin County No. 6 coal.

Si0 ²	43.80 per cer	IT.
$\mathrm{Fe^20^3}$.82	
AI20s	39.36	
Mg0	.16	
Ca0	1.17	
Loss on ignition	15 40	

This was in essential agreement with the analysis by the Bureau of Mines of a sample from a Franklin County coal and indicates that the mineral has very nearly the composition of the mineral kaolinite. Detailed studies by Mr. Clayton G. Ball of the Illinois Geological Survey has established the importance of this mineral in our coals. Its most characteristic occurrence is as shrinkage-crack facings in the vitrain.

This mineral is of considerable importance in coal. In general the coals low in pyrite content will have a relatively high kaolin content, and as a result the ash is relatively refractory. In low sulphur coal undoubtedly the coal mineral of greatest importance is kaolinite. This of course assumes that the bands of clay or shale possibly interbedded with the coal are not included as coal minerals but are removed in the cleaning process.

In addition to the three important minerals which are mainly of secondary origin, a few primary minerals such as quartz, feldspar, zircon, garnet, etc., are present just as they are likely to be in any sedimentary rocks. Many of these were probably blown into the coal swamp. mineral matter is unimportant in comparison with the secondary mineral matter noted. Gypsum is commonly regarded as an important coal mineral but this does not seem to be the case as far as Illinois coals are concerned. The sulfate sulphur of Illinois coals is always minute in quantity and occurrences of gypsum as facings seem to be rare.

This description of the plant and mineral components of coal provides a general idea of the nature of coal petrography and of the character of the ingredients and constituents possible of determination and differentiation. It gives little idea of the technique of investigation and of the possibilities of differentiating the physical components of Illinois coals nor does it mention the dependence of the investigations upon the related studies in coal botany which are so essential to an understanding of coal geology. These matters, however, are not particularly pertinent to this occasion.

Attributes of the coal constituents

The physical heterogeneity of Illinois coal has little practical significance unless the various constituents possess significant individuality in composition and attributes and can be fairly easily isolated.

Attributes of special constituents

In considering the specific attributes of the components of coal only generalized statements can be made. Each is likely to prove only partly correct as knowledge increases. It will be my good fortune, indeed, if any prove eventually to have merit. Let us consider the character of the four most commonly and easily identified constituents in coal, namely (1) coalified wood, or anthraxylon, (2) resins, (3) waxes, and (4) carbonized wood or fusain.

It is doubtful whether wood exists as wood in coal material advanced to the rank attained by Illinois coal. A derivative of woody substance probably represents the original lignified woody stems and fibres. What this coalified derivative (anthraxylon) may now be is not well known. We find that these once woody parts of Illinois coals when oxidized either artificially or in nature are soluble in alkaline solutions. When reprecipitated and dried they again form a solid jet black gel resembling the vitrain bands from which much of the material was probably largely derived. A thorough understanding of the nature of Illinois coal calls for chemical investigation of this

humic material which probably makes up about three-fourths of the coal substance.

Resins or resinous material more or less modified by coalification exist in great quantities in Illinois coals, Although the properties of resins of living plants have been thoroughly explored, we do not know the effect of coalification upon the resins. This is an inviting field for chemical investgation for if resinous bodies exist as such in Illinois coal to anywhere near the extent that seems probable from microscopic determination, they must exert some influence on the character of the coal.

Waxy substances that occur in great quantities in some coals represent the more resistant portions of the plants such as the outer sheath of stems and leaves, individual granules, and larger part of the exine or outer covering of spores and pollens. Such substances form a large portion of cannel coal and give it its highly volatile character evidenced by its long smoky flame and are particularly numerous in splint coals (durain). In general waxy bodies are less modified by the coalification process than any other plant forms except possibly those parts which have been fusainized. Cuticles and exines can be isolated from the coal by maceration (Figs. 7 and 8) showing their original surface markings and often showing but slight evidence of carbonization. It is probable, therefore, that these substances retain more of their original attributes, whatever they may be, than any other substances recognizable in the coal. Undoubtedly resistance to change is one of their characteristics and their general highly volatile character is another.

Fusain or mineral charcoal is carbonized rather than coalified wood. Because it is concentrated in bands and is readily isolated its character is well known at least so far as it can be expressed in terms of the proximate and ultimate analysis. Like anthraxqlon it is obviously no longer wood but a derivative of wood through some process of carbonization. It will neither dissolve in alkalies nor swell when heated. properties are fairly uniform, being composed of about four-fifths fixed carbon and one-fifth volatile matter or less on the ash and moisture free basis, irrespective of the rank of the coal in which it is found, at least for a wide range in rank. Since our Illinois coals contain an unusually large amount of fusain their character is necessarily modified thereby.

Attributes of the Banded Ingredients

has been explained, the banded ingredients represent types of coal substance; that is to say, concentrations of one or more of the plant constituents found in the coal. The attributes of the bands indicate the general characteristics of the materials of which they are composed. The bands are relatively easy to sample, whereas samples of the plant ingredients in pure form would be exceedingly difficult to obtain except in instances where the bands were composed of a single variety of plant constituents. The bands other than fusain, however, are rarely composed of single plant substances. Vitrain is in some cases entirely of woody origin without resin, although usually resinous bodies are present. Vitrain rarely contains waxes, whereas clarain is likely to have much waxy material present.

Within the last few months we have had an opportunity to collect information in regard to the chemical composition of the banded ingredients of some of our coals, representing several beds in various parts of the State. The following generalizations seem justified with respect to vitrain, clarain, or fusain.

- (1) Vitrain is characteristically low in ash—in some coals the vitrain samples contained less than 1 per cent ash. Out of 17 samples the highest ash content was less than 3 per cent.
- (2) The sulphur content is usually low in vitrain but may be higher than the ash content. The amount of organic sulphur usually exceeds the amount of pyritic sulphur commonly as much as two to three times, hence it is probably largely volatile sulphur.
- (3) The unit coal B. t. u. value of vitrain is somewhat less than that of the whole coal or of the other ingredients.
- (4) The moisture content of vitrain is slightly higher than that of clarain. Vitrain appears to possess considerable capacity to retain moisture.
- (5) In general the volatile content and pure coal B. t. u. value of clarain exceeds that of vitrain but the ash content is higher. Hand picked clarain of course will not have as high ash as the entire face samples. The variation in ash content in seven samples of clarain was from 4.2 to 7.7 per cent ash with coals ranging up to 9.8 per cent ash.
- (6) Fusain on a unit coal basis usually shows a heat value of about 15,000 B.t.u. Analysis of 13 samples showed a range of unit coal values from 14,590 to 15,440 but 10 of these did not vary more than 150 units from 14,500.
- (7) The moisture content of fusain is very erratic but is rarely less than 15 per cent and usually more than 20 per cent in the mine sample.
- (8) The ash content of fusain is also variable. No samples showed

less ash than the vitrain from the same locality, but samples might show more or less ash than the whole coal or clarain.

The mineral matter in the banded ingredients varies considerably both in kind and amount. Fusain is the single porous ingredient or constituent in coal and for that reason probably frequently contains a high percentage of mineral matter filling original pore spaces. Pyrite is the most common mineral in fusain but both kaolinite and calcite may be present. Kaolinite occurs mainly as fillings of small cavities representing the original cells The mineral matter in clarain consists predominately of detrital clay, secondary calcite, disseminated pyrite and kaolin. kaolin in clarain occurs mainly as fillings of small cavities in fusain fragments, to a small extent as joint fillings, and in the form of detrital clay. Calcite occurs mainly as joint fillings.

Summary. Such limited and general information as is available in regard to the organic constituents and banded ingredients of Illinois coals indicate that it consists of an aggregate of plant constituents and mineral substances. Supported by what is known concerning the character of the original components and the character of the banded ingredients the assumption seems warranted that the coal components possess individual and peculiar characteristics.

III. Practical Significance of the Modern Rational Ideas of Coal Constitution

It has been my desire in describing the newer methods of coal investigation to show that such investigations are reasonable or rational in their procedure, in contrast with the previous methods which were conducted without regard to the very evident physical structure of coal. The superiority of the rational method of investigation over a method which proceeded on the assumption that coal is simply a compound of volatile matter, fixed carbon, moisture, and ash is apparent.

The main result of considering coal from the newer point of view is that attention is transferred from the coal as a substance undergoing combustion to a natural rock substance consisting of an aggregate of different constituents. From this point of view it follows that a correct understanding of the aggregate requires examination and understanding of the constituents.

Is it not apparent that if full advantage is to be obtained from investigations projected on the newer rational basis, the whole general attitude toward coal must conform? Mining, preparation, and combustion problems must be restated in the new terms in order that solutions to such problems may be found in the results of investigations projected or underway.

The point I wish to make is briefly this: Since a rational consideration of the nature of coal requires that the procedure of investigation is first the determination of the identity of the visible and obvious components of coal, next the determination of their physical characteristics and attributes, then the discovery of their more hidden chemical characteristics and attributes, it would seem logical that matters relating to coal classification, preparation, and utilization should be similarly organized.

Inasmuch as the advances in our rational procedure in coal investigation with respect to the nature of the coal aggregate have been small it is possible to indicate the practical significance of a rational point of view only with respect to the more general attributes of coal. It will be impossible without indulging in unwarranted speculation to give more than a few definite examples of the general effect of adopting the new point of view toward coal. These, however, will be sufficient to indicate the general tendency.

- (1) The most important general effect that will result from a more discriminating understanding of the nature of coal will be a greater accuracy of description, classification, and grading because of the increasing precision in the standards of evaluation and comparison.
- (2) Establishing the existence in the coal of readily differentiated physical constituents provides a natural basis for developing methods of artificially modifying or controlling the character of coal or of preparing fuels of definite attributes by artificial blending. It is apparent that in the early stages of advancing knowledge only the more obvious differences will be of importance or even known. At the present time the most obvious differences are those that exist between the different banded ingredients.
- (3) The nature of the separable components will of course determine the physical conditions under which separation can take place. In the case of the banded ingredients, for example, the thinness of the bands obviously determines to a large extent the size to which the coal must be crushed if satisfactory concentration of the banded constituents is to be accomplished. In order to take advantage of any benefit that might result from selective preparation, coal would have to be reduced to fine sizes. Whether or not any such advantage might accrue depends on the nature of the ingredients and

since some have very positive and unique attributes that are readily discernible the first efforts at separation will probably be applied to these ingredients, particularly to fusain.

(4) A better realization of the nature of the mineral constituents of coal and the effect of variations in kind as well as in quantity will probably eventually result in efforts to control the fusion temperature of the ash modifying the relative quantity of the various minerals present, particularly as it is realized that the significant minerals are few in number. It will probably be realized that quantity of mineral matter may be a less serious handicap than its character.

These four items represent the more obvious practical effects or possible effects of assuming a rational attitude toward the constitution of They rest upon or rise from real differences in coal apparent at the very threshold of the rational search for the nature of coal material. Other attributes and differences will necessarily be of a less obvious character and hence somewhat or even much more difficult to discover, but none the less real. is obviously impossible to foretell the practical application of such discoveries until they are made. Otherwise we would scarcely go to the trouble of investigation. The justification for continuing such investigations rests not in the assurance that discoveries will have this or that practical application but in the validity of the method of search which we feel to be fundamentally sound, and in the fact that the field of investigation is large and essentially unexplored. We say that the field is

large because our microscope discovers a numerous variety of components within the coal substance, many of which can be conveniently classified in groups, so that utter heterogeneity does not exist. And the field is essentially unexplored, because of the limitations of our knowledge in regard to the nature of these physical components originally of plant origin.

(Applause.)

Chairman McFadden: Thank you, Doctor Leighton. In his customary and efficient manner. Doctor Leighton has presented to you a most comprehensive analysis of the research work so far accomplished as to the make-up of the coals we mine in Illinois. Are there any questions any of you want to ask Dr. Leighton at this time? There being no response to the question, the Chairman said: If not, we will proceed with the next paper. by Mr. Paul Weir, Vice President of the Bell & Zoller Coal and Mining Company, Centralia. I wish to say that I think probably most of you know that Mr. Weir has had quite an important part in representing Illinois in the making up of the Code as it applies to Illinois, and if all of you do not know, I want to tell you, that he is the party who coined the word "technician". That is one of the classes that are exempted from the Code as it applies to the mineral industries. So far, we have not been able to determine what a "technician" is. Perhaps Mr. Weir is going to tell us the definition of that word in his paper. Mr. Weir is still working with some of the Illinois operators in Washington, and his paper will be read by Mr. E. L. Berger.

THE COAL CODE

By PAUL WEIR Vice-President, Bell & Zoller Coal & Mining Co.

Sometime ago our Program Committee asked me to speak briefly before the fall meeting of the Illinois Mining Institute on the Coal Code. Inasmuch as I was in Washington during most of the time this code was being written and consequently am aware of the fact that there is available sufficient material for a sizeable book for the events of each and every day from early in June until the present time. I attempted to obtain from the committee ideas which would limit to some extent at least, the scope of anything I might try to say. The consensus of opinion was that I should try to tell you things which would be of interest to practical mining men such as you and might be helpful to you in cooperating with the National Recovery Administration in fulfilling the purpose for which it was created.

For many years the coal industry has been held up by politicians, economists, bankers, educators and others as a very bad example of poor management and poor organization. It has been a football for outsiders and a football game without rules except those of the jungle for those two insiders-the miners and the operators. Miner was playing against miner, and operator against operator, as well as miners against operators. The acute depression of the past few years intensified the fierceness of the game. Many miners and many operators became casualties. It developed into a death struggle from which none could escape. While this description specifies the coal industry, practically all other industries in the country have been experiencing the same difficulties since 1930. The need for a set of rules for such a game is obvious. The differences between miners and operators and between the operators themselves had become of such proportions that they seemed impossible of reconciliation. A rule maker in the form of the Federal Government was provided when the National Industrial Recovery Act became a law in June of this year.

The basic ideas upon which NIRA was formulated are not altogether new. Perhaps you will be interested in some of the legislative efforts in behalf of the coal industry during the last decade and before NIRA. By act of Congress, the United States Coal Commission was created in 1922. In its voluminous report published in 1925, it recommended a form of governmental intervention to assist in placing the coal industry on a sane Congress took no action on these recommendations. In 1928 Senator Watson of Indiana introduced in the United States Senate a bill which provided for governmental regulation of the coal industry. Hearings were held on the bill by the Committee on Interstate Commerce, but it was not given consideration by the whole Senate. In 1932 the Davis-Kelly bill came up for consideration before the Senate Committee on Mines and Mining. During these comruttee hearings the Hayden-Lewis bill, patterned after the British Coal Mines Act of 1930, made its appearance. After the present national administration came into power on March 4, 1933, a special session of Congress was convened by the President. One of the first bills introduced at this session was the so-called Black or 30-hour bill. While the

Watson, Kelly-Davis, and Hayden-Lewis bills were for the coal industry only, the Black bill was for all indus-The hearings on this 30-hour bill brought forth the best thoughts of industry and labor on the things which should be done or which might be done to start re-employment of the idle 10,000,000 wage earners, to increase purchasing power of the Nation, and to start the wheels of industry turning. The proponents of all these bills were considered as being friendly to labor They sought primarily to improve the lot of labor by shorter hours and higher wages, The Watson, Kelly-Davis, and Hayden-Lewis bills did permit collective marketing action by the operators. On the side of industry, the Walsh bill introduced by Senator Walsh of Massachusetts in May, 1933, was designed to permit prejudging by the Federal Trade Commission of marketing practices. This, in effect, was to set aside some of the rigid provisions of the Anti-Trust Laws and permit all industries to discuss destructive competition in a constructive way without being threatened with jail sentences. These various legislative efforts undoubtedly paved the way for Senator Wagner's NIRA. Labor wanted wage-slashing stopped. dustry wanted destructive price-slashing stopped. President Roosevelt wanted re-employment for 10,000,000 men and women. In the light of the emergency it seemed wise to give industry and labor the things for which they were contending when these very things showed every promise for returning people to work. Labor conceded the elaxation of the Anti-Trust Laws and industry conceded shorter hours and higher wages, together with collective bargaining. Governmental agencies were to be the referee and a Code of Fair Practice

was to be written for each industry. Instead of a football game in which every man made his own rules, there was to be a game with definite rules for all participants and the rules were to be enforced by governmental authority. Instead of chaos there was to be orderly procedure and the unfair players, or chiselers, were to be eliminated if they failed to observe the written rules. Such is the plan of NIRA. In less than five months weekly hours of labor have been shortened, wages have been raised and 3,500,000 unemployed returned to work.

The first step taken by coal operators in the formation of a code of fair competition came on June 5 before NIRA had actually become a law. From that time until President Roosevelt approved the code on September 18, life for coal operators was just a continuous series of conferences. There was no great difficulty in getting the operators to agree on fair practices in the marketing of their product. The difficulty lay in formulating new wages and conditions of work in an area which contributes about two-thirds of the Nation's production but which for some years had not practiced collective bargaining with their men as we know it. Eventually the wage scales and working conditions in Illinois were used, in a large measure, as a basing point and comparable wages and working conditions were established in all producing areas. Thus, to a large extent and for the first time in a decade, Illinois is now on a reasonably fair competitive basis as far as wages and working conditions are concerned.

The Coal Code is the book of rules for the industry. It can be revised or amended by Presidential action. Contrary to the opinions of those who fought against the adoption of any code, this Coal Code contains a minimum of governmental regulation and interference. Anyone who has even a passing knowledge of the coal industry knows the difficulties in reconciling the views within an industry so widely spread geographically and so highly competitive from within and without. Differences of opinion between operators are difficult to adjust. Many times they are left to wear out to the detriment of everyone. Some outside influence is invariably necessary to effect even a compromise. The code provides this outside influence in the NRA. A Coal Code is one problem and the administration of that code is another problem. A good code might be ruined by poor administration and a poor code might even be helpful if judiciously administered. The present code is becoming increasingly The staff of the NRA is popular. sympathetic to the problems of the industry and is anxious to have coal settle its own difficulties in the manner provided in the code. The NRA is closely observing the operation of the code. If the industry can govern itself, there is every reason to expect that it will be left to do so. If after a fair trial it becomes apparent that it cannot, we may look for more government in our business.

Much of the difficulty in applying a code to an industry lies in the efforts of many in the industry to find ways and means of getting around the provisions of the code. If this same energy were devoted to whole-hearted planning of ways and means to comply, a better situation would obtain. The whole purpose of the code is to put the production and marketing on an absolutely fair competitive basis. It is not designed to take away from the efficient and

give to the inefficient. Its measure of efficiency is not sharp practice and unfair methods.

Every operator now has a book of standard rules. His operating personnel must realize that to survive they must hew to the line and develop efficient methods and produce a superior product. Wage-slashing is no longer a measure of efficiency. Price-cutting is outlawed as a substitute for efficient sales.

The coal industry in Illinois has reached a turn in the long hard road. A wonderful opportunity for regaining lost markets exists. Full advantage taken of this opportunity means a prosperous industry in this State. Illinois must offer to its coal customers the very best in preparation. Superintendents, mine managers, and miners must realize that only by careful attention to everything that influences quality can full advantage of our opportunity be obtained. regain customers which have been lost to Illinois, we must give them hetter values than they have ever received from us.

There is nothing mysterious to Illinois operators in the labor provisions of the code. For almost forty years these same provisions have been in the making in our contractual relations with the miners. Only as modified by the code are our present agreements with the miners changed. There are some differences of opinion as to what the term "technicians" This is a matter to be includes. passed upon by the NRA or its designated agency. Our present labor contracts provide for 48 hours weekly of mine operation. The code provides for a maximum of 40 hours weekly for the individual employee. is no conflict here. It is generally agreed that if any operator wants to operate his mine on a 48-hour schedule, he may do so by taking on an additional complement of men and staggering their work days so that he has a full crew each day but so that no individual works more than 40 hours weekly. In general, employees exempt from the jurisdiction of the miners are likewise exempt from the restrictions of the code.

The daily press is voicing much opposition to the certain features of the NRA. Time alone will tell whether their criticism is justified. It is variously labelled at times "The Two-Year Plan", inferring that it is Communistic or Russian. Perhaps it is not out of place to point out that the Russian Planned Economy is designed to stimulate production to take care of consumption. Our problem in the United States is to curtail production in an orderly manner without destructive wage-slashing and priceslashing, so that it meets the consumption demand without having an enormous surplus.

It seems almost foolish to speculate on the permanency of the NRA. It does have a definite appeal to most thinking coal operators. Many operators who opposed it are now giving it wholehearted support. They feel that its good points outweigh its bad ones. It does seem certain that after the years of chaos, no one in the industry or out of the industry will want coal to sink to its recent low depths. The future of the industry still rests largely with the operators and miners. Close cooperation between them with the aid of the government can place our industry on a high plane.

(Applause).

Chairman McFadden: Thank you, Mr. Berger. Gentlemen, you have just heard Mr. Weir's very fine paper on the Coal Code as it applies to the mining industry in Illinois. Any discussion? If not, I think our President has a word to say to you at this time.

President Hamilton: Thank you, Mr. McFadden, for serving as chairman of the morning session. After the morning meeting started, we found one of our former Presidents had arrived. I see Professor Callen in the rear of the hall, and I understand he has something of interest to say, and I know you will all be glad to greet him.

(Applause).

Prof. A. C. Callen: Mr. Chairman, and the Four Horsemen:

Mr. Weir has been talking about a "football game" in his paper. Some of you may have heard that there is going to be one at Urbana tomor-We persuaded the business manager of the association to bring twenty-five tickets over here and he will be at the desk outside immediately upon adjournment (before the luncheon), and if anyone is interested in tickets for the Michigan-Illinois game tomorrow he will be able to take care of you. He also has a few tickets for the Northwestern-Illinois game to be played at Evanston and if anyone wants to get one here, he will be glad to take care of you. The price of tickets for the football game is \$2.20. Tomorrow is "Dad's Day", and there will be a big bunch of fathers there. In the evening there will be an ice hockey game with the Black Hawks.

President Hamilton: Luncheon will be at 1:00 P. M. and we will convene again here promptly at 2:30. May I ask that we be prompt, as we have two extremely interesting papers to be read this afternoon which will probably bring out considerable discussion and we would like to start promptly? Luncheon tickets can be secured in the hall and also the dinner tickets, and inasmuch as the at-

tendance today has somewhat exceeded the estimate made by the Arrangements Committee, will you be good enough to secure your tickets for the banquet immediately after we adjourn so that we may get a definite idea of what the attendance will be, because we want to prepare enough seats for everyone for this evening?

There will be a meeting of the Executive Board immediately after noon adjournment and before lunch. Fearing lest your memory does not serve you correctly as to the personnel of the present Executive Board, it is comprised of:

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

T. J. Thomas Paul Weir

and I ask that they come up here for a short meeting.

Mr. Geo. C. McFadden: I would like to make clear the request to get your dinner tickets at the same time that you get your luncheon ones, making it possible to count accurately the number of seats we will require. I also wish to express to you my appreciation of the attention you have given the papers this morning.

President Hamilton: There being no further business at this time, the meeting is adjourned until 2:30 P. M. Luncheon at 12:30.

Adjournment of morning session. Meeting of Executive Board.

LUNCHEON

for members of the Illinois Mining Institute at Hotel Abraham Lincoln at twelve thirty. Luncheon was served to those members of the Institute and guests who desired to partake of it.

The musical program by Messrs. Sheehan and Roche was enjoyed by

The speaker provided for the noon function was unable to be present, and President Hamilton expressed his regret, calling upon a popular member of the Institute to make an informal address.

HARRY FISHWICK responded in his usual happy manner, speaking extemporaneously on "Current Events in the Coal Mining Industry."

(Applause).

After the conclusion of the meal and entertainment the members gathered in groups around the hotel, renewing old acquaintances and making many new ones, until time for the afternoon session to begin.

AFTERNOON SESSION of Illinois Mining Institute, November 3, 1933, 2:30 P. M.

After lunch and a short period for social amenities, the afternoon meeting was called to order by the President at 2:30 P.M., whose opening remarks were as follows:

President Hamilton: As Chairman for the afternoon session, I am honored and privileged to introduce to you an ex-President of the Institute, Fred S. Pfahler, of the Superior Coal Company, Gillespie. (Applause).

Mr. Pfahler (rapping): The gentlemen will please come to order. I do not know why the President wants to shirk his responsibility and unload me on this audience.

The first thing on the program this afternoon is the big entertainment feature which should have been shown at the luncheon. We will have the lights out, please. (Lights are turned off.) In the rear of the hall the lights were still burning and the Chairman called out to know if there was an electrician in the audience. Someone remarked: "We've burned out a cable." Finally, everything being arranged to the satisfaction of the operators of the machine, a sound motion picture was thrown on the screen behind the Chairman's desk, which was announced as a sound picture built by Edwin C. Hill, famous radio and newspaper star reporter, entitled, "The Dramatic Story of Preformed Wire Rope."

These pictures were claimed to demonstrate the greatest basic improvement in wire rope construction of this century. Many pictures of the development of the new wire rope were thrown on the screen and in contrast were shown pictures of the old type, much frayed and worn. It was claimed that this new preformed wire rope would save untold

thousands of dollars to operators, in shop, mine, factory and projection work and that it would eliminate the costly, destructive stresses which cut down the life of ordinary wire rope.

The movie was received with much interest and hearty applause at the close.

Chairman Pfahler: I am sure everyone present has enjoyed this very interesting talking movie and we thank you very much.

Is Mr. T. J. Thomas in the audience? (No response). Will someone please see if he is standing outside and tell him that Mr. Budd is waiting for him down in the lobby?

The first paper on the program this afternoon will be on "The Preparation of Coal for the Market by the Dedusting Process," by Thomas Garwood, Engineer, C. W. & F. Coal Company.

THE PRODUCTION OF COAL FOR THE MARKET BY THE DEDUSTING PROCESS

By THOMAS GARWOOD

Orient No. 2 Mine, C. W. & F. Coal Co.

West Frankfort, Illinois

The production of coal for the market by the dedusting process has been in evolution for several years. The desire of combustion engineers for ideal operation in any boiler plant demands that the fuel with which the fires are fed be of uniform qual-This might mean that the analyses have reasonably constant values for ash, sulphur, moisture, clinkering qualities, ash fusion characteristics, etc., or it might mean that the sizing be consistently uniform. At any rate the engineer might be expected to get better results and higher efficiency from the boiler plant when

conditions are normally constant and of known values.

It has been the ambition of combustion engineers for several years to produce a coal for the market that might be uniform in sizing and that each car of coal shipped to a customer would be uniform throughout the entire length of the car, with the minimum quantity of dust in the coal, and that each car be identical to the last one and to the next. To this end we have been experimenting for several years.

The problem of dedusting coal has gone thru a long trial at our mine and many methods of removing the dust were tested in our early experi-While there has been dementing. dusting equipment in existence for a number of years in England and other European countries, this equipment was designed primarily for the removal of the dust causing washing troubles and sludge problems and did not fulfill the requirements that have been set up by our combustion engineers to produce a sized coal. development of an entirely different machine at our mine resulted, and a small unit was put into operation about three years ago for experimenting and determining the value of such a product on the market difficulties in controlling the size of dust removed, with a minimum loss of the larger pieces, were many and the products which we desired necessitated a screening to relieve the dedusting equipment of large particles of coal. It was found by screen analyses that the amount of dust in the larger sizes of coal was insufficient to warrant any attempt of its removal, Our small experimental machine for dedusting the Carbon coal had a capacity of only four or five cars of the finished product per day and the ability to make, by combination, two grades of small coals each with the dust removed. The production of these coals was continued for about two and one half years or until it was established that the commercial success of such a coal was possible and that the demand for this type of product would justify the installation of a larger unit. This large plant has been built and placed in operation with gratifying results. We are now supplying a growing market and expect to have in the near future, comparative data from boiler plants using the new dedusted coal as against the natural run of mine screenings.

Ordinarily, the production of screenings at any mine is a variable proposition. With different sizes of coals coming from the mine at different times and the dumping of an occasional car of undercuttings with its high percentage of fine dust, the production of a mine run screenings with a constant low portion of dust is obviously an impossibility.

It was found that the different methods of mining might increase the percentage of lump and that rougher handling would make a greater percentage of screenings but that in the screenings themselves the character of the smaller sizes and of the fines remained unchanged. It was then decided that this character of screenings with respect to the objectionable dust would not be changed by modifying methods of handling or mining and that to produce a coal commercially with a minimum amount of dust would require a mechanical treatment in the tipple such as our machine was doing successfully.

Since this machine is designed to treat the carbon size of coal and inasmuch as one large enough handle our entire raw feed of screenings is impracticable, it is necessary to separate the carbon from the other sizes and after removing the dust replace the dedusted carbon in the larger size mixture to make a dedusted screening. This mixture is made as the coal is being loaded into the railroad cars. When sized coal is being made in the rescreener the products of the deduster may be loaded directly as an ideal fuel for small stokers.

Natural screenings, composed of all pieces passing thru a specified screen down to and including the dust, are mixed in such a way that the smaller pieces fit into the spaces between the larger sizes and the dust

which fills the smallest openings finally blocks the nir passages thru which drafts should pass in the process of burning the coal. By removal of this fine dust these passages remain open and air for combustion can get to all the pieces of coal on the grates. In the natural screenings, with their uneven mixture air might travel through one section of the fire bed leaving other parts of the fire bed to coke, the first being burned quickly leaving air holes in the fire bed. The increased uniformity of the air distribution through the fuel bed results in better efficiency and greater economy. The possibility of forcing greater quantities of air through the fuel bed will permit carrying a greater load on the boilers at peak demands without the trouble ordinarily occurring from clinkering. It is difficult to wet natural screenings quickly, due to the seal caused by the fine particles and their greater capacity for holding water. However, with the dedusted coals, wetting can be accomplished in a short time with a minimum of water; either in the pile, on the truck, or on the railroad car The little dust that is formed in transportation is thus easily prevented from blowing about.

Aside from the convenience then the outstanding advantages in the use of the dedusted coals are:

- Improved efficiency due to more uniform flow of air through the fuel bed.
- 2. Less clinkering.
- Increased load capacity during peak demands.
- The coal is easily dampened before used in the boiler rooms.

One long time test showed that the load on one boiler room could be carried more efficiently with dedusted Carbon than with natural screenings, while the natural or un-dedusted carbon could not be burned in the plant, even without load. We believe we will soon have data on the burning of dedusted screenings that will be comparable to this test.

(Applause.)

Chairman Pfahler: Thank you, Mr. Garwood. Has anybody here any questions they want to ask Mr. Garwood?

No one had any, apparently, and Chairman Pfahler said: What's the matter with you fellows? Don't you know anything about dedusting coal? Or perhaps you know all about it? (Laughter).

Mr. D. R. Mitchell: What percentage of dust is left in your product?

Mr. Thos. Garwood: Well, it varies; — ordinarily about 14 per cent. I would like to say that so far, the main trouble we have had is that boiler plants are not ordinarily equipped to handle dust. (Here he went into an explanation of how plants could be changed to burn the dust).

Chairman Pfahler: Any other questions?

Mr. H. F. Hebley, Engineer, Allen & Garcia Company:

I think the C. W. & F., Mr. Garwood and his associates, deserve a great deal of praise for their pioneering in dedusting work. For several years we have been conducting dedusting tests from time to time, and in testing of coals for the removal of dust sixteen tests on five different seams from the Illinois-Indiana and West Virginia fields show that with a feed of %"x0" slack, two fractions are generally formed in the following percentages:

When attempting to separate at 48 mesh, the per cent of 48 mesh left in the coal varies from .75—3%, depending on the moisture in the feed. The per cent of —48 mesh in the dust extracted varies from 75 to 93%.

Coals that contain thin laminated pieces generally cause trouble, as these pieces lift like a leaf in the wind and tend to sail.

Coals that contain fine particles of pyrite require an adjustment to be made for the difference in specific gravity, of pyrite and fusain. Assuming a specific gravity of

-2.4 for pyrite and 1.4 for fusain

the velocity of the aspirating air for lifting the heavier pyrite particle will often lift a larger particle of light coal.

There is a distinct drying effect of air when it is used for dedusting. In one test the moisture content varied as follows:

Moisture	in	raw	coal		15%.
Moisture	in	dedu	sted	coal	12%
Moisture	in	dust			8%

Dr. Cady's paper pointed out that Illinois coals contain a concentration of fusain in the —100 mesh. He also pointed out that the fusain ran high in ash, high in moisture and high in carbonization,

The disposal of the dust—a quantity ranging from 10 to 15% of a mine's 34" x 0" screenings production is a serious problem, but can be solved.

Burning this dust under boilers without further regrinding has been accomplished and 80% efficiency has been attained.

At the present time in Indiana there is one plant burning coaldust from dedusting equipment, but further pulverization has been adopted.

Within the last month or so we have been carrying on research investigating the possibility of rearranging the present low set hand fired horizontal return tubular boilers generally installed at coal mines to burn the dust without further regrinding.

After some disappointments, we have discovered a burner designed primarily for use in the very restricted furnace flues of marine and Lancashire boilers.

With this burner HRT boilers set 3' 6" above the grate can be arranged to burn the dust and still keep the hand fired grates in place to burn ROM if the dust supply fails. The design data for such a rearrangement on a 150 H.P. boiler is as follows:

BTU release (cu. ft.) hr	9,500
Flame travel	26 to 30 ft.
Burner fishtail grid type.	
Prim. air	13-15%
Sec. air	40%
Tert. air	45%
Furnace temp. 1700-1900	degrees F.
CO-2	8.0%

Vol. of Com. chamber 900 cu. ft.

The CO2 is deliberately held low to insure the ash being held below the fusion point. Efficiency has also been kept low as the problem is at the present time one of dust disposal and the destruction of the dust under the boilers serves a two-fold purpose—provides heat and eliminates a dust nuisance.

However, the efficiency can be readily increased if desired by reducing the excess air, provided the high resulting furnace temperatures do not set up troublesome slagging conditions.

Chairman Pfahler: Thank you, Mr. Hebley. Has anyone else any questions?

President-elect Treadwell: We might be interested to know that some of the stoker manufacturers are trying to utilize this grate. They have made some careful tests using their stoker and they are willing to make tests on the corrected results. That is of interest because most of us fellows who have been trying to utilize this dust have run into pulverized fuel, which means a rather high cost. However, these stoker people claim that they can burn this dust in their stokers with very few changes.

Chairman Pfahler: Any other questions?

Mr. Johnson: I would like to ask Mr. Garwood if the percentage of ash in the separated dust is higher in southern Illinois than in northern?

Mr. Garwood: It would be somewhat higher,

Chairman Pfahler: Is Mr. J. I. Thompson of the Koppers-Rheolaveur Company of Pittsburgh here? I would like to hear from him on dedusting coal if he is in the audience.

Mr. J. I. Thompson: I do not believe that I have anything much to say. The only thing that might be of interest to you (and some of you already know it) is that we have built a small separator with which we have tried to carry out all the principles of a full-sized plant. This separator can be fairly easily handled and put into a plant. It is about 8 or 9 feet high, 5 or 6 feet wide and 7 feet long. We tried it out in one of the plants of the Peabody Coal Company. That separator was handling 11/2"x2.0" coal, but the results are not yet available. We had some difficulty in feeding 11/2"x2.0" coal (as one of the other stoker people has mentioned). That is due to the openings not being large enough for the larger-sized coal.

We are putting some additional apparatus on our equipment and we hope to be able to get results on the larger sizes. This equipment is available now, and, under the experiments we are making, it would apply on any coal.

One of the difficulties that we have run into in separating coaland one of the difficulties that the Chicago, Wilmington and Franklin people have tried to overcome, is the fact that in fine coal the moisture content is greater in the fine sizes. In other words, the fine sizes are much wetter than the coarse stuff, and we found that there was a big tendency for the dust to go on through the larger particles of coal. After they were put in the cars and shipped and dried, these particles of dust would fall off, but the coal as obtained from the mine after dedusting seemed to be quite free from dust. Perhaps this was caused by a dry atmosphere.

I do not know that I can add anything more at the moment, but if there are any questions any of you would like to ask, I will try to answer them.

Chairman Pfahler: Thank you, Mr. Thompson.

Mr. Johnston, I understand your company has been making some experiments along this line. Can you tell us anything about them?

Mr. J. M. Johnston: Our experiments have been on a small scale, and, so far, our plant is still on paper. Therefore we have no results to offer from our dedusting. We are going to try and burn our dust in our own plant, but whether we will accomplish this on the type of stoker we are using at present. I do not know. We have tried burning some of our dust, with more or less good results, and we have tried burning it mixed with other fuel, but we found that when mixed with other fuel, it would pack and of course we could not get a good fire. We have also tried blowing our dust and we found that by keeping a good

bed of coals on the grate we were able to burn the dust. But our plant (as far as dedusting is concerned) is still on paper and we have had no results from it.

Chairman Pfahler: Thank you, Mr. Johnston. Has anybody else anything to say or questions to ask Mr. Garwood? (No response).

The gentleman who is to give our other paper this afternoon is a little bit late. He 'phoned from Centralia. He had to come all the way from Benton, but he will be here in a few minutes. President Hamilton wants to make some announcements at this time.

President Hamilton: At the morning session you authorized the appointment of two committees. A meeting of the Executive Board was held immediately after the morning meeting and these committees were selected. I will now ask the secretary to read the names.

B. E. Schonthal, Secretary: The Special Committee on Scholarship is: Charles F. Hamilton, Chairman.

J. M. Johnston.

H. H. Taylor, Jr.

George F. Campbell.

L. D. Smith.

The Special Committee on Resolution to be sent to Washington to try to secure an appropriation from the Government to further Mineral Industries Research is as follows:

George N. Reed, Chairman.

Paul Weir.

T. J. Thomas.

Chairman Pfahler: Anybody else anything to suggest while we wait for Doctor Moore, or anything of interest to say? We would be glad to hear from anybody. (No response).

Chairman Pfahler: Is there a man in the room who has not been asked to join the Illinois Mining Institute? If so, do not be backward in saying so. The Secretary here, or the registration people out in the hall, will be glad to take care of you.

While I am on my feet at this time I think it would be well to announce again that the banquet will be at 6:30 sharp. We were very fortunate in securing a very prominent, outstanding railroad man, Mr. Ralph Budd, President of the C. B. & Q. Railroad, to be our speaker tonight, so we would like to get started as near 6:30 as possible, and we will appreciate it if you will be on time.

Has anybody anything else to say? What's the matter with John Garcia? Is he asleep? Oh, I see—he has disappeared.

George F. Campbell: Might I suggest that we recess for fifteen minutes or half an hour and come back here then?

Chairman Pfahler: Well, that would be a good suggestion if I could be sure you'd be back here, but, after a recess, it is rather hard to get the men back, once they have left the hall. The Doctor ought to be here any minute; but, George, we are not going to let you sit down by just making a suggestion that we recess. Can't you say something of interest to us?

George F. Campbell: Well, I have enjoyed this Institute very much and hope to enjoy a lot more before I get through, and I hope that the evening session will be as pleasant as the morning session and this one.

Chairman Pfahler: Thank you. I can vouch for George as a good bridge player. If anyone wants any instruction in the game, they can go to him.

The President suggests that I ask you to stay right here, as he apparently concurs in my thought that if we were recess for thirty minutes you might not come back.

Mr. A. W. Plumlee: I would like to suggest that a true copy of Dr. Cady and Dr. Leighton's paper and pictures be put in printed form. This is only a suggestion—not a motion.

Chairman Pfahler: We will be glad to consider your suggestion, Mr. Plumlee: however, they will appear in full in the Year Book. (President, Chairman, and Secretary consult.)

Now, gentlemen, we have had a change of heart and change of mind. I believe George Campbell's suggestion is pretty good, as I see that a number of you are beginning to drop out by one and two at a time and rather than have that happen to Doctor Moore, we will stand adjourned until 4 o'clock.

Adjourn to 4 P. M.

Afternoon Session reconvened at 4 o'clock. Chairman Pfahler, rapping for order, spoke as follows:

May I ask the people in the hall to please step back into this room? When everyone was seated and silence was restored, he continued:

The next paper will be by Doctor J. B. Moore, of Benton, Illinois, whom I now take pleasure in introducing to the Institute. (Applause.) Doctor Moore's subject will be:

"THE RELATIONSHIP OF THE INDUSTRIAL SURGEON AND THE EMPLOYER OF MEN"

Dr. J. B. Moore: I am a little bit surprised at the hearty greeting I got after delaying you for so long. You know I am not bragging, but it takes a lot of nerve to talk to an audience like this. I can talk to a lot of doctors with much more ease, but I have never tried to talk to a group of engineers before, and, in order to stay on my own side of the fence, I am going to stick strictly to the notes I am going to read.

'THE RELATIONSHIP OF THE INDUSTRIAL SURGEON AND THE EMPLOYER OF MEN"

By J. B. MOORE, M.D. Benton, Illinois

I think that you will all agree with me that the interests of "The Industrial Surgeon and the Employer of Men" arise from common ground, centering in the injured employee. The general recognition that industry should share the financial burden of loss of time and disability resulting from personal injury, has fused the surgeon with the other elements making up an industry.

In recent years the surgeon has become an indispensible part of the coal mining industry in Illinois. What then should this industry expect of him? It should expect aid in the prevention and minimizing of injuries, and cooperation with the compensation department in the return of the men to work, and in the final disposition of their cases,

The intelligent and persistent instruction of the employee in the care of minor injuries is quite important. The "Skinned Shin" which occurs so often, is many times the cause of much loss of time. The injury is not serious as to the final outcome, but the payment of temporary compensation is a very large item in the course of a year.

The workmen generally consider it of such minor importance that they neglect to report it until it gets sore, two or three days later. In the meantime the clothing has thoroughly infected it. I have seen such cases resist treatment for weeks. They should have immediate attention.

Toe injuries are very common in the coal mine. The conditions are ideal for this to happen. Some of us have seen this type of injury almost disappear in territories where a shoe with a protective tip is worn.

All of you are familiar with the dangers of having a fellow workman attempt to remove a foreign body from the eye, or of putting it off until tomorrow. But this information must be driven home to the men in the works, if it is to be of any use. The surgeon can help to do this through cooperative efforts. I think that the surgeon should come in contact with the men in some capacity other than through the necesary care of an injury.

There should be friendly, trustful cooperation between the surgeon and the compensation department. Free and honest discussions of their problems is essential to an efficient organization. There should be no "Buck Passing".

The compensation department has a right to expect a prompt accurate report of injuries, prompt release when a man is able to return to work, and a plain statement of facts, in-sofar as the surgeon is able to do so, as regards the final condition. In the latter the surgeon should be firm but fair and sympathetic with the injured man. I think that he should not enter directly into the financial settlement of the cases.

It is very desirable that the surgeon maintain the good will and confidence of the injured employee. This can not always be done, but when possible it greatly facilitates the man's return to work, and an agreeable final disposition of the case.

Getting a man back to work is many times one of our most difficult tasks. Lack of cooperation between the operating and compensation departments is too often "The Nigger in the Woodpile". For consideration-suppose we are dealing with a trip rider, who has received a broken ankle. After three or four months he is able to do some kind of work, something that will cause him to use the injured part more than when he is at home, and that will help to regain its use and establish him on a work basis. It may be several months before he is able to return to his original job, never-the-less the onerating department insists that he be kept out until he is able to ride trips again.

Suppose a man has been off several months on account of a serious back injury, eventually it is agreed that he is able to do some work. This type of case progresses just so far and no farther until they return to some kind of employment. The rehabilitation is slow, but if managed properly, he will be able to return to loading or his machine. He is discharged for work and taken off compensation. The operating department immediately puts him back in a machine gang where the men share equally in the earnings of the group. It is soon quite evident, that he cannot do his part of the work. The other men complain, and he returns in one or two days discouraged and convinced that he will never be able to do heavy work again. He demands to be placed back on compensation, and whether he is or not, he becomes a more complex problem.

Now, suppose that these men are placed in a "Rehabilitation Squad" to do some odd jobs in the mine. Cleaning up falls, cleaning roads, etc., under a firm, but sympathetic understanding supervisor. They will be kept in the squad for a few days, or weeks, as the case may demand, when they are put back in their old places or at some regular job. I believe that this plan would be well worth while, not only as regards the individual, but to reduce compensation for injuries.

The surgeon should expect loyal support from the industry that he may be serving. In the smaller communities I think it is mutually advantageous for the company doctor to do some general work. It helps to establish him with the public, and there should be no conflict.

It must have occurred to you that the surgeon's real service is rendered at a time when the employer and the employee are in complete agreement, and demanding the same thing, viz: the quickest and the most complete recovery.

(Applause).

Chairman Pfahler: Thank you, Doctor Moore, for your very interesting paper. Does anybody want to ask Doctor Moore any questions?

C. J. Sandoe: I would like to ask the doctor how much first aid should be given at a mine to men who are to be sent to a doctor—or should the men stay away from a doctor?

Dr. J. B. Moore: Well, you know, that is quite a problem. I have seen a number of complications from too much first aid in the mine. I know that a few years ago, in many States, tincture of iodine was distributed in first aid stations in the mines, as it was in Illinois till we had some terrific burns from it. Some people are very susceptible to iodine burns; in fact, most people are susceptible to iodine burns, and I think iodine should be very carefully used, if at all, for dressings. I think first aid, particularly in the southern Illinois territory mines, should be confined to

stopping blood where there are hemorrhages—and temporary slings for broken legs and arms. I think there should be no attempt to use anything in the way of dressings except the most simple type of dressing, with nothing in it on the order of tincture of iodine that might cause trouble or burns. In fact, we are getting away, more and more, from dispensaries around the mine or home.

Chairman Pfahler: Any more questions?

Mr. John A. Garcia: I would like to say something on this question of accidents around coal mines. It is my experience that we keep pounding first aid all the time into the bosses, superintendents, mine managers, etc., all down the line,-but we never get to the fellow who really gets hurt, the worker (so-called.) We call meetings among the bosses and discuss the question-and we put certain rules in force-but I do not know of any place that we have ever called the so-called worker into our meetings and discussed accidents around the mines. For the last ten years I have been gathering reports and bulletins from the different coal companies, like Bell and Zoller, Union Pacific, and different companies who issue reports as to how the accidents happen-and I study them, not only because I am interested in coal mining accidents, but for my own good, so that when I go around a mine I will have learned from studying these reports just how men get injured. This I know is a selfish motive. I do not know but what it would be a very good idea for the Illinois Mining Institute to collect these statistical bulletins issued from time to time by various coal companies and the Bureau of Mines, and send them directly to the men who actually do the work in the mines-to the men who may get killed or hurt.

We operate a little mine down in Indiana and every time a man is injured we either publish a bulletin or post a notice on a bulletin board, giving the details, so that the men will know just how the accident happened—and with the help of the Bureau of Mines, we have collected this data and put it in a conspicuous place at the mine so that the men can hardly resist seeing just how these men got hurt.

We have our meetings once a week down in Indiana on accident prevention, but no one ever comes to those meetings except mine superintendents, foremen or bosses,—and after you have done that for two or three years, your organization gets saturated with your attempts to prevent accidents. What you have to do is to get this to the fellow who is running a motor—a triprider—and the men who usually suffer these injuries.

The Bureau of Mines and all these different State organizations have done their best to educate people in the safety movement,—but they do not get down to "brass tacks" and educate the man who earns his daily bread with the sweat of his brow as to how these things occur.

I have perhaps saved my life at times in traveling around mines, by what I have learned reading about how accidents happen to the other fellows. There is some co-ordination or cooperation amongst the operators of mines in the middle west and I think it would be a mighty fine thing for the Illinois Mining Institute, through the Bureau of Mines, to cooperate and get the details of these accidents and post them at the different mines so that the men themselves can find out how their own fellows get hurt.

Chairman Pfahler: Thank you, Mr.

Garcia. Anyone else wish to discuss this matter?

Mr. Berger: In our own properties, we issue these bulletins, and we see that they not only go to the bosses, but to every man. We distribute them right with the pay-checks. Every man is offered one of these, and he can see (as Mr. Garcia said) just how the accidents happened.

We also sometimes have an artist draw a picture of how an accident happened, and post it in a conspicuous place for the attention of the men, and it does attract attention. But a poster must not stand in a place indefinitely, as it loses its appeal. You have to change them frequently in order to draw the attention of the men to it.

I think there is a gentleman here, Mr. Alex Miller, of the Bureau of Mines, who has been going around giving first aid and safety first lessons, (which is a fine thing,) but our experience has been that when the gentleman did come and put over first aid lessons, he talked accident prevention to the men themselves and in that way they reached everyone, and we have got very much better cooperation from our men than we ever expected we would get from men of that kind.

Chairman Pfahler: Anybody else anything to say?

Mr. Alex Miller, Associate Engineer, U.S. Bureau of Mines: I can verify the statement of Mr. Garcia, as far as accident reports are concerned. I have had the privilege of making a survey of thousands of accident reports in the past few years, and I want to say that I do not believe I have run across any that gave any information pertaining to the CAUSE of the accident. Practically each and every one stated WHAT CAUSED THE INJURY—but none of them stated WHAT CAUSED THE

ACCIDENT. There is a vast difference between what may cause an accident and what may cause an injury -the injury is only one of the products of the accident-and unless we get down and analyze the cause of the accident, it is self-evident that we are not going to get at real accident prevention. As far as reaching the miner is concerned, we have found that first aid is one of the best features of educational work in accident prevention that we have run across, because it brings to the mind of the individual the seriousness of accidents.

I attended one of those meetings Mr. Garcia spoke of, last Wednesday in Indiana, where there were one hundred and twenty-six people present—most of them miners. The superintendent of that mine had every report of accidents that had occurred in that mine for the month of October read before the meeting, and the men discussed the causes of those accidents, and suggested means of removing the same.

I think all the officers of an organization should be personally interested in accident prevention firstand then carry it to the men. I have ofttimes heard it said that you could not get cooperation from the menbut I believe that is a mistake, because I have seen some of the best cooperation in the State of Illinois that any person could hope to receive in any movement he might see fit to inaugurate. I think it is possible to put the causes of accidents before the men and get them to take a personal interest in holding future meetings for that purpose.

Chairman Pfahler: Anyone else anything to say? If not, we have in our midst a very prominent, outstanding coal operator in the State of Illinois with us today. If my memory serves me correctly, I believe this is the first time he has been at one of our meetings. He has been very active in modeling and remodeling the Coal Code and also in seeing that it functions properly. He has recently been in Washington—in fact, I believe he flew here to be at this meeting this afternoon. I take pleasure in introducing George B. Harrington, President of the Chicago, Wilmington and Franklin Coal Company:

George B. Harrington: Fellow Members of the Illinois Mining Institute: I am sorry I did not hear Mr. Weir's paper on the Code, because I fear that almost anything I may say about it is likely to be a "repeat". I know that there are a great many questions in your minds as to just what is the present status of the NRA, and, by the same token, the status of the Code. What I say will have to be more or less a personal opinion and not an authoritative statement, because I am going to give you a little of my own guess on the situation.

The Code (which was largely the work of Illinois operators assisted by men from other States who were already operating under Union contracts), had as its first object a standardization of wages and working conditions and hours within the various districts in the United States-and the reasonable standardization of these conditions between districts serving the same markets. We with Union contracts felt that we were under an unfair handicap and wanted to take this opportunity to get that handicap squared up. I do not need to tell you how through the depression our non-Union competitors were able to cut down to where they practically put the Union fields in the north out of business, and we all know that it was an unfair situation. The NRA gave us the chance to

straighten that up and at the present time differentials between our field and the former competitive non-Union field are written in the Code. Having made a big drive on that, the Illinois people were not so insistent on their own ideas as to price fixing. I think it is safe to say that we all had various ideas, and that they were boiled down pretty much to a feeling that the companies are entitled to the cost of production plus a reason-However, during the able profit. spring, the Appalachian coal organization, which was based on the latest Supreme Court decision, had gotten a good deal of a start and the operators who were familiar with that had a good deal to do with writing the price-fixing part of our Code, which is based on the Appalachian idea. has been put into Price-fixing several other Codes, but some of the industries do not have it.

Speaking of some of the difficulties of NRA in getting organized:-Gen. Johnson promised that he would not have over one hundred and fifty Within the past men in the NRA. week the Republican National Committee have issued a pamphlet in which they criticize the Democratic Administration for many things, but among them they criticize the NRA saying it now has more than one thousand employees additional in the field-that they really have not got started yet-and when they get organized to carry out the numerous functions of the Code, it will be a large bureaucracy. These criticisms got under the skin of Gen. Johnson and he and Mr. Richberg have been in a series of conferences with the President as to how big this thing is going to be. I mention this because we have been wondering why we do not get our Presidential appointee for Illinois. The answer is that until the NRA decides how hig it is going to be, they hesitate to make all these additional Code appointments. They have asked whether the coal industry would chip in and pay the expenses of these people. Most of the big groups said they would and the little ones said they would not, but it looks a little as if the industry would pay for the Presidential appointees. Then some of the fellows who said they would be willing to pay qualified that by saying that if they paid they ought to be allowed to pick their own representatives, and they all began sending in names. We have sent in the name of Doctor Honnold, whom you all know. He was put on the slate. and when that slate got up to Gen. Johnson it is said that either someone told him or he thought that "these industries are going to run things and fix prices and that will make a tremendous target for Congress to shoot at next January,"-so he turned down all of these appointees, and Doctor Honnold was disapproved among all the others. Then it was a great day for all the unemployed engineers. You know a great many very worthy engineers are out of work, so many of them applied for jobs, but none of them have been picked-but at the present time it looks as though most of those who will get jobs will be mining engineers or someone who knows something about the mining business. As you saw by the papers this morning and yesterday, some of the leading industrialists in the NRA have resigned; they have said they were not quitting but just going back to their own business-and the answer is that nobody knows whether the NRA will be organized into a permanent instrument to govern industry they do now under the Code or whether they will try to contract themselves to their original purpose, or as Mr. Swope put it, be somewhat like a National Chamber of Commerce, and run themselves. I am not much of a believer that the last is practicable.

So we have just got to be patient until they decide the policy of the NRA. Now that may not sound very cheerful as to our Code but on the other hand I do not think that Illinois stands to lose very much whichever way this thing is decided.

The big thing we need out here is to play the same rules of the game as the other fellow-that is-to be able to work the men a certain number of hours at a certain rate of wage, and actually pay the payrolls-and things of that kind. If we just had the Code and the NRA blew up we might drop right back into the old conditions; but, in addition to the Code, we now have the UMWA in districts where formerly they did not exist, so that the mine workers are really in, whether the Code blows up or not, and I doubt if that will change for quite a while-so that from our point of view it is undoubtedly going to be of value in this district for a long time to come, and for that I believe we are to be congratulated, that we did take the position that if there is to be a Code that Code must apply to everybody in the industry. In other words, we could not have a separate Code for West Virginia or West Kentucky. Indiana or Pennsylvania, and then write our own separate Codeand no one pay any attention to it. We got one Code for the whole industry-and I think that is very important.

I do not know whether I have helped clarify anything you wanted to know, but I will try to answer any questions:

Chairman Pfahler: Thank you,

Mr. Harrington. Anybody else any questions?

Mr. John A. Garcia: I have been approached (an unemployed engineer—more or less employed) in connection with a technical matter in Washington—and necessarily I had to turn it down. I have quite an intimate acquaintance with each of the three technical advisors on coal mining in Washington, and I want to say that there is not in Washington a technical advisor who has any connection of any kind with Illinois and Indiana.

Some of the men, to my personal knowledge have never been in a coal mine themselves and that position technical advisor in Washington is of very vital importance to the middle west. Instead of an eastern man sitting down there in Washington advising the commission on our problems in Indiana and Illinois I would like to suggest to the commission that we have now in both Illinois and Indiana, Mining Institutes and they can submit their problems in Illinois and Indiana to men from those Institutes rather than to some stranger, and I think it would be very wise for the Illinois Mining Institute to create a situation whereby any problems of our industry will be referred to one of those Institutes. (Applause.)

Chairman Pfahler: Before turning the meeting back to our President, I again urge you to be prompt at our banquet. Purchase your tickets at the registration desk any time before 6:30—and for the benefit of those who were not in the room before, I want to state again that Mr. Ralph Budd, President of Chicago, Burlington & Quincy Railroad will be our principal speaker tonight and he will make a very interesting talk.

I thank you gentlemen for being quiet this afternoon, making it easy

for me to preside. I now turn the meeting back to Mr. Hamilton.

President Hamilton: Thank you, Mr. Pfahler, for your services as chairman of the meeting this afternoon. I have nothing more to offer to the Institute at this time except to again urge that your schedule be so arranged between now and 6:30 P.M. that you can be here promptly to start the banquet on time. It will not be of long duration and there will be ample time afterwards for the other activities I know you enjoy.

Is there any further business? If not, the Institute will stand adjourned until 6:30.

After the business session and the the morning and afternoon programs of the Illinois Mining Institute had been completed, the members adjourned until 6:30 P.M., when a sumptuous banquet was served in the gold ballroom of the Hotel Abraham Lincoln to the membership and friends of the Institute,

President Hamilton called the meeting to order and gave a brief resume of the work accomplished by the Institute during his term as President, which showed that it is in a very flourishing condition.

It had been arranged that the Honorable Thurlow G. Essington, Chief Counsel of the Illinois Coal Operators' Association, should serve as Toastmaster, but unfortunately other engagements prevented his being present. In his absence President Hamilton said that we were fortunate in securing the services of the Honorable Walter W. Williams, President of the Illinois State Chamber of Commerce of Benton, Illinois, to act as Toastmaster for the evening. With a very appropriate introduction, Mr.

Williams was called upon to act in that capacity and in his own pleasing and efficient manner he very graciously accepted this responsibility.

After a few appropriate remarks concerning the Institute and the mining industry in general, the Toastmaster introduced the officers for the ensuing year and the members of the Executive Board, but in view of the fact that the program was lengthy, the incoming officers responded in an informal way.

Several distinguished guests were present at the banquet. Harvey Cartwright, Secretary of the Indiana Mining Institute and Indiana Coal Operators' Association, upon being introduced extended a very cordial welcome to the entire membership to be present at the Indiana Institute meeting to be held December 4th at Terre Haute. In a very able manner, Mr. Cartwright spoke of conditions as they exist in Indiana at this time, with particular reference to the NRA in that State. There were also presented to the meeting Mr. George B. Harrington, President of the Chicago. Wilmington and Franklin Coal Company, Dean Thompson of the University of Illinois, Mr. W. C. Hurst of the C. & I. M. Railroad, and W. D. Ryan of Kansas City, who, in his usual happy mood, spoke very enthusiastically of the work that had been accomplished by the Illinois Mining Institute.

Following all of these introductions, in a few choice words, Mr. Williams introduced the principal speaker of the evening, Mr. Ralph Budd, President of the Chicago, Burlington and Quincy Railroad, who spoke on "Some Personal Observations in Russia." (Applause.)

"SOME PERSONAL OBSERVATIONS IN RUSSIA""

By RALPH BUDD

President, Chicago, Burlington & Quincy Railroad

It is appropriate for a railroad man whose line participates substantially in the movement of coal from Illinois mines to meet with this group, and I appreciate the honor of being your guest on this occasion. Railway men and coal men ought to be interested in each other's success because each group is one of the other's best customers. Products of mines account for 55% of all the tonnage moved by the railways in the United States, and coal mines furnish the most of it. The Burlington gets nearly thirty per cent of its tonnage, and nearly sixteen per cent of its revenue from bituminous coal, and most of that is Illinois coal. We have been concerned, as I know you have, to see the percentage of total United States coal produced in Illinois decline very rapidly in recent years. The figures I have seen indicate a reduction of from nearly 17% in 1921 to about 10% at present. Let us hope that one result of the efforts to stabilize industry along fair competition lines may be to restore to the Illinois coal mines its former and, I believe, its normal position in the country's production.

We have understood your situation and I feel certain that I may speak for the railroads generally in saying that we appreciate the loyalty of your industry to the railroads. We are primarily vendors of service and our first duty is to provide the service that best fits your requirements. This we have tried to do and will continue. We may not be able always to meet your views entirely, or to comply altogether with your requests, but we shall always be glad to deal

with any problem you may oring to us and will do so in a sympathetic way, knowing that our success to a large extent is inter-dependent and our purposes mutual.

It has been suggested that I tell you something about a trip through Russia. So much has been said and written about that subject in the last few years that I am afraid it has been worn threadbare. The pending conferences between our President and the Soviet's Commissar of Foreign Affairs may, however, make the subject of sufficient immediate importance to constitute an excuse for my narrative on this occasion.

All of you are familiar with the so-called Five Year Plan for industrializing Russia. It seems to me, after discussing their plans, that the expression "Five Year Plan" is a misnomer, because the planned economy which has for its primary object the extensive industrialization of what had previously been almost solely an agricultural country, extends over many more years than Five. first fifteen years of the plan were quite definitely outlined when I was there in 1930 and these fifteen years had been divided into three periods of five years each. I think a more descriptive as well as more accurate expression would be "The First Five Years of the Plan", "The Second Five Years of the Plan", "The Third Five Years of the Plan", etc. However that may be it was the so-called Five-Year Plan which resulted in my going there, the purpose being to give advice concerning the improvement and rationalization of the Russian railway system, which by reason of

industrial program would called upon to handle a much larger volume of traffic than it had carried previously. There were two views among the officials of Soviet Russia on the railroad question. One was that the roads should be Americanized and brought up to the standards of the railways of this country, and the other was that they should be improved to conform with the modern railway standards of Europe, having in mind particularly the German railways.

In order to base their decision on first hand information a commission of approximately twenty Russian railway men was sent through Europe and Canada and the United States to investigate and make a report on the matter. At the conclusion of this inspection trip early in 1930 the members of the commission decided that the railways of this country and Canada were more suited to the transportation requirements of Russia than the railways of any other country, but in order to check their own conclusions they wished the opinion of some American railway men. It was in response to this desire that five of us visited Russia in the summer of 1930 and traveled rather extensively over that country for the purpose of determining whether in our opinion American railway standards, methods, and practices are entirely suitable for Russian transportation requirements. It seemed to us that there were three primary factors to be considered. First, the topography of the country as to the practicability of lines with low grades and easy curves; second, the climatic conditions; and, third, what may be termed the railway duty of the country, that is, the character of commodities to be handled, the density of the traffic, the length of haul, etc. We were in Russia 73 days and inspected most of the large terminals and most of the important traffic routes, covering some 17,000 miles of a total of about 50,000 miles of railway in the country. Entering Soviet Russia through Poland, a fourteen hour ride brought us to Moscow. This trip was across a terrain somewhat like the cut-over lands of Northern Wisconsin and Minnesota and occupied mostly by what would be termed backwoods farming communities. with a fair amount of livestock. Moscow is the business as well as the political center of the nation, although the heaviest railway traffic routes do not pass through there, but are confined to the industrial regions farther south. After several days study of the Moscow terminals, we went southerly through the Ukraine and inspected the terminals adjacent to the great coal and iron mining regions about 500 miles from Moscow. most important of these are the Donetz Basin coal fields, and the Krivoy Rog iron mines which are about 200 miles west of Donetz. gether they constitute the heart of Russia's industrialization plans in The Donetz coal and the Europe. Krivoy Rog iron, as I have said are about 200 miles apart, the former to the east and the latter to the west of the Dnieper River. On the Dnieper, some 100 miles to the south of the coal and iron deposits, is the socalled Super-Power Plant, which was under construction in 1930 and recently has been completed. It was built by Colonel Hugh L. Cooper of Keokuk Dam fame, Electrical power from this plant supplements the coal and iron. These sources of raw materials and water power are roughly half way between Moscow and the Black Sea, and here is the heaviest railway traffic density to be found within the limits of the Union of Soviet Socialistic Republics, Production capacity of coal and iron mines were being enlarged and smelters, rolling mills, and factories were being built at suitable places on the Dnieper River and elsewhere in the triangle formed by the Donetz coal mines, the Krivoy Rog iron field, and the Dnieper Dam. Hectic activity in every kind of construction was evident throughout this region.

In addition to the industrial traffic the Ukraine produces a large volume of agricultural tonnage and is the most densely populated section of rural Russia. The Ukraine was the first great wheat growing area which we saw. The surface of this country is a rather flat rolling prairie, not unlike the territory between Chicago and St. Louis, and until one nears the Black Sea practically the whole country is under cultivation. There are three double track railway routes connecting the Ukraine with Moscow.

We visited the Crimea and spent two days on the Russian Riviera in the vicinity of Yalta, some sixty miles east of Sebastopol. This stretch of Black Sea shore along the southern coast of the Crimean peninsula for a distance of about thirty miles adjacent to Yalta was occupied before the world war by the nobility and the rich people of Russia. Attractive and beautifully landscaped grounds lined this entire shore. These now have been taken over for pleasure resorts of the workers and peasants, but more especially for the workers, and when we were there towards the end of June all of the villas were crowded with occupants. Usually two weeks free vacation time is given and either free or greatly reduced passenger rates are made to enable the workers to enjoy the various rest resorts, of which the Crimea is the foremost. The transportation problem from the north to Sebastopol which is the gateway to Crimea is chiefly that of passenger business. The railway is mostly double track and, owing to favorable soil conditions for maintaining track and the country being very flat, the track is in comparatively good condition.

From Crimea we returned to the southern part of the Donetz, then southerly through Rostov at the mouth of the Don River, and thence to the North Caucasus country which constitutes the northern slope of the Caucasus Mountains. You will recall that the Caucasus Mountains are about 700 miles long and extend from the Black Sea on the west to the Caspian Sea on the east; they also form the boundary between Europe and Asia Minor. The railway from the north skirts along the north slope of the Caucasus and reaches the Caspian Sea north of the ancient town of Derbent, thence it follows the shore of the Caspian Sea southerly around the east end of the Caucasus Mountains, turns westerly and extends some 700 miles from Baku on the Caspian to Batum on the Black Sea. Thus is described a giant hairpin encompassing the north and south sides and the east end of the Caucasus Mountains.

The North Caucasus country is the second of the great wheat regions we passed through, and the traffic carried on the railway there in addition to agricultural products consists of a heavy tonnage of oil from the Baku oil fields. On the line from Baku to Batum oil is the chief tonnage and that railway, which is about 700 miles long and largely single track, is loaded to capacity. are two pipe lines which carry oil from Baku to Batum but they are of relatively small capacity. Batum on the Black Sea is the port where the oil is loaded on tank ships for export.

The Caucasus Mountains are by far the highest in Russia, and until recently it has been considered impracticable to build a railroad across them; hence the detour around their easterly end. We crossed these mountains about their middle, by an ancient road known as the Georgian Military Highway. The distance from the railway at Vladikavkaz on the north of the Caucasus to the railway near Tiflis on the south is 120 miles by this highway, while around the east end of the Caucasus Mountains the distance by rail following the great hairpin bend is about 900 miles.

We investigated the feasibility of building a railway across this loop and found that, by following rather closely the route of the Georgian Military Highway and by electrifying the line, a railway could be built with about the same grade and curve characteristics as are used by most of the railways in crossing our own Rockies, Cascades and Sierra Ne-The summit would be about vadas. 8,000 feet above sea level and the summit tunnel would be approximately six miles long, occupying Kazbek Pass. On either side of this pass are mountains ranging from 16,000 to as high as 18,000 feet elevation in the case of Mt. Elbruz, and approaching the Pass in both directions the perpetually snow capped peaks afford the most sublime and superb of mountain scenery.

The height of land which separates the drainage of the Black Sea from that of the Caspian Sea and over which the railroad from Baku to Batum passes is a southern spur of the Caucasus Mountains and is only about 50 miles east of the Black Sea so that the railway line eastward from this height of land occupies a valley gently sloping toward the Caspian. This is the valley of the

Kura River in which the very picturesque and polyglot city of Tiflis is located, approximately half way between the Black and Caspian Seas. The country between Tiflis and the Black Sea is quite similar in appearance and in climate to that of northern California and the products also are similar, consisting chiefly of melons, cherries, apricots, peaches and grapes. We did not see oranges growing but found Persian oranges and tangerines on the Batum and Tiflis markets. Tea is grown along the Black Sea coast. Baku, being the center of the great oil producing region, is a typical, bustling city of the mushroom type, having grown from a small place to a city of half a million inhabitants in only a few years. We went on a small steamship from there across the Caspian Sea to Krasnovodsk, about an eighteen hour trip, and there began a four-day journey through the hot desert sands of Turkestan. This single track railway line of about 1,200 miles from the Caspian Sea to Tashkent was built in the '80s as a military road along the southern boundary of Russia. traverses a generally flat country with sand as white and fine as drifting snow of the northern winters. To the south the mountains which form the boundary between Russia and Persia are often visible. The temperature reached 120 degrees Fahrenheit every day in the desert. This railway, which formerly served as a military measure, now carries a fairly large volume of traffic due to the fact that at its eastern end in the vicinity of Bokhara, Samarkand, and Tashkent vast tracts of land are being irrigated, and also due to the completion of the railway which connects Turkestan with Siberia to the north-Tashkent, thus giving a east of through route for lumber, cotton, and grain to flow southward and west-

ward and for oil to flow eastward and northward from the Caspian. The line is single track and of light construction. Strange phenomena in crossing these desert stretches, especially as one nears the eastern end, are four or five wide rivers of clear water flowing northward out of the mountains to sink in the sands toward the Aral Sea. These magnificent streams, whose flow is quite dependable because of their sources in the snows of the northwestern spurs of the Himalayas, provide the water for irrigating the large projects which are partially completed and will supply the larger ones which are planned for the future. One of these rivers, the Oxus of Alexander's time, was in flood when we crossed it early in July and a full mile and a quarter wide.

At Tashkent we met Arthur Powell Davis, who had been there for more than a year in charge of laying out the irrigation projects, which were being developed. He told us of the vastness of the possibilities, stressing the favorable soil and climate, as well as the abundant supply of water. You will remember that Mr. Davis was for some years head of the United States Reclamation Service and first conceived the Boulder Dam project which is now being carried to completion, and for which he was consulting engineer at the time of his death a few months ago.

One cannot visit these old cities of Bohkara, Samarkand and Tashkent without being greatly impressed by the evidences of ancient grandeur and pondering the changes which time has wrought. This is the country of Ghengis Khan and Tamerlane and the latter made Samarkand the most magnificent capital of its age. The history of its once dominant position seems utterly fantastic and unreal in view of its present remote-

ness and inaccessibility from the important centers of commerce and culture. We think of Tamerlane and Ghengis Khan as symbols of faded glory, but Samarkand was an ancient city and the river valleys there were old in history before Tamerlane. Alexander the Great campaigned through them before the Christian Era and who can tell how long civilization had known them already.

The westward flow of progress has left these valleys with their relics of early magnificence and power in a quiet eddy for centuries. Even now their relative activity is merely local and they seem destined to remain far from the main current of events and the ruins of their gems of architecture crowded by concrete factories and square squat socialistic apartment houses.

Soon after leaving Tashkent we reached the newly created Turkestan-Siberian line, commonly called the Turk-Sib. This line is proudly pointed out as the greatest single accomplishment of the Soviet Government. It is about 900 miles long and like the line from the Caspian Sea to Taskhent follows closely the international boundary between Russia and Mongolia. It was planned by the Czar, and about 300 miles of line were built from the Trans-Siberian Railway at Novo-Sibirsk southerly to Semipalatinsk on the Irtysh River. The new railway between Tashkent and Semipalatinsk is through the Kirghiz Steppes which extend westward from the foothills of the high range of mountains forming the Mongolian frontier. It is a semi-arid country occupied by tribes of nomads -the Kirghiz-who live in circular houses called Yurtas, which resemble Indian tepees, set on vertical circular walls three or four feet high. These nomadic people live almost entirely on the bands of sheep which they follow northward in summer and southward in winter. The Turk-Sib is single track with one per cent grades and construction similar to a secondary or branch line in this country. The traffic will consist almost wholly of through business, chiefly products of forests and grain from the north, and oil, cotton, and products of irrigated lands from the south.

At Semipalatinsk and from there northerly 300 miles to a connection with the Trans-Siberian railroad at Novo-Sibirsk, we were in the third wheat region visited and the largest in Russia. A short distance to the east is the great Kuznetz coal field, and 1.200 miles westerly from the Kuznetz coal is abundant iron in the Ural Mountains. The Kuznetz coal, together with coal, iron, and other mineral deposits in the Urals, constitutes the basis for the second major industrial activity of Russia which is located in and easterly from the Ural Mountains-in other words, between the Kuznetz coal fields and Urals which are 1,200 miles apart. Siberian plains which lie between the Kuznetz mines and the Ural Mountains are almost as level as a floor, so that although the distance which coal and iron have to be transported is long, the traffic can move over practically level grades and the transportation cost will be relatively small. Here, as in the Ukraine mining, refining, manufacturing and city building, all are being planned and developed simultaneously at several strategic places. The immediate output of factories is to be harvesting and other agricultural machinery to take care of the needs of this great Inland Empire which is more than 2,000 miles from a seaport.

We returned from Novo-Sibirsk by a line which crosses the Ural Mountains near Chelyabinsk which is the site of one of the large tractor factories. The Urals are negotiated on one per cent grades and the railway summit is about 2,600 feet above the sea. This is a fairly good railway but the traffic is too heavy for it and is increasing rapidly. To provide for present and future business the line is being double tracked. West of the Urals we passed through the Volga Valley, which is the fourth large wheat growing region we saw and in normal years a beautiful fertile country. It was hard to believe the stories of famines such as that of 1921. From the Volga at Samara back to Moscow the railway crosses a rolling prairie country, in appearance much like that of northern Missouri. It is a very old settled country and was fought over back and forth by the Tartars and the Russians as early as 700 years ago. The railway from the Volga River at Batricki (60 miles south of Samara) to Moscow is mostly double track and the last 250 miles from Pensa to Moscow is as good as any in Russia.

After a short stay in Moscow we went to Leningrad (formerly St. Petersburg) over the double track line, which in some ways is the best The distance is railway in Russia. about 350 miles and the line is nearly straight and fairly level all the way. The country is rolling and partly wooded and was formerly occupied by many large estates. This line was built by the American engineer, George Washington Whistler, who came as a small child to Chicago when his father, Captain John Whistler, established Fort Dearborn. Washington Whistler's son was James McNeill Whistler, the famous artist.

It was concerning the line between Moscow and St. Petersburg that the story is told of how the Czar when he learned that the several large land owners were trying to influence the location of the line to pass by their places, solved the problem by laying a straight-edge on the map and expressing the wish that the line be built as nearly straight as possible. Leningrad presents the problem of a busy ocean port where heavy transfer of freight is made between rail and ship, although most of the export from Leningrad is lumber and pulpwood and most of that moves down the Neva River on rafts or barges.

We left Leningrad after four days and made the trip of about 6,500 miles to Vladivostok with no stopovers except a day or a half day here and there to inspect terminals, route is through a flat and somewhat marshy wooded country most of the distance west of the Urals, and east of them the great Siberian Railroad traverses first about 1,200 miles of level plains where wheat is the main production, then through a more forbidding country on account of the intense cold, where furs, gold mining, and some lumbering constitute the chief production. The first of these regions was partly covered in our trip from Novo-Sibirsk to Omsk, and is the scene of great industrial activity in the industrialization program. Only two or three features were especially interesting from the railway viewpoint in the second region, that is east of Irk-The railway line around the utsk. south end of Lake Baikal for a distance of about 150 miles involved construction work quite similar to that encountered in the mountains of the western United States and is the heaviest construction work in Russia. Easterly from Lake Baikal the crossing of the Yabloni Mountains takes the railway over the highest point reached, which is about 3,600 feet above the sea, although no particular physical difficulties are encountered. Easterly from Chita we went by the All-Siberian route lying north of the

Amur River rather than by the shorter Chinese Eastern through Harbin, and for 1,200 miles east of Chita we traveled over ground that is perpetually frozen to a depth as great as 300 feet. When the surface thaws out in summer and when this surface freezes again in the early fall, there are serious maintenance problems which are not encountered in the United States. The coastal strip, 300 or more miles wide, has much milder climate and lumbering, stock raising and farming are engaged in extensively. Kharborovsk, where the railway crosses the Amur and turns south to Vladivostok, is a city of 100,000 and growing. From Chita to Vladivostok but more particularly from Kharborovsk on, military activities were everywhere evident. It was explained that these preparations did not mean aggression but did mean defense against any attempt to take any part of Russian territory. Amur River bridge is the longest in Russia, approximately 8,000 feet. Like many others it had been partially destroyed during the civil war of 1919-1920. The Russians were especially indignant about the destruction of spans in this and other bridges in Siberia by the retiring Japanese army and spoke of it frequently.

This sketch I hope, will give you an outline of our itinerary. We had found that the topography of most of the territory in the Soviet Republics is about as flat as the Mississippi Valley and that the country as a whole is singularly devoid of mountain areas, there being only three ranges, the Caucasus, which are very high and rugged but are not now crossed by any railway, the Urals, which resemble the Alleghanies, and whose passes are about 2,600 feet above the sea, and the Yabloni range of Siberia, which the Trans-Siberian

Railroad crosses at about 3,600 feet elevation. The climate for the most part is about like that of our northern states but comprises extremes of both heat and cold somewhat beyond our limits. The railway duty as regards commodities, is much like that of this country, the heaviest traffic being in coal, lumber, grain, livestock, and iron. The average length of haul of freight was about 50% longer than that in this country.

Now the basic feature of improvement in our railroad transportation plant has been the development of larger and larger units both in cars and locomotives, and consequently the handling of more and more tons per train. In other words, the idea of mass production has guided the railway managements as it has manufacturers in America. This has resulted in reducing the grades on important traffic routes to as nearly level as practicable, sometimes at tremendous expense. No such policy has been followed in Russia. have not made any special effort to reduce their gradients and they have fairly steep grades even in flat coun-Their cars are about 24 feet long, with a single pair of wheels at each end and have a capacity of about 12 tons, which compares with 46 foot cars having about 47 tons average capacity here. Their locomotives are correspondingly light and their trains carry about onefourth as much freight as ours. Their freight cars are not equipped with air brakes and only about one car in six has even hand brakes. They do not have automatic couplers, but use the hook and link with a turnbuckle to take up the slack after the hook has been inserted-a slow process and also a very dangerous one.

Track construction is naturally light in accordance with the requirements for the lighter equipment and

locomotives; the heaviest rail weighs about 90 pounds to the yard and the average rail on the main lines is about 70 pounds to the yard; ties are small, with wide spacing; ballast, where used, is taken from wayside pits without any preparation and for the most part consists of sand. only one respect is the track of the Russian railways equal to that of the United States, and that is in the matter of gauge, theirs being five feet, instead of 4'81/3" which is our standard. The five ft. gauge, in my opinion, is equal, if not superior, to 4'81/3", and is particularly adaptable for the American railway ideal of mass transportation in large units.

There were practically no improved highways in Russia and very few automobiles, practically all of those being assigned to Government officials, or being used as taxicabs in the lar-As a result of this, and ger cities. also as a result of the policy of granting two weeks free vacation, with either free transportation or exceedingly low rates, passenger trains were greatly over-crowded. It was common to see them with 15 or 16 cars all loaded to capacity, and usually several times as many people would be waiting at stations for the trains as so that could be accommodated, around all the railway stations there were always large throngs of people, some of whom evidently had been waiting for considerable periods. The passenger train accommodations would be considered very crude in this country, only a small portion of the cars being of the so-called soft seat variety, and in a good many instances, on account of the railways being taxed beyond their capacities, people were being handled in box cars. A larger percentage of the total railway mileage is double track than in America. Doubtless this was due to the policy of going from single track to double track operation rather than undertaking to develop a geater capacity on single track railways as we have done by the use of signals and a system of train dispatching unknown to Russian railway practice.

Perhaps the most significant statistics reflecting the relationship of the railways to every day life in Russia compared with this country are the following: The country is about two and one-half times as large as the United States. It has perhaps one-third more people, but only onefifth as many miles of railway. The freight traffic density per mile of railway in 1930 was quite similar to the freight traffic density per mile of road in the United States. The passenger traffic density was probably four or five times as great. would indicate that people about one-sixth or one-seventh as many tons of freight per capita as we do on the railways, and travel almost as much per capita as we do. This of course does not by any means represent the relative amount of travel done in the two countries, because the railways in the United States handle only about one-tenth of the total traveling of the American people, the other nine-tenths being done on the highways, and the freight figures do not include the amount of trucking done in America. which is quite considerable. amount of traffic moved per employe by the Russian railways is not quite one-third as much as is moved per employe by our railways. not be surprised if this corresponds fairly closely with the production in other lines as well as in railroading. The production of their coal mines runs about a ton per employe per day, although that may have been raised considerably in very recent years because of mechanization.

believe the average production per employe in the United States is about 5 tons. The total coal production in all Russia is about 60,000,000 tons per year, compared with about 500,000,000 tons in this country, or about one-tenth as much coal per capita as we produce. Incidentally Russia's total production is about equal to the normal output of the State of Illinois.

It was our opinion that there are no physical reasons why the American standards, methods, and practices of railroading would not be well adapted to the needs of Soviet Russia in accordance with their industrialization program. When we were there this program had been under way for about two and one-half years, although rehabilitation of the country had been gradually going on for five This industrial movement predominated and permeated the entire life of the country. There was construction of every kind, including the planning and building of entire cities with all of the types of construction involved in such undertakings. We saw the building of imfactories, the opening of mines, the building of railways, the building of water works, sewer systems and streets and the rebuilding of these for the large cities like Kharkov and Moscow, whose population has increased so rapidly as to completely outgrow the old facilities. This attempt suddenly to change from an almost wholly agricultural country to one of industrial importance of course brought about the reaching and changes in the lives of the people, and everywhere there was migration from the peasant farms and villages to the construction jobs and facto-This migration was noticeably that of the younger and more vigorous and enthusiastic persons and for

that reason as well as the fact that it is all being carried on to the accompaniment of extensive propaganda, there was evident a great amount of enthusiasm among the workers. Practically all of the theatrical programs which we saw included communistic allusions, newspapers are strictly censored, parades are arranged for frequent celebrations and in every conceivable way the success of the party is acclaimed. In the larger cities where one would come in contact with a cross-section of the entire population the physical and mental strain of the drive was very apparent. Except at the vacation resorts and in some remote regions the people do not laugh and indulge in gaiety. Everywhere they were exceedingly shabby, and none too well fed. The women have taken as important a part in the work as the men and do their full share of the hard physical tasks; fully one-half of the track forces on the railroads are women. They do not have any time or opportunity or facilities for keeping themselves well dressed or well groomed, and this is true of all the women, all of whom, except for short periods allowed for child bearing, are expected to work. Members of the theatrical profession by the nature of their calling of course do present a different appearance and are very noticeable when seen in public.

The period of planning and construction had not yet passed when we were there and of course the success of industry will depend on the ability to operate plans as well as to plan and build them; in fact, the planning and building there was largely carried out under direction of foreign engineers and contractors. There is no doubt whatever but what improvements of the character I have indicated were being successfully built in a most extensive way.

The thought behind the entire movement of course is to raise the standard of living by making use of the natural resources of the country and converting these natural resources into modern living conveniences which are enjoyed by the highly industrialized countries of the world. In order to finance this vast undertaking in the absence of long time credit, there was no choice but to pay for the material, tools, and machinery brought in from other countries, and there was only one way in which that could be done, namely, by exporting raw products and selling them in the world markets so as to be able to buy what was needed. This is perhaps the most vital point about Russia's so-called Five Year Plan as it affects the United States and other foreign countries. A country consisting of 160,000,000 people, most of whom have never known anything but the lowest standards of living, is foregoing many of the necessities of life in order to finance improvement work through which it hopes ultimately to raise its people's standard of living. They are without adequate clothing, many of them are without shoes; they are under-nourished and being fed according to a system of rationing more rigid than ever has been known outside of famine or war times, and yet in this situation they are being obliged by the program which has been adopted to export from their country the very things they need so badly. It is a surprising fact of great importance which is not in any way suppressed or denied in Russia that except for such things as manganese ore, caviar, furs, and a few other things, they do not have any exportable surplus except as it is artificially created through the greatest of deprivation and sacrifice. Al-

though showing plainly the hardships through which they had passed and were passing, there was an astonishing enthusiasm about what they were accomplishing and through the all pervading propaganda by the press, by word of mouth, and by radio each accomplishment in the way of progress or completion of a building or job was well advertised and used for the best effect on the morale. characteristic of the people from one end of the country to the other was their great eagerness to learn. There was naturally some curiosity concerning a group of American railway men. but their main purpose in gathering around at every opportunity as we visited the shops, roundhouses and terminals was to hear, and if possible, to take part in the series of questions and answers that were being exchanged. Illiteracy is disappearing quite rapidly-night schools are everywhere prevalent for the adults and the stress which is being placed upon child education and care is well known.

The question most often raised in connection with Russia is the menace of Communism, should any closer contact be maintained. Our observations led us to think that the surest cure for Communism in this country would be for our people to know exactly how the people in Communistic Russia live and do not prosper. The next question seems to be whether, if Russia prospers, she may not interfere with our own success. It is difficult for me to see how we could benefit by keeping that great nation at any lower level of existence than they might attain, even if we could do so. They need their lumber, coal,

oil and food at home and will use them for generations if they can avoid sending them abroad. On the other hand, the idea that we can prevent Russia from making advancements in science and industry is almost as fantastic as it is egotistical. Germany and other countries are courting the opportunity to give technical advice and provide the machinery and equipment for Russian development.

Our short visit convinced us that our people have nothing to fear from Russian competition and also that her communistic planning is not for us. This is not to say that in the long evolution, of which her present experience is a phase, it was not necessary for Russia to pass through this stage. As to that I do not pretend to know. But our people are so different in background and temperament. our situation so diametrically opposite as respects supply and demand, and our standards of living so far above theirs that I am satisfied whatever route we may travel in our search for a way out of the maze created by our unbalanced distribution, their way, that is the Communistic way does not offer us any promise.

At the conclusion of his talk on Russia, Mr. Budd was given a rising vote of thanks for his splendid address and the wonderful information he gave on modern conditions in Russia.

President Hamilton then turned the meeting over to the incoming President, H. A. Treadwell, who, after making a few appropriate remarks, declared the meeting adjourned sine die.

THE ILLINOIS COAL INDUSTRY

By JOHN E. JONES Safety Engineer, Old Ben Coal Corporation West Frankfort, Ill.

The following article is an address delivered some months ago to many civic clubs and printed in the daily press of many of our cities in Illinois. It is an economic view of the state's coal industry from the earliest records up to the present time. The picture presented indicates the trends of the state's coal mining industry, the present trend being definitely downward. It is an article well worth the study of any who depend upon the coal industry for a livelihood, and is worth preserving for future comparison and reference.

Any address upon industrial development is bound to contain tabulative data and statistics. Such are invariably difficult to follow, so I have chosen to give the tabulations graphically, hoping by this method that I can give you a mental picture of the coal industrial condition in general and that of Southern Illinois in particular.

EX LOUIS

BE O. R. R.

BANKET CORUMNES

BIO MARCE

CHART NO. 1

Early History Chart No. 1 is an outline map of

Illinois. I have shown here the leading early historical events relative to coal.

The first reference of coal transportation in the Middle West is eight years before Illinois became a state. In the second biennial report of the Bureau of Labor Statistics of Illinois it states that coal was mined in Jackson County as early as 1810 and was conveyed by flat boats down the Big Muddy to the Mississippi river. Occasionally the coal was taken as far as New Orleans. This was six years before Jackson county had become a county. No other record of mining appears until 1832 when several boatloads were sent from the same vicinity to market. The next year 6,000 tons are recorded to have been hauled in wagons from the bluffs in St. Clair county to the St. Louis market.

In the year 1835 a company was organized under a special charter from the State Legislature for the purpose of mining and shipping coal in Jackson county.

The year 1833 marks the beginning of government records of the production of coal in Illinois. A gradual increase is shown per year until in 1881, 6,720,000 tons were produced, or a total from beginning of operations to and including 1881, of about 74,000,000 tons.

Outcrops of coal occur in many parts of the state. Father Hennepin in 1668 recorded the location of a "cole mine" in the Illinois river bluffs. It is natural, however, for the developments to begin here for it is in Egypt that recorded population began.

Early Markets

The chief requirements for coal were for river navigation and for the larger settlements. Many of our present larger cities had begun and by 1839, when the seat of state government was moved to Springfield, coal industrial possibilities were fairly well recognized. From Perrin's history of Illinois we get "The impulse toward improvement was not alone in the public mind, but private enterprises also began to be set on foot, Thus was formed by ex-Governor Reynolds the project of a plan on private account to build a railroad which may justly lay claim to having been the first in the Mississippi Valley and in fact the entire West. This was in 1837. It ran from the Mississippi River, from the site of the present city of East St. Louis, eastward across the American Bottom for about six miles to the Bluffs. These Bluffs are a range of hills full of coal and it was in order to connect these coal fields with the market that this pioneer western road was built. Louis on the west side of the American Bottom and across the river was the market to be reached." This, the first railroad in our state, six miles in length, of wooden rails, and horses for motive power, was the pioneer railroad in the development "of the great coal fields of Southern Illinois."

St. Clair county also holds the distinction of the oldest mine in the state records, this being the International Coal Company mine opened in 1851.

An impetus was given to Southern Illinois coal mining when the Illinois Central in 1854 was built. In the same year L. Ashley and Brothers sunk a slope mine at St. Johns, two miles north of DuQuoin. This is recognized as being the first railroad shipping mine in the state.

During the Civil War period, the production per year increased at a rate of nearly a quarter million tons per year. By this time railroad building was advancing at an accelerated rate. It increased from 6 miles in 1837, to 3,156 in 1863. By 1881, 8,260 miles of railroad were completed.

From the first coal report we learn: "In 1868 the superior quality of the lower portion of the seam in Jackson county attracted the attention of iron manufacturers, and led to the erection of blast furnaces at Grand Tower for the reduction of Missouri ores, by the use of this coal, which was found sufficiently free from sulphuret of iron to admit of its being used in smelting furnaces in its raw state."

Many mines by this time in various localities in Egypt were in operation, nearly all of them being in coal seams close to the surface. In 1869 and 1881, two other shipping mines were in St. Clair county. In 1872 the first shaft mine at Centralia was completed. By 1882, 192 coke ovens with a total capacity of 1,172 tons daily, were installed in the Big Muddy field. In the same year a Gallatin county mine was opened and later coke ovens installed. The Chicago market caused developments of coal mines in Northern Illinois, especially LaSalle county, so that by 1882 St. Clair county took second place in the annual coal production of the state.

Production History by Graphs

Such is, briefly, the early history of coal mining in Illinois, and especially that of Egypt. In 1882 state annual reports were begun. These reports were, in part, the result of legislation started in 1870. We have, therefore, complete statistics and records of coal mining events for a period of over fifty years.

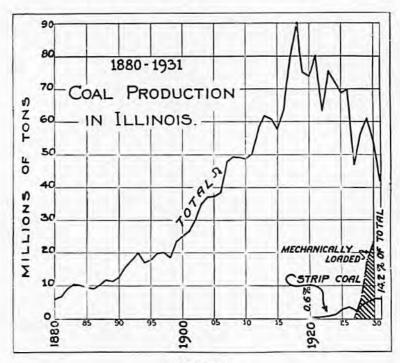


CHART NO. 2

Chart No. 2 is a graph showing the production of coal in Illinois by years from 1880 until January 1, 1932. For 1880 the tonnage was 6,720,000 tons. Production increased year after year until it reached its peak in 1915—89,979,469 tons. Since then production has, in general, declined until last year it was only 43,000,000 tons; the lowest annual tonnage for 26 years.

Chart No. 3 is given to show Egypt's production exclusively from 1918 to and including 1931. I have carefully considered all of the production in the 17 counties that produced coal in Egypt during all or any part of that 19 year period. These counties are named on the Chart. You will note that for our region the peak was reached in 1918, during which year 46,000,000 tons, over half of the peak production of the state, were produced here. Franklin county acquired first

place in the state's production in 1915 and has maintained it ever since. This is shown in Chart No. 4. It has dropped 39 per cent from its peak production. The graph for St. Clair county is shown on Chart No. 5. It has dropped 69 per cent from its peak production. Thus is shown charts for the youngest and oldest coal producing counties in the state. As with the state, Egypt's production declined from 1918 to less than half of its peak production—22,000,000 tons in 1931.

There is a set of causes, of course, for the remarkably rapid-coal industrial development of Egypt—and its downfall. My purpose here is to show, in a very general manner, these causes as I understand them. If I am successful, you will have a fair mental picture of the facts concerning the coal industrial development of Egypt when I am through.

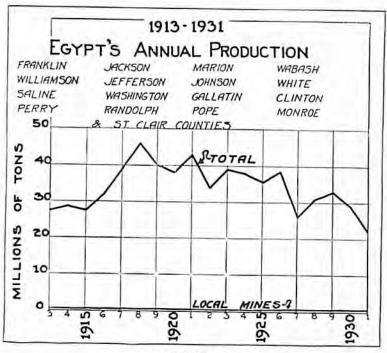


CHART NO. 3.

Chart No. 6 is a map showing the coal fields of the United States. These fields are shown by the shaded area. They include all ranks of coal from lignite to anthracite. You probably know that this does not indicate that coal is everywhere found within a shaded area. It simply means that the formation is that of a coal bearing period in geological structure. One must understand that the importance of a coal area is not necessarily in proportion to its extent. shaded areas include various thicknesses of coal seams. The Western Interior area, the largest indicated on the map and just west of the Mississippi River, while apparently of vast expanse, supplies only three per cent of the nation's coal production. have, therefore, shown on Chart No. 7 those coal producing centers which in 1929 gave five million tons or more.

These centers also indicate the higher quality coals.

Analyzing this map, one can readily appreciate the natural markets of the various coal producing states. The development of the Pennsylvania coal industry grew with the eastern industries and seaboard cities. Likewise the Western Pennsylvania and Ohio coal industry grew with the steel industry and the Great Lakes trade. It was natural for the Illinois and Indiana coal fields to develop along with the rapidly growing industrial centers, St. Louis and Chicago, and the increasing population in the northwest.

From 1880 to 1930 the population of the United States has doubled. The forepart of this period was a time great in railroad building. This 50 year period has never been equalled in industrial development. Power re-

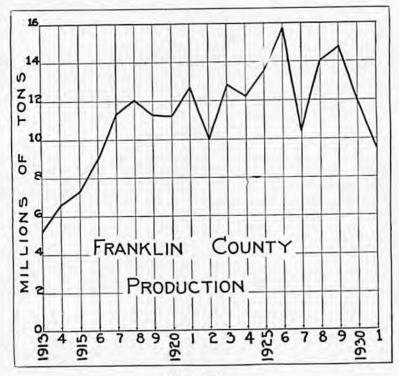


CHART NO. 4

quirements have increased beyond the most radical prophecies. In Chart No. 8, made from Bureau of Mines statistics, is shown the rapid increase in the production of coal (indicated in trillions of B.T.U.'s). From 1879 to 1918, a period of forty years, the increase is nearly nine-fold. In the same period of time Illinois' tonnage increased 18-fold. This doubled increase was due largely to the proximity of the Illinois coal fields to their natural markets and in no little measure to the development and growth of the rich coal field in Egypt. Nation's and the State's coal production developments have been the natural results of the great industrial development and the population increase while coal was king.

There is a different story to tell for what has happened since the 1918 peak, apparently the turning point in coal production. From that time to and including 1931, the loss of coal tonnage in the Nation is 33 per cent as compared with its 1918 tonnage. But, Illinois and Egypt have both lost 53 per cent as compared with their 1918 tonnages. Granting that it is logical we should decrease in Egypt's tonnage in equal ratio to the Nation's decrease, our tonnage this year would have been 31,000,000 instead of 22,-000,000. We, therefore, have lost 9,000,000 tons and in Illinois 18,000,-000 tons over and above the proportionate loss of the Nation.

First, I will endeavor to show the cause of the Nation's loss of its 33 per cent. These causes should apply in like proportion to Illinois and to Egypt. On Chart No. 8 I have shown, from the Bureau of Mines figures, the

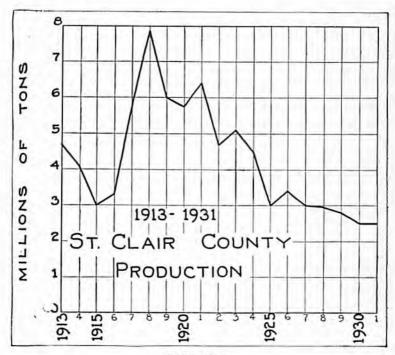


CHART NO. 5

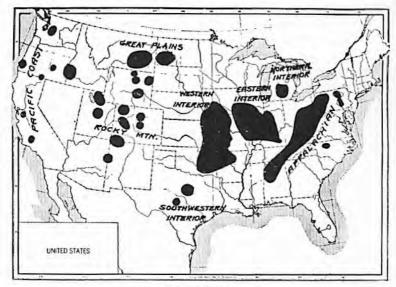


CHART NO. 6

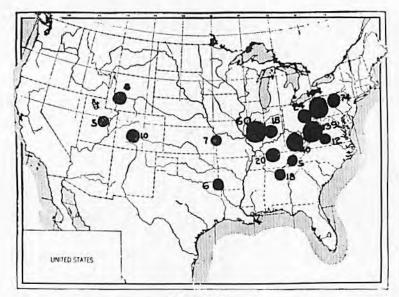


CHART NO. 7

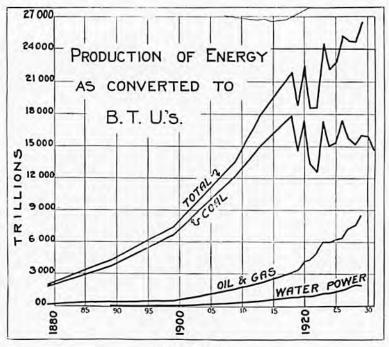


CHART NO. 8

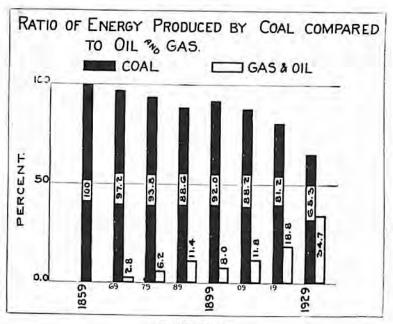


CHART NO. 9

energy in trillions of B.T.U.'s. When using different sources of energy, we must get a common denominator. As previously stated, coal was king in energy production for a great many years. It is still the chief source of energy, but developments, most especially in the last decade, have shorn him of his prestige. The other graphs of Chart No. 8 show the development of other fuels on the same common denominator basis. Water power has been of such slight effect as to be considered negligible here; yet it is now responsible for 8 per cent of the total energy produced. Oil and gas, as shown in the ascending graph, are factors of immense importance.

Chart No. 9 shows the inroads of oil and gas as energy producers. Reading from the graph: In 1899 coal produced 92 per cent of the energy consumed that year and oil and gas produced 8 per cent. In 1929 coal produced 65.3 per cent of the energy consumed that year and oil and gas

34.7 per cent. The same story is told more in detail by Chart No. 8. Here the changes are shown annually since 1880 for the three chief energy sources—coal, oil and gas, and water power. Here also, in the upper graph, is shown that the trend of total energy requirements for the Nation is upwards. Since 1929 there have been stupendous increases in pipe lines from gas fields over thousands of miles to industrial centers.

This United States map, Chart No. 10 (Coal Age, Vol. 37, No. 2), shows the 5,000 miles of gas lines laid during 1931. You will note that the majority of this gas line mileage adversely affects our Illinois coal markets. Pipe lines installed previously, now under construction, or proposed, are not shown since their number would be confusing. The possible replacement of coal by just one of the large gas lines across our state into Chicago is many million tons annually. We wonder at this sudden and enor-

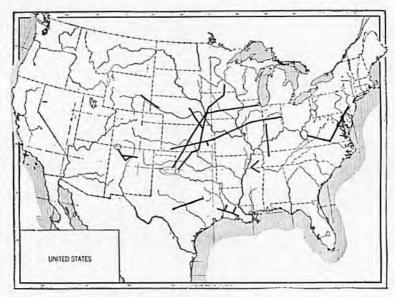


CHART NO 10

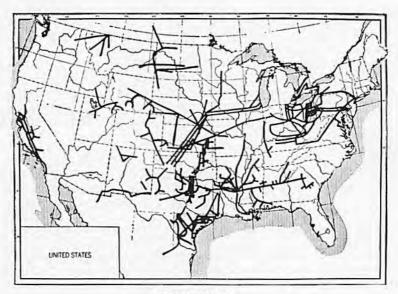


CHART NO. 11

mous increase in natural gas encroachment as an energy producer. As coal men we are concerned that natural gas is increasing at rates, recently, 25 per cent greater than each preceding year. The causes are these. First, pipes of large size and superior strength manufactured in mass production, and so welded on the job as to make one long single pipe, together with cheap and efficient

methods of installation; and, second, successful research into efficient long distance and cheap methods of pumping. Chart No. 11 shows, in the United States, the total gas lines now installed, proposed and in process of installation to be completed this year. This map conveys to you to what great extent natural gas alone has become a competitor of Egypt's coal industry.

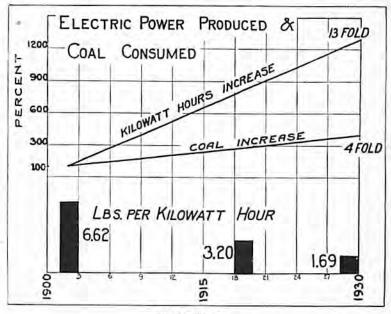


CHART NO. 12

Another cause attributed to the 33 per cent loss for the Nation is the increase in the efficient use of coal. In the production of electric power it required, in 1902 (see Chart No. 12), 6.62 pounds of coal to produce one kilowatt hour. In 1919 it required 3.20 pounds, and in 1929 it required 1.69 pounds—a decrease of 47 per cent in coal requirements in the generation of electricity in the last ten year period.

Great increases in the efficient use of coal have been made in railroad transportation. Railroad locomotives consume about 25 per cent of the Nation's coal output. The efficiencies in coal used here, according to the Bureau of Mines, have been such that 75 tons of coal in 1927 would do the work of 100 tons in 1920; thus in that seven year period there was a 25 per cent improvement in the efficient use of railroad fuel.

Likewise there have been efficiencies in the general manufacturing industries, 22 per cent; the steel industry, 11 per cent, and the domestic

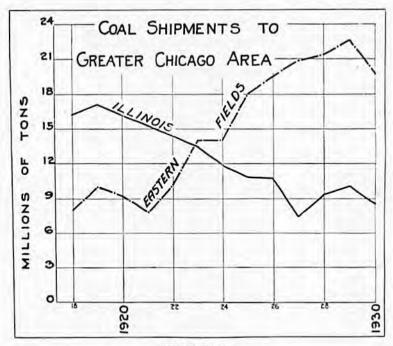


CHART NO. 13

market. The amount of saving in the domestic consumption of coal per unit of energy produced is rather indeterminable, yet with increased knowledge upon the correct firing of coal, improvement in heating equipment, and the more recent advent of mechanical stokers, there is bound to be a telling improvement in such use of coal.

As stated, however, Illinois and Egypt have suffered an additional 20 per cent loss from the peak of 1918 to the close of 1931. Where much of this tonnage has gone is graphically illustrated on Chart No. 13. Here the shipments to the Greater Chicago area from 1918 to 1931 are shown for Illinois and for Illinois' chief competitors, the Eastern districts. These Eastern districts are the West Virginia and Eastern Kentucky coal As shown, Illinois' tonnage has decreased over this twelve year period from over 116,000,000 to 8,000,-

000, while the Eastern districts have increased from 8,000,000 to 22,500,000.

Not only have we in Egypt taken a defeat along with the rest of the Nation in our inability to compete with other energy producers than coal, accepted our share of tonnage loss because of the higher efficient use of coal, and shouldered our proportionate share of loss due to the depression, and its consequent decrease in the use of coal, but we have also lost in our own natural markets in competition with producers of coal who are much farther from our markets than are we. In other words, we have not even held our own relative position but have sunk farther than the general depression of the coal industry has sunk.

Chart No. 14 shows graphs of Kentucky's, West Virginia's and Illinois' percentage of change in production from 1917 to and including 1931. The

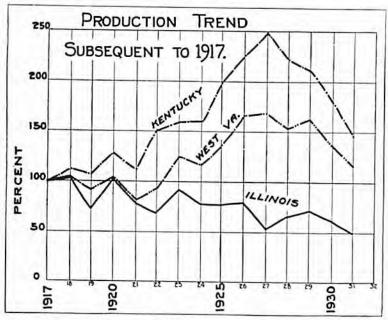


CHART NO. 14

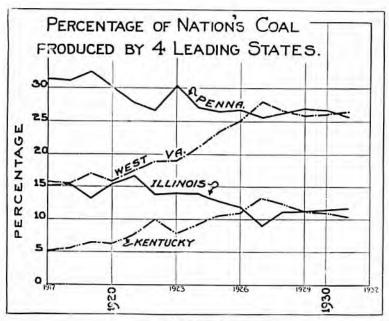


CHART NO. 15

chart needs no explanation, simply graphically showing that our chief competitors in coal production have gained each year above the 1917 production and Illinois has lost each year.

Chart No. 15 is given to show from 1917 to and including 1931, the percentages of production of the four chief coal producing states, Pennsylvania, West Virginia, Kentucky and Illinois, compared with the Nation's production of 100 per cent each year. Pennsylvania, since 1917, has dropped from 31.2 per cent to 25.7 per cent, West Virginia has increased from 15.7 per cent to 26.4 per cent, Kentucky has increased from 5.1 per cent to 10.5 per cent, and Illinois has dropped from 15.2 per cent to 11.7 per cent.

Looking Ahead

There has been invested in Franklin county not less than fifty millions of dollars in coal mining property, twenty-five millions of dollars in homes, and immense investments in business and public buildings that have resulted almost entirely from the mining industry. This is typical of many communities in the entire state. The value that this represents in Egypt rests upon whether or not the industry can be kept intact, can be made to be self-supporting and, perhaps, again be made to prosper. If the existing facts are faced separately and honestly, the alarming trend indicated by these charts can be turned into a happier condition. The problem is not one of civil strife between the employer and the employee, it is not a question of barter between these two forces as to the share each shall receive. It is a more momentous problem than that. It concerns whether or not there shall be anything to share. The strongholds of the Illinois coal industry have been invaded by outside competition. The two forces must, if success is to be had, join into one to forge ahead towards the goal of holding our coal industry intact and on to the successful maintenance of the industry which our natural conditions and location warrant.

Rarely if ever does a sound principle fail when the true facts are studied and understood, and when all the forces unite to make that principle successful. This problem is a perplexing one and apparently an insurmountable one. But only apparently is it insurmountable. Courageous, definite and intelligent analysis and action will win for the industry here with its great resources that which rightfully belongs to it. I do not presume to dictate the solution. I do most earnestly urge discarding antagonistic prejudice for concerted action solely based on facts. The only question now weighed in the balances is whether or not this will be done in time.

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 arrears 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 exofficio 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 sub-

mitted 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 be 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 Product C Co.
BROOKS, C. W
BUCHANAN, D. W., PresOld Ben Coal Corp., 230 S. Clark St., Chicago, Ill.
BUTCHER, FRED E First National Bank Bldg., Danville, Ill.
CLARK, FRED KHulburt Oil & Grease Co., Box 997, R. 5, Webster Groves, Mo.
COWIN, G. D., PresBell & Zoller Coal & Mining Co., 307 N. Mich. Ave., Chicago, Ill.
DUNCAN, W. M., PresDuncan Foundry & Machine Works, Inc., Alton, Ill.
GARCIA, JOHN AAllen & Garcia Co., 332 S. Michigan Ave., Chicago, Ill.
GREEN, ARTHUR C
HAMILTON, Chas. F., VPPyramid Coal Corp., 230 N. Michigan Ave., Chicago, Ill.
HARRINGTON, GEO. B., Pres. Chi., Wilm., Franklin C. Co., 332 S. Mich. Ave., Chgo., Itl. JENKINS, S. T. Goodman Mfg. Co., 322 Clark Ave., St. Louis, Mo.
JONES, JOHN EOld Ben Coal Corp., West Frankfort, Ill.
JOYCE, A. RThe Wood Preserving Corp., Marietta, Ohio
LEACH, B. K., President Egyptian Tie & Timber Co., 514 Rialto Bldg., St. Louis, Mo.
KNOIZEN, A. S
McFADDEN, GEO. C., Asst. Vice-Pres., Peabody Coal Co., 20 N. Wacker Dr. Chicago, Ill.
PELTIER, M. F., Vice-PresPeabody Coal Company, 20 N. Wacker Dr., Chicago, Ill.
RYAN, JOHN T., VP. and G. M Mine Safety Appliances Co., Pittsburgh, Pa.
SANDOE, C. J., VP., West Virginia Coal Co., Boatmen's Bank Bldg., St. Louis, Mo.
SCHONTHAL, B. E., President, B. E. Schonthal & Co., Inc., 59 E. Van Buren St. Chicago
SCHONTHAL, D. C., PresidentWest Virginia Rail Co., Huntington, W. Va.
TAYLOR, H. H., JrFranklin County Coal Co., 135 S. La Salle St., Chicago, Ill.
THOMAS, T. J., PresidentValier Coal Co., 547 W. Jackson Blvd., Chicago, Ill.
THOMPSON, J. I., President Koppers-Rheolaveur Co., Koppers Bldg., Pittsburgh, Pa.
WEIR, PAUL, Vice-PresidentBell & Zoller Coal & Mining Co., Centralia, Ill.
ZELLER, HARRY, Vice-PresidentWest Virginia Rail Co., Huntington, W. Va.
The state of the s

HONORARY MEMBERS

MOORSHEAD, A. JColon	nial Apt.	Hotel,	La Jolla,	Calif.
MURRAY, HUGH			Equali	ty, Ill.
TIRRE, FRANK7126 No				

ACTIVE MEMBERS

ABERLE. JOS. F
ABRELL, JOHN, SuperintendentPeabody Coal Co., No. 7 Mine, Kincaid, Ill.
ACKERMAN, ROBT. M. M., Cons. Coal Co. of St. Louis, 612 W. Main St., Staunton, Ill.
ADAMS, R. L., Chief EngineerOld Ben Coal Corp., Christopher, Ill.
ADAMS, WILLARD C Koppers Rheolaveur Co., 1301 Koppers Bldg., Pittsburgh, Pa.
ADAMSON, C. H Stephen-Adamson Mfg. Co., 20 N. Wacker Drive, Chicago, Ill.
ALFORD, NEWELL G Eavenson, Alford & Hicks, Union Trust Bldg., Pittsburgh, Pa.
ALLARD, A. F

ALLEN, H. GThe Alton Railroad Co., 340 W. Harrison St., Chicago, Ill. ANDERSON, J. CUnited Electric Coal Co., 511 Adams Bldg., Danville, Ill. ANDERSON, J. S., Dist. Supt......Madison Coal Corp., Edwardsville, Ill. ANDERSON, W. F., Dist. Mgr., Timken Roller Brg. Co., 3300 Lindell Blvd., St. Louis ARGUST, W. C., Div. Supt......Peabody Coal Co., Taylorville, Ill. ARNOLD, MARK R., A. Leschen & Sons Rope Co., 810 W. Washington Blvd., Chicago BALDING, R. WBaltimore & Ohio Railroad, S. Wells & Harrison Sts., Chicago, Ill. BARKER, CHAS., Supt......Peabody Coal Co., 104 W. College St., Harrisburg, Ill. BASKIN, E. D., Dist. Sls. Mgr Upson-Walton Co., 737 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. BENNER, DALE A., Alum. Co. of America, 1825 Boatmen's Bk. Bldg., St. Louis, Mo. BENZ, FREDERICK....U. S. Rubber Products Co., 440 W. Washington St., Chicago, Ill. BERGER, E. L., G.S......Bell & Zoller Coal & Mining Co., Zeigler, Ill. BERGFELD, R., JrVacuum Oil Co., 59 E. Van Buren St., Chicago, Ill. BLAKE, ARTHUR......Peabody Coal Co., Marion, Ill. BLANKENSHIP, G. F.....Egyptian Iron Works, Murphysboro, Ill. BOEDEKER, S. A., Mgr. Ind. Sls......Sligo Iron Store Co., 1301 N. Sixth, St. Louis, Mo. BRADBURY, WM. Map Draftsman, Federal Land Bank, 208 N. Harvey St., Urbana, Ill. BRANDENBURGER, E. W., Dist Sls. Mgr., Southern Coal Co., Inc., St. Louis, Mo. *BROOKS, CHASON W., Sec-Tr., Brooks & Stewart, Inc., 53 W. Jackson, Chicago, Ill. BROWN, BYRON, Mine Mgr......Franklin County Coal Co., Herrin, Ill. *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. Div. E.E., Peabody Coal Co., 705 W. Boulevard, Marion, Ill. *BUTCHER, FRED EFirst National Bank Bldg., Danville, Ill. CADY, GILBERT HState Geological Survey, Urbana, Ill. CALLEN, PROF. A. CTransportation Bldg., Urbana, Ill. CAMPBELL, GEO. F., V.-P. and G. M., Old Ben Coal Corp., 230 S. Clark St., Chicago CAMPBELL, H. E., P.A.....Peabody Coal Co., 20 N. Wacker Dr., Chicago, Ill. CARGAL, GORDON......Jeffrey Mjg. Co., Herrin, 111. CARTER, DALE, Supt......Mine No. 2, Bell & Zoller, Zeigler, Ill. CARTWRIGHT, HARVEY......Indiana Coal Operators Assn., Terre Haute, Ind. CASSADY, PETER A., G.A., Pac Lub. & Serv. Co., 1500 S. Western Ave., Chicago, Ill. CASSIDY, S. M. Supt......Saxton Coal Mining Co., Terre Haute, Ind.

A PARTIE DE LE LES CONTRACTORS DE LA CONTRACTOR DE LA CON
CAVATAIO, J. WEast Side Armature Works, 1308 Missouri Ave., E. St. Louis, Ill.
CAWVEY, C. E., E.E
CECIL, C. HBethlehem Steel Co., 400 N. Michigan Avc., Chicago, Ill.
CHRIST, ROBT. J., Div. EngrPeabody Coal Co., 1836 Lowell Ave., Springfield, Ill.
CHRISTIANSON, CSullivan Machinery Co., Mt. Vernon, Ill.
CLABAUGH, ALBERT, Illinois Power & Light Corp., Spivey Bldg., East St. Louis, Ill.
*CLARK, FRED KHulburt Oil & Grease Co., Box 997, Rt. 5, Webster Groves, Mo.
CLARKSON, C. E
CLARKSON, JOHN L., Pres
CLEMENTS, LOUIS
COLLINS, G. H., Dist. Mgrlllinois Power & Light Corp., Duquoin, Ill.
COLQUHOUN, ALEX., Asst. Div. EngrPeabody Coal Co., Taylorville, Ill.
CONWAY, C. C., Chief ElectConsolidated Coal Co., of St. Louis, Staunton, Ill.
CONWAY, LEE, M.E
COOK, WALTER
COOLEY, H. B
*COWIN, G. D., Pres., Bell & Zoller Coal & Mining Co., 307 N. Mich. Ave., Chicago, Ill.
COX, R. L., Sales ManagerJeffrey Mfg. Co., Columbus, Ohio
CRAGGS, WM. C., SuptPeabody Coal Co., Mine No. 43, Harrisburg, Ill.
CRAWFORD, J. G., Gen. MgrValier Coal Co., 547 W. Jackson Blvd., Chicago, Ill.
CURRIE, ADAM, Supt
DAKE, WALTER M
DAVIS, A. JOsborn & Lange, Insurance Exchange, Chicago, Ill.
DAVIS, JOHN H
DAVIS, WM. HSimplex Wire & Cable Co., 568 S. Boyd St., Decatur, Ill.
DAWSON, HUGHBethlehem Steel Co., 500 W. Monroe St., Herrin, Ill.
DAY, SAM, Supt
DAYHOFF, LYLE H., Vice-PresDorthel Coal Co., 28 E. Jackson Blvd., Chicago, Ill.
DETWEILER, M. H., MgrZeigler Coal & Coke Co., Zeigler, Ill.
DE VAULT, G. PBox 98, Edwards, Ill.
DEVLIN, FRANCIS JSpringfield, Ill.
DEVONALD, D. H., Asst. to VPPeabody Coal Co., 20 N. Wacker Dr., Chicago, Ill.
DE WITT, C. S., P.A
DICKSON, S. A., Asst. SupervThe Alton Railroad, Springfield, Ill.
DODD, A. F., Gen. Supt United States Fuel Co., 157 N. Vermillion St., Danville, Ill.
DONIE, P. L. Little Betty Mining Corp., Linton, Ind-
DOONER, P. J., SuptCentral Ill. Coal Mining Co., 1341 N. Third St., Springfield, Ill.
DOUGHERTY, JAS
DOWIATT, P. J., Jr
DOWIATT, PETER J., SrDowiatt & Son, Westville, Ill.
DUBOIS, JAS., Supt
DUFF, MILTON JPhillips Mine & Mill Sup. Co., 2227 S. Jane St., Pittsburgh, Pa.
DUNCAN, A. W
DUNCAN, GEO, DDuncan Fdry. & Machine Co., Alton, Ill.
DUNCAN, GEO. D., JrDuncan Fdry & Machine Co., Alton, Ill.
*DUNCAN, W. M., PresDuncan Fdry. & Machine Co., Alton, Ill.
DUNN, JAS., G.SOld Ben Coal Corp., West Frankfort, Ill.
DUNN, THOS. JOld Ben Coal Corp., Christopher, Ill.
EDE, J. A
EDGAR, R. LWatt Car & Wheel Co., Barnesville, Ohio

ELDERS, W. M., SuptPeabody Coal Co. Mine No. 19, West Frankfort, Ill.
ELSHOFF, CARL, PresMine B Coal Co., 1039 N. Vine St., Springfield, Ill.
ENGLISH, THOS., Inspector at LargeDept. of Mines and Minerals, Springfield, Ill.
EQUITABLE POWDER MFG. COEast Alton, Ill.
ESSINGTON, T. G., Chief Counsel, Ill. Coal Op. Assn., 231 S. La Salle, Chicago, Ill.
EYSTER, R. M., Pres. and Mgr., Glenwood Mining Co., P. O. Box 45, Edwards, Ill.
FALCETTI, OSCAR, SuptThe Mine "B" Coal Co., Springfield, Ill.
FENTON, J. R., VPJ. K. Dering Coal Co., 332 S. Michigan Ave, Chicago, Ill.
FIRMIN, W. H
FIRTH, B. H., SuptLumaghi Coal Co., Collinsville, Ill.
FISHWICK, HARRY, Pres
FLASKAMP, F. A Broderick & Bascom Rope Co., 4203 N. Union St., St. Louis, Mo.
FLEMING, J. BMine Safety Appliances Co., 403 Pennsylvania Ave., Urbana, Ill.
FLETCHER, J. H
FLYNN, EDWARD
FLYNN, ROBERT
FOSTER, JOHN R., SuptChicago, Wilm. & Franklin Coal Co., West Frankfort, Ill.
FRASER, JOHN K., State Mine Inspector
FRASER, THOMAS
FRIES, J. J., Gen. Supt
FULKE, FRANK L
FULLER, CHAS. R., Chief ElectrPeabody Mine No. 24, Danville, Ill.
*GARCIA, JOHN A., PresAllen & Garcia Ca., 332 S. Michigan Ave., Chicago, Ill.
GARWOOD, THOMAS L., Chicago, Wilm. & Franklin Coal Co., West Frankfort, Ill,
GASTON, HARVEY, SuptSaxton Coal Mining Co., Terre Haute, Ind.
GAUEN, C. F., A. V. PEgyptian Tie & Lumber Co., 514 Rialto Bldg., St. Louis, Mo.
GEBHART, B. RIllinois Coal Bureau, 309 W. Jackson Blvd., Rm. 1901, Chicago, Ill.
GILES, WM. S
GILGIS, W. L., Pur. AgentSuperior Coal Co., 1417 Daily News Bldg., Chicago, Ill.
GILLEN, JAMES AValier Coal Co., 547 W. Jackson Blvd., Chicago, Ill.
GILLESPIE, EDWARD
GIMBLETT, J. HInternational Shoe Co., 4213 S. Kings Highway, St. Louis, Mo.
GIVEN, IVAN A., Asst. Editor, McGraw-Hill Pub. Co., 330 W. 42nd St., New York, N.Y.
GLENWRIGHT, J. W
GODBY, J. K
GORDON, O. M., Treas., Bell & Zoller Coal & Mining Co., 307 N. Mich. Ave., Chicago
*GREEN, ARTHUR CGoodman Mfg. Co., 4834 S. Halsted St., Chicago, Ill.
GREEN, KENNETH,Pennsylvania Elec. Repair Co., 129 First Ave., Pittsburgh, Pa.
GREENE, D. W., G.SWest Virginia Coal Co., O'Fallon, Ill.
GRIMMETT, O. C
GRISSOM, FRANK
HABERLE, MPeabody Coal Co., Mine 53, Springfield, Ill.
HAGERTY, P. J., Pres
HAIGH, H. W
HAIR, C. E301 W. Reed St., Benton, Ill.
HALBERSLEBEN, PAUL, G.SSahara Coal Co., Harrisburg, Ill.
HALES, W. M605 W. 116th St., Chicago, Ill.
HALL, HECTOR HBell & Zoller Coal & Mining Co., Zeigler, Ill.
HALL, R. DAWSON340 Burns St., Forest Hills, Long Island, N. V.
HALLER, EMILConsolidated Coal Co. of St. Louis, Mt. Olive, Ill.

*HAMILTON, CHAS. F., VP., Pyramid Coal Corp., 230 N. Michigan Ave., Chicago, Ill.
HAMPTON, I. H
HANTMAN, SAMUEL
HARCARIK, JOHN, JR., Night Boss, Peabody Mine No. 24, Danville, Ill.
HARCARIK, JOSEPH, Asst. Mine MgrPeabody Mine No. 24, Danville, Ill.
HARDY, JOHN W., Mgr.,Peabody Mine No. 9, 1220 W. Main St., Taylorville, Ill.
HARDY, WM., SuptPeabody Coal Co., Taylorville, Ill.
*HARRINGTON, GEO. B., Pres., Chgo., Wilm., Franklin C. Co., 332 S. Mich. Ave. Chgo.
HARRIS IOE
HARRIS, JOE Joy Mfg. Co., Franklin, Pa.
HARTWELL, LEN, Supt
HARVEY, HADLEY
HASKELL, J. B
HASKINS, LEE, Supt
HAWLEY, E. W
HAYDEN, C. T., Gen. MgrSahara Coal Co., 332 S. Michigan Ave., Chicago, Ill.
HAYWOOD, ALLAN S., Field RepU. M. W. of A., 408 Russell St., Peoria, Ill.
HEBLEY, HENRY FAllen & Garcia Co., 332 S. Michigan Ave., Chicago, Ill.
HEINRITZ, M. W., Mgr., Cent. Div., Phileo Radio & Telev. Corp., 3335 W. 47th, Chicago
HELBING, ERNESTFranklin County Coal Co., Herrin, Ill.
HELM, GUIDO
HELSON, J. R
HENRY, J. E
HESSLER, JOHNFort Harrison Mining Co., Terre Haute, Ind.
HINDSON, HARRY C
HODGES, FRED T
HOLMES, JOHN K., Secy., Rob. Holmes & Bros., Inc. 520 Junction Ave., Danville, Ill.
HOOK, GEORGE H., Sales Mgr., Beck & Corbitt Co., 1230 N. Main St., St. Louis, Mo.
HOPE, JOHN, Supt.,Peabody Coal Co., Danville, Ill.
HOWARD, HUBERT E., Pres., Pyramid Coal Corp., 230 N. Mich. Ave., Chicago, Ill.
HUNTER, THOS
HURST, W. C., Sen. VP., Chgo & Ill. Mid. Ry. Co., 821 Pub. S. Bldg., Springfield, Ill.
HUTTON, WM
JACOBS, C. D., Gen. Mgr., Utilities Elkhorn Coal Co., Dixie Termi. Bldg., Cincinnati, O.
JEFFERIS, J. A Illinois Terminal R. R. System, 710 N. 12th Blvd., St. Louis, Mo.
JENKINS, G. S., M. E., Con. Coal Co. of St. Louis, Ry. Exch. Bldg., St. Louis, Mo.
*JENKINS, S. TGoodman Mfg. Co., 322 Clark Ave., St. Louis, Mo.
JENKINS, W. J., Pres., Con. Coal Co. of St. Louis, Ry. Exch. Bldg., St. Louis, Mo.
JOHNSON, E. HSafety Mining Co., 307 N. Michigan Ave., Chicago, Ill.
JOHNSTON, J. M., Ch. EngBell & Zoller Coal & Mining Co., Ziegler, Ill.
JONES, ARCH M., John A. Roebling's Sons Co., 904 Olive Plaza Bldg., St. Louis, Mo.
JONES D. W. Supt
JONES, H. W. Sanford-Day Iron Wks., 417 E. Big Bend Blvd., Webster Groves, Mo.
*JONES, JOHN EOld Ben Coal Corp., West Frankfort, Ill.
JONES, JOHN Z
JONES, RALPH BStudent, University of Illinois, 405 E. John St., Champaign, Ill.
JORGENSON, F. F., G. M
*JOYCE, A. R
*JUYCE, A. K
JOYCE, PETER
KENNEDY, H. M., Pres., Kennedy-Webster Electric Co., 500 W. Admits St., Chicago, H.
K1DD, WM. EU. M. W. of A., 609 W. Armstrong, Ave., Peoria, Ill.

For the County Coal Co. Bounton III
KINSMAN, HENRY J., M. M. Franklin County Coal Co., Royalton, Ill.
KLEIN, GEO
*KNOIZEN, A.SJoy Mfg. Co., Franklin, Pa.
KOSTBADE, C. J., PresBerry Bearing Co., 2715 S. Michigan Ave., Chicago, Ill.
KREUSSER, O. T., Director, Museum of Science & Ind., 57th St. & Lake Mich., Chicago
LA MENA, C. J
LANGTRY, W. D., Pres., Commercial Testing & Engr. Co., 360 N. Mich. Ave., Chicago
LAWRY, R. GRoberts & Schaefer Co., 400 N. Michigan Ave., Chicago, Ill.
*LEACH, B. K., PresEgyptian Tie & Timber Co.,, 514 Rialto Bldg., St. Louis, Mo.
LEDNUM, E. T., Mgr., E. I. DuPont de Nemours & Co., 332 S. Mich. Ave., Chicago, Ill.
LEE, CARL, Elec. Engr
LEIGHTON, M. M., ChiefState Geological Survey, Urbana, Ill-
LEMING, ED., Supt
LETE, ACHILLE
LEWIS, A. D
LEWIS, JAMES, Supt., Mine No. 8Peabody Coal Co., Taylorville, Ill.
LINDSAY, GEORGE, Supt
LINDSAY, W. L
LOHR, CARL P., Repr
LONG, JOSEPH A
LOTT, GEO. M., D. MJeffrey Mfg. Co., 332 S. Michigan Ave., Chicago, Ill.
LYMAN, G. E., G. S
LYTLE, GEO. F
LYTLE, GEO. F
MABRY, H. E
MacFARLANE, MALCOLM
MacMURDO, P. W., Supt., Mine No. 51, Peabody Coal Co., R. R. No. 5, Springfield, Ill.
MacVEAN, GORDON, Mgr., Mining DeptMine Safety Appliances Co., Pittsburgh, Pa.
MALKOVICH, MSullivan Machinery Co., 2639 Locust St., St. Louis, Mo.
MALSBERGER, A. HDupont Powder Co., Springfield, Ill.
MANCHA, RAYMONDGoodman Mfg. Co., Halsted St. & 48th Place, Chicago, Ill.
MARBLE, G. EGeneral Electric Co., 230 S. Clark St., Chicago, Ill.
MARDIS, EARLE JAmerican Steel & Wire Co., 208 S. La Salle St., Chicago, Ill.
MARSH, I. D., Supt
MARSHALL, HARRY1721 S. College St., Springfield, Ill.
MASELTER, JOHN E., Shop Supt. Gen. Electric Co., 1110 Delmar Blvd., St. Louis, Mo.
MAYOR, E. S., Subt
MEISSNER, JOHN F., Dist. Mgr., Robins Con. Belt Co., 37 W. Van Buren St., Chicago
MEISTER, V. SThe Jeffrey Mfg. Co., Terre Haute, Ind.
MELKUSH, ONEYPeabody Coal Co., R. R. No. 5, Springfield, Ill.
MELVILLE, J. B. F., Vice-PresUnited Elec. Coal Co., Adams Bldg., Danville, Ill
MEYER, BRUNO F., Dist. Supt., Consolidated Coal Co. of St. Louis, Staunton, Ill.
MEYER, CARL
MILLER, ALEX U., Asso. Mng. Engr., U.S. Bur. Mines, La Plante Bld., Vincennes, Ind.
MILLER, D. H. Trainmaster,
MILLER, FRED Franklin County Coal Co., Herrin, Ill.
MILLER, JAS. B.,
MILLER, RICE, V. P
MILLER, RICE W., Secy
MILLHOUSE, JOHN GLitchfield, N.
MITCHELL, D. R. Transportation Bldg. Urbana, Ill.
MATCHESO, B. Ramana and Matcheson Didge Crownia, Inc.

MOELLER, A. C.	1212 Plaza-Olive Bldg., St. Louis, Mo.
MOORSHEAD, A. J	Colonial Apartment Hotel, La Jolla, Calif.
MORGAN, F. O., Chief ClerkPeabody	Coal Co. Mine No. 18, West Frankfort, Ill.
MORRIS, NELSON, Ch. Engr	Sahara Coal Co., Harrisburg, Id.
MOSES, HARRY M., Gen. Supt	
MOSES, THOS., Pres., H. C. Frick Coal Co.	, 1863 Frick Bldg. Annex. Pittsburgh, Pa.
MULLINS, T. C., Pres., Northern Illinois Coa	
MUNRO, C. WNational Armature & Elec	
MULLEN, E. C., PresE. C.	
MURRAY, HUGH	
McAULIFFE, EUGENE, Pres., Union Pacific	
McBRIDE, W. PAmerican Car & Four	
McCABE, LOUIS C., Asst. Geol., Ill. Geol. Su	
McCARTHY, J. D., V P., Republic Coal & C	
McCLEISH, W. J	
McCLOUD, DON B Liquid Oxygen Explos.	
McCULLOCH, L. HHulburt Oil & Gr	
McCULLOCH, WM. AEv	
McELHATTAN, D. F., Safety Engineer	
*McFADDEN, GEO. C., A. V. P., Peabody Co.	
McFADDEN, JOSEPHPeab	
McFADDEN, NAT., Div. Engr.,	
McGRAW, W. CWestinghouse Elec.	
McGURK, SAM, SuptMt. (
McKENNA, THOS	
McLAREN, A. B., Pres	
McLAREN, W.S	Binkley Coal Co., Linton, Ind.
McPHAIL, ROBT., Mine MgrP	eabody Mine No. 18, West Frankfort, Ill.
McREAKEN, C. W. Div. Supt.,	Peabody Coal Co., Marion, Ill.
McSHERRY, JAMES, DirD	
NEAL, DAVEConsolida	ted Coal Co. of St. Louis, Mt. Olive, Ill.
NELSON, I. C	Beall Bros. Supply Co., Marion, Ill.
NEW, ERNEST	
NICHOLSON, H. P	
NIELSON, A. M., Pres., Carterville Coal Min	
NOE, DR. A. CGeologi	
NOVARIO, LESLIE, Top ForemanPeal	. 이 사람이 사용되었다면 하는 이 경험에 가장하게 되었다면 하는데
NOYES, J. ASullivan Mach	
NUCKLES, C. EPost-Glover Elect	
O'BRIEN, FRANKAmerican Cable	Co., 114 S. McKinley St., Harrisburg, Ill.
O'BRIEN, WILLIAM, Asst. Mine Mgr	Peabody Mine No. 24, Danville, III.
O'CONNOR, PHILIP S., Shop Supt., Westing.	Elec. Mfg. Co., 717 S. 12th, St. Louis, Mo.
OHLE, JOHN	Franklin Hotel, Benton, III.
OLDHAM, R. J., Supt	
O'NEIL, CHASDupont Por	Fuel Co., McCormick Bidg., Cincago, III.
ORD, MARK, Mine MgrU. S. I	202 W Lindell St West Frankfort III
O'ROURKE, JOHN, Mine Mgr	Lemature & Elec Warbs Bluefield W Va
OVERSTREET, J. W., Gen. Mgr., National & PATTERSON, FRANK	Mine Rescue Station Eldorado III
*PELTIER, M. F., VPPeabody C	Coal Co. 20 N. Wacker Dr. Chicago. Ill.
*PELITER, M. P., VPFrance	ent cod to the hacker to d concess, the

PENWELL, WARREN, PresPenwell Coal Mining Co., Pana, Ill.
PENWELL, WARREN, Pres. Carl Co. 100 W. Madison St. Chicago III
PFAHLER, F. S., PresSuperior Coal Co., 400 W. Madison St., Chicago, Ill.
PHILLIPS, EDGAR RTyson Roller Bearing Co., Massillon, Ohio
PHILLIP, THOS. W., SuptSuperior Smokeless Coal & Mng. Co., Tahona, Okla.
PICKARD, A. E
PLUMLEE, ARTHUR
POLING, J. WEvansville Elec. & Mfg. Co., 600 W. Eichel Ave., Evansville, Ind.
POWELL, JAS., SuptSuperior Coal Co., Gillespie, Ill.
POWERS, F. A
PREVAL, HPeabody Coal Co., Springfield, Ill.
PRITCHARD, WGoodman Mjg. Co., 322 Clark Ave., St. Louis, Mo.
PRINS, KLAAS, Mech. Engr., Allen & Garcia Co., 322 S. Michigan Ave., Chicago, Ill.
PROFFITT, R. PTimken Roller Bearing Co., 2534 S. Michigan Ave., Chicago, Ill.
PRUDENT, EDBell & Zoller Coal & Mining Co., Zeigler, Ill.
QUADE, JOHN CPeabody Coal Co., Harrisburg, Ill.
RASSIEUR, B. F., Sec.,Central Mine Equipment Co., Webster Groves, Mo.
REED, A. L., Chief ElectrPeabody Coal Co. Mine No. 18 West Frankfort, Ill.
REED, FRANK HState Geological Survey, Urbana, I'll.
REES, EDWIN1808 S. College St., Springfield, Ill.
REIS, C. A., G. MGreen River Fuel Co., Mogg, Ky.
REITHER, E. CTimken Roller Bearing Co., 4925 Liberty Ave., Pittsburgh, Pa.
REUTER, W. P., Div. MechPeabody Coal Co., Marion, Ill.
RHINE, F. EDuncan Fdry & Machine Co., Alton, 1ll.
RICHARDS, JAS214 N. 12th St., Belleville, Ill.
RICHART, F. W
RIHACEK, GEO. J., Sales Mgr., Cosgrove & Co., 310 South Mich. Ave., Chicago, Ill.
RITCHIE, JAMES, Asst. Mine MgrPeabody Mine No. 24 Danville, Ill.
ROBERTSON, C. EWestinghouse Elec. Co., 20 N. Wacker Drive, Chicago, Ill.
RODENBUSH, JOHN, Supt., Chgo, Wilm. & Franklin Coal Co., West Frankfort, Ill.
ROGERS, THOS
ROLLO, JAMESEgyptian Powder Co., Herrin, Ill.
ROMAN, F. W
RONK, R. K
ROZANSKI, M., Mine MgrPeabody Mine No. 8, 524 S. Cherokee, Taylorville, Ill.
RUSSELL, W. H., E. EConsolidated Coal Co., 608 Eddy Bldg., Saginaw, Mich.
RUTLEDGE, J. J. Bureau of Mines, 22 Light St., Baltimore, Md.
*RYAN, JOHN T., VP. and G. M
RYAN, W. D
SACKBAUER, L. A., Coal Traffic Mgr., Missouri Pacific Railroad Co., St. Louis, Mo.
*SANDOE, C. J., VP., West Virginia Coal Co., Boatmen's Bank Bldg., St. Louis, Mo.
SAYLOR, H. N., Pres., Saylor Tie and Timber Co., 2121 Ry. Exch. Bldg., St. Louis, Mo.
SCHOEN, W. H. JR., Pres., Pittsb. Knije & Forge Co., 718 Park Bldg., Pittsburgh, Pa.
*SCHONTHAL, B. E., Pres., B. E. Schonthal & Co., 59 E. Van Buren St., Chicago, Ill.
*SCHONTHAL, D. C., PresWest Virginia Rail Co., Huntington, W. Va.
SCHONTHAL, JOSEPH, Secy., B. E. Schonthal & Co., 59 E. Van Buren St., Chicago, Ill.
SCHREIER, G. ASchreier Elec. Co., 1508 E. Main St., West Frankfort, Ill.
SCHULL, B. H., Supt.,
SCHULL, FRANK
SCOTT, G. WTimken Roller Bearing Co., 3300 Lindell Ave., St. Louis, Mo.
SCULLY, T. ALVIN, Pres
The state of the s

CPINIO D
SEARLS, E. C
SELETTO, JAMES
SEVER, L. G., Asst. to Pres, Mt. Vernon Car Mig. Co., Mt. Vernon Ill
SHAFFER, A. G., C. E., C. W. & F. Coal Co., 702 W. St. Louis St., West Frankfort, Ill.
SHEPARD, M. M., P. A., Franklin County Coal Co., 135 S. La Salle St., Chicago, Ill.
SHERIDAN, H. A. Davis Emergency Equipt. Co., 440 W. Washington St., Chicago, Ill.
SHIMER, F. L. C. I. P. S. Co., Marion, Ill.
SIMPSON I H Min F and C Market B.
SIMPSON, J. H., Mines Equipt. Co., 1946 N. Broadway, St. Louis, Mo.
SLINGLUFF, W. H., D. M
SMITH, C. M. Research Assoc., U. of I., 214 Transportation Bldg., Urbana, Ill.
SMITH, GEO. M., Mine Supt., Peabody Coal Co., 1800 Whittier Ave., Springfield, Ill.
SMITH, HARRY Consolidated Coal Co. of St. Louis, Mt. Olive, Ill.
SMITH, L. D., VP., Chicago, Wilm. & Franklin Coal Co., 332 S. Mách. Ave., Chicago
SNEDDEN, GEO
SNEDDON, JAMES, Asst. Mine MgrFranklin County Coal Co., Valier, Ill.
SOLOMON, E. C., VP., Panther Creek Mines Inc., First Natl. Bk. Bldg., Springfield, Ill.
SOLOMON, G.W., VP., Panther Creek Mines, Inc., First Natl, Bk, Bldg. Springfield III
SOLOMON, H. A., Pres., Panther Creek Mines, Inc., First Natl. Bk. Bldg., Springfield, Ill.
SOMERS, BYRON, Supt, Truax-Traer Coal Co., St. David, Ill.
SOUTHWARD, G. B., Mech. Engr., Amer. Mng. Cong. Munsey Bldg., Washington, D. C.
SPAHT, A. WOld Ben Coal Co., West Frankfort, Ill.
SPICER, C. B
STAREK, R. B
STARKS, J. W., Supt
STEDELIN, JOHN W., PresMarion County Coal Co., 725 S. Elm, Centralia, Ill.
STEFFENS, A. B., Pres., Indiana & Illinois Coal Corp., 309 W. Jackson Blyd., Chicago
STEIGER, A.E., G.S
STELLING, H. CUnion Carbide Co., 30 E. 42nd St., New York, N. Y.
STEVENS, E. F
STINTON, WM. S., Asst. Sales Mgr., Vacuum Oil Co., Inc., 3504 Wash., St. Louis, Mo.
STUART, H. E., Sec.,
SUTHERLAND, HARRY TStandard Oil Co., Marion, Ill.
SUTOR, DON M., Mgr., Sullivan Mach. Co., Railway Exchange Bldg., St. Louis, Mo.
SWALLOW, H. A., PresUnited Electric Coal Co., Adams Bldg., Danville, Ill.
SYERS, JACOBWestern Powder Co., 825 Jefferson Bldg., Peoria, Ill.
TARRACH, A. C., Consolidated Coal Co. of St. Louis, Route 2, Box 86, Staunton, Ill.
TAYLOR, H. HPres., Franklin County Coal Co., 135 S. La Salle St., Chicago, Ill.
*TAYLOR, H. H., Jr.,Franklin County Coal Co., 135 S. La Salle St., Chicago, Ill.
THIES, HENRY
THOMAS, G. W
THOMAS, JEFFERSONWestern Powder Mfg. Co., 825 Jefferson Bldg., Peoria, Ill.
THOMAS, R. H
*THOMAS, T. J., PresValier Coal Co., 547 W. Jackson Blvd., Chicago, Ill.
*THOMPSON, J. I., Pres., Koppers Rheolaveur Co., 1550 Koppers Bldg., Pittsburgh, Pa.
THOMPSON, JOHN Aget, Mina May Penhadu Mina No. 24 Danville III
THOMPSON, JOHN, Asst. Mine Mgr.,
THOMPSON, R. A
TIRRE, FRANK 7126 Northmoor Dr., St. Louis, Mo.
TOENNIGES, F. E., Chief Engr., United Electric Coal Co., Adams Bldg., Danville, Ill.
TOVEY, STEVE,
TREADWELL, H. A., G. S., Chicago, Wilmington & Franklin Coal Co., Benton, Ill.

TROEGER, FREDPeabody Coal Co., Taylorville, Ill.	
TROEGER, L. D	
TWAY, JOSEPH R., Sales Rep., Macwhyte Co., 5739 Brdwy. Terrace, Indianapolis, Ind.	
VAN PELT, J. R., Asst. Dir., Museum of Science & Industry, 57th & Lake Mich., Chicago	
VANSTON, J. M., Electric Storage Battery Co., 1058 S. Vandeventer Ave., St. Louis, Mo.	
VEACH, F. M	
VLASAK, JOS., Supt., St. Louis & O'Fallon C. Co., 2001 Bowman Ave., E. St. Louis, Ill.	
VOELKEL, E. G., Utility Conv. & Mine Equipt. Co., 620 Tower Grove Ave., St. Louis, Mo.	
VOLTZ, GEO. P., EngrPeabody Coal Co., 2025 S. Sixth St., Springfield, Ill.	
VON PERBANT, LAllen & Garcia Co., 332 S. Michigan Ave., Chicago, Ill.	
VOSKUIL, DR. W. H., Min. Econ., State Geol. Survey, Ceramics Building, Urbana, Ill.	
WALDRON, LEWIS, Supt., Mine No. 59Peabody Coal Co., Springfield, Ill.	
WALKER, ROBERT, Mine ManagerPeabody Mine No. 24, Danville, Ill.	
WALSH, HOWARD T. Sullivan Machinery Co., 400 N. Michigan Ave., Chicago, Ill.	
WANLESS, W. H., Supt.,Peabody Mine No. 53, 1521 Dial Ct., Springfield, Ill.	
WATERMAN, C. W., V. P., McNally-Pittsburg Mfg. Corp., 205 W. Wacker Dr., Chicago	
WATTERS, C. CWest Virginia Rail Co., Huntington, W. Va.	
WAUGH, ROBERT, Mine Mgr., Franklin County Coal Co., Herrin, Ill.	
WEART, EVERETT T., John A. Roeblings Sons Co., 205 W. Wacker Dr., Chicago, Ill.	
WEIR, JAMESBenton, Ill.	
*WEIR, PAUL, Vice-Pres., Bell & Zoller Coal & Mining Co., 311 E. Brdwy., Centralia, Ill.	
WEISSENBORN, F. E., Asst. Comm., Ill. Coal Op. Assn., 4266 Arsenal St., St. Louis, Mo.	
WEST, JETT J., Trav. Auditor,Peabody Coal Co., Box 224, Marion, Ill.	
WHITE, JAMES, Supt., Mine No. 48Peabody Coal Co., Shelburn, Ind.	
WHITE, JOHN	
WILCOX, D. D., G. S., Superior Coal Co., Gillespie, Ill.	
WILCOXSON, R. JSangamon Coal Co., P.O. Box No. 56, Springfield, Ill.	
WILDMAN, W. Y., Illinois Coal Traffic Bureau, 309 W. Jackson Blvd., Chicago, Ill.	
WILKEY, FRED S., SecyIll. Coal Op. Assn., 309 W. Jackson, Blvd., Chicago, Ill.	
WILLIAMS, GARNER, V.P., Cabin Creek Consolidated Coal Co., Kayford, W. Va. WILLIAMSON, J. E410 W. Tremont St., Hillsboro, Ill	
WILLS, DON, Asst. Mine Mgr.,Peabody Mine No. 24, Danville, Ill	
WILLS, S. J., Div. SuptPeabody Coal Co., Public Service Bldg., Springfield, Ill	
WILSON, J. C	,
WILSON, ROBERT SConsolidated Coal Co., of St. Louis, Staunton, Ill.	
WINN, ISAIAH, Mine MgrValier Coal Co., Valier, Ill	
WOOSLEY, CLYDE W., Chief ClerkPyramid Coal Corp., Pinckneyville, Ill	
WRIGHT, D. D., Sls. Engr., Westingh. Elec. & Mfg. Co., 523 S. Market St., Marion, Ill	
YOUNG, C. C., Div. Engr	
YOUNG, WILLIAMPeabody Coal Co., 814 E. Ash St., Taylorville, Ill	
YOUNG, W. P., G. S	
*ZELLER, HARRY, V.PWest Virginia Rail Co., Huntington, W. Va	
ZINKGRAF, J. W., Dist. Mgr., Chgo. Pneu. Tool Co., 1931 Wash. Ave., St. Louis, Mo	

^{*} Life Members

[†] Honorary 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

JOSEPH VIANO December 12, 1932

JOHN ROLLO February 6, 1933

DAVID I. ROCK August 2, 1933

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



HERCULES EXPLOSIVES



DYNAMITE
HERCOMITE
GELATIN
GELAMITE
PERMISSIBLE POWDERS
BLASTING POWDER
PELLET POWDER
BLAKSTIX
ELECTRIC BLASTING CAPS
ELECTRIC SQUIBS
ELECTRIC IGNITERS
BLASTING CAPS
SAFETY FUSE
BLASTING MACHINES

HERCULES POWDER, COMPANY

WILMINGTON, DELAWARE

McCormick Bldg. Chicago, Ill.



Railway Exchange Bldg. St. Louis, Mo.

The WEST VIRGINIA RAIL CO.

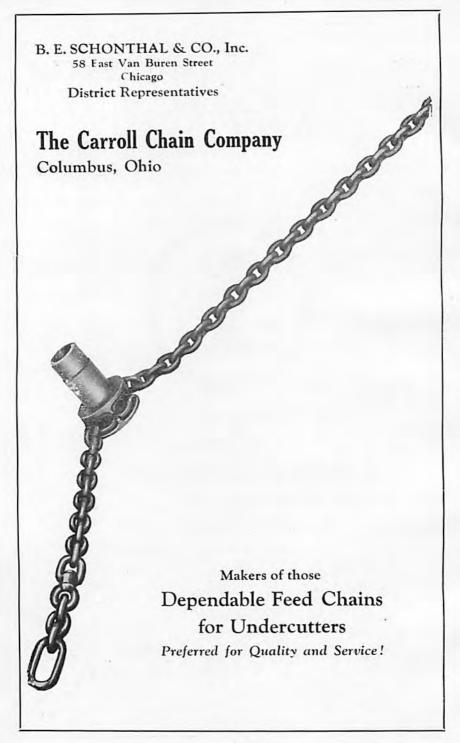
Twenty-seven Years of Service to the Coal Mining Industry



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



COAL and WATER ANALYSIS

POWER PLANT ENGINEERING

- 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.

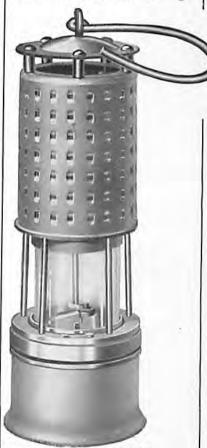
- A-1. Questions and Answers pertaining to Boilers, Stokers, Boiler Tests and Draft.
- B-2. Tests on Model Heating
- C-3. Questions and Answers for Those Interested in the Buying and Selling of Coal.
- D-4. Coal Ash and its Fusion.
- E-5. Research on Mixing Garbage and Coal with relation to Clinker Formation
- F-6. Spontaneous Combustion of Coal.

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

Sixty-Six Years of Dependable Insurance Service

CRITCHELL MILLER WHITNEY & BARBOUR

1535 INSURANCE EXCHANGE
CHICAGO
PHONE WABASH 0340

Send for Our Green Calendar

Small Revolving Shovels, Draglines, Cranes, Clamshells, Dragshovels, Etc. Readily Convertible

1/2-yard steam A—12-yard steam
16-B—12-yard gasoline, Diesel, electric
1020—12-yard gasoline,—Diesel, electric
21-B—12-yard gasoline,—Diesel, electric
B-3—13-yard steam
GA-3—14-yard Gas-Air

GA:3-1½-yard Gas-Air
32-B-1-yard gasoline,—Diesel, electric
37-B-1½-yard gasoline—Diesel, electric
42-B-1½-yard electric or steam
43-B-1¾-yd. gasoline,—Diesel, electric
45-B-1 to 2½-yard Diesel dragline
or clamshell

Mine and Quarry Loaders and Strippers

50-B-2-yard electric or steam 52-B-2 4-yard Diesel or electric 75-B-2 4-yard electric shovel

100-B-3-yard electric shovel 120-B-4-yd electric shovel

170-B-5-yard electric shovel 200-B-6-yard electric shovel

375.B—8-yard electric shovel 750.B—12 to 20-yard electric shovel

Large Draglines

Class 111-31/4-yard Diesel Class 200—5-yard steam, Diesel-electric electric or

Class 375-8-yard steam or electric

Bucyrus-Armstrong Blast Hole Drills 29-T—3,000 lbs. of tools, 8" to 12" hole 29—2,200 lbs. of tools, 6" to 8" hole 26—1,600 lbs. of tools, 4" to 9" hole Bit Dressers and Drill Tools

Bueyrus-Monigham Walking Draglines 1 to 10-yard sizes; Dipper, Hydraulic Elevator and Placer Dredges; Loadmaster, handy gasoline Crane; Railway Cranes; Tunnel Shovels; Tower Excavators; Un-loading Plows; Spreader Plow; Red Arch Dragline Buckets.

Modern

excavating machinery for any job

The unequalled experience gained by Bucyrus-Erie in building over 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.

BUCYRUS-ERIE COMPANY

South Milwaukee, Wis.



The Users of Olson Cages are their Greatest Recommendation



Bell and Zeller Coal & Mining Co.
Binkley Mining Co.
Chicago Wilmington and
Franklin Coal Co.
Consolidated Coal Co. of
St. Louis
Cosgrove Meehan Coal Co.
Crescent Coal Co.
Crescent Coal Co.
Granklin Coal and Coke Co.
Galesburg Mining Co.
Hillsboro Coal Co.
Ludiana & Illinois Coal Corp.
Jefferson Coal Corp.
Lumaghi Coal Co.

O'Gara Coal Corp. Nos. 1,
3 and 12
Old Ben Coal Corp. Nos. 8,
9. 12, 14, 15, and 18
Panther Creek Mines Inc.
Nos. 3, 4 and 5
Peabody Coal Co. Nos. 7
8, 9, 18, 47 and 58
Superior Coal Co.
W. G. Sutton
Union Coal Co.
U. S. Fuel Co., Bunsenville,
Vermillion, Universal and
Middle-fork
Valier Coal Co.
West Virginia Coal Co.
and many others.

EAGLE IRON WORKS DES MOINES · · IOWA

Insurance Brokers

Average Adjusters

OSBORN & LANGE, Inc.

Insurance Exchange

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 Bonds

Casualty

Lake, Ocean and Inland Marine Comprehensive Coverages OPERATOR-Is my haulage cost too high?

ENGINEER—Yes.

OPERATOR-How can I cut my cost per ton?

ENGINEER—Purchase modern mine cars of greater carrying capacity.

OPERATOR-How will modern cars accomplish this?

ENGINEER—In several ways - But here are a few of them:

- 1. Place fewer cars in the rooms.
- 2. Greater efficiency out of loader.
- 3. Haul more coal per trip.
- 4. Dump more coal per dump.
- Eliminate expensive repairs on old cars.

OPERATOR—That certainly is good dope. Whom shall I ask to discuss modern car design?

ENGINEER-I recommend WATT.



Here is a modern all steel car carrying a pay load of 6.000 lbs. which replaced old wooden cars having a capacity of only 3,000 lbs.

The Watt Car & Wheel Co.

BARNESVILLE, OHIO

Chicago Agents, B. E. Schonthal & Co. - 59 E. Van Buren St.

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.

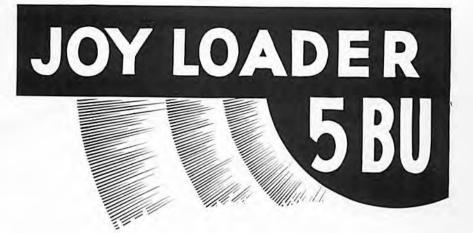
ALTON PELLET POWDER—This new form of packing B Blasting Powder is designed for greater convenience and safety. It is packed in wooden boxes and in paraffin paper cartridges like permissibles, and has all the conveniences of permissibles.

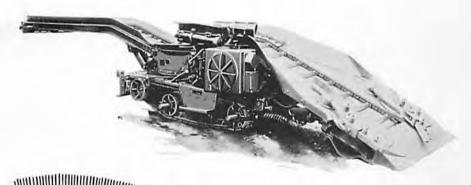
ALTON PERMISSIBLES—Recommended when the mining conditions do not permit the use of granular or pellet powder. We will be glad to furnish expert advice on the grade of Alton Permissibles best adapted to your coal.

"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





This mobile, compact Joy unit capable of loading in excess of 2 tons per minute, has brought new standards of costs to the bituminous coal producing states.

Consult Joy on your problems.

JOY MANUFACTURING CO.
FRANKLIN PENNSYLVANIA

COMPLIMENTS OF

BEALL BROTHERS SUPPLY CO.

MANUFACTURERS OF

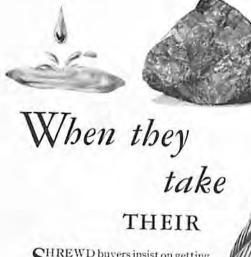
COAL MINERS' TOOLS

and

MINERS' SUPPLIES

C. W. BEALL, Manager

FACTORY: Alton, Illinois BRANCH HOUSE: Marion, Illinois



CHREWD buyers insist on getting back of the "make-up." They are never deceived because oil, coal or wire rope looks good. They know that the TRUTH will out in an engine working under full load, in a red-hot fire box and under the grinding stresses of drums and sheaves.

Just as two lumps of coal look alike, so do non-preformed wire rope and TRU-LAY Preformed Wire Rope, but performance reveals a vast difference. Side by side on the same job. non-preformed wire rope quickly fatigues and breaks down because of its hidden internal stresses. TRU-LAY, with its wires and strands relaxed by preforming in its manufacture, is able to give full measure of service.

That's why on hundreds of jobs, TRU-LAY Preformed Wire Rope has cut wire rope costs materially. Shrewd buyers appreciate seven other outstanding advantages of TRU-LAY Preformed Wire Rope... By preforming the wires and strands

"Make-up"

of TRU-LAY each carries its share of the load . . . There is less slippage . . . Preforming gives you a wire rope which resists kinking . . . The advantage of being able to cut TRU-LAY without seizing needs no comment . . . And TRU-LAY is easier to handle because crown wires that break afterlong wear lie flat in position and do not wicker out . . . Because it is easier to splice ... TRU-LAY Preformed Wire Rope makes independent wire rope center and "Lang Lay" practical . . . Made in all standard sizes, constructions and lavs.

Write today for ample proof of how TRU-LAY Preformed Wire Rope has cut wire rope costs everywhere.





Address the
AMERICAN CABLE COMPANY, Inc.
WILKES-BARRE, PENNSYLVANIA An Associate Company of the American Chain Company, Inc. District Offices: Atlanta, Chicago, Denver, Detroit, Houston, New York, Philadelphia, Pittsburgh, San Francisco

B. K. LEACH, Pres.
JOHN FUHRER, Sec.-Treas.

T. B. CLEMENT, Vice-Pres. C. F. GAUEN, Asst. V.-P.

EGYPTIAN TIE & TIMBER COMPANY

514-18 RIALTO BLDG. ST. LOUIS, MO.

Mine Timbers, Cross Ties, Lumber and Piling

PHONE 8181

Barker Goldman Lubin (o

SPRINGFIELD

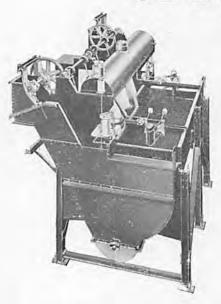
ILLINOIS

COMPLETE LINE OF MINER'S SUPPLIES

DISMANTLING of COAL MINES

WE BUY AND SELL USED COAL MINE EQUIPMENT RAILS - BEAMS - CHANNELS

Meet the BATTLE of the FUELS



with Washed Coal Produced by the NORTON SYSTEM

Clean coal, free from refuse and impurities, has a tremendous sales advantage. Hand picked coal or coal washed by the old methods cannot compare with the sales value of Norton Washed Fuel.

In less than two years, Norton coal washing plants, built by McNally-Pittsburg, have been contracted for or installed in six states. Such recognition is the best evidence of the superiority of the Norton System over old style manually-controlled washers.

McNally-Pittsburg engineers will gladly submit, without obligation, answers to any questions regarding estimates of costs and expected results of the Norton Coal Washer at your mine. These figures are backed by actual results over a period of years in England and America.

Meet the competition of other fuels in your region with "Norton Washed" Coal. Sell "premium" fuel. Write for the Norton Data Book.

THE McNALLY-PITTSBURG MFG. CORP. 205 W. WACKER DRIVE CHICAGO, ILL.



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

Koppers-Birtley Dedusters And Dust Collectors

These units have been proven by nine years experience.

A commercial scale test unit is available for installation at your tipple to show what can be gained by dedusting your coal. Carloads of your coal can be prepared to meet various types of market. Demand and prices can be determined before complete plant is erected.

An actual test during tipple operation will take account of raw coal moisture and size variations and accurately predict the commercial possibility, which cannot be shown by tests at a distant point where changes during shipment of sample will seriously affect performance.

Koppers-Rheolaveur Company

Sales Office 823 Peoples Gas Building Chicago, Ill.



Reg. U. S. Patent Office

Rheolaveur Coal Washing Plants in the United States on January 1, 1934 had a total Annual Capacity exceeding 18,550,000 tons. Rheolaveur accounts for one-third of the total Bituminous Washing Plant Capacity in the United States.

This record is due to a simple, effective washing system, coupled with sound engineering practices applied to the needs of each job.

> You can spend money to experiment or you may utilize Koppers-Rheo wide experience—and avoid costly mistakes.

Koppers-Rheolaveur Company Koppers Building Pittsburgh, Pa.

Sales Office 823 Peoples Gas Building Chicago, Ill,



PROX

CUTTER CHAINS

Made and improved since 1898 for all types of mining machines.

CATERPILLAR CHAINS

Extra strong and durable for the type Joy loading machines.

"Made to Out-Perform— Not to Undersell!"



FRANK PROX COMPANY CRUFT STREET AT WABASH RIVER TERRE HAUTE, INDIANA

RIGHT HERE!

Need Lubrication
TO GIVE MAXIMUM SERVICE



All Macwhyte Mining Ropes are thoroughly lubricated with an elastic non-drying film of lubricant completely encasing each wire. The melting point of this lubricant is so high that it is not affected by climatic temperatures. It will not fly off, drip off, crack or flake off the rope.

It completely lubricates the inside of the rope affording both chemical and mechanical protection. Ordinary acids do not affect it. Because of its heavy consistency, it tends to keep the wires from rubbing upon each other.

Get the complete story on Internal Lubrication. Drop us a card

MACWHYTE WIRE ROPE

INTERNALLY LUBRICATED :: PREFORMED OR REGULAR CONSTRUCTION

Macwhyte Company :: Kenosha, Wisconsin 507 S. Clinton St. — Chicago, Ill.

REFER TO
KEYSTONE COAL MINING CATALOGS FOR DATA ON
MACWHYTE MINING ROPES

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 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, Illinois

COALMASTER



We are glad to cooperate with you in the objective of putting your mine on a more economical drilling basis, giving you more satisfied drillers and a better quality of coal. In order to attain this objective to the fullest extent, we make many sizes and styles of drill bits and drill heads.

We are in a position to render you an unexcelled service with respect to organizing your drilling operation to function smoothly and most economically. This service is freely given, with your benefit as our chief objective.

More Illinois and Indiana mines use Coalmaster Drill Bit equipment than any other make.



Central Mine Equipment Company

SAINT LOUIS



Jute Brattice Cloth

An Integral Element in Safe Mine Ventilation!

Durable

Economical

Non-Inflammable

When Brattice Cloth is needed, the wise user always specifies FFFF—because he KNOWS the FFFF is made up from long-fibre, tough, new jute, to withstand an exceptional amount of wear and tear. The very close weave of FFFF cloths explains their positive deflection of air, the prevention of air seepage, and the proper direction of air to the working face.

FFFF Brattice Cloth is absolutely non-inflammable. Try this test with a Fulton FFFF sample; unravel one edge, separating the individual yarns. Hold a match or any other flame steadily to these yarns. The hot-test flame will only cause the yarns to smoulder—never to break out in flame. And it will stop smouldering the instant the flame is removed.

Such a test indicates high standard of protection for your miner's safety and comfort; it is faulty economy to give them less. It improves any workman's productive morale to know that a really safe brattice stands at all times between him and danger.

No. 8 FFFF

No. 8 FFFF

No. 155 FFFF

The highest quality double A very closely woven fabric, A closely woven fabric of warp goods, made from strong, durable and assurpractically the same confard twisted selected yarn, ing maximum resistance to in demand where the very acid conditions, fungus from a slightly lighter best is desired.

All standard widths carried in stock. Fast service from St. Louis brings FFFF brattice to your mines quickly.

Established 1870

FULTON BAG & COTTON MILLS, Inc.

Manufacturers of Clear Non-Inflammable Jute Brattice Cloth

217 Cedar St.

St. Louis, Mo.

ATLANTA KANSAS CITY NEW ORLEANS DENVER NEW YORK CITY CHICAGO DALLAS OKLAHOMA CITY MINNEAPOLIS

A Tested Mine Loader Grease

Superla Mine Loader Grease was developed especially for use in the Joy Loader. It was tested and found satisfactory under a test more gruelling than ever experienced in everyday mine operation.

You can use Superla Mine Loader Grease with the assurance that it will give effective, economical service. One of our lubrication engineers will be glad to give you complete details and prices on this efficient coal loader lubricant. Just communicate with our nearest office.

Standard Oil Co.

910 S. Michigan Avenue, Chicago, Illinois

Decatur - Evansville - Indianapolis - Peoria - Quincy - Joliet

For Fifty Years...

We have had the Privilege of Supplying Illinois Mines—

Holmes Shaker Screens

Weigh Hoppers

Chutes

Spirals

Dust-o-lators

Cages

Sheave Wheels

Castings

Danville Hoists

The Largest and Most Complete Shop at your Service Day and Night

Write, Wire or Call

Robt. Holmes & Bros., Inc.

510 Junction Ave.

DANVILLE, ILL.

1 3 6 3

IS A "KEYED" ADDRESS

USED ONLY IN THIS YEAR BOOK

-OUR FUTURE ADVERTISING-

DEPENDS ON YOUR INTEREST



Write for Catalog Today!

No. 18 Catalog

Describes 70 Unusual Tools, Devices and Materials for

ELECTRICAL and MECHANICAL MAINTENANCE

The Martindale Electric Co.

1363 Hird St., Lakewood CLEVELAND, OHIO, U. S. A.

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. Electric 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.

THE PELTON STEEL CASTING CO. MILWAUKEE, WISCONSIN

Quality Electric Steel Castings from customers' patterns Extremely prompt deliveries.

Standard conveyor flight castings for loading machines carried in stock at all times for immediate shipment.

We solicit your inquiries whenever you may be in need of steel castings, pattern equipment or conveyor flights.

Phone Canal 5564

PAC LUBRICATING & SERVICE CO.

Quality Lubricants

1500 S. Western Avenue CHICAGO ILL.

PETER A. CASSADY, General Manager

We have QUALITY LUBRICANTS in all densities from a light fluid to a solid for lubrication of

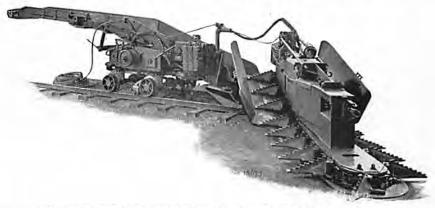
MINE CAR WHEELS
MINING MACHINERY
JOY LOADERS
AIR COMPRESSORS
GEARS
GENERATORS
MOTORS

MOTORS DYNAMOS, etc.

All our products are covered by a guarantee which assures their purity and high lubricating qualities.

LET US SERVE YOU

JEFFREY 44-D Loader



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 neeks 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 New York Philadelphia Pittsburgh Scranton, Pa. Huntington, W. Va. Birmingham Denver Salt Lake City

JEFFREY MANUFACTURING COMPANY, LTD., OF CANADA Head Office and Works, Montreal; Branch Offices: Toronto—Calgary—Vancouver

JEFFREY
Coal Mine Equipment

Boiler Tubes
Copper Ferrules
Pipe
Valves
Fittings
Steam Specialties
Seamless Steel Tubing

CHICAGO TUBE & IRON CO.

2531 W. 48th Street CHICAGO, ILLINOIS



Distributors of

STEEL

Hot and cold finished bars; Structural angles, beams & channels; Sheets and plates; Tool steel; Rezistal stainless steel.

COMPLETE INDUSTRIAL LINES

NORTON grinding wheels MORSE drills and reamers REGO welding equipment NICHOLSON files WILLSON goggles & respirators REPUBLIC pipe LENOX hacksaw blades WILLIAMS wrenches AMES shovels YALE and TOWNE hoists BLACK & DECKER electric tools UNA arc welders REGOROD welding rods BUFFALO blowers and forges SIMPLEX jacks TOLEDO pipe tools STARRETT tools CUSHMAN lathe chucks WHEELER protective apparel bolts, nuts, rivets, washers, capscrews, fittings, tools, etc.

SLIGO

SAINT LOUIS SLIGO IRON STORE COMPANY
1301 N, Sixth Street Saint Louis, Missouri

Railway Steel-Spring Co.

General Office: Cortland Bldg., 30 Church St., New York

×

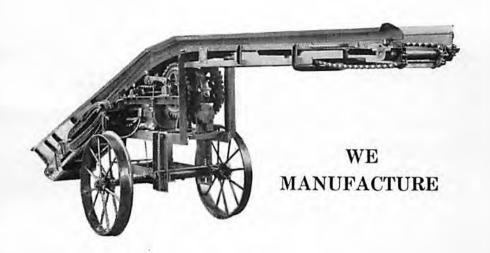
Springs
Steel Tired Wheels
Locomotive and Car
Wheel Tires
Journal Box Lids

×

BRANCHES:

Chicago Cleveland San Francisco St. Louis Denver

Washington St. Paul Pittsburgh



Steel and Gray Iron Castings

of all descriptions

Conveyors

Elevators

Cages

Tipple Equipment

Mine Car Wheels and Axles

Roller Bearing Wheels

Plain Bearing Wheels

Timken Roller Bearing Wheels

DUNCAN

FOUNDRY & MACHINE WORKS, Inc.

Our wheels cast from electric furnace iron have greater strength, closer grain, and deeper chill.



Lubricating Oils

Greases

There is a

Gargoyle Lubricant

Especially Suited For Every
Piece of Equipment You Operate
Call On Our Engineers
They Will Be Glad to Help
You Make the Proper Selection

VACUUM OIL COMPANY, Inc.

A Socony-Vacuum Company

3504 Washington Blvd. St. Louis, Mo. 59 E. Van Buren St. Chicago, Ill.

The NEW

The OLD

THE ENDS

OF THESE WIRE ROPES

TELL THE WHOLE STORY

BOTH are unseized. Yet HAZARD LAY-SET, the new rope for mining, (shown to left above) does not go "wild." Its wires and strands are <u>preformed</u> to the shape of the rope body. What you see at the ends obtains throughout the length of the rope—perfect RELAXATION that eliminates Internal Stress and prolongs the life of the rope to an extraordinary extent.

<u>Preforming also makes LAY-SETWire Rope easier</u> to handle. It spools perfectly, reduces wear on sheaves and drums, runs straight and resists kinking. Replace now with

LAY-SET PREFORMED WIRE ROPE

Write
HAZARD WIRE
WILKES-BARRE



ROPE COMPANY
PENNSYLVANIA

New York Pitt San Francisco

Pittsburgh

urgh Chicago Birmingham

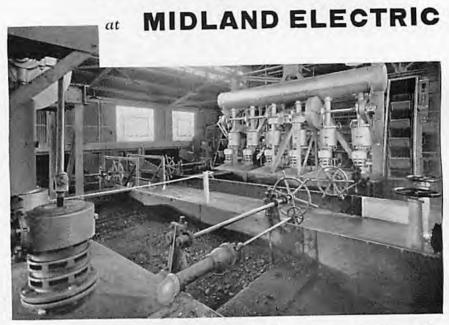
Since 1846

Denver Fort Worth
Philadelphia

Los Angeles Tacoma

LINK-BELT

Simon Carves Cleaning



Link-Belt Products Include:

Complete Coal Tipple Equip-ment. Link-Belt Simon. ment. Link Washeries. Dry Cleaning Equipment, Extraction Equipment, Elevators and Conveyors of all Types. Screens (Vibrating, Shaking, Revolving, etc.)
Picking Tables, Loading
Booms, Feeders, Crushers. Car Dumpers. Chains (Mal-leable Iron, Promal or Steel), Shovels, Cranes, Draglines, Positive Drives: Draglines. Positive Drives: Silent Chains; Silverlink Roller Chain; Speed Re-ducers; P. I. V. Gear Vari-able Speed Transmission, Complete line of Accessories.

OR this outstanding stripping operation-Midland Electric Coal Corporation, Farmington, Illinois-the Link-Belt Simon-Carves Cleaning System was selected. Twin washing units, each having a capacity of 200 tons per hour, wash all coal from 4 in. to 0.

This large tonnage is being easily handled with very satisfactory results.

Allen & Garcia Company were the consulting engineers, and Marion Steam Shovel Company, the contractors.

The Link-Belt Simon-Carves system has demonstrated that it is low in capital outlay, depreciation, supervision, repairs, renewals, and power consumption, and that it cleans coal thoroughly. Over 285 washing units have been installed for service all over the world.

LINK-BELT COMPANY

CHICAGO, 300 West Pershing Road Philadelphia Kansas City, Mo. St. Louis Wilkes-Barre

Pittsburgh Seattle

Huntington, W. Va. Toronto

CONTROL YOUR SHOTS

By Making Them With



PELLET POWDER No. 4

125 Sticks 1½ in. x 8 in. in 50-lb. Case 4 Pellets to a stick!

THE FIRST LOW DENSITY pellet powder stick made with 4 uniform pellets alike in size, solidity, weight and execution. Each pellet produces the same velocity, force and effect.

Every shot can be ACCURATELY GAUGED. Sticks are always easily broken into 1/4, 1/2 or 3/4 length with the certainty that each portion contains the EXACT QUANTITY required—an advantage offered by no other pellet or stick powder of this density.

Much LESS SMOKE follows the shooting of No. 4 Pellet Powder than results when using other pellet or granular powders.

Every No. 4 Pellet is compressed solidly—does not crumble while loading. Easier, safer, quicker, more accurate loading assured.

Pellet Powder No. 4 shoots stick for stick against any other stick or pellet powders.

Pellet Powder No. 4, because of its low density, individual packing, accurate loading and uniform action will produce more lump coal, cause less checking and slack, and reduce your mining costs.

E. I. DU PONT DE NEMOURS & CO.

INCORPORATED

Wilmington :: Delaware

BRANCH OFFICES:

Chicago: McCormick Bldg. Joplin: Nat'l, Bank Bldg.

SHOOT



POWDER

M. S. A. SKULLGARD



TYPE D Black Micarta

Lighter in Weight Lower in Price Flexible Around Shell Base

The ULTIMATE in COOLNESS COMFORT and SAFETY . . .

Its distinctive design gives maximum protection to the head, face and neck. . . . its tough fracture-resisting Micarta construction is far superior to ordinary fibre because it never softens from mine water or perspiration. The comfortable cushioned linings conform easily to the shape of the head and assure good, cool ven tilation without sacrificing any of its protective features. Lampholders for various types of lamps are built into the design of the cap.

Write for descriptive bulletin and new low prices

MINE SAFETY APPLIANCES CO., PITTSBURGH Braddock, Thomas & Meade Sts.

ST. LOUIS SCREW AND BOLT CO.

ST. LOUIS, MO.

44

MANUFACTURERS OF STANDARD AND SPECIAL

BOLTS, NUTS AND SCREWS

SINCE 1887

44

OUR COMPLETE STOCKS
INSURE PROMPT SHIPMENT

44

WE

WOULD LIKE TO QUOTE ON YOUR NEXT ORDER

Forty-Four Years of Progress in Mine Ventilation

Fans and Blowers
for
All Purposes

Robinson Ventilating Company Zelienople, Pa.

Special Representatives;
Goodman Manufacturing Company
Chicago, Ill.

Modernize Your Cutting and Hauling With Goodman Equipment



20-Ton, Three Motor, Haulage Locomotive with Loads.

Open — Enclosed — Government Approved
One Motor—Two Motors—Three Motors
Storage Battery—Combination—Trolley
Drum—Semi Magnetic—Full Magnetic
Hauling — Gathering — Tramming
Standard Speed—Slow Speed
Two to Thirty Tons



Mounted Bottom Cutter Ready to sump.

Standard—Low Vein
Cuts a Smooth Bottom
Self-Contained—Self-Propelled
Open—Enclosed—Government Approved
8 Inches below Rail Tops to 7½ Inches above
Cuts in Either Direction with Gear Controlled Feed
Cutting Range of 15½ In. May be Raised above the Bottom



National Armature

and

Electric Works

J. W. OVERSTREET, General Manager BLUEFIELD, W, VA.

TELEPHONE 1000

Manufacturers of Electrical Coils

YOUR INQUIRIES INVITED

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

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

9

MINE EQUIPMENT

"LITTLE GIANT" COAL DRILLS, mounted, unmounted (Electric, Pneumatic)

"LITTLE GIANT" PERMISSIBLE ELEC-TRIC COAL DRILLS, mounted, unmounted

MINE CAR COMPRESSORS, Electric Motor Driven

SINKER DRILLS

AUGER DRILLS

ELECTRIC AND PNEUMATIC DRILLS for Car Repair and Maintenance Work

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

Little Giant 700 Type Mounted Coal Drill The Name

"Upson-Walton"

Stands for

—Quality Products—
—Prompt and Helpful Service—
—Responsibility—

BRATTICE CLOTH

The well-known U-W grades of non-inflammable jute Nos. 9626 - 5071 - 8372 - 2098—widths 36" to 96" Non-inflammable Cotton—2 grades Air-tight and waterproof Jute or Cotton

WIRE ROPE

Shaft Hoist Ropes — Room Hoist Ropes Haulage Ropes — Tail Ropes Special Mining Machine Cables

MANILA ROPE

Upson-Walton Manila greatly exceeds U.S. Gov't. strength requirements. 3 grades—all waterproofed

ROPE FITTINGS

Turnbuckles — Sockets — Shackles — Clips and other wire rope fittings A Complete and Dependable Service

AT YOUR SERVICE

We will appreciate the opportunity of quoting on your next requirements

The Upson Malton Ker

Established 1871

1310 West 11th St.

Cleveland, Ohio

Sales and Service Branches

Buffalo — Chicago — New York — Pittsburgh

7 REASONS WHY TIMKEN IS THE DOMINANT MINE CAR BEARING

1 The Timken Tapered Roller Bearing embodies certain elements of design that are essential to maximum performance in mine car wheels, not found in other bearings. One of these important features is Timken positive roll alignment which prevents the rollers skewing both when in and out of the load zone. Another is the correct spacing of the rollers, with a truly perforated cage, preventing roller to roller contact and reducing internal friction to the vanishing point.

Timken Tapered Roller Bearings are made of Timken alloy steel, a special steel produced in Timken's own steel mill under the direct supervision and control of Timken metallurgists and engineers. This material is largely responsible for the greater load carrying capacity, endurance and long life of Timken Bearings.

The Timken Roller Bearing Company originated the tapered roller principle 35 years ago and has had more engineering experience in applying anti-friction bearings to mine cars than any other bearing manufacturer.

The Timken mine car bearing mounting includes an all-steel dust collar shrunkon the axle—a patented feat-

ure developed for your benefit. This protects the bearing against the side-wise pounding of the loaded car, preventing it from being forced out of adjustment. The shrunk-on dust collar will not turn on the axle, thus eliminating the usual axle wear at the shoulder which would of course be disastrous to the bearing. It forms a permanent seal against the ingress of dust, grit and water and prevents the escape of lubricant. Make sure of getting this vital feature when buying bearings or cars.

5 Over 1,000 mine operators have proved the dependability and economy of Timken-equipped mine cars during years of profitable service.

6 All the leading mine car builders install and recommend Timken Tapered Roller Bearings, because they know Timken is strong enough to stand back of each installation regardless of size.

The entire engineering, financial and manufacturing resources of the Timken Roller Bearing Company are behind every Timken Bearing that goes in a mine car to assure the operators satisfaction. Don't experiment; specify Timken-equipped—it pays.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

TIMKEN Tapered ROLLER BEARINGS

STEEL for Coal Mine Use

HEN 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.

Partial list of steel and allied products carried in stock:

Alloy Steel Allegheny Metal (Stainless) Angles Babbitt Metal Bands Bars Beams Bearings, Ryertex Billets, Forging Boiler Tubes Boiler Fittings Boiler Plates and Heads Bolts, All kinds Brass Chain Channels Copper

Corrugated Roofing

Flanges Flat Bars Floor Plates H Beams Hoops I Beams Iron, Refined Iron Plates Sheets Machine Tools Machinery, Metal Working Nails, Nuts Pipe Plates Ry-ax, Ry-arm Rails Reinforcing Bars Rivets Safety Treads

Shafting Sheets, Plain, Galvanized or Corrugated Sheets, Stamping, Auto, Electrical, etc. Screw Stock C. R. Solder Spikes, Railroad Staybolts Strip Steel Structural Steel Tees and Zees Tools, small Tool Steel Turnbuckles Washers Welding Rods Wire

Zinc, etc.

Write for the Ryerson Stock List

JOSEPH T. RYERSON & SON, Inc. Plants at: Chicago, Milwaukee, St. Louis, Cincinnati, Detroit, Cleveland, Buffalo, Boston, Philadelphia, Jersey City

RYERSON

GREETINGS

to the

ILLINOIS MINING INSTITUTE

SW

The Davies Supply Co.

NATIONAL STEEL PIPE BYERS WROT IRON

Fittings-Valves

Plumbing and Heating Materials

6601-6633 Grand Avenue

CHICAGO, ILLINOIS



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 KW service.

KW BATTERY CO., Inc.

Chicago - New York - Pittsburgh

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

HAY 8073 8074 8075 8076

Hawkins Electric Company

Wholesalers

1445-1447 Washington Boulevard CHICAGO, ILLINOIS

Distributing Nationally Known Electrical Products to the

MINING INDUSTRY MANUFACTURERS INDUSTRIAL PLANTS

WILLIAMS LEATHER PRODUCTS

Have Been Quality Products for 90 Years

Our Cocheco and Shedite oak tanned Leather belting and our Flex-Tan Super-flexible belting have no superiors. We also make Rawhide and Indian Tanned lace leather, Chrome Cup packings and Special packings for Joy Loading Machines, harness leather, hame straps, miner's belts, etc.

Highest quality and a trial will prove their worth.

I. B. WILLIAMS & SONS

Factory Dover, N. H.

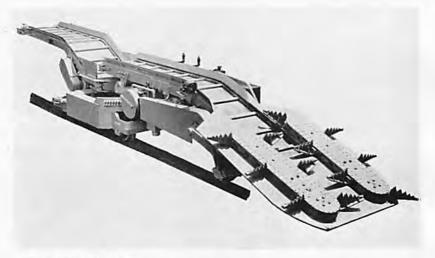
Branches:

1215 Washington Blvd. Chicago, Ill. 71-73 Murray Street New York, N. Y.

UTILITY LOADER

Reliable

Efficient



Weight: 11 tons. Chassis and Loading Head: 33 inches above top of rail. Clutched swing and hydraulic lift mechanisms.

Loading head, 15 H.P. Louis-Allis motor, gear-in-head herringbone transmission.

Tramming mechanism, 10 H. P. Louis-Allis motor, same type transmission.

Rear conveyor, 5 H.P. Louis Allis motor, same type transmission.

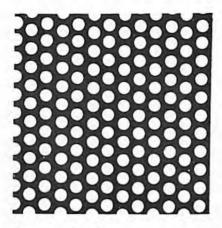
Rear conveyor, swing mechanism, 3/4 H.P. motor.

Cutler-Hammer drum controllers and magnetic circuit breakers.

Baldwin 1½ inch pitch highspeed roller chain used throughout.

UTILITY CONVEYOR AND MINE EQUIPMENT COMPANY

ST. LOUIS, MISSOURI



Standard Stamping & Perforating Co.

3131-37 W. 49th Place CHICAGO



PERFORATED METALS

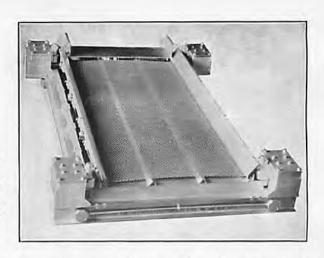
for

Coal Mines . . . Stone Quarries
Feed and Hammer Mills
. . . and many other purposes

Let us figure your screen requirements



SERVICE . . QUALITY . . PRICE



TYPE 400 BREAKS RECORDS!

By no other means can you screen damp coal in fine sizes and get the tonnage and efficiency shown by the Type 400 Screen!

CAPACITY:

4'x 8' SCREEN

3/8" Separation

Feed $-1\frac{1}{4}$ " slack, $50\% - \frac{3}{8}$ "

Moisture-damp.

Tons per hr. 200 T. per screen. 6.3 T. per sq. ft.

Tailings $\begin{cases} +3\% \text{ Coal,} & 92.0\% \\ \text{Near Mesh Undersize, } 6.2\% \\ -3\% & 1.8\% \end{cases}$

10-Mesh Separation*

Feed $-\frac{5}{16}''$ slack, 31% - 10-mesh.

Moisture—damp.

Tons per hr. \ 86 T. per screen. 2.7 T. per sq. ft.

 $\begin{array}{l} \text{Tailings} \\ \text{Product} \end{array} \begin{cases} + \text{ 10-mesh coal,} & 93.6\% \\ \text{Near Mesh Undersize, } 4.7\% \\ - \text{ 20} & \text{"} & 1.7\% \\ \end{array}$

100.0%

FEATURES:

VIBRATOR AT EACH CORNER!
INTENSE VIBRATION OF ENTIRE SURFACE!
EQUAL DISTRIBUTION OF POWER OVER ENTIRE SCREEN AREA!
NO LUBRICATION!

A PRACTICAL MEANS OF DE-DUSTING — A NEW SOURCE OF PROFIT!

*The Type 400 has made it possible for the first time to eliminate the undesirable dust from household stoker coal by screening at 10 mesh in combination with air separation.

Operators interested in producing coal for this or other purposes are invited to write for further information.

THE W.S. TYLER COMPANY, Cleveland, Ohio

We Are Pleased to Present a

Catalog of Egyptian Products

Will you check the list and start the year 1934 right by securing our prices before purchasing? Our representative will gladly call and go over your requirements.

Reid Cast-in-one-piece Safety Shaker Screen Driving Equip-Frogs, semi-steel and cast steel

Switch Materials Split Switches Frogs Crossings Guard Rails Rail Braces Switch Stands Gauge Rods, etc.

Mine Cars Complete

Trucks Complete Wheels plain and equipped with Timken Bearings, Ball Bearings, Hyatt Bearings; Journal Boxes Axles, Channels, Bumpers, Body Irons.

Egyptian Wheels are made of Northern iron and steel and annealed with a deeply chilled tread. All Egyptian wheels carry our standard guarantee.

Light Push Cars with Bicycle Type Wheels.

ment:

Eccentrics Straps Channel Arms Journal Boxes Shafts Crossheads

Cage Parts: We manufacture Bond Cage Parts for prompt shipment, also castings and parts for your special cages.

Boiler Repairs: Smoke Stacks Grate Bars Finger Bars Stoker Clips Fire Box Liners Door Liners

Miscellaneous Castings made of: Cast Iron Semi-Steel Bronze

Fully equipped Machine Shop, including Blacksmithing, Electric Welding and Oxy-acetylene Welding.

Brass

Cast Steel

When you want SERVICE, night or day, see

Egyptian Iron Works

MURPHYSBORO, ILL.

FLEXIPIPE

for efficiency and economy

Because Flexipipe brings pure air to working faces, shafts, slopes, and entries, it makes men more efficientand that means economy.

And because it clears the air at the working face 5 minutes after shooting, it saves time--which is MORE efficiency and economy.

Write for reasons why Flexipipe is the standard auxiliary ventilating system in coal mines.

BEMIS BRO. BAG CO.

412 Poplar St. Houis Mo.



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.

GENERAL E ELECTRIC



Atlas greets the Mining Industry of Illinois with the

Atlas Accordion Fold Electric Blasting Cap Package

....a new contribution for added safety and convenience in electric blasting.

In the Accordion Fold the leg wires are folded Accordion-wise around the Blasting Cap to cushion and protect it. The resulting package occupies small space. The wires unfold naturally avoiding kinks and snarls. This exclusive Atlas package is handy to carry and handy to use.

Atlas maintains complete facilities for the manufacture of Blasting Powder, High Explosives and Blasting Accessories to serve Illinois Mining needs.

A Proper Explosive for Every Blasting Requirement.

Atlas Powder Company

JOPLIN, MO.

and

ST. LOUIS, MISSOURI

TYSON Cageless TAPERED ROLLER BEARINGS

30%-50% greater reserve capacity



Longer anti-friction bearing life means a lower cost per ton of coal mined, an objective of every operator who has applied Tyson Cageless Tapered Roller Bearings in mine car wheels, locomotives, conveyors, loaders and other mining machinery. Data sheets giving Tyson bearing recommendations for different capacity cars and recommended designs for mountings will be sent at your request.

TYSON ROLLER BEARING CORPORATION Massillon, Ohio



BROWNBILT SAFE-TOE SHOES

prevent many lost-time accidents, painful foot injuries and are another step toward practical work clothing for miners.

The steel box which withstood 1500 pounds pressure in experimentation has already withstood even more severe tests in actual use. These shoes have been perfected after several years of constant improvement.

They are comfortable and smooth on the inside and provide ample toe room.



"Brownbilt Safetoe" shoes have become such an important part of our business we have prepared a special "Safetoe" catalog and will gladly send you one upon receipt of your request.

Erraymod sode nwork

MANUFACTURERS ST. LOUIS, MO.



4-ton trolley gathering locomotive.



6-ton permissible storage-battery gathering locomotive.

Saving Haulage Dollars

from Room to Tipple

FROM the 4-ton, low-height gathering locomotive to the powerful 38-ton, 3-motor machine, there is a Baldwin Westinghouse locomotive for every coal mining haulage need . . . in both gaseous and non-gaseous locations.

In mines throughout the country, Baldwin-Westinghouse locomotives are cutting operating expenses by increasing tonnage outputs and lowering maintenance costs.





6-ton explosion-tested trolley gathering locomotive.



6-ton trolley reel gathering locomotive.



10-ton combination trolley and storage battery baulage locomotive.



15-ton double-end trolley baulage locomotive.



38-ton 3-motor trolley baulage locomotive.

Baldwin-Westinghouse

SKF - Hess-Bright - Timken - Hyatt

BERRY BEARING CO.

2715 Michigan Ave. Chicago

Phone CAL umet 2250

The RIGHT bearing at the RIGHT time

Gurney - Fafnir - New Departure - Rollway

United States Rubber Products

INCORPORATED

440 West Washington St.



CHICAGO, ILLINOIS

Manufacturers

BELTING - HOSE - PACKINGS

The "US" Line of Wires and Cables
"US" Royal—Mining and Locomotive Cable
"US" Holdtite Friction Tape—"US" Relio Rubber Tape

U.S.
RUBBER PRODUCTS
GIVE
THAT EXTRA
SERVICE

We specialize in Brattice, Pit Car, Mine Shaft, Building Lumber and Mining Timbers. Shipments are made from our Chicago yard or from our own mills.

EDWARD HINES LUMBER CO.

2431 South Lincoln St., Chicago, Illinois Phone: Canal 0349

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.

PORTABLE COMPRESSED AIR For the Coal Mine



Compressed air power—in portable units—proves both convenient and economical for underground mining needs.

Sullivan Machinery Company offers mine car compressors in vertical and horizontal types, with multiple V-belt drive or direct connection to electric motor (AC or DC). Compressor and motor are mounted, with an air receiver, on a truck gauged for use on the regular mine track.

Minimum overall dimensions and short wheel base permit operation under any conditions where a mine locomotive can be used.

A Government approved explosion proof model is built for gaseous mines and a special sized machine for low vein workings.

Compact—dependable units.

SULLIVAN MINE EQUIPMENT

Coal Cutters
Cutter Bit Sharpeners
Stationary Compressors

Hoists Hammer Drills

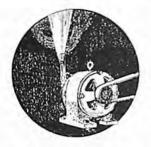
Drill Sharpeners

Stripborer Drills
For removing overburden
in strip pit mines

DIAMOND DRILL CONTRACT SERVICE

SULLIVAN MACHINERY COMPANY

400 North Michigan Avenue, Chicago



If Motors Could WHISTLE!

IF electric motors could whistle, or blow off steam the way boilers do when overloaded, there would be no reason to use safety and control devices. But, because a burned-out motor is an expensive signal, mine operators everywhere have found it profitable to include O-B circuit breakers, fused trolley taps and automatic motor starters in their standard equipment specifications. These inexpensive devices, which protect and safeguard men and costly machinery, pay for themselves quickly; then continue to increase savings. Without such protection. maintenance, replacement and lost time costs cut heavily into an already small margin of profit.





Circuit Breaker Switch



Automatic Motor Starter

1655M

OHIO BRASS COMPANY

Canadian Ohio Brass Co. Limited

Ohio, U. S. A. Niagara Falls, Ontario, Canada

New York • Philadelphia • Boston • Pittsburgh • Chicago • Cleveland Atlanta • Dallas • Los Angeles • San Francisco • Seattle

BUETTNER SHELBURNE MACHINE COMPANY, INC.

Exclusive Manufacturers of Supplies for Electrical

COAL MINING MACHINERY

Main Office and Works:

South Third and Minshall Sts.

Telephone Crawford 8854

TERRE HAUTE, IND., U. S. A.

Coal Mining Screens Perforated Metals

We manufacture Coal Mining Screens of every type—flat—flanged end—cylindrical or special shape. Any size or style screen in whatever thickness of metal you desire. We are supplying Coal Screens to many leading coal mines—made to their exact requirements and specifications.

CHICAGO PERFORATING CO.

2445 W. 24th Pl., Chicago, Ill.

Mechanical Rubber Goods



Conveyor Belts Rock Dusting Hose

Compensated Belt Air Hose

V-Belts Industrial Brake Lining

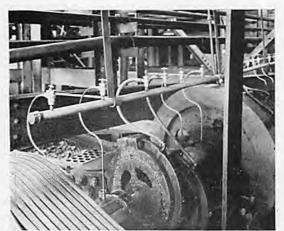
Water Hose Asbestos Brake Blocks

Steam Hose Fire Hose



THE MANHATTAN RUBBER MFG. DIVISION OF RAYBESTOS — MANHATTAN Inc.

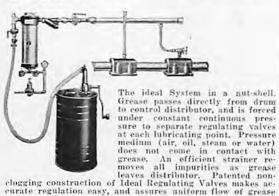
Executive Offices and Factories-Passaic, N. J.



Typical application of Ideal Mechanized Lubrication to eccentric bearings of reciprocating drive for shaker screens in authracite coal breaker.



Ideal Lubrication applied to Shaking Screen Drives modern Pennsylvania coal preparation plant of large Bituminous Producer.



curate regulation easy, and assures uniform flow of grease as long as adjustment remains unchanged.

Goal Operators . . Save Money Through "Ideal" Lubrication

Correct Lubrication is an ex-tremely important factor in the remely important factor in the efficient operation of modern coal handling and coal preparation plants, and progressive coal companies everywhere are not only cutting costs but also increasing production through the use of "Ideal" constantie ed controlled lubrication, Most modern plants and many Most modern plants and many others, are partly or entirely equipped with the "Ideal" Sys-tem. Some of the big ad-vantages thereby secured, are; An Average Saving of 70% in

Lubricant Expense By applying the proper amount of grease continuously, instead of applying excessive amounts intermittently, astonishing savings have been achieved. ings have been achieved. On a large set of crushing rolls, for instance, the amount of grease consumed was reduced from 400 lbs. per day to 40 Other reports show savings of from 30% up, the savings from all installations reported averaging about 70%. Another important advantage secured through correct continuous lubrication is greater cleanliness and reduced fire hazard.

Power Costs Reduced 121/2 % Careful tests by one progressive coal company showed that after applying Ideal Lubrication to its shaker screens, 17½% less bower was required for starting, and 12½% less for continuous operation. Because Ideal Lubrication once installed and adjusted is practically infallible, the actual savings in power cost over a long period of operation are probably even greater than during a limited test period.

test period.

Bearing Replacements
Practically Eliminated
The continuous supply of pure
grease delivered by the Ideal
System at constant pressure to
every bearing; and the outward
flow principle which automatically keeps out dust, water, and
all other impurities from the
bearing surfaces, practically
eliminate the maintenance expense ordinarily caused by lack
of proper lubrication. Figures
furnished by users of the Ideal
Lubricating System show an
average saving of 94% in labor
and material costs for repairand material costs for repair-ing and replacing bearings.

IDEAL LUBRICATOR COMPANY PACKARD BOG.

Safety Directors Here's News!

2880 men wearing Hy-Test Shoes reduced foot injuries 50% in large mine



Actual Statement by Safety Director of Large Mining Company:

"A year ago my ambition was to get all our men into Hy-Test Safety Shoes within a period of two years. Now, at the end of the first year, 90% of our men are so equipped. The result is our foot accidents have been reduced 50%. We employ 3200 men."

Just one of the actual cases of definite savings in time and money that Hy-Test Safety Shoes have accomplished for leading industrial concerns the country over.

Hy-Test Shoes offer distinct advantages made possible by the vast resources and facilities of the WORLD'S LARGEST SHOE MANUFACTURERS. Their lower prices for genuine quality make them the outstanding Safety Shoe value today. Models are stocked for every industrial requirement.



HY-TEST SAFETY SHOES

Designed and Manufactured Exclusively by

INTERNATIONAL SHOE COMPANY

St. Louis, Mo.



H. CHANNON COMPANY

FOUNDED 1875

North Wacker Drive and Randolph St. Chicago, Illinois

MINE MILL RAILROAD

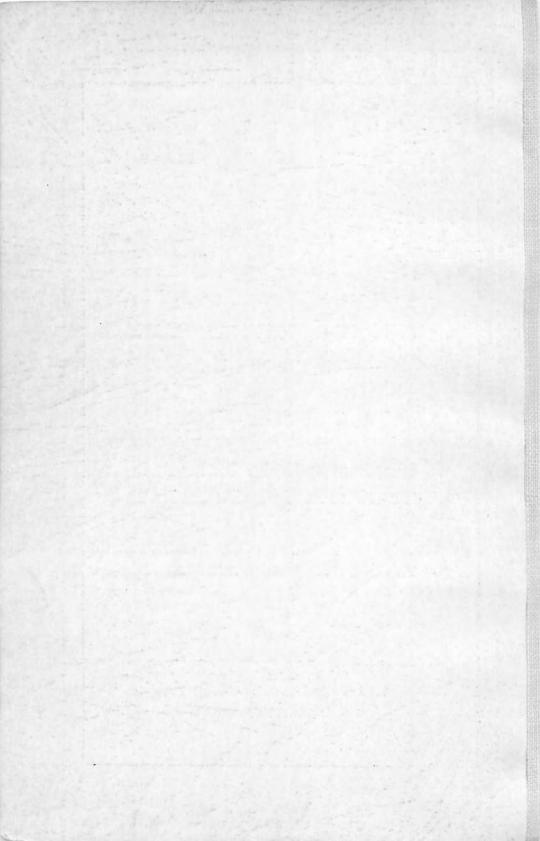
and

INDUSTRIAL SUPPLIES WHOLESALE ONLY

INDEX TO ADVERTISERS

NAME ADV.	NO.
American Brattice Cloth Co.	29
American Cable Co.	13
Atlas Powder Co.	60
Atlas Towner Co	. 00
Barker-Goldman-Lubin Co.	
Barker-Goldman-Lubin Co.	. 15
Beall Bros. Supply Co.	. 12
Bemis Bro. Bag Co.	. 58
Berry Bearing Co.	. 64
Brown Shoe Co.	. 62
Bueyrus-Erie Co	. 7
Buettner Shelburne Mch. Co.	. 68
Carroll Chain Co.	. 4
Central Mine Equipt. Co.	. 24
Channon, H., Co.	. 72
Chicago Perforating Co.	69
Chicago Pneumatic Tool Co.	46
Chicago Tube & Iron Co.	39
Clarkson Mfg. Co.	93
Clarkson Mig. Co.	
Commercial Testing & Engrg. Co.	
Critchell, Miller, Whitney & Barbour	
	50
Davies Supply Co.	. 50
Dooley Brothers	. 02
Duncan Fdry. & Mch. Wks.	
	20
E. I. du Pont de Nemours & Co.	. 09
Dala Isaa Washa	. 0
Egyptian Iron Works Egyptian Tie & Timber Co.	. 57
Egyptian Tie & Timber Co.	. 14
Fanitable Pow Mfg Co	. 10
Evansville Electric & Mfg. Co.	. 29
Farnum, F. D., & Co	. 17
Fulton Bag & Cotton Mills	. 25
General Electric Co.	. 59
Goodman Mfg. Co.	. 43
Hazard Wire Rope Co	. 37
Hambing Plantuin Co	. 00
TT I Daniel Co	
Hines, Edw., Lumber Co.	65
Hines, Edw., Lumber Co.	27
Holmes, Robt., & Bros.	1
Hulburt Oil & Grease Co.	
Ideal Lubricator Co.	70
Ideal Lubricator Co.	71
International Shoe Co.	
Jeffrey Mfg. Co., The	21
Jeffrey Mfg. Co., The	11
Joy Mfg. Co., The	

NAME ADV.	NO.
W. B. H C.	= 1
K. W. Battery Co.	0 10
Koppers-Rheolaveur Co1	8-19
Link-Belt Company	. 38
Macwhyte Company	. 21
McNally Pittsburg Mfg. Corp	. 16
Martindale Elect. Co., The	28
Mine Safety Appliances Co.	40
Manhattan Rubber Mfg. Div	. 10
of Raybestos-Manhattan, Inc., The	. 69
VI 111, 111, 111, 111, 111, 111, 111, 11	
National Armature & Elect. Wks.	. 44
Ohio Brass Co	. 67
Osborne & Lange, Inc.	. 8
B 11: // 6 G . G	0.0
Pac Lubricating & Service Co.	. 30
Pelton Steel Casting Co.	. 30
Pelton Steel Casting Co. Portable Lamp & Equipt. Co.	. 5
Prox, Frank, Co.	. 20
Railway Steel-Spring Co.	94
Railway Steel-Spring Co.	. 34
Revere Electric Co.	. 45
Robinson Ventilating Co. Roebling's, John A., Sons Co.	. 42
Roebling's, John A., Sons Co.	. 45
Ryerson, Jos. T. & Son, Inc.	. 49
Simplex Wire & Cable Co.	17
Simplex wire & Gable Co.	. 17
Sligo Iron Store Co.	. 33
Solvay Sales Corp.	. 65
Standard Oil Co.	. 26
Standard Stamping & Perf. Co. St. Louis Screw & Bolt Co.	. 55
St. Louis Screw & Bolt Co.	. 41
Sullivan Mchy. Co	. 66
min I no Delley Desire Orange	
Timken Roller Bearing Co., The	. 48
Tyler, W. S., Co.	. 56
Tyson Roller Bearing Co.	. 61
Upson-Walton Co.	400
U. S. Rubber Products, Inc.	41
U. S. Rubber Froudets, Inc.	. 64
Utility Tool & Mfg. Co.	. 54
Vacuum Oil Co., Inc.	. 36
Watt Car & Wheel Co.	0
West Virginia Rail Co.	3
Westinghouse Electric Co.	60
Williams, I. B., & Sons	. 00
Transminer at Mr. W DVIID matter transminer to the contract of	13.5



Annual Boat Trip

and

Summer Meeting

ILLINOIS MINING INSTITUTE JUNE 8-9-10, 1934

S. S. CAPE GIRARDEAU

Leave St. Louis 11 p. m. June 8 Arrive St. Louis 10 a. m. June 10

A SPLENDID PROGRAM IS BEING ARRANGED MAKE YOUR RESERVATIONS EARLY

B. E. SCHONTHAL, Secretary 59 EAST VAN BUREN STREET CHICAGO