Charles C. Boley

PROCEEDINGS OF THE ILLINOIS MINING INSTITUTE

FOUNDED FEBRUARY 1892

1934

Sent to Jack A. Simon, Secretary-Treasurer of IMI on June 10, 1966 from Dr. Charles C. Boley, U.S. Bureau of Mines, Grand Forks, N.D.

GEO. D. LOUDEN PRINTING COMPANY
Champaign, Illinois

PROCEEDINGS

of the

ILLINOIS MINING INSTITUTE

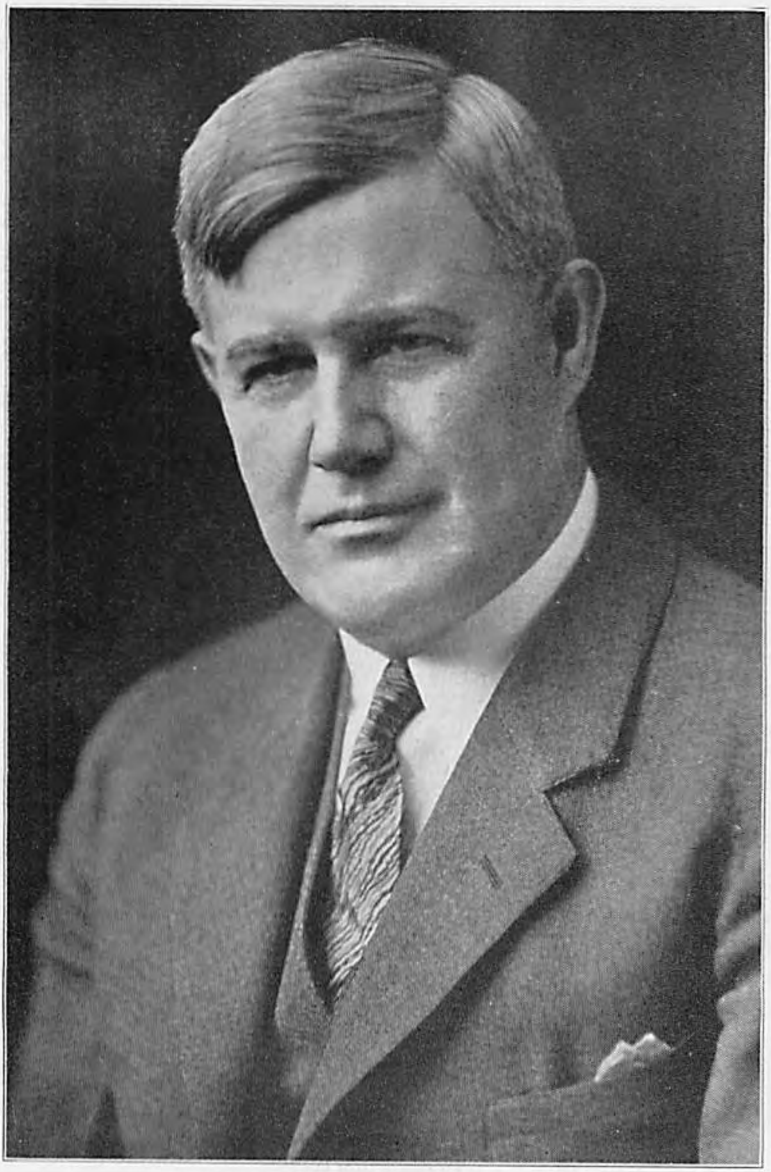
Founded February, 1892

1934

Summer Meeting
on Board S. S. Cape Girardeau
June 8-9-10

and

Annual Meeting
SPRINGFIELD, ILLINOIS
November 2



HARRY A. TREADWELL

President, 1934

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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	WALTON RUTLEDGE, State Mine Inspector, Alton, Ill.
1895 1911	Institute inactive.
1912-3	JOHN P. REESE, Gen. Supt., Superior Coal Co., Gillespie, Ill.
1913-4	THOMAS MOSES, Supt., Bunsen Coal Co., Georgetown, Ill.
1914-5	J. W. STARKS, State Mine Inspector, Georgetown, Ill.
1915-6	WILLIAM BURTON, V. P., Illinois Miners, Springfield, Ill.
1916-7	FRED PFAHLER, Gen. Supt., Superior Coal Co., Gillespie, Ill.
1917-8	PATRICK HOGAN, State Mine Inspector, Carbon, Ill.
1918-9	WILLIAM HALL, Miners Examining Board, Springfield, Ill.
1919-20	WILLIAM HALL, Miners Examining Board, Springfield, Ill.
1920-21	FRANK F. TIRRE, Supt., North Breese Coal & Mining Co., Breese, Ill.
1921-22	PROF. H. H. STOEK, Mining Dept., University of Illinois.
1922-23	JOHN G. MILLHOUSE, State Mine Inspector, Litchfield, Ill.
1923-24	D. D. WILCOX, C. E., Superior Coal Co., Gillespie, Ill.
1924-25	H. E. SMITH, Gen. Supt., Union Fuel Co., Springfield, Ill.
1925-26	E. G. LEWIS, Supt., Chicago-Sandoval Coal Co., Sandoval, Ill.
1926-27	WM. E. KIDD, State Mine Inspector, Peoria, Ill.
1927-28	JAMES S. ANDERSON, Supt., Madison Coal Corp., Glen Carbon, Ill.
1928-29	JOHN E. JONES, Safety Engineer, Old Ben Coal Corp., West Frankfort, Ill.
1929-30	PROF. A. C. CALLEN, University of Illinois, Urbana, Ill.
1930-31	JOSEPH D. ZOOK, Pres., Illinois Coal Operators' Assn., Chicago, Ill.
1931-32	GEO. C. MCFADDEN, Asst. Vice-Pres., Peabody Coal Co., Chicago, Ill.
1932-33	CHAS. F. HAMILTON, Vice-Pres., Pyramid Coal Co., Chicago, Ill.
1933-34	HARRY A. TREADWELL, Gen. Supt., C. W. & F. Coal Co., Benton, Ill.

A WORD TO THE MEMBERS FROM THE SECRETARY

I doubt whether our members realize the tremendous amount of work connected with getting together the year-book which is presented herewith. Probably none of the members have ever stopped to consider what is necessary to make this book possible.

First of all, we are dependent upon the suppliers for advertisements in order to defray the expenses of the year-book. This is our sixth issue. Many of the advertisers have contributed to each issue, and we feel that the users of equipment would assist the Institute very materially if they would give due consideration to the suppliers whose advertisements appear in the advertising section in the back of this book, whenever in need of equipment and supplies.

It will be of great assistance for future issues if you will patronize our supporters, the advertisers, whenever possible. The success or failure of this publication and the issuance of future editions will depend greatly on this assistance.

OUR RIVER TRIP

We've done a lot of grumblin' and a cussin' of our luck,
And talked of rotten business and the President gettin' stuck,
But when we get our notice that the River Trip is near,
We push all other things aside and the world seems full of cheer.

'Tis then we tell our bosses of the business we will lose
If we fail to take this river trip or do not pay our dues,
And then the sun begins to shine as the cashier writes a check,
For we know our feet will once more hit the Cape Girardeau's deck.

For sixteen years we've sailed these shores with Happy Captain Buck,
And made each port along the way from Thebes to Keokuk.
We always meet some dear old friends and make some new ones too,
And mine more coal, if talking counts, than all the miners do.

Our business sessions, held on deck, are interesting, indeed,
As almost every mining man hears something he should heed.
Good papers and discussions are given us each day,
By able minded mining men who know just what to say.

To those who take these river trips, there's nothing to be said
About the jovial times we've had, from supper-time till bed.
You either join a game of cards or talk with those you've met,
Or listen to "Sweet Adeline" by some barber-shop quartette.

And then our midnight lunch is spread, with sausages galore,
With beans and cheese and hard-boiled eggs; you'd never ask for more.
Of course, there's always hot-dogs, both rubber and of meat,
With coffee, which is good and hot, it surely is some treat.

Then, when our trip is ended and the dock is drawing near,
We gather on the forward deck and this is what we hear:
"Good-bye Harry, good-bye Bael," farewell is the cry,
Be sure to make the trip next year, on the good boat I. M. I.

J. A. ("JEFF.") JEFFERIS.

CONTENTS

SUMMER MEETING AND BOAT TRIP

June 8-10, 1934

Annual Summer Meeting and Boat Trip of the Illinois Mining Institute held on S. S. Cape Girardeau, leaving St. Louis Friday, June 8, 1934, at 10:30 p. m., and returning to St. Louis Sunday, June 10, 1934, at 8:30 a. m.

MORNING SESSION

Meeting called to order at 9:45 a. m., Saturday, June 9, 1934, by Harry A. Treadwell, President.

Harry Treadwell: It is very much of a pleasure this morning to greet the members of this Institute, and it is very gratifying to find 113 at this meeting today that are actively interested in the coal business and the operation of the Institute.

As we have quite a little business and quite a long program, I believe we should get started on it. As the yearbook is out and the minutes are in it, we can dispense with the reading of the minutes. So we will now have the roll call by the Secretary and will ask everyone to stand up as his name is called.

ATTENDANCE

ILLINOIS MINING INSTITUTE SIXTEENTH ANNUAL BOAT TRIP

St. Louis, Down the Mississippi River, and Return
June 8-9-10, 1934

ADAMS, W. C. ---------------- Koppers-Rheolaveur Co., Pittsburgh, Pa.
ADAMSON, C. H. -------------- Stephen-Adamson Mfg. Co., Chicago, Ill.
BARLOW, J. E. -------------------- Goodman Mfg. Co., Springfield, Ill.
BARTLETT, A. G. -------------- Austin Powder Co., West Frankfort, Ill.
BASKIN, E. D. ---------------------- Upson-Walton Co., Chicago, Ill.
BELTZ, J. S. ---------------------- Jeffrey Mfg. Co., Columbus, Ohio
BENNER, DALE A. ----------- Aluminum Co. of America, St. Louis, Mo.
BERGFELD, R., JR. ------------------ Vacuum Oil Co., St. Louis, Mo.
BLAKE, ARTHUR --------------------- Peabody Coal Co., Marion, Ill.
BLANKINSHIP, G. F. ----------- Egyptian Iron Works, Murphysboro, Ill.
BREWSTER, BURT B. ------------------------- Webster Groves, Mo.
CARGAL, GORDON -------------------- Jeffrey Mfg. Co., Herrin, Ill.
CARTER, DALE -------------- Bell & Zoller Coal & Mining, Zeigler, Ill.
CHINN, ERWIN -------------- Franklin County Coal Co., Royalton, Ill.
CHRISTIANSON, C. ------------ Sullivan Machinery Co., Mt. Vernon, Ill.
CLARK, FRED K. ------------- Hulburt Oil & Grease Co., St. Louis, Mo.
COFFEY, E. J. --------------------- Binkley Coal Co., St. Louis, Mo.
COLCLESSER, R. Y. ------- E. I. duPont deNemours Co., Terre Haute, Ind.
COOK, WALTER ------- Central Mine Equipment Co., Webster Groves, Mo.
DAVIS, W. H. ---------------- Simplex Wire & Cable Co., Decatur, Ill.
DAWSON, HUGH -------------------- Bethlehem Steel Co., Herrin, Ill.

DAY, SAM ---------------------- Clarkson Coal Mining Co., Nashville, Ill.
DODD, A. F. ------------------------------- U. S. Fuel Co., Danville, Ill.
DOUGHERTY, JAMES -------- Bell & Zoller Coal & Mng. Co., Zeigler, Ill.
EDMUNDSON, RAY ------------------ United Mine Workers, Benton, Ill.
EVANS, JOHN H. ---------------------- Wasson Coal Co., Harrisburg, Ill.
FARNSWORTH, NAT -------------- West Virginia Coal Co., Gillespie, Ill.
FIRMIN, WALTER H. ---------------- Joyce-Watkins Co., Metropolis, Ill.
FLEMING, J. B. ---------------- Mine Safety Appliances Co., Urbana, Ill.
FOSTER, JOHN R. -------------- C. W. & F. Coal Co., West Frankfort, Ill.
GARCIA, JOHN A. --------------------- Allen & Garcia Co., Chicago, Ill.
GARWOOD, THOMAS ---------- C. W. & F. Coal Co., West Frankfort, Ill.
GIVEN, IVAN A. ------------------------- "Coal Age," New York, N. Y.
GRISSOM, J. FRANK ----------------- Aluminum Ore Co., Belleville, Ill.
HALBERSLEBEN, PAUL -------------- Sahara Coal Co., Harrisburg, Ill.
HALL, L. W. -------------------------- Goodman Mfg. Co., St. Louis, Mo.
HAMILTON, C. F. ---------------------- Pyramid Coal Co., Chicago, Ill.
HARTWELL, LEN ------------------ Pyramid Coal Co., Pinckneyville, Ill.
HARVEY, HADLEY -------------------- Ohio Brass Co., Evansville, Ind.
HELSON, JAMES R. ----------------------------------- Metropolis, Ill.
HERRINGTON, M. K. ------------ Dept. Mines & Minerals, Springfield, Ill.
JEFFERIS, J. A. -------------------- Ill. Term. Ry. System, St. Louis, Mo.
JOHNSON, E. H. ---------------------- Sullivan Mchy. Co., Chicago, Ill.
JONES, ARCH M. ------------- John A. Roebling's Sons Co., St. Louis, Mo.
JONES, JOHN E. --------------- Old Ben Coal Corp., West Frankfort, Ill.
JONES, WALTER M. ------------------------- Joy Mfg. Co., Franklin, Pa.
JOY, DEWEY ------------------------- Sullivan Mchy. Co., Chicago, Ill.
JOY, JOSEPH ------------------------ Sullivan Mchy. Co., Chicago, Ill.
KINSMAN, HENRY -------------- Franklin County Coal Co., Royalton, Ill.
KNOIZEN, A. S. ----------------------------- Joy Mfg. Co., Franklin, Pa.
LEIGHTON, M. M. ----------------- State Geological Survey, Urbana, Ill.
LEMING, ED -------------------------------- Union Colliery, Dowell, Ill.
LINDSAY, W. L. ---------------------------- Vacuum Oil Co., Benton, Ill.
LONG, JOSEPH A. ------------------ Jeffrey Mfg. Co., Terre Haute, Ind.
MacVEAN, GORDON --------- Mine Safety Appliances Co., Pittsburgh, Pa.
MALSBERGER, A. H. --------------- DuPont Powder Co., Springfield, Ill.
MARSH, I. D. ------------------------------ Alcoa Ore Co., Belleville, Ill.
MARTIN, ENOCH -------------- Dept. Mines & Minerals, Springfield, Ill.
MILLER, FRED -------------------- Franklin County Coal Co., Herrin, Ill.
MILLER, JAMES ------------------ Mines Equipment Co., St. Louis, Mo.
MILLHOUSE, JOHN G. ---------------------------------- Litchfield, Ill.
MITCHELL, D. R. -------------------- University of Illinois, Urbana, Ill.
McFADDEN, GEO. C. ------------------- Peabody Coal Co., Chicago, Ill.
McREAKEN, C. W. ----------------------- Peabody Coal Co., Marion, Ill.
NIEDRINGHAUS, RAY ------- A. Leschen & Sons Rope Co., St. Louis, Mo.
O'BRIEN, FRANK ------------------ American Cable Co., Harrisburg, Ill.
OEHM, KARL --------------------- Sahara Coal Company, Harrisburg, Ill.
O'ROURKE, JOHN ------------- C. W. & F. Coal Co., West Frankfort, Ill.
O'ROURKE, PETE ------------------ Wm. Hales Co., West Frankfort, Ill.

O'TOOLE, COL. E.	American Coal Cleaning Co., Welch, W. Va.
PFAHLER, F. S.	Superior Coal Co., Chicago, Ill.
PHILLIPS, E. R.	Tyson Roller Bearing Co., Massillon, Ohio
PICKARD, A. E.	Mt. Vernon Car Co., Mt. Vernon, Ill.
POWERS, F. A.	Dooley Bros., Peoria, Ill.
PRITCHARD, W.	Goodman Mfg. Co., St. Louis, Mo.
REUTER, WM.	Peabody Coal Co., Marion, Ill.
RHINE, FRANK	Duncan Foundry & Mch. Co., Alton, Ill.
RICHART, F. W.	General Electric Co., Carterville, Ill.
RODENBUSH, JOHN	C. W. & F. Coal Co., West Frankfort, Ill.
ROMAN, FRANK	Hercules Powder Co., Chicago, Ill.
SACKBAUER, L. A.	Missouri Pacific Ry., St. Louis, Mo.
SANDOE, C. J.	W. Va. Coal Co., St. Louis, Mo.
SCHONTHAL, B. E.	B. E. Schonthal & Co., Chicago, Ill.
SCHULL, B. H.	Binkley Mining Co., Clinton, Ind.
SCHULL, FRANK	Binkley Mining Co., Clinton, Ind.
SCHUMACHER, H. J.	Joyce-Watkins Co., Chicago, Ill.
SCOTT, G. W.	Timken Roller Bearing Co., St. Louis, Mo.
SCULLY, T. ALVIN	State Mine Inspector, Troy, Ill.
SHACKELFORD, N. P.	Friedman-Shelby Shoe Co., St. Louis, Mo.
SKINNER, S. E.	Standard Coal Co., Wheatland, Ind.
SMITH, C. M.	University of Illinois, Urbana, Ill.
SPICER, CHAS. B.	Hercules Powder Co., St. Louis, Mo.
STARKS, J. W.	Peabody Coal Co., Taylorville, Ill.
STEIGER, A. E.	Pyramid Coal Co., Pinckneyville, Ill.
STELLING, H. C.	Union Carbide Co., New York, N. Y.
SUTHERLAND, H. T.	Standard Oil Co., Marion, Ill.
SUTOR, DON M.	Sullivan Mchy. Co., St. Louis, Mo.
SYERS, JACOB	Western Powder Co., Peoria, Ill.
THIES, HENRY	Portable Lamp & Equipt. Co., Pittsburgh, Pa.
THOMPSON, J. I.	Koppers-Rheolaveur Co., Pittsburgh, Pa.
THOMPSON, ROBERT	Hercules Powder Co., Chicago, Ill.
TIRRE, FRANK	Better Business Bureau, St. Louis, Mo.
TOBIN, HOWARD	Coal Stripping Co., Pinckneyville, Ill.
TREADWELL, H. A.	C. W. & F. Coal Co., Benton, Ill.
VLASAK, JOSEPH	St. Louis & O'Fallon Coal Co., Caseyville, Ill.
WEART, EVERETT T.	John A. Roebling's Sons Co., Chicago, Ill.
WIEDERANDERS, E. O.	Jeffrey Mfg. Co., Springfield, Ill.
WILKEY, FRED S.	Ill. Coal Oper. Assn., Chicago, Ill.
WILSON, J. C.	Ohio Brass Co., Mansfield, Ohio
WOOSLEY, C. W.	Pyramid Coal Corp., Pinckneyville, Ill.
WRIGHT, D. D.	Cent. Ill. Pub. Serv. Co., Marion, Ill.
WYLAND, RAYMOND	American Coal Clng. Co., Welch, W. Va.
YOUNG, WM. P.	Crescent Mining Co., Peoria, Ill.

Harry Treadwell: Next we will have the report of the different committees and will hear first from Mr. Hamilton, Chairman of the Scholarship Committee.

(Mr. Hamilton reads paper giving report of Vocational Training Committee).

REPORT OF VOCATIONAL TRAINING COMMITTEE

Chicago, Illinois, June 5th, 1934.
Mr. Harry A. Treadwell, President, Illinois Mining Institute.

Members of the Institute.

Dear Sir and Gentlemen:

At the annual meeting of the Institute held at Springfield on November 3, 1933, a motion prevailed for the appointment of a Committee of five to inquire into and arrange for considering an appropriation for a scholarship in Mining Engineering at the University of Illinois. This Committee has had four meetings.

At the first meeting Mr. George F. Campbell was appointed as a Sub-Committee to contact and secure all possible information regarding the establishment of scholarship at the University of Illinois. The result of his efforts is given in the following communications:

"Dr. Arthur H. Daniels, Acting President, University of Illinois, Urbana, Illinois.

Dear Dr. Daniels:

I have just been advised by one of the executives of the Illinois Mining Institute that they want to establish a scholarship at the University of a value not to exceed $500 per annum.

Their plan, I think, is to create a trust fund, the income from which will provide the necessary funds. They want to do this in connection with our School of Mining Engineering at the University. I think they will want to make the deposit with us in trust, to be operated by the University in accordance with their plans. I told them I would get them the full details with regard to it.

While I did not discuss that detail, I imagine they will want to deposit with us enough gilt-edge securities to provide the fund, same to be administered by us.

What would be the cost and method of administration of a fellowship in mining engineering instead of a scholarship?

Very truly yours,
(Signed) WALTER W. WILLIAMS."

"Hon. Walter W. Williams, Benton, Illinois.

Dear Mr. Williams:

This is in reply to your letter of May 4, concerning the plan of the Illinois Mining Institute to establish a scholarship at the University of Illinois of a value not to exceed $500.00 per annum.

Scholarships are usually awarded for distinction or achievement in scholarship and ordinarily do not carry with them any obligation to render service. Fellowships are frequently awarded to persons who are expected in return to do research work in a certain field. Sometimes they are called research fellowships or research assistantships. We prefer to call such positions research assistantships when the funds are supplied to further research work.

The University has not made any charge against trust funds established for scholarships and fellowships, so that there would not be any cost in administering the proposed Illinois Mining Institute's trust. You also ask what would be the method of administration. It is customary to leave the selection of the recipients of such awards to the University.

The department in which the research work is done makes nominations to such fellowships or research assistantships in the same way as it recommends persons for appointment to the staff. If the Illinois Mining Institute will indicate in general terms the purposes for which it wishes to endow a fellowship we shall be glad to supply its officers with any further information they desire. Perhaps the following statute of the Board of Trustees should be called to the attention of the Institute:

Merging of Gift Funds

Every donation to the University in a sum of $5,000 or less, for the purpose of providing a fund, the annual income of which shall be used for a purpose designated by the donor, if accepted, shall be accepted with the condition and proviso that the capital sum of the fund thus established may, after the lapse of twenty-five years, be merged with other capital funds given to the University for similar purposes.

When any donation or donations to the University are thus merged, the record of the consolidated fund shall indicate the names or titles of the smaller funds so consolidated.

Since the Institute wishes to provide an income of $500.00 per annum I assume that the above provision will not apply to its trust fund since an income of $500 per year would require an endowment of at least $10,000.

If I have not covered all of the questions you had in mind, please let me know and I shall be glad to give you any additional information you may desire.

Cordially yours,

(Signed) ARTHUR H. DANIELS,
Acting President."

At the next meeting the Committee decided that the Institute at this time did not have sufficient funds to establish either a scholarship or fellowship at the University, and further that the establishment of either a scholarship or fellowship was a matter for more extensive study and consideration.

It then gave consideration to either a Safety Contest in the state, or an Essay Contest on SAFETY by the school children of the state. The latter idea seemed to prevail and the following data was secured from the National Safety Council.

The National Safety Council will conduct, on behalf of the Illinois Mining Institute, an Essay Contest for a sum not to exceed $100.00. In explanation, we wish to add that the National Safety Council is an association operating without profit and is only charging the actual out-of-pocket expense, plus an estimated amount for the services of its organization, which will be used in this work.

The committee, therefore, recommends that the Institute appropriate the sum of $350.00 for use in an Essay Contest for the year 1934, to be conducted by the National Safety Council on behalf of the Illinois Mining Institute under the following general plan:

1. Subject: Why should coal miners be interested in Safety?

2. No Essay shall exceed 500 words.

3. Eligible pupils of the Fifth, Sixth, Seventh and Eighth Grades, who are fourteen years of age or less, and who attend schools within the State of Illinois and within the counties and districts in which coal is mined are eligible to compete in this contest.

4. Closing of Essays should be submitted to School Principals on or before October 20, 1934.

5. Originality of thought, clearness of expression, and truthfulness of facts will be considered in making awards.

6. Prizes:

a. Best essay in the state, $25.00.

b. Second best essay in the state, $15.00.

c. Third best essay in the state, $10.00.

d. Each of the ten next best essays in the state, $5.00 each.

e. Best essay in each district (approx. 20 dist.), $4.00 each.

f. Second best essay in each district (approx. 20 dist.), $2.00 each.

7. No pupil will be eligible for more than one prize.

8. Selection: No more than four essays will be submitted to the National Safety Council from any one school. It is suggested that each school select one essay from each of the four grades (5th, 6th, 7th and 8th).

9. The four best essays from each school shall be selected by the School Principal, or in some manner designated by him or her.

10. Contest Judges: The judges in this contest shall be the President of the National Safety Council, the President of the Illinois Mining Institute, and the Director of the Department of Mines and Minerals, State of Illinois.

Your Committee further recommends that a new committee of three be appointed to cooperate with the National Safety Council in arranging further details for this contest, and that another committee of three be appointed to further investigate the question of scholarship or fellowships at the University of Illinois.

Respectfully submitted,
GEORGE F. CAMPBELL.
J. M. JOHNSTON.
L. D. SMITH.
H. H. TAYLOR, Jr.
C. F. HAMILTON, Chairman.

Harry Treadwell: You have heard the report of the committee. Are there any comments on it?

E. H. Johnson: Do I understand that it is not possible for the Institute to contribute any help to some chap whom they might wish to aid?

C. F. Hamilton: Yes, that is the situation as it now stands. We thought we could try this essay contest and at the end of the contest the committee could make what other recommendations they wanted.

E. H. Johnson: I think the essay contest is a good idea, but would it not be possible to figure out some way so that we could help out some fellow whom we think deserving?

C. F. Hamilton: It would be possible to do that, but I think the Institute is taking a chance in establishing this scholarship. The one we select may decide he does not want to finish his education. And if the boy does go through his college work he may want to change to something else. It would seem that if the Institute were to establish this scholarship they should have the directorship of the class of work to be taken. We all thought we should have more time to study the whole problem.

D. R. Mitchell: I think the committee has done the right thing in taking more time to think this over. I do believe that President Daniels may have got the wrong slant on just what was wanted. In fact the students who are working their way through school, if they can get enough for their fees, are the ones we want to help. But there are a great number of angles to this thing, and I believe the committee did right by taking more time in thinking it over. We get but very few boys from the mining regions who follow or want to enter into mining work, and I think the type of man to be selected for work of this kind should be given much thought.

(Motion made and seconded that the recommendations of the committee be accepted. Motion carried unanimously.)

Harry Treadwell: As Mr. Thomas, Chairman of Appropriation for Mineral Industry Research Committee, is not with us, will ask Dr. Leighton to give us some idea of what has been done along this line.

Dr. M. M. Leighton: You will remember that last Fall your attention was called to the fact that the Mineral Industry Research that was being carried on at the University of Illinois was handicapped because of lack of funds and the idea of providing for Mineral Industry Research was brought out at this last meeting. A part of the research work has been carried on in several ways in temporary laboratories at the University for the last two and one-half years.

The matter was also called to your attention at our last session in Springfield last Fall, that these laboratories are very poorly housed, and a committee was appointed to look into this to see what could be done; the thought being that this planning would not in any way displace the work already started, but rather add to it.

T. J. Thomas, Geo. N. Reed and Geo. B. Harrington went into this matter very carefully, and they pointed out that this was a very worthy cause. They were shown, however, where some 30% of the cost of such an appropriation could be borne by the Federal Government, but to take advantage of this, it would be necessary for the State of Illinois to deposit with the Federal Government bonds to cover the 30% to be advanced by the Federal Government, but the State of Illinois does not have any bonds to deposit, and consequently we would be unable to take advantage of this opportunity.

A report of a measure to provide for this work was made to the legislature, but nothing came of it. Mr. Thomas has been very active in this work, and the committee has done a lot of work to be sure that the measure would be the kind that the industry could find to be of the most value. So looking forward toward having a measure of this kind passed, a committee from the Operator's Association is co-operating with the Institute Committee together with the State Geological Survey to present a consolidated report on this measure.

Harry Treadwell: We will now have a report from the Membership Committee. As Mr. Herb Taylor is not on the boat, will ask our Secretary, Mr. Schonthal, to give this report.

B. E. Schonthal: We have had a very active, successful membership committee this year. We have secured 132 new members, and have also secured about 12 or 15 on this boat trip. We had 470 members up to this morning, and we will probably have about 485 members when this trip is over, as there are several on this trip who are not members, and we are going to sign them up.

Harry Treadwell: I will now turn the chair over to Mr. Hamilton, who will act as your Chairman for the morning session.

C. F. Hamilton: I am advised that the Program Committee has deemed it advisable and necessary to make a change in the program. Therefore the first paper we will have this morning will be "How Can Labor be Made to Realize Its Responsibilities for Prevention of Accidents?" by W. J. Jenkins. As Mr. Jenkins is not with us will ask Mr. Fred Wilkey to read his paper. The paper by Mr. Jones will be presented a little later in the morning session.

HOW CAN LABOR BE MADE TO REALIZE ITS RESPONSIBILITIES FOR PREVENTION OF ACCIDENTS?

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

Mr. Chairman and Members of the Illinois Mining Institute: The subject assigned to me by your Program Committee is "How Can Labor Be Made to Realize Its Responsibility for Prevention of Accidents?"

When we are able to "get over" to our employees as a whole the acceptance of the truth, as expressed in a recent National Safety Council Poster, reading,

"It Takes Only a Few Minutes to
Get to the Hospital but a
Long Time to Come Back"

we will have gone a long way toward supplying the answer in connection with the subject under discussion. However, labor—including in some instances members of the supervisory staff—will ultimately recognize the truth set out in the poster just referred to.

When labor recognizes the fact and takes it seriously, that their individual happiness, as well as the welfare of their fellow employees is at stake, we may then anticipate another step forward toward the minimizing of causes, as well as a lowering numerically of the number of accidents whether or not they be of a serious nature.

"Familiarity with danger breeds contempt." This saying is peculiarly applicable to those engaged in operating coal mines, and only intelligent daily direction of the working force by our supervisory staff can bring about the acceptance of this truth.

It is surprising to learn how many of our employees accept as inevitable the superstition, "That major accidents occur in cycles of 3s." Should one be so unfortunate as to experience a major accident, the management should "tighten up" and insist upon an immediate strict observance and compliance with all Safety Rules and Practices to "stamp out" this and any other superstitious idea.

In connection with our own company—First Aid work has been accepted by our employes generally as having a bearing on their own individual welfare. When the thought that it should extend over and include a fellow worker, is likewise accepted, we shall, and not until then approach the time when labor will not only recognize but will acept their individual responsibility in connection with prevention of accidents.

The responsibility rests upon the employer to determine accurately and impartially:

1st. Cause of accident.

2nd. Was it possible to prevent it through means of proper uses of materials to be supplied?

3rd. Was the employee qualified for the particular job? I mean mentally as well as physically.

4th. Was it due to non-observance of "Safety Rules"? Was the injured employee cognizant of such rules?

So far as our own company is concerned a copy of each accident reaches me direct. The three questions just mentioned are applied, for the purpose of determining whether the accident is due to the lack of Safety Rules or to negligence on the part of anyone of our supervisors, having always in view the avoidance of repetitions under similar circumstances.

An analysis of our accident record January 1, 1927, to date, shows:

Southern Illinois Mine No. 7 produced 2,113,612 tons.

Central Illinois Mine No. 15 produced 5,204,862 tons.

Number of Fatal Accidents at Herrin No. 7 4

Number of Fatal Accidents at Mt. Olive No. 15 8

Surface Employees

— Mechanic —	Herrin	Mt. Olive
Bursting Throttle Valve on Hoisting Engine	1	

Had the principles as outlined in the earlier part of this paper been in practice all underground fatal accidents might possibly have been avoided. The surface fatal I look upon as unavoidable.

Fatal Accidents Underground Employees

	Herrin	Mt. Olive
Fall of Top Coal ...	1	
Fall of Face Coal ..	-	2
Fall of Slate	-	4
Total	1	6
Occupations—		
Certificated Miners Making Places Safe, Mech. Ldg.	1	3
Certificated Miners, Hand Ldg.	-	1
Cutting Mach. Oper.	-	1
Cut. Mach. Helper .	-	1
Total	1	6
Other Inside Fatal Accidents—		
Trip Rider	1	-
Timbering Shaft Bottom	1	-
Main Line Road Cleaner	-	1
Bottom Battery Charger	-	1
Total	2	2
Total All Fatal .	4	8

Lost Time on Non-Fatal Accidents

During the 7¼ years in question our analysis develops the fact that there was a total loss in

Southern Illinois (Herrin Mine No. 7) of 6,806 Mine Days.

Central Illinois (Mt. Olive Mine No. 15) of 39,131 Mine Days.

A further analysis shows that the "Lost Time" includes:

Night Forces at Herrin ..	142 Days
At Mt. Olive	421 Days
Top Crews at Herrin	389 Days
At Mt. Olive	1,581 Days
Miscellaneous at Herrin ..	707 Days
At Mt. Olive	8,292 Days

There was produced for each "Mine Day" loss:

At Herrin Mine ---------- 310 Tons
At Mt. Olive Mine ------- 133 Tons

Contrary to the earlier views of many, the introduction of mechanical loading devices resulted in a larger volume of mined tonnage per compensable accident as compared to Hand-Loading methods.

The result following which takes into consideration Cutting, Drilling, Shooting, Loading, Timbering, Track-Laying and in fact, all labor including repairs to Drilling, Loading and Cutting Machines, the transportation of the coal between the face and the parting, and representing as it does 75% of those employed underground on a work day, proves conclusively that the introduction of mechanical devices has actually reduced the hazard to all such classified workers.

Tonnage Produced Per Compensable Accident

Face to Parting at Mt. Olive No. 15 Mine

All Hand Loading, year 1927 --------------5,252 Tons
Hand Loading and Some Conveyor Loading, year 1928 --------------5,685 Tons

Mine equipped with Mechanical Loading as of November, 1929.

	Tons
Mechanical Loading 100%, Year 1930	10,600
Mechanical Loading 100%, Year 1931	17,064
Mechanical Loading 100%, Year 1932	19,790
Mechanical Loading 100%, Year 1933	14,931
Mechanical Loading 100%, First Quarter 1934	16,815

Face to Parting at Herrin No. 7 Mine

This mine, which was equipped with Mechanical Loaders during the year 1931, produces 90% of the tonnage, and Loading 10%.

	Comparisons		Average
Year 1931	Mech. Ldg. 12,514 Tons	Hand Ldg. 6,768 Tons	10,909 Tons
Year 1932	Mech. Ldg. 25,811 Tons	Hand Ldg. 7,755 Tons	21,514 Tons
Year 1933	Mech. Ldg. 20,976 Tons	Hand Ldg. 4,745 Tons	16,425 Tons
1st 5 Months 1934	Mech. Ldg. 24,744 Tons (100% Clear Record; No Accidents)	Hand Ldg. 17,147 Tons	27,193 Tons

A very commendable spirit of cooperation exists among many of our employees on the safety problem and to this we largely credit the reduced number of major or so-called Compensable Accidents.

C. F. Hamilton: Mr. Leming has prepared some interesting data on safety, which I will now ask him to give.

SAFETY SAVINGS CONTEST

By ED LEMING
Supt., Union Colliery Co., Dowell, Ill.

After being idle over two years the mine started operation in May, 1929. Many of the men who started to work had been unemployed during these two years, some were new employees and all were in positions and circumstances similar to new employees. Without any other apparent cause the cost of accidents was much too high, costing 6c per ton for 1929.

Not only was the cost of accidents high but due to the nature of the accidents the records looked very bad. Several fatal accidents and broken limbs were accounted for in this period immediately after resuming operations.

The officials were looking for some new means of curbing the appalling major accidents and also to reduce the cost due to these. The usual methods of accident prevention were not getting results. It was at this time that the Safety Savings Contests were started.

The mine is entirely on a mechanical loading basis and each section has either one or two loading machines with a foreman for the section. This allowed the men to be divided into groups very easily and each group with its foreman was designated as a team in the contest. These loading crews made eleven teams. In addition to these, a team was composed of mechanics and the Chief Electrician. Another team was composed of the Motor Boss and his main line men. Another team was made up of the Night Boss and his men. Two more teams were made up on top. A total of eighteen teams was entered in the contests.

It was figured that 5c per ton was a standard cost for all expenses in connection with the prevention of accidents and the care and treatment of injured men. Hence it was proposed that if accidents could be reduced to a point that the cost would be less than 5c per ton the company would split the savings 50-50 with the men and foremen of the winning teams, that is, the teams having the fewest man days lost due to injuries over the three month period. Rules of the contest were drawn up, a committee appointed to arbitrate points of dispute and the first contest was started Oct. 1, 1930.

The first contest was ended with a cost of accidents of 2.9c per ton, making a savings of $6789.14 Half of this amount, or $3394.57, was distributed to 127 men and 5 foremen. The foremen received 15% of the total which amounted to $100.00 each, and the men $22.78 each.

To date seven contests have been conducted, each for a three month period. The success of the first contest has not been obtained in every succeeding period but the results as a whole are very gratifying. Rules have been changed and new ones made, but the general plan has been followed in every contest. One of the main changes that has been made has been to make the rules more strict on time lost and now calculations are made on a basis of man hours instead of man days. When the contests started it was figured the winning team would be the team w th the fewest man days lost and a second, third and fourth team could be picked according to the number of man days lost and awards made on that basis. It is however, a matter of record that no team has shared in any of the money in any of the seven contests which has had any lost time charged against it. There have been as many as ten teams to go through the three month period without any compensable injury or any lost time due to injuries. As many as 365 men have shared in one contest. This alone shows the success of the plan.

After the sixth contest the mine was shut down for about 4½ months and when work was resumed the contests were not started and during this period from August, 1932, to December 31, 1933 the cost of accidents was 5½c per ton.

The seventh contest was started January 1, 1934, and for the three months from January 1 to April 1 of this year the cost of accidents was .024c, leaving $6,271.94 saved. Half of this, or $3,135.97, was divided among the men and foremen. From the point of cost of injuries this contest just ended was the most successful and the management is still sold on the principle of paying the men to take care of themselves and their fellow workmen.

Here are the results of each contest:

Contest	Date	Number of Foremen	Amount to Each Foreman	Number of Men	Amount to Each Man	Total	Tonnage	Cost of Accidents
1st	Oct. 1 to Dec. 31, 1930	5	$100.00	127	$22.78	$3,394.57	324,011	$.029
2nd	Jan. 1 to Mar. 31, 1931	5	105.73	118	23.99	3,524.77	325,357	.028
3rd	Apr. 1 to June 31, 1931	4	25.00	137	5.00	785.00	255,303	.044
4th	July 1 to Sept. 31, 1931	6	25.00	253	4.70	1,340.58	269,625	.040
5th	Oct. 1 to Dec. 31, 1931	8	5.00	357	1.47	415.50	201,278	.046
6th	Jan. 1 to Mar. 31, 1932	10	10.00	318	2.91	1,027.58	145,103	.036
Idle March 31 to Aug. 11, 1932								
No Contest from Aug. 11, 1932, to Dec. 31, 1933, accidents cost .055c per ton								
7th	Jan. 1 to Apr. 1, 1934	8	58.80	288	9.26	3,135.97	246,727	.024

Total amount distributed to men and foremen during 21 months of operation of the seven contests, $13,623.97.

C. F. Hamilton: You have all heard the papers, and I think we should have some discussion on them. Will ask Mr. Martin to say a few words.

Enoch Martin: It is not my desire to take part in the discussion, for the reason I have just joined this Association, and I would rather just listen.

C. W. McReaken: As a matter of information, I would like to ask Mr. Leming how he figures his partial and total disability cases on a three months period?

Ed Leming: We have our doctors make an estimate on those injuries and try to make it high enough to take care of everything and so far our estimates have always come out very well.

Our tonnage has increased right along since we started this, and you would be surprised at the interest an employee of one team shows in the safety of another employee of his own team.

At first we figured the foreman should get 15% of the saving, but at this time we are thinking of cutting the foreman's part down to 10%.

All of our men have had some first aid training and about 75% of them have finished the course.

John Millhouse: When I came on this boat trip I thought I would just listen. But when you start talking about safety in mines and accident prevention, I find it too hard just to listen.

I believe that everyone here is very much interested in preventing accidents. I believe one of the primary interests of our Institute is to aid in the prevention of accidents. But we are not getting the results we ought to. And my observation and experience has taught me this: that unless you can sell the operators on accident prevention you will not get very far. Some of our companies have taken this thought in mind and followed it out, both as a humanitarian and as a business proposition.

However, I believe there is one angle to this proposition that we are all forgetting, and that is the attitude toward life of the worker. There is a desire in the heart of every man to feel secure. And if the workers were guaranteed economic security I am sure our accidents would be materially reduced. For a man who is deprived of his work to such an extent that he can not adequately provide for himself and family soon loses interest in life, even to the point of leaving this world before he ought to.

You heard a very interesting discussion by Mr. Leming, which gives some of his experience in accident prevention, and shows you are going to have to pay men to keep themselves safe. Paying men to work safely is something new. Why should a man be paid for taking care of his life and limb? But somehow you must do this. But a man should have something to look forward to in the future. Many men in our mining industry today have raised large families, and their attitude toward life cannot tend to help the cause of safety under stressed economic conditions. You men have probably read the answer to this made by our great President. He struck at the root of all things—"Security." What security have you got? I may be wrong, but I hope I am not. I believe if the mine operators and men would think more of this than wages and bargaining, the whole industry would be better off.

C. F. Hamilton: Between the State and National government it seems that we have had an open season on making laws or changing laws. Very appropriately your Program Committee has had a paper prepared upon the history of law making in relation to explosion hazards, by Mr. John E. Jones.

CAUSES AND PREVENTION OF MINE EXPLOSIONS — A REVIEW

By JOHN E. JONES
Safety Engineer, Old Ben Coal Corporation, West Frankfort, Ill.

This address was given before the Mine Inspectors Institute of America, Pittsburgh, Penn., May, 1933, and the Illinois Mining Institute Boat Trip June, 1934.

Experience is a stern and relentless teacher. She does not quibble concerning the answers to her problems. Her students profit when their answers are correct. Fortunately, we can to a great extent copy the lessons and answers from one another. She is more stern, more cruel, in some of her subjects than in others, there being less margin of safety between correct and incorrect answers. Among such of her subjects is that of mine explosions. She has manifested no patience, applying the same punishments decade after decade for the lessons not learned, or not applied.

This following brief but general review of causes and prevention rightfully begins with the first recorded events. It deals with the causes as given and the slow evolution of preventive measures. We have now had more than three centuries of experience and the lessons have been fairly well learned. Their application commensurate with the rapid growth of a century of industry in our nation has not been so thorough.

America's knowledge in coal mining, when the industry began, had a background of two centuries of European experience. The earliest recorded hazards show these to be chiefly water and choke-damp, the fire-damp hazard being encountered with more extensive and deeper penetration for coal.

The first record in Great Britain of accident occasioned by fire-damp is found in the registry of St. Mary's Church, Gateshead, under the date of 14th of October, 1621, where is recorded the interment of "Richard Backas burn'd in a pit." This is found with other records pertaining to pit accidents. The same author quotes in part from The Compleat Collier of 1681, " . . . . by his ignorance he may be burnt to death by the surfet (fire-damp), which is another dangerous sort of bad air, but of a firey nature like lightning, which blasts and tears all before it, if it takes hold of the candle, while an experienced laborer will discover and extinguish though it be going to take at his candle, and can sometimes smell to be dangerous or hurtful; therefore all sinkers should be skilled in these matters for their own security sake, as also for the benefit of

NOTE—Much of the material in this paper has been taken from:
"Annals of Coal Mining and the Coal Trade," Galloway.
"Historical Review of Coal Mining," Mining Association of Great Britain.
The Colliery Year Book of Great Britain.
U. S. Bureau of Mines Annual Fatality Bulletins.
"History of the Coal Mines of the United States," Roy.
Bureau of Labor Statistics of Illinois.
History of the Explosives Industry in America.

the master of the colliery. For if 1,000 pounds, or more, be spent in carrying down a pit or shaft, almost to the coal expected, and then by an ignorant man should be blasted by a strong blast, by surfet, so that it may (as has been known) tear up your timber work and shatter the gins, and take the stone work and frame work, so as to let in feeders of water, besides the destruction of the persons in the shaft, this would be a dismal accident with a witness." The foregoing is the first recorded cause and proposed prevention the writer has found.

In Derbyshire, as in a number of other parts of the kingdom, explosions of fire-damp began to become alarmingly violent about 1665-70. An account of various kinds of damps with which mines are infested, with remarks regarding them, from the pen of Mr. Jessop, of Broomhall, Yorkshire, was communicated to the Royal Society, in two parts and published in the Philosophical Transactions. After writing upon three damps, he continues "The fourth which they call a damp, is that vapor, which being touched by their candle presently takes fire, and giving a crack like a gun produceth the like effects, or rather those of ligthning." It is from Mr. Jellop's writings that we learn, " . . . fire was known to be a present remedy, if by means of it a circulation of air could be produced through the infected place." Evidently stoppings were used prior to this time.

As it became necessary to work deeper seams, and as ventilation from the "fire lamp" developed, the collieries increased in size and more work people employed thus exposing more lives at a time to the risk of accident. Fire had been employed prior to this time to ventilate coal mines in Belgium. Dr. Plot in writing about the removal of choke-damp wrote in 1675, " . . . but chiefly by fire, which they let down in an iron cradle they called their lamp."

An early report given by Mr. J. Beaumont to the Royal Society in 1681 upon explosion prevention is, "Many men of late years have been killed, many others maimed and burnt; some have been blown up at the work's mouth." To combat the fire-damp the miners endeavored to "keep their air very quick" and made use of very thin candles.

In the removal of gas an early method was "beating out the gas" as with a coat. This was used very early to remove choke-damp. However, it was a secondary method to that termed the "ordinary" way. This method of gas removal was by firing. There are many records of its use but the earliest account of this primitive system is in a paper prepared in 1675 for the Royal Society by Mr. Roger Mostyn. A new shaft was sunk and as the coal excavation progressed and there was scarcity of air the fire-damp began to "breed." At first the workmen toyed with it with their lighted candles, until one morning "the first collier that went down, going forward in the witchet with his candle in his hand, the damp presently darted out violently at his candle that it struck the man clear down, singed all his hair and clothes, and disabled him from work hereafter." The colliers then would select one from their group, more resolute than the rest, to go down and ignite the gas. Clothing himself with the worst rags he had, saturated with water, this "fireman" crawled forward holding a long pole before him with one or more lighted candles at its end. Should flame result the fireman would lie flat on the floor.

Upon completing his rounds the other workmen would enter. In one mine, at least, the gas was fired three times per day.

Reference has been made to the fact of the first accident on record occasioned by fire-damp having taken place in a pit at Gateshead in the early part of the Seventeenth Century. Here also it was that the first great colliery explosion, involving the loss of a considerable number of lives, occurred nearly a century later. This happened about the 3rd or 4th of October, 1705, over thirty individuals perishing by the blast. From the burial record of St. Mary's Church, Gateshead, is found the list of the dead under the dates (evidently) that the bodies were recovered. The list is headed by the remark, "These were slain in a coal pitt in the Stony Flatt, which did fire."

Three years later, 18th of August, 1708, at Hatfield there occurred the sudden eruption of violent fire discharging itself at the mouth of three pits, with as great a noise as the firing of cannon, or the loudest claps of thunder, and sixty-nine persons were instantly destroyed. Three of them, viz., two men and a woman, were blown quite from the bottom of the shaft, 342 feet deep into the air, and carried to a considerable distance from the mouth of the pit. After explaining the effects of stith (choke-damp) and sulphur (fire-damp) the narrator proceeds to say:

"To prevent both these inconveniences, as the only remedy known here, the viewer of the works takes the best care he can to preserve a free current of air through all the works, and as the air goes down one pit it should ascend another. But it happened in this colliery, there was a pit which stood in an eddy, where the air had not always a free passage, and which in hot and sultry weather was very much subject to sulphur; and it being then the middle of August, and some danger apprehended from the closeness and heat of the season, the men were with the greatest care and caution withdrawn from their work in that pit and turned into another; but an overman, some days after this change, and upon some notion of his own, being induced, as is supposed, by a fresh, cool, frosty breeze of wind, which blew that unlucky morning, and which always clears the works of all sulphur, had gone too near this pit, and had met the sulphur just as it was purging and dispersing itself, upon which the sulphur immediately took fire by his candle, which proved the destruction of himself and so many men, and caused the greatest fire ever known in these parts."

From the above account it is obvious that the Hatfield pits were at this date (1708) still dependent upon such circulation of air as could be obtained from natural ventilation.

As the coal industry developed in the early part of the 18th Century explosions became more frequent and more terrific. Fire setting, fire lamp and candles were the chief causes of ignition. More attention was given to ventilation and in about 1765 the improved method from Cumberland of "coursing the air" was begun in the north of England. Hitherto it had been deemed sufficient to cause the ventilating current merely to sweep round the points where the miners were at work getting coal—an arrangement known as "face airing" to the neglect of the waste. The too frequent explosions forced the adoption of the practice to ventilate the entire mine. Wallis, writing in 1769, remarks that "against this vapour, or damp, a large iron lamp full of coal is kept continually burning in the mine." A century earlier, at Liege, a chimney or tube above one of the openings was known. At the early part of the 18th Century in England the ventilating fire was sometimes placed at the surface in connection with the tube. The steam ventilator, the hot cylinder and the air pump were tried in fiery mines at about this period. Considerable light was shed on the principles of ventilation by M. Jars who appears to be one of the first to make a scientific inquiry into the phenomena connected therewith and who left an account of the results of his investigations in a memoir written in 1764. He had frequently inquired why it was customary to build tall chimneys on the surface to promote a circulation of air in mines but failing to obtain a satisfactory explanation, set about examining into the matter himself, arriving at the conclusions now so well understood by mining students. The great discovery of the pressure of the atmosphere had been applied by men of science prior to 1662.

It is natural that the illumination in coal mines would, at first, be similar to that used in dwellings. Examples of lamps in bronze and terracotta have been left by the Romans. In England, candles replaced the lamps. A knowledge of fire-damp naturally led to attempts at safer illumination than by open lights. Workings very close to the surface were in a limited way illuminated by reflecting mirrors. Attempts also were made to use the light from phosphorescent materials, such as fungus tinder, or partly putrescent fish. The use of the latter was chiefly in rescue work.

The steel mill was introduced in this early period. They were first used at Hatfield Colliery on the Wear, after an explosion which occurred in 1763; having been brought from Whitehaven, where they had been invented shortly before by the ingenious Mr. Spedding. The first reference to it is in 1753. In this machine a thin disc of steel, five or six inches in diameter, was made to rotate (by handle and gears) with great velocity against a piece of flint. A continuous flow of brilliant sparks was emitted which afforded a glimmery light for five or six miners. It was at first regarded as being safe but was soon found not to be absolutely so. The sparks gave indications of the presence of inflammable gas by increase in size and luminosity. On approaching the firing point they gave off a bluish light, and when in excess of the explosive limit the sparks were of a blood red color.

We thus find in the infancy of coal mining the very causes, viz., accumulation or sudden liberation of fire-damp, atmospheric changes, open lights and sparks, which we have today and also two of the fundamental preventions, attempts at ventilation and safe illumination.

From the end of this 200 year period of infancy, 1800, for the next 125 years is a period of growth in coal mining that is one of the greatest factors, if not the greatest towards our present industrial development. Virtually it set the wheels of industrial progress turning. More scientific and political thought has been given to prevent explosions than any other mining hazard. Many improvements resulted because of professional men, unconnected with the industry, taking interest. The 19th Century begins with the soundest suggestion that was offered at this time (1805) by an anonymous writer who styled himself "A friend to rational schemes of improvement." He was the inventor of "splitting the air." This was probably Mr. Buddle, the greatest mining magnate of that time.

Greatly improved ventilation conditions were now possible with this new method. By 1850 furnace ventilation was improved to give larger air volumes and the hazard of explosive gases passing over furnace fires was reduced. Volume of air passing per minute in at least one mine was increased from 5,000 cu. ft. per minute in 1835 to 121,360 cu. ft. per minute in 1850. At one colliery in 1850 the volume amounted to 190,000 cu. ft. per minute induced by three underground furnaces. Another colliery records 96,300 cu. ft. per minute in 1835. But explosions also increased. Galloway states that during the period 1835-50 no less than 643 explosions took place in the coal mines of Great Britain (an average of over 40 a year) and that the following facts were definitely established:

(1) That as a rule explosions were of most frequent occurrence in the early part of the week.

(2) That they were caused for the most part by accumulation of fire-damp taking place during periods of cessation of work, when the ventilation of the mines was in a more or less stagnant condition.

(3) That the ignition of the fire-damp was brought about in the majority of cases by the persistent use of naked lights in fiery mines.

In this same period mechanical ventilators had their inception; 1807—exhaust air pump at Hebbum Colliery; 1827—horizontal fan at colliery in Scotland; 1849—Brunton fan at Gelly Gaer Colliery, Glamorganshire. The Brunton fan is the first centrifugal fan. By 1850 furnace ventilators had almost entirely been replaced by mechanical ventilators on the continent. In Great Britain, however, furnace ventilation up to this time was considered the more reliable. Mr. Guibal's (of Belgium) invention of the spiral casing, shutter and evase chimney at about the same time made possible the use of the centrifugal fan, from that time to the present the standard ventilating unit.

It was during the first half of the 19th century that safe lighting of mines was given much important consideration. An explosion in 1812 at the Felling Colliery in which 92 miners were killed was an important stimulus. From 1813 to 1816 was a three year period in which the Clanny, Stevenson and Davy lamps were invented. The controversy is well known to all mining students. None of these lamps were patented. The reason is contained in Sir Humphrey Davy's reply to a query upon this question—"No, my good friend. I never thought of such a thing; my sole object was to serve the cause of humanity, and, if I have succeeded, I am amply rewarded in the gratifying reflection of having done so."

There evidently was opposition to the safety lamps as is shown in the following two extracts. In one the pitmen of the Tyne and Wear published in a pamphlet in 1825 the following statement: "Sir Humphrey Davy's invention of the safety lamp has been an advantage to the coal owners, but a great injury to the comforts and earnings of the pitmen, for while the former remain indifferent about the safety of the mine, and neglect to force the atmospheric air to the inner part of the pit, on account of the great power of the safety lamps to resist combustion or explosion, the poor miner has to suffer the most awful agony in an exceedingly high temperature, inimical to the health, comfort and even life." In the other is an extract from a Great Britain—Select Committee on Accidents in Coal Mines—which in 1835 expressed the opinion on the merits of the Davy Safety Lamp "that ignorance and a false reliance in cases attended with unwarrantable risk, have led to disastrous consequences." The committee, however, recommended a more extended use of safety lamps.

Legislation for mine safety was slow to start. This was largely due to the miners of that early age having developed into a race isolated from the rest of the people. They developed into an inferior people, such ignorance prevailing as to present no thought or hope for assistance from society. The explosions and terrific loss of life, however, had attracted outside attention and in 1813 there was formed the Sunderland Society. Sir Ralph Millbank was president of the Society. This organization secured the services of Sir Humphrey Davy. So momentous was the discovery of his safety lamp considered, the Sunderland Society dissolved itself on the ground the object of its formation had been achieved. A similar expression was given in January, 1816, by Mr. Buddle, one of the committee to test the Davy lamp, in the statement, "To my astonishment and delight, it is impossible for me to express my feelings at the time when I first suspended the lamp in the mine, and saw it red hot; if it had been a monster destroyed, I could not have felt more exulted than I did. I said to those around me, 'We have at last subdued the monster.' "

The series of accidents in 1837 and 1838 caused interest again to be aroused from the outside. In consequence of an explosion at the Hilda Colliery at South Shields in 1838 in which 51 miners were killed, the South Shields Committee formed and set themselves to investigate coal mine hazards. Mr. Thomas Mather was president of this committee. Their report, containing the results of three years' work, was indeed thorough. It dwelt strongly upon registration of plans, inspection, and prohibition of women and child labor. Part of this became a law in 1842.

In 1845, again in consequence of a series of accidents, two commissioners were appointed, this time by the government, to inquire into the dangers from noxious gases in the mines and to advise on the means of preventing the evils caused thereby. The movement was fostered by Lord Ashley. Their report, promptly embodied in a bill to the House of Commons contained an elaborate inspectional system resembling that which exists today. But the time was not yet ripe and the bill was dropped, as was another proposed for the prohibition of naked lights and gunpowder in fiery mines. Sir George Elliot, once a trapper boy, but then one of the leading colliery operators, testified and among other things said, "I am a great advocate for plenty of air in a pit; I believe it is the cheapest way to work a mine safely; I believe in government inspection of mines; the inspectors ought to go down the pit, and they ought to be practical men who understand the pit when they go down; in fact, they ought to be practical miners."

Interest in legislative action was increased by the Haswell disaster which in 1844 caused the death of 95 persons. This colliery was regarded as a model colliery. Ignition was from a candle or a faulty safety lamp. Professor Faraday, Sir Charles

Lyell and Mr. Scutchbury were appointed by the government to report upon the cause. The burden of this work fell upon Faraday. In their report they stated that:

"In considering the extent of the fire from the moment of explosion, it is not to be supposed that firedamp is its only fuel; the coal dust swept by the rush of wind and flame from the floor, roof and walls of the works would instantly take fire and burn, if there were oxygen enough in the air present to support its combustion, and we found the dust adhering to the face of the pillars, props and walls in the direction of, and on the side towards, the explosion, increasing gradually to a certain distance, as we neared the place of ignition. This deposit was in some parts half an inch, and in others almost an inch, thick; it adhered together in a friable coked state; when examined with the glass, it presented the fused, round form of burnt coal dust, and when examined chemically, and compared with the coal itself reduced to powder, was found deprived of the greater portion of the bitumen, and in some instances entirely destitute of it. There is every reason to believe that much coal-gas was made from this dust in the very air itself of the mine by the flame of the firedamp, which raised and swept it along; and much of the carbon of this dust remained unburnt only for want of air."

From these various commissions and their reports, and the pressure of public opinion, the government at last was induced to present a bill of its own which passed on August 14th, 1850, with provision for four inspectors, and that the bill should only continue in force for five years. The trade unions now began to press for legislation to make definite safety measures compulsory. A leader was Alexander McDonald from Scotland. On August 14th, 1855, a law replaced the previous one and for the first time laid down a standard set of seven rules to be observed by all mines. This law also was to continue in force for five years. The bill introduced by the government on February 14, 1860, was designed to be a permanent document. This new act was supplemented two years later by another requiring the provision of two shafts at every mine, this new act being the result of the imprisonment and suffocation of 205 miners on January 16, 1862, in the Hartley Colliery, caused by the breaking of the pumping beam of the water engine. One half of it, weighing 20 tons, fell down the shaft filling up the only exit with debris to a height of 60 feet from the bottom.

These two acts mark a definite epoch in the history of mining legislation. The law had been brought to very nearly apply to the mining science of that period. While considerable reforms were agitated, no further bills were passed until 1872 when a bill was passed which was destined to codify and stabilize the mining law for a period of fifteen years. This law embodied practically all of the principles which now direct the administration of the law so far as safety is concerned. Subsequent legislative acts, while relatively voluminous, have been based upon the application of the principles laid down in the mining law of 1872.

Along with the natural explosion hazards there had been introduced at a very early age the hazard of gunpowder. It had been used prior to 1627 in Hungary and Germany for blasting minerals and was introduced in the Cornish mines in 1689. The first mention of its use in the coal mines is in 1719 when it is spoken of as dealing with a hard rock. It had become the common blasting agent in the early part of the 19th Century. In 1831 William Bickford invented his safety fuse which marked a great advance on the earlier crude methods of firing charges of powder. Electric detonation had been considered earlier but was not of practical use use until about 1840. Dynamite was discovered by Nobel in 1867. In 1875 he invented the gelatinous explosives which were the forerunners of present day permissibles.

As the use of blasting explosives in mining extended, the occurrence of several serious disasters caused the governments of most European countries to study the cause of these accidents. In Great Britain, attention had been paid from 1835 and such attention led, in 1872, to the Coal Mines Regulation Act of that country. Special "Fire Damp" commissions in France (1877), England (1879) and Germany (1880) gave consideration to explosions originating from blasting. Early attempts to control blasting flame from igniting gas and coal dust included the placing of a water cartridge above the charge, moist non-combustible tamping, and a water curtain in front of the bore hole. These methods did not solve the problem and efforts were made to devise explosives that would be safe. In Great Britain a committee was appointed in 1888 to make inquiries into and report on the subject of "flameless" explosives. Much progress resulted from about 1897 in "permitted" explosives for coal mine use.

There is some doubt as to when electricty was first introduced into collieries. This in Great Britain was probably in Trafalgar Colliery (Forest of Dean) where a small pumping set was installed below ground in 1882, and an arc lighting set at the pit top in the same year. The development and use of electrical appliances underground in Great Britain has been under strict supervision and regulations so that, compared with the United States, electric installation for underground work is small. However, mine lighting of pit bottoms and other such permanent locations has become general. The first satisfactory attempt of underground lighting was in 1882 in Scotland.

Portable electric lamps were being supplied in 1889 by John Davis & Son but the development and use in Great Britain has been relatively slow.

As previously stated, Faraday in 1844 had drawn attention to the effects of coal dust in extending the flame of an explosion, but the first investigator to realize the real part played by coal dust in producing explosions was Dr. William Galloway of Cardiff. As a Junior Inspector of Mines, he had opportunities to see the effects of several great explosions in Welsh collieries, and he drew the conclusion that it is coal dust which carries the flame with such disastrous effects along the roads of a colliery.

His conclusion was so unpopular that he was obliged to resign his appointment as Inspector. Messrs. W. H. and J. B. Atkinson then published a book, also very unpopular at the time, supporting Galloway's views. By degrees, the new views made headway and received the support of a Royal Commission, which reported in 1893 after various very convincing experiments had been made for it. As study was made of "safety" explosives, the problem of rendering the coal dust inexplosive was further considered. Watering was partly carried out or attempted in many collieries. Dr. Galloway, Mr. Atkinson and Mr. Garforth had observed that a coal dust explosion was checked wherever a considerable percentage of stone dust was present on a colliery road. Experiments were conducted by Mr. Garforth at Altofts Colliery, which was under his management. Here much of the present knowledge relative to the possible effectiveness of stone dust was learned. The possible dangers of damage and injury resulted in moving the gallery and apparatus to a site near Eskmeals, on the Cumberland Coast away from ordinary human habitation. Coal-dust explosion tests by France at Lievin under Taffanel were begun in 1907 after the Courrieres disaster (1100 deaths), and by Great Britain in 1908. The British Coal Commission on Coal Dust sat from 1891 to 1894.

Success in the prevention of explosions in Great Britain did not obtain at once upon the discovery of the means of prevention. Explosions persisted but at a declining rate. As stated, explosions in the early part of the 19th Century were at the rate of 40 per year. It seemed that with each of the early discoveries, explosions increased in number and in violence. Great advancement, however, has been made in the last half century as is shown by the accompanying graphs.

This address to this point has been a brief review of the causes of explosions chiefly in Great Britain, and is a review of the efforts at prevention. The experience and its resultant legislation in that country is equally the heritage of the United States. The beginning of coal mining here was a duplication of the experience in the old country, men from the pits there migrating here to develop and work the coal mines of America for their livelihood.

The early 18th Century experience here in working the coal close to the surface, having water and chokedamp as the chief hazards, was similar to the experience in Great Britain of the late 16th Century. The greater area and relative shallowness of coal measures here presented and still present a less acute problem in fiery mines as compared with the old country. However, coal production here increased at a much greater rate, the development of mines and the consequent legislation covering a much shorter period of time.

The birthplace of the coal industry in America rightfully belongs to the Appalachian coal field. In 1786, twenty years after Pittsburgh was laid out, William Penn was granted a charter to mine coal in the hills fronting the city. Coal was first mined along the Monongahela River. The first mining company formed was in the anthracite field. It was the Lehigh Coal Mine Company organized in 1803.

The first explosion disaster, causing five deaths or more, recorded by the Bureau of Mines, is one near Richmond, Virginia, in 1839. It caused the death of forty men. The next is at Pottsville, Pennsylvania in 1847 losing seven lives. From 1850 to 1867, six explosion disasters caused the loss of 176 lives, all in Virginia. The Avondale disaster was the result of a mine fire, the furnace igniting the shaft partition. It occurred on September 6, 1869, and 179 (Roy gives 109) lost their lives through suffocation. This was almost a duplicate disaster to that of the Hartley Colliery in England in 1862 both of which were instrumental in laws being passed for two places of egress.

The leading coal mining states quickly adopted mining laws, using the British law to guide them. Among the first records is an appeal, in 1858, of the miners of Schuylkill County, Pennsylvania, to the State Legislature because of the very high fatality rate. It was not considered, and in 1866 the bill was again introduced but was defeated in the Senate. In 1869 it was successful. It provided for one inspector for Schuylkill County, the other counties being left out. The next year following the Avondale disaster of September 6, 1869, a law was enacted for the anthracite field. There was no effort to have its provisions include the bituminous field, the soft coal miners of Pennsylvania making no legislative effort until 1876 when a commission was appointed by the Legislature and the first mining law was enacted on the 19th of April, 1877, providing for the regulation, ventilation and inspection of the bituminous mines of that State.

Illinois is the first state in the uinion to recognize by legislation the need for laws in the bituminous coal industry. Many efforts were made prior to 1870 in that direction but these had proved ineffectual. When the Constitutional Convention of 1870 was organized, however, one of the first committees formed was on "Mines and Minings." One of the first reports presented for the consideration of that body of men, was prepared by the committee. A very full discussion of its merits took place on the 24th of January, 1870, and resulted in incorporating into the constitution the following language of article four of section twenty-nine:

"It shall be the duty of the General Assembly to pass such laws as may be necessary for the protection of operative miners, by providing for ventilation, when the same may be required, and the construction of escapement shafts, or such other appliances as may secure safety in all coal mines, and to provide for the enforcement of said laws by such penalties and punishments as may be deemed proper."

With this section as a basis, many legislative acts on coal mining were made during the decade 1870-80. The first Illinois mining laws enacted under the provisions of the Constitution was by the 27th General Assembly (1871), approved March 27, 1872. It provided for inspection of mines by county inspectors and all reports to be made to county boards for the health and safety of persons employed in coal mines. The following session a change was made making the County Surveyor ex-officio inspector of mines. This was unsatisfactory and on May 23, 1877, the Act of 1872 was amended by creating office of mine inspector in each county where mining was carried on, giving the County Board the right to appoint inspectors in their respective counties. Great dissatisfaction existed in regard to inadequacy of the laws and to the county inspection service because of its inefficiency so that on June 18, 1883, the 33rd General Assembly passed a complete revision of the mining laws of the state, including a state mine inspection system. The other leading coal mining states had preceded Illinois in the adoption of this system of inspection. The county inspection system, however, was not abolished, the resultant mining law authorizing state mine inspectors to require county boards to employ county mine inspectors. Nearly all coal producing counties employ county inspectors as assistants to the state mine inspectors.

Ohio was the second state in the union to receive legislative recognition in the bituminous fields, 1873: Maryland was third, 1876; and Pennsylvania was fourth, 1877. The other states soon followed until now all of the coal mining states have laws fairly commensurate to the mining science of today in the prevention of explosions.

As in the earliest years of coal mining in the old country, explosions here increased at an alarming rate for many decades. One would expect, having a less gassy condition and the experiences of the old country, that the explosion rate here would be less than in Great Britain. The two graphs on print No. 1 show that explosion fatalities per 100,000 men employed and per 1,000,000 tons of coal produced are less in that country.

Coal mines in the United States were at first almost wholly manned by emigrants from coal producing countries. These men brought over with them both their experience and desire for greater independence. They left a strict supervisory system of mining approaching militaristic regulations, to work in a loosely regulated system in which discipline as known in the old country did not exist. There were also many employed in the mines here as miners, but who had never worked in mines. The growing youth became full-fledged mine workers without the training in safety procedure and apprenticeship regarded essential over the sea. Tales at the fireside, at times exaggerated, tended to impress the young that the discipline their fathers lived under was oppression. Need for individual care against explosions was apparently of but little importance and therefore was not stressed. Legislation seemed to be the hope to prevent explosions, but even as legislation became enacted, ventilation improved, and inspection increased, there was an alarming increase in number of explosions and number of explosion fatalities.

During the three decades from 1880 to 1910, an excessive number of explosions from the handling and use of black powder added to the explosions originating from fire-damp. States, such as Iowa, having practically no gas hazard, began to have explosion disasters. In some sections coal mining resembled quarrying. The quantity of black powder used for one blast would occasionally be the entire contents of one 25 pound keg and frequently one keg to break down sufficient coal for one man for one day. An illustration of the increased use of black powder is that in the 5 year period 1882-6, (no mining machines reported) 74 tons of coal per keg of powder were produced in Illinois, while in 1902-6, (an average per year of 672 mining machines were reported) only 41 tons per keg were produced.

There are many who can recall the controversies on stopping the fan at shooting time, and the discussions on the explosiveness of coal dust during this period. The 1888 coal report of Illinois refers to coal dust as being the "new danger in coal mines," although the first recorded explosion disaster of the State, January 9, 1883, in Coulterville, had been known as being initiated by a black powder shot and propagated by coal dust.

America was slow in taking up the study and application of "Safety Explosives," and up to 1902 very little was done. At this time, the DuPonts sent a man to Europe to study what had been done there since the appointment of their "Fire Damp" commissions. This resulted in the installation (1904) of testing equipment in the Company's laboratory and later (1907) the Technologic Branch of the U. S. Geological Survey to study mine explosions and explosives. The Pittsburgh Testing Station was opened on December 3, 1908. The Technologic Branch was raised to the status of an independent bureau in the Interior Department by the act of May 16, 1910, which created the U. S. Bureau of Mines "to make diligent investigations of the method of mining, especially in relating to the safety of miners, the use of explosives and the prevention of accidents, and other matters relating to mining." The work done at the experimental mine and the explosives testing laboratory, located at Bruceton, Pennsylvania, is very well known. With the introduction of good permissibles in 1908 there came a rapidly increasing demand for this type of explosives so that by 1924 about 50,000,000 pounds were used annually in the coal industry of the nation. At that time consideration was being given to the loosening of coal by the expansion of the inert and harmless gas, carbon dioxide. This requires a steel cartridge. It is a permissible device and is used in some of the gassy mines in this nation and in Europe. A new device being introduced at this time (1933) is one that uses carbon dioxide and compressed air, and another using only compressed air.

As prevention against blasting succeeded, a new hazard in the ignition of gas developed. The machine age in coal mining is considered as having begun with the mining machine. The compressed air puncher was introduced in the early 80's but its life was short after the introduction in the early 90's of the electric chain mining machine. The electric locomotive was introduced at about the same time, and since then the growth in the use of electric energy in coal mines throughout the nation has been phenominal. From 1910 to 1923 the number of electric locomotives increased from 5000 to 20,000. Mechanization in mines of the United States is generally understood as electrically driven machinery.

Explosion disaster fatalities from ignition of electric arcs or sparks have increased. In 1931, 154 of the 264 fatalities were from electric ignition, in 1931, 13 of the 56 fatalities, and in 1932, 14 of the 145 fatalities. For the 3 year period, 39% of the explosion disaster fatalities were from electrical ignition origin. The Bureau of Mines grants permissibility to flame-proof electrical machinery. This is the most difficult of the permissible equipment to be kept flame-proof because of the frequent need of repair of the machines and the difficulty in maintenance in accordance with their original permissible standard.

The first miners' electric lamp approvals given by the Bureau of Mines were in April, 1913, at which time three lamps were placed on the permissible list. These were later withdrawn. The first permanent approvals were three lamps in 1915. The original intent was the use of a lamp that would not ignite gas. The success of that original intention is beyond question. There has been added the factors of practicability and greater illumination, and the success of these is also beyond question. The following tabulation is given to show the rapid growth of this safety factor in the United States.

	Safety Flame Lamps	Permissible Electric Lamps
1912 -------		None
1915 -------	140,000	20,000
1920 -------	100,000*	140,000
1925 -------	80,000*	200,000
1930 -------	65,000*	260,000
1933 -------	59,000	285,000

*Estimate.

The Bureau of Mines has experimented extensively upon coal dust explosions and the value of rock dust, in its experimental mine, and has published the findings from time to time. This work was begun in 1911 and has progressed to the present almost without interruption. The first practical application of rock dust in the United States to prevent the propagation of an explosion by coal dust was in 1912 in the Delagua mine, Victor American Fuel Company, Colorado. The second was in the Old Ben Coal Corporation mines in Southern Illinois. This second was the result of a terrific explosion of coal dust, initiated by gas ignited by open light, in Old Ben No. 11 Mine near Christopher. This explosion was on Thanksgiving night (November 29, 1917) and caused instant death to the 17 men who were in the mine. 600 men were employed on the day shift. Flames shot several times far above the surface of both shafts from the workings 600 feet below. The explosion extended into every portion of the workings, except that it was stopped in two rock cuts that had been driven through a "roll." With the assistance of the Bureau of Mines, the coal dust explosion hazard of all the Company's mines was determined and all the Old Ben mines were rock dusted during the next few months. The Coal Company developed barriers and troughs to suit the conditions encountered, and developed an electrically driven rock dusting machine to coat the roof, ribs and floor. This latter method proved to be the most efficient and became the standard method of application. The Company patented the three methods and gave them to the government so that all who may desire may use them.

The Company's success in preventing propagation of explosions by means of rock dust became widely known and mining men from all the chief coal mining states and nations visited the Company's mines between the years 1917 and 1924. This period is accepted as that during which rock dusting "was sold" to our industry. Rock dusting is now done, either in whole or in part, in many of this country's mines that are recognized as having the hazard of explosion from coal dust.

There have been other agencies developed resulting from explosions and the efforts made towards their prevention. Mine safety appliances companies, having among their equipment that pertaining to explosion prevention, are important factors. The personnel of these companies have not only been of great influence in the study of explosion causes and efforts towards their prevention, but also in keeping the coal-mining mind explosion conscious.

Various methods, based upon humanitarian, educational and economic motives, chief of which are our mining schools, the U. S. Bureau of Mines, our state mining departments, mining periodicals, our mining institutes, numerous coal producing companies and compensation acts have and are giving this subject much attention. The thought and work done by these various agencies is good in quality and large in quantity. The only factor of weakness is the small percentage reaching and being accepted by those at work in the mines.

My address to this point has been of a chronological nature, simply being a review concerning mine explosion causes and prevention from the earliest records to the present time. Tabulated data upon causes of ignition are obtainable from state and federal annual reports. I wish now to include statistical data for as much of the period of this address as I have records. This data is shown in the following four tabulations and graphically in the four plates made from them.

More scientific thought and legislative effort has been given towards the prevention of coal mine explosions than to all other coal mining hazards put together. There has not been, however, an accomplishment of success that is warranted by the efforts made; that is, the success in preventing explosions is not in proportion to the advanced knowledge and laws applicable towards their prevention. There is no question but that the pioneers who formulated our mining laws felt that they had done a great work towards the prevention of explosions. It is certain that they anticipated greater progress than has been obtained.

The following graphs show that Great Britain has in the last half century made considerable success. This is despite the deeper seams worked, therefore more gas and greater difficulty of ventilation decade after decade. One of the chief reasons for their success in lowering the explosion fatality rates is the strict application of their mining laws. Their tendency of strict compliance with law and order on the surface is observed in the mines and has added to it a sort of militaristic obedience and responsibility. There is also an approach to stabilization of mining methods resulting in one generation of mining men carrying on the work of the preceding generation.

The tendency here in the states is, natural to a younger nation, speed and change. This is evinced upon our highways as well as in our mines. The price of greater freedom is less responsibility.

We now have three centuries of coal mine experience behind us. It is difficult to imagine the quandaries and consternation of the earliest pioneers of our industry who suffered explosion and loss of which they did not know the cause. We of today know the causes of explosions and the means for successful prevention. We cannot plead ignorance of adequate preventive measures in this enlightened day. Success in the future may depend upon the discovery of new preventive methods: in all probability, however, it will hinge rather upon how thoroughly the present known means of prevention are applied.

C. F. Hamilton: I think we should have some interesting discussion on this paper and will call first on Mr. McFadden.

G. C. McFadden: I believe all of you who have been connected with the mining industry are familiar

Table No. 1

TREND OF EXPLOSION DISASTERS AND FATALITIES IN U. S. BITUMINOUS MINES AS RELATED TO MAN-SHIFTS AND TONNAGE

1888-1933

Percentage of Total Occurring Within Each 5 Year Period

Five Year Period	Millions of Tons	Per Cent	Millions of Man-Shifts Worked	Per Cent	Number of Explosions*	Per Cent	Number of Fatalities**	Per Cent
1888-92	540	3.47	208.23	5.04	6	1.95	335	3.76
1893-97	668	4.29	230.83	5.58	15	4.87	319	3.58
1898-02	1,058	6.73	350.17	8.47	26	8.44	833	9.34
1903-07	1,615	10.37	491.20	11.89	52	16.88	1,825	20.47
1908-12	1,986	12.76	572.20	13.85	56	18.18	1,492	16.73
1913-17	2,399	15.41	636.21	15.40	33	10.72	1,322	14.83
1918-22	2,452	15.75	611.86	14.80	29	9.42	454	5.09
1923-27	2,660	17.09	584.04	14.16	49	15.91	1,456	16.33
1928-32	2,192	14.08	447.66	10.83	42	13.64	880	9.87
45 Years	15,570		4,133.41		308		8,916	

*Causing five or more fatalities.
**From explosion causing five or more fatalities.

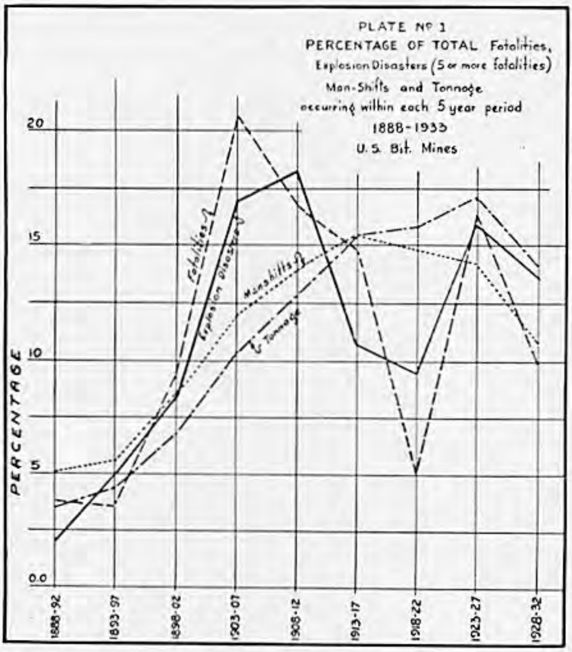


Table No. 2

EXPLOSION DISASTERS—AVERAGE ANNUAL FATALITY RATE PER MILLION SHORT TONS IN EACH FIVE YEAR PERIOD

1888-1932

	UNITED STATES					GREAT BRITAIN		
	Millions Short Tons Bituminous Mines	NUMBER OF DEATHS IN EACH FIVE YEAR PERIOD: 5 Deaths or More	NUMBER OF DEATHS IN EACH FIVE YEAR PERIOD: 10 Deaths or More	FATALITY RATE PER MILLION TONS: 5 Deaths or More	FATALITY RATE PER MILLION TONS: 10 Deaths or More	Millions Short Tons* All Mines	Number Deaths in Each Five Year Period	Fatality Rate Per Million Tons, 10 Deaths or More
1888-1892	540	335	335	0.62	0.62	1,000	532	4.53
1893-1897	668	319	286	0.48	0.43	1,025	582	0.57
1898-1902	1,058	833	778	0.77	0.73	1,195	116	0.10
1903-1907	1,615	1,825	1,709	1.13	1.06	1,345	188	0.14
1908-1912	1,986	1,492	1,321	0.75	0.66	1,465	862	0.59
1913-1917	2,399	1,322	1,276	0.55	0.53	1,465	464	0.32
1918-1922	2,452	454	354	0.19	0.14	1,263	206	0.16
1923-1927	2,660	1,456	1,327	0.55	0.50	1,305	279	0.21
1927-1931						1,102	122	0.11
1927-1932	2,192	880	761	0.40	0.35			

*Scaled from Graph.

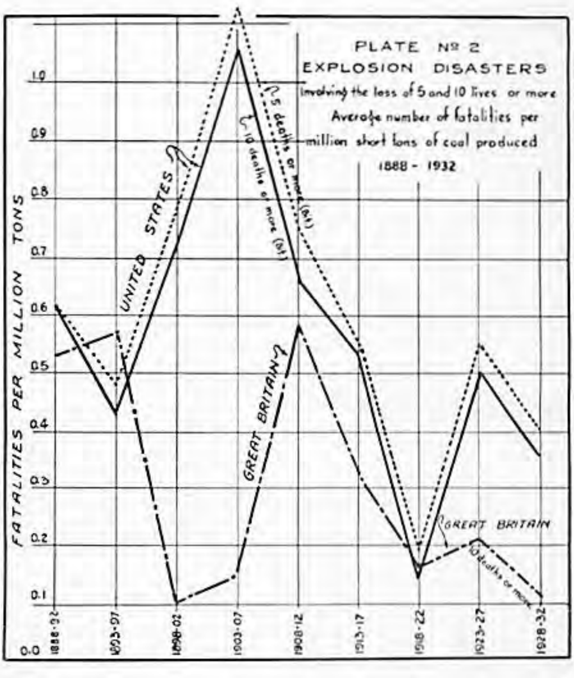


Table No. 3

EXPLOSION DISASTERS INVOLVING THE LOSS OF 10 OR MORE LIVES

Average Number of Fatalities for Each Year of the 5 Year Periods

Per 100,000 Employed

1888-1932

	UNITED STATES			GREAT BRITAIN		
	Average Number Employed Per Year (x 1000)	Number Deaths in Each 5 Year Period	Fatality Rate Per 100,000 Employees	Average Number Employed Per Year (x 1000)	Number Deaths in Each 5 Year Period	Fatality Rate Per 100,000 Employees
1888-1892	186	379	40.7	662	532	16.1
1893-1897	241	286	23.7	729	582	16.0
1898-1902	308	778	50.5	803	116	2.9
1903-1907	461	1,709	74.1	904	188	4.2
1908-1912	543	1,271	46.8	1,070	862	16.1
1913-1917	575	1,308	45.5	1,054	464	8.8
1918-1922	646	446	13.8	1,169	206	3.5
1922-1927	620	1,351	43.6	1,154	79	1.4
1928-1931				980*	122	3.1
1928-1932	480	777	32.4			

*Estimate.

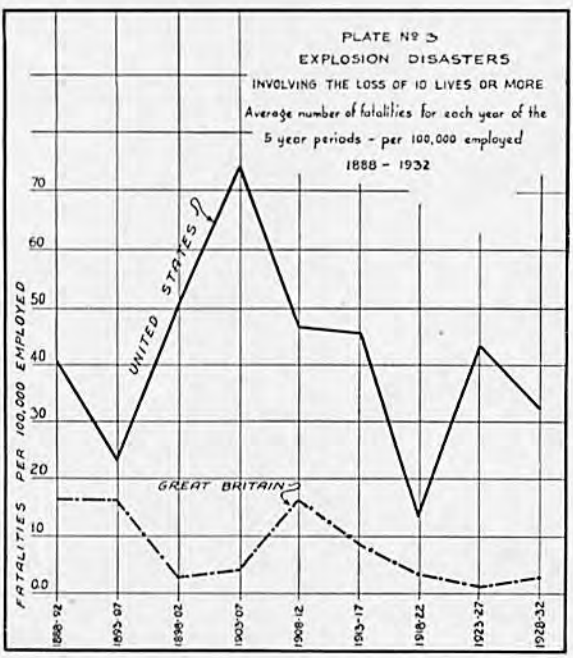
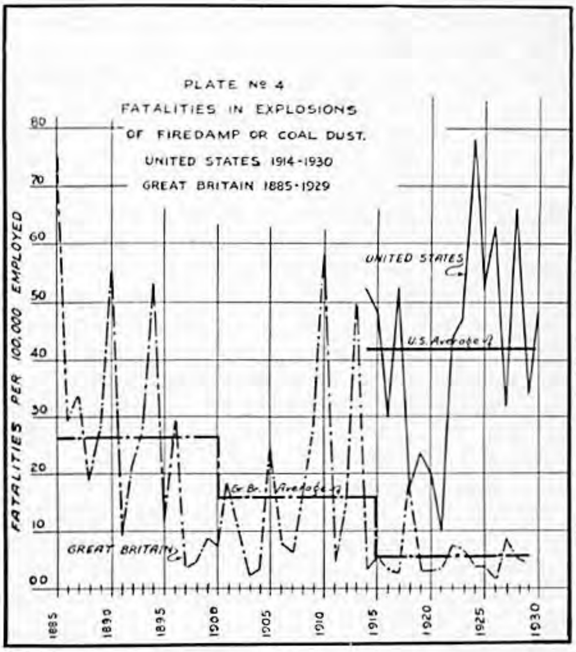


Table No. 4
FATALITIES IN EXPLOSIONS OF FIREDAMP OR COAL DUST INVOLVING ALL EXPLOSIONS RESULTING IN FATALITIES SHOWING TRENDS IN PERIODS OF FIFTEEN YEARS
UNITED STATES—1914-1930 GREAT BRITAIN—1885-1929

UNITED STATES			GREAT BRITAIN			GREAT BRITAIN			GREAT BRITAIN		
Year	Fatalities Per 100,000 Employed	15 Year Average	Year	Fatalities Per 100,000 Employed	15 Year Average	Year	Fatalities Per 100,000 Employed	15 Year Average	Year	Fatalities Per 100,000 Employed	15 Year Average
1914	52.2		1885	75.9		1902	9.2		1916	2.7	
1915	48.5		1886	28.8		1903	2.0		1917	2.4	
1916	29.1		1887	33.9		1904	3.1		1918	19.8	
1917	52.9		1888	18.8		1905	25.1		1919	2.8	
1918	16.8		1889	28.2		1906	7.6		1920	2.6	
1919	23.8		1890	54.6		1907	5.7		1921	3.0	
1920	20.0		1891	9.2		1908	15.7		1922	7.8	
1921	9.2	41.59	1892	21.5		1909	27.2	16.56	1923	6.1	
1922	43.3		1893	28.0	25.99	1910	57.9		1924	3.5	5.18
1923	46.8		1894	53.7		1911	4.1		1925	3.2	
1924	78.4		1895	9.4		1912	13.8		1926	1.0	
1925	51.4		1896	30.0		1913	49.9		1927	8.6	
1926	62.8		1897	3.3		1914	3.0		1928	4.7	
1927	31.5		1898	4.6		1915	5.4		1929	4.3	
1928	66.5		1899	8.9					1930		
1929	33.4		1900	7.0							
1930	47.4		1901	18.7							



with the Mining Investigation Commissions that have been appointed for each legislative session to make recommendations for needed changes in our mining laws. Wm. Starks was a member of the first commission appointed.

Our good friend, John E. Jones, and I worked for three years and put in a lot of time to make some constructive changes in the law. But in the final windup we found that all of our work had come to naught, and that our hands were tied, because we could not get even one change that could be agreed on 100%. I would like to have Mr. Starks give you a statement on this.

Wm. Starks: In the matter of correlation of mining laws, you have one factor to contend with, and that is your State Legislature. I don't know how many of you have been in Springfield and seen the State Legislature in session, but I want to say that most of the members in the legislature have very little knowledge of coal mining conditions.

One time I spent three months with a fellow who was a very able man. We met practically everyone in the State of Illinois that ought to know about mines and mining. We had a copy of the mining laws of each and every state, and after all the effort we had put out and changes we had recommended, not one of them was adopted. It is an almost hopeless task, as there are only about five or six men in the legislature who know anything about mining.

I read a paper about three years ago on this boat trip in which I reviewed the mining laws since 1883. In this paper I compared our mining laws to a shed that was built and then a little added on to it every now and then. There is no reason why they should say a cross-cut should be driven about 60 feet. This was all right when the law was made, but we have better ventilation than we ever had before, and we have different conditions now. For instance down in Treadwell's mine at West Frankfort they are using a McKinley machine that cannot drive a cross-cut. But as long as he keeps the air to the face, why should he be put to this extra expense? Gentlemen, I tell you as long as you can put the air to the face it does not make any difference how far the cross-cuts are apart.

John Millhouse: I don't know whether you men are aware of the fact or not, but there are many laws in the present mining laws that are dead. When the Civil Code was made a law it nullified a lot of our laws. After you read the laws as they are today, they are entirely in conflict with the Administrative Code.

Under the Administrative Code the Department of Mines & Minerals was given the administrative powers of the State Mining Law, which practiccally eliminated the functions of the State Mining Board; that is, under the present set up the State Mining Board does not have the administra tive function of the old State Mining Board.

As time goes on, our laws do not fit in as they should do. Many changes have taken place in mining, and every man knows you cannot live up to the letter of the law.

The last legislative commission devoted a lot of time in formulating changes in the mining law. I listened in on a lot of their discussions, and they asked me if their proposed changes suited me. I said, Yes, if you could get them through the legislature. At that time I had no thought that I would be called before the legislature. However, I was called and did the best I could, but as you all know nothing was done.

There was one proposed change, however, that I was not in favor of, and that was the abolishing of the county mine inspector. By this I do not mean that a county that had only one mine would be expected to hire a man. But mines are not inspected as often as they should be. The inspection of mines by the State and County is a free service and shoud be worth something. I believe in keeping a county mine inspector, but I do not believe in keeping one in every county. I believe our State Mine Inspectors are over-loaded now, and when you go to the working face it takes time. One thing I regret today is that there are more mine inspectors interested in what they receive than in the work they do. I regret they do not take their work as seriously as they should.

Our laws need many changes. When you come to the explosive question, there are different methods of breaking down coal being initiated. We are improving along that line. The Cardox method is very interesting. But this method as all other things has been abused. This method had been in limited use for about three years when I took office. It was being used in a dangerous manner, and there are men here who know that men had been killed by these flying shells used in the Cardox shooting. I called the attention of the Franklin county men to this condition. We have need of a law for that form of explosive, although at this time it is under the shot firers' law. And now we are getting into the air method of breaking down coal, and these new methods call for changes in our laws.

Our laws are obsolete in many ways, and there is need of a change. We have some wonderful mining laws, but they do not fit in with the times. The individual mine does not have power any more, the company has it, and the restriction of that power is a serious proposition for the Department of Mines and Minerals.

There was one other point where I disagreed with our mining commission, and I hated to do it, and that was the exploding of explosives while the men were in the mine. If there is any exploding needing to be done, it should be done when the men are out of the mine.

Wm. Starks: I wish to disagree with our illustrious friend on some points. He speaks of the Mining Board as it is now constituted. The Mining Board has functioned for many years, and I want to tell you today that the Mining Board is functioning and the operators are well represented. Our present Director of Mines & Minerals does not assume any undue authority, and the State Mining Board interprets the law as it thinks it should be interpreted.

The present State Mining Board is going to function as it should. It is not going to enter into any personal or political fights in any way, and we are not going to let either politics or labor troubles enter into any decisions which we may be called upon to give.

John Millhouse: We have had a sorry situation in Illinois as far as labor conditions are concerned. All of our laws seem to have broken down.

Enoch Martin: As I understand it, one of the purposes of this Institute is to foster and promote ideas to make mines a safer place to work.

Laws that are adopted in the legislature are devised from a humanitarian standpoint to protect the fellow who does the menial task and also for the man who directs him.

I wish to assure you that there is no friction whatever between the present State Mining Board and the Director and the Assistant Director of the Department of Mines & Minerals.

C. F. Hamilton: If there is no more discussion on Mr. Jones' paper will ask Mr. Marsh to present his paper on "The Use and Advantages of Light Weight Mining Equipment."

THE USE AND ADVANTAGE OF LIGHT WEIGHT MINING EQUIPMENT

By I. D. MARSH
Supt., Aluminum Ore Co., Belleville, Ill.

Only a few years ago it was believed that extreme weight was necessary in an automobile for control and safety at even moderately high speeds. Until just recent years the railroads continued to build heavier and heavier rolling stock for safety and comfort and as they then thought to make high speeds possible. Today all this is changed and the lightest cars have comfort and speed and safety far beyond that of the heaviest cars of a few years ago. Their light weight design makes the new high speeds possible with entire safety. On the rails new light alloy trains are beginning to change the entire transportation picture, for speed, comfort, safety and lower operating costs bid fair to revolutionize their entire passenger and express carrying problem. In the mining industry comparable progress is being made with reduction in weight a major factor in many cases.

You are all familiar with the gigantic stripping shovels which are today uncovering nearly 20% of the coal mined in Illinois. The 20 cubic yard buckets or dippers for these shovels are commonplace, but dippers up to 30 cubic yard capacity are now being considered, made possible on present shovels by the use of light alloys. In the smaller sizes, through the use of these materials a 5 yard bucket has replaced a 2½ yard bucket and a 16 yard bucket a 12 yard one without other change in the equipment. The reduction in dead weight of the buckets is being turned into increased pay load. This shovel development is recent, however, engineering progress will undoubtedly extend the use of light alloys to the dipper sticks and shovel booms and equipment. It is now common practice to build even the largest drag line booms of light alloys, in fact these materials make the present long boom lengths possible.

As a general rule excessive dead weight is a serious handicap especially where acceleration is eating up power or heavy impact is shortening the life of equipment. Under these conditions the application of strong light alloys can help lower costs and solve many difficult problems. It is now possible to get light alloys in all standard sizes and forms and structural shapes which are equal to structural steel in strength per square inch but of one-third the weight. Light weight castings and forgings are also available in high strength heat treated alloys.

In the tipple, screens and conveyors are operated which weigh two to three times the weight of the coal passing over them at capacity, and they are probably at capacity only a small percentage of the time. This weight is started and stopped again from 60 to 150 times a minute. Reduced weight would reduce vibration, reduce the needed structure to support and reduce the power to drive. Manufacturers are using light alloys on the vibrator type screens and conveyors and have by this means increased the efficiency of these rapidly moving units.

Aerial type conveyor buckets fabricated of light alloys reduce their rope costs and increase capacity. Reducing the weight of cages and skips has come in for considerable discussion with many engineers in the past few years and numerous installations have been made in this country and more especially in Canada, England, Germany, France, Russia, Africa, etc. What advantage is gained by reducing the weight of two cages which are in balance is the first question usually asked. As the conditions in every shaft are different, no discussion will fit all or any majority of mines. There are, however, several factors which are common to all hoists.

On all installations any reduction in the weight of the cages will reduce the rope load and cost, and increase the safety factor, and rope life. This applies also to all elements of the hoist train from cage chains, rope sockets and hitching, bearing loads, tooth pressures, breaks and anchorages. Cages are only in balance when at rest. The moment they start to move they become unbalanced, the one hoisted increased by its inertia and the other decreased as far as its rope pull is concerned by the same factor. As the hoist acceleration approaches the speed of falling bodies the cage being lowered approaches zero in rope pull regardless of its mass or weight and in the first few seconds where the maximum power loads come, the air speed of the cage is low enough to have little effect. On the other hand every pound hoisted is taking its power toll in accelerated load. So that, though balanced at rest, cages approach a totally unbalanced condition as acceleration approaches the speed of falling bodies and at every intermediate speed the conditions fall in between these two extremes. The peak power loads and total power loads in hoisting should always be reduced by lighter cages and lighter rope loads. The amount of saving would be different for each hoist but as probably one-third of each hoist cycle is acceleration, one-third constant speed and the last third coasting in, the saving would cover fully half the power cycle and if power is used for breaking, the same saving would hold true for deceleration.

There are also several special cases. A hoist which is underpowered could increase its acceleration rate and its capacity by lighter loads. Skips which are limiting the mine capacity, or the bottle neck in the operation, can have part of their dead load replaced by light alloys of high strength and their size increased to greater capacity, without other change. Thus the mine capacity can be increased with the same number of hoists or the old tonnage handled with fewer hoists relieving possible congestion at the bottom and releasing empties quicker. This would be much cheaper and easier than new hoists. In changes to mechanized loading where larger capacity mine cars were needed, new light cages would solve an overloaded hoist condition.

One other condition rather prevalent throughout the coal mines is that many cages have been rebuilt year after year and constantly beefed up and strengthened to enable them to handle the faster hoisting and added abuse. This has overloaded ropes but cages continue to fail. In general these cages have just grew, like Topsy, and considerable improvement could be made by careful engineering and design. Probably in every case adding strength has also added weight which means added shock and impact loads so that the results have been at least partly lost. If, however, added strength were accompanied by less weight and consequently lower stresses great freedom from failure would result.

In the mine a great deal of the equipment must be used and carried about by hand labor. The coal drill has gone through a complete transformation in the past ten years and if any of you were shown today the electric coal drill which we purchased 12 years ago, you would laugh at it, and yet outside of being bulky and weighing about 225 pounds it is a good drill. All the manufacturers of this type of equipment have made great progress but the outstanding accomplishment is reduction in weight. One of the newest drills weighs only 38 pounds. Engineering and design are large factors in this, but all of this equipment today has as a major material, some of the light strong alloys. One of the new developments in fans which has been very successful owes part of its efficiency to the characteristics of its light alloy blades. These are special tools of the mining industry. Two general purpose tools whose new light weight should make them of special interest to us are a safety chain hoist and screw jack. The chain hoist of more or less standard design but using a maximum of light strong alloys, weighing only 58 pounds, would be mighty useful in tight situations which are the rule in the mine. Also a 15 ton screw jack which weighs 19 pounds would be very welcome to the man who had to carry it to the next entry.

The majority of the light alloys are highly resistant to corrosion in mine conditions and so are admirably fitted to its service.

This resistance to weak acid waters and moisture makes their use in the form of a non-skid safety tread plate ideal in escape ways and tipples where painting and other protection is often impossible. Tools also have the added advantage of a permanently bright color and so are easily seen and less apt to be covered up.

One of the most recent developments in special mine tools is a line of rail benders and a punch for the lighter rails. This is a very severe service but here the weight of the tools is a major factor in their efficiency. Here again by some development in design and the use of a strong light heat treated alloy casting, a bender for 25 pound rail and under, weighs less than 20 pounds and has been tested to 58,000 pounds screw pressure before failure. Two other sizes for 40 pound rail and 60 pound rail show similar saving in weight, weighing approximately half that of the best design of older types. The punch designed for 20-25 and 30 pound rails weighs only 26 pounds and should make the fishplating of all inside track and short rail universal practice. It should work equally as well for preparing these size rails for the press type bonds.

It has not been possible to cover all the developments and applications where reduction in weight was a major factor for ease, safety, economy or efficiency in the time at hand. It has rather been my purpose to remark upon those applications of strong light alloys with which I was most familiar and suggest by example the possibilities for development. The manufacturers are giving the mine operator and mine laborer the finest tools in the world as fast as we call for them and has recognized with the rest of industry that excess dead weight is waste. It is now possible in our own shops at the mine to take this factor into consideration and with our present tools and equipment use the new strong light materials in our repairs and in all those special appliances which we make for ourselves whether it be a hand truck for the drillers or a splint for the safety box.

Gordon Cargal: Would like to ask Mr. Marsh what his company has done in regard to developing lighter jack pipes for mining machines.

I. D. Marsh: Light alloy jack pipes were developed and they have worked out admirably well. We put aluminum alloy jack pipes on a loading machine for nearly two years now, and they have worked out very well. A jack pipe in the light alloy weighs about 18 pounds for a 7 or 8 foot pipe while an iron or steel pipe of the same size will weigh 40 or 50 pounds.

Joseph F. Joy: In using this aluminum alloy for jack pipes, can they be straightened and retain their original strength?

I. D. Marsh: Yes, they can. But not by heating them. These jack pipes are ordinary double strength pipes, and can be straightened by dropping them across a wooden timber.

Wm. Starks: Mr. Marsh, I understand you are a representative of the Aluminum Ore Company. How can your product be welded?

There are about twenty alloys on the market that are available. The simple alloys, which are not heat treated, can be welded by the oxacetylene torch or the electric arc torch. In the higher strength heat treated alloys welding can be done but it takes out the temper. Will your product respond to electric welding?

I. D. Marsh: Yes, it can be done, but it takes some practice and skill.

C. F. Hamilton: The Chair regrets very much to bring this interesting discussion to a close, but we are running over our time, and will now stand adjourned until after lunch.

AFTERNOON SESSION

Harry Treadwell: This afternoon we will have as our chairman, C. J. Sandoe. I now turn the afternoon session over to Mr. Sandoe.

C. J. Sandoe: I am sure you all realize that it takes a lot of time and effort to get these papers together, and I know you will all give them your earnest attention.

The first paper on the program is "Coal Saw Development and Its Possibilities in Illinois," presented by Joseph F. Joy.

COAL SAW DEVELOPMENT AND ITS POSSIBILITIES IN ILLINOIS MINES

By DEWEY E. JOY
Sullivan Machinery Co., Chicago, Ill.

The ultimate objective of the coal operator is to produce coal of such commercial value that will enable him to not only meet competition but to conduct a profitable business as well. The development and introduction of machines for coal mine use has served greatly to improve mining methods and increase production. Combined, these factors have contributed in no small way toward a reduction in mining costs.

The machinery used at the working face has served to cut the coal, drill for explosives and load the coal into mine cars or some other transporting conveyance. The only remaining operation that was not performed mechanically was the dislodgement of the coal. This has always been accomplished by the use of explosives because it has been considered the only practical and economical means of breaking down the coal.

Until recent years little or no thought was given to the destructive effects that explosives had on the quality of the product. The economic distress through which we have passed since the World war has brought about a changed condition in the industry. The consumer is making more exacting demands on the producer. Quality now governs the available markets more decidedly than ever before and overproduction has served to beat down the prices of the smaller less desirable sizes to such an extent that many mines were forced into idleness because they knew of no available means by which they could improve their situation. "How can I reduce my slack output and obtain a firmer coarse product" became the cry of the hour. As a result, the explosive manufacturer was called upon to furnish a slower and smoother acting powder that would have less shattering effect on the coal. Much experimenting was done in the mines to determine the necessary amount of explosive to properly dislodge a cut of coal and thus improve the efficiency and cost of shooting as well as the quality of the product. Considerable progress was made and the cooperative spirit of the powder manufacturers is to be commended for the time and effort they contributed to this good cause.

It was this trend, however, that attracted the attention of Mr. J. F. Joy about the year 1929 and inspired him to develop a machine that would mine and dislodge the coal without the use of explosives but still prepare the coal in such manner that it could be loaded without difficulty. Through a desire to advance the interests of the coal mining industry this machine, now commonly known as the "Coal Saw" has been perfected and the "Sawing System of Mining" established. This development has since been acquired and is now being marketed by the Sullivan Machinery Company.

The soundness of this new system as well as the design, construction and application of the coal sawing machine has been more firmly established by the fact that a number of coal operating companies now have their mines completely equipped with coal saws and have identified themselves as producers of Sawed Coal exclusively. Mines that formerly operated at little or no profit have by the use of coal saws, become highly profitable operations. As a result, the Coal Saw and the Sawing System of Mining have become a matter of paramount importance to the coal mining industry.

To those yet unfamiliar with the Sawing System of Mining and the manner in which sawed coal is produced, it may be somewhat difficult to visualize the simplicity with which it can be quickly applied to the average mine. It is not necessary to deviate from any preferred method of recovering the coal or change the layout of the mine. Whether it be by the room and pillar, long wall or any modification thereof, this new machine reduces the mining cycle to its simplest form. The coal is sawed and completely dislodged from the face of the seam in one easy operation. It is then loaded in the usual manner.

Prepared to meet any specific requirements, several types of coal saws are now available after having been thoroughly tested under actual operating conditions. The Type 6-A is a track mounted machine which performs all of the sawing operations while resting on the mine track. It is capable of sawing horizontal slots in the coal face to a distance of 18 feet on either side of the track center line. It also saws a vertical slot in the coal face from the floor to the roof at any point from the center line of track to 12 feet on either side. These vertical slots may be made to run parallel with the track and thus permits sawing a straight rib. The flexibility of the machine and its ease of operation permits the turning of room necks, crosscuts and the mining of pillar coal without special preparation. It is adapted to use in seams of coal 3 feet thick and upwards to as much as 8 feet. It weighs approximately 6½ tons and can be accommodated by rails weighing 20 pounds to the yard.

The types 51-B and 52-B saws are of a design somewhat different than the type 6-A. They perform all of the sawing operations from the mine floor. They are transported from one working place to another by an independent motor driven truck provided with high and low speeds in either direction. Upon reaching the working place the saw is unloaded and moved to the face by means of steel ropes and self-winding drums. When the sawing cycle is completed the saw is then loaded in the same manner and moved to the next place. These machines are adapted to use in a seam of coal measuring 3 feet in thickness and upwards to 5 feet. They are recommended for use in wide rooms where the width exceeds 12 feet on either side of the track, on long wall faces or with conveyors. The weight is approximately 5 tons, including the transporting truck. Rails of 16 pounds per yard or more is sufficient to sustain this weight for transporting purposes.

Another type designed as 53-B and somewhat similar in design and performance to the 51-B and 52-B is recommended for thin seams measuring from 24 to 48 inches in thickness. This machine saws horizontally at the bottom of the seam only but will shear to a height of 48 inches. Where the coal parts freely from the roof this saw will provide the thin seam operator with all the advantages that the other types will give and at considerable less investment. It may also be used in combination with the hydraulic breaker pad or explosives for dislodging the coal where the coal does not part freely from the roof.

All other previous mentioned types are capable of sawing both horizontal and vertical slots at any point in the face of the seams for which they are recommended. The standard saw slot is 2 inches by 6 feet deep, but the gauge of the cutting teeth may be set to saw a 3 inch slot when desired to meet special conditions. The number of slots necessary to permit dislodging the coal depends upon the thickness of the seam, the location and nature of dirt or bone bands if any, and the general structure and characteristics of the coal. In each instance the coal may be dislodged by the previously mentioned hydraulic breaker pad, an accessory to the coal saw. This pad is inserted in the saw slots and when inflated with oil is capable of exerting a pressure of 150,000 pounds against the sidewalls of the slots. This is more than sufficient to dislodge the cut of coal as well as tough bands of slate and other impurities. The same hydraulic pump that inflates and deflates the breaker pad, is also used to operate the various movements of the coal saw.

The sawing capacity of either type coal saw depends upon the conditions to be met. It is conceded, however, that the track mounted saw has a capacity about one-third greater than either of the floor type machines. This is partly accounted for by reason that a certain amount of time is consumed in unloading and loading the floor type machines upon arriving and leaving the working faces.

Sketch No. 1 illustrates the method of sawing as applied at a mine operating the Straight Creek seam in Southeastern Kentucky. The seam measures approximately 40 inches in thickness including 4 inches of Black Rash next to the roof which comes down with the coal. Rooms are driven 40 feet wide and entries 18 feet. The coal parts freely from the rash and the rash parts freely from the roof. For this reason it is necessary to make one horizontal cut only and it is made at the bottom. The coal sets down as soon as the shear cuts are made at the ribs. Two or 3 additional shear cuts are then made to properly prepare the coal for the miner to load. Loading sawed coal, the men increased their loading capacity 1.5 tons per day. The average per machine shift is 150 tons or about the same as was formerly obtained from shortwall mining machines at this mine. Because the 4 inches of rash is not broken up by explosives and allowed to mix with the coal the ash content of the 2 inch Nut and Slack size was reduced 2 per cent. Six of the 52-B floor type saws have been operating double shift in this mine for 18 months. The maintenance costs including material and labor for tipping the saw chains, oil, grease, repair parts and labor has been 4 cents per ton as compared to

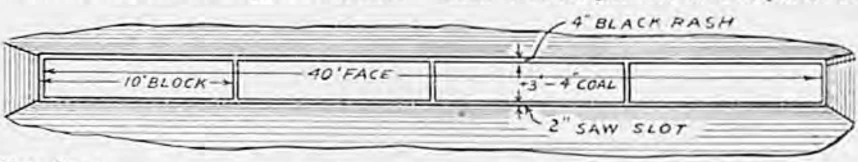


Plate No. 1

Sawing System Used in Straight Creek Seam, Southeastern Kentucky, Sullivan 52-B Floor Type Coal Saw

8 cents for the former shortwall mining machines. The mining machines had been in service 15 years when discontinued and I may add that severe cutting conditions exist at this mine.

Sketch No. 2 shows the system of sawing used at a mine in Southern

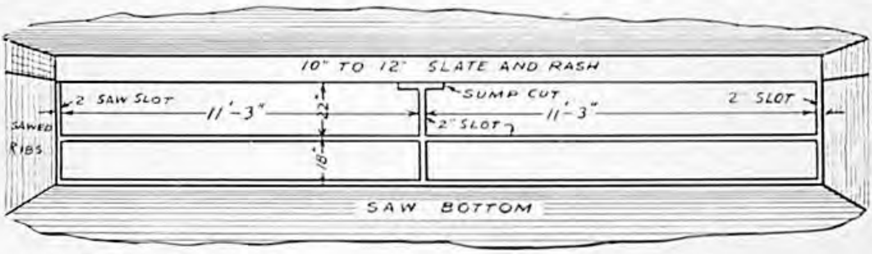


Plate No. 2
Sawing System Used in Pocahontas No. 4 Seam, Southern West Virginia, with Sullivan 6-A Track Type Coal Saw, Capacity 220 Tons, 7 Hours

West Virginia operating the Pocahontas No. 4 Seam. The coal is of a woody structure and lacks any pronounced fece or fracture cleats. In this case the bottom cut is made and both ribs sheared first. The saw blade is then sumped in at the top of the seam near the center of the place and withdrawn, thus providing a slot into which the breaker pad is inserted and the full cut of coal dislodged. A third shear cut is then made in the center of the place and followed by a horizontal cut about half way up the seam. In making this last horizontal cut the saw blade is tilted up slightly toward the back of the cut and as the saw proceeds across the place the upper bench of coal keeps breaking off at intervals of about every two feet and slides forward onto the floor. This creates a very favorable preparation and the miners state a preference for loading sawed coal, even though the loading rate is 3½c per ton less than for shot coal. Their loading capacity has increased 1.14 tons per day and they are able to obtain more weight on the cars because they have enough large lumps to put a top on the cars. The type 6-A track mounted saw is used at this mine and has a capacity of 220 tons per 7 hour shift. This is about the same as the shortwall machine and the rate paid the crews is the same in both cases. Maintenance costs have amounted to 1.12c per ton including material and labor for tipping the saw chains, oil, grease,

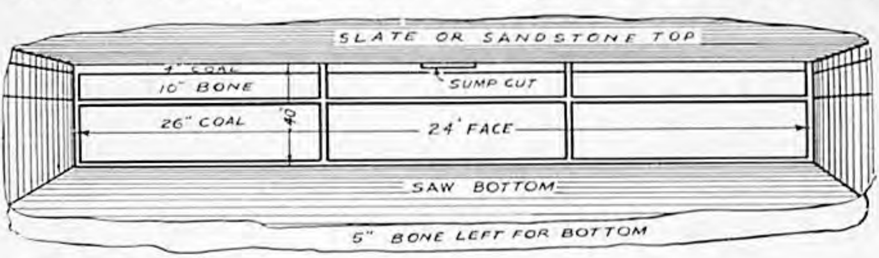


Plate No. 3
System of Sawing Pocahontas No. 3 Seam, Type 6-A Track Mounted Coal Saw, 190 Tons, 7 Hour Shift

repair parts and labor. Two saw chains are required to cut 15 places per shift.

Sketch No. 3 illustrates the method used at another mine in the same field. This is the Pocahontas No. 3 Seam, whereas the other was No. 4. The sawing cycle is practically the same. The middle horizontal cut separates the 10 inches of bone from the coal at the bottom of the bone where there is no natural cleavage plane. The top 4 inches of coal parts freely from the bone during the loading process. The bone is accordingly gobed by the miner whereas before it was broken up, by the explosive, and an average of 1,100 pounds loaded in each 3½ ton car and hauled to the surface where the cleaning plant was depended upon to take it out. This resulted in a very substantial reduction in haulage costs and a reduction of 2 per cent in the ash content of the ½ inch slack. The loading rate is the same for sawed coal as for shot coal because of the additional labor of gobing the bone that is now imposed on the miner. No tonnage rate has as yet been established for the saw crew but it is expected that it might be 1c per ton more than the shortwall machine rate. Tests revealed that the degradation which occurred in a 2 ton truck load of sawed coal transported over a rough road for a distance of 15 miles was 25 pounds as compared with 400 pounds for shot coal under the same circumstances and conditions. This is a tremendous market advantage that greatly reduces sales resistance.

Sketch No. 4 is another example of a system as applied in a mine operating the Sewell Seam also in Southern West Virginia. The type 6-A saw is used and has an average of 300 tons per 7 to 8 hour shift.

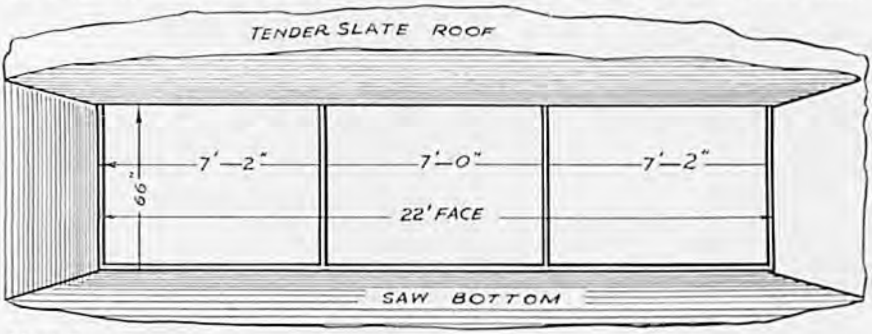


Plate No. 4

System of Sawing Sewell Seam, Southern West Virginia, Type 6-A Track Type Saw, 300 Tons Per Shift

The loading rate is 3c per ton less for the sawed coal than for shot coal at this mine. Loaders on the sawed sections have actually refused to load shot coal. In about 50 per cent of the places the cut sets down after the bottom cut is made and both ribs sheared. When this occurs the saw crew receives 7c per ton. If the cut does not set down the Breaker Pad is inserted in the top of the shear cuts and inflated to move the blocks of coal sidewise and thus loosen them from the top and back of the cut. In such instances the saw crew is paid at the rate of 8c per ton. Sometimes the saw blade is sumped in at the top and the breaker pad inserted there to break the coal down as referred to in Sketch No. 2. The shortwall machine rate at this mine is 6½c per ton or 1c per ton less than for the average rate on the sawed coal. The coal saw has been operating in this mine for 9 months and it is believed that a lower sawing rate will be obtained at a later date. Thus far repair costs for the saw have been negligible.

Sketch No. 5 covers a mine in Southeastern Kentucky operating the Elkhorn No. 6 Seam. Being a cap-

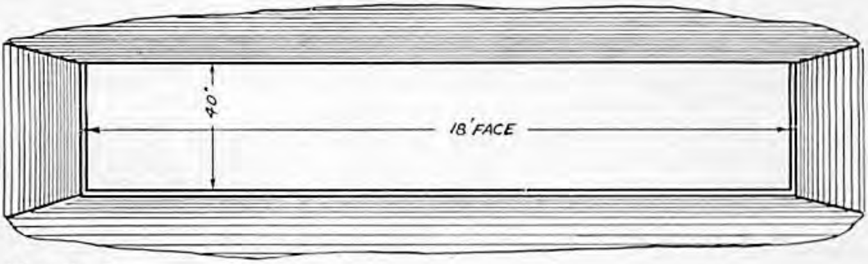


Plate No. 5

System of Sawing Elkhorn No. 6 Seam, Eastern Kentucky, Type 6-A Track Saw, 400 Tons Per Shift

tive mine slack is no problem but the saw is used as a means of obtaining lower cutting costs and the use of less explosives to dislodge the coal. The type 6-A saw is used to undercut the coal and shear both ribs. It requires an average of 20 minutes to do this or about ⅔ the time required for the shortwall machine to make one cut across the bottom. After the sawing cycle is completed two holes are drilled as shown and one stick of powder used in each hole to dislodge the coal. This compares with 3 holes and 5 sticks of powder for the regular machine cut coal. In the narrow 14 foot entires only one hole is used and one stick of powder to shoot the place. Ten places have been sawed with one saw chain at this mine as compared with 4 places to a set of mining machine bits. The miners show a preference for loading the sawed places but as yet no differential has been established in the loading rates.

Sketch No. 6 shows another method of sawing as used at a mine in

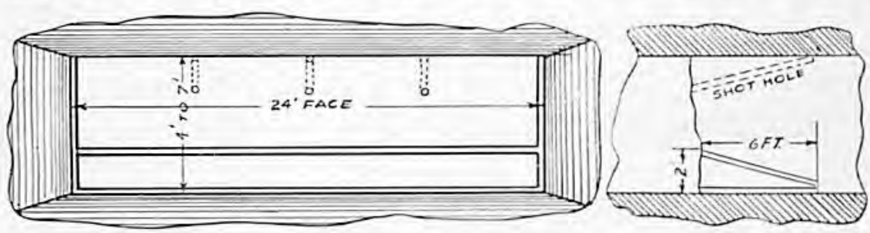


Plate No. 6

Sawing and Blasting Pittsburgh No. 8 Seam and Experimented with in Indiana No. 5 Illinois No. 6 Seams

Eastern Ohio operating in the Pittsburgh No. 8 Seam and also during special trial tests in Indiana and Southern Illinois mines. After the bottom cut is made the saw blade is elevated 6 to 12 inches with the point of the blade tilted downward in a manner that it will intersect the bottom slot at the back of the cut. This gives a snub effect and serves to roll the coal over when dislodged with explosives. By the addition of shear cuts at each rib this method serves exceptionally well for loading machines because it avoids loader delays caused by tight corners. In the Southern Illinois mine to which I have made reference this last mentioned method was applied where loading machines were in use. The result was 30 tons of coal per pound of powder used for the sawed coal as compared to 8 tons per pound of powder for the regular machine cut coal.

This same method was used in an Indiana mine where Joy Loading Machines were used to load the coal. The seam is 7 feet thick. Three holes were about equally spaced across a 24 foot room and a total of 2½ sticks of powder used to shoot the coal. This compared with 5 holes and 9 sticks of powder for the regular machine cut coal.

We have learned that no matter how lightly the coal is shot or how small the charge it has a shattering effect on the coal. The result is excessive degradation of the product while being handled and transported to market. When coal saws are first installed in a mine it is necessary to advance the working places into the solid a distance of 20 to 30 feet without the use of any explosive before powder stains and shattered coal disappears.

While our experience in sawing coal to be loaded mechanically has been brief we are at present of the opinion that to obtain the most satisfactory results some combination of sawing and shooting will be necessary. We believe Air Shooting will serve this purpose remarkably well because it does not shatter the coal and will therefore permit the highly mechanized mine operator to reap the full benefits from coal saws that are being derived at the hand or conveyor loading operations.

Sketch No. 7 shows the method of sawing adopted at a mine operating in the 5th vein central Illinois field. The coal is dislodged by the Hydraulic

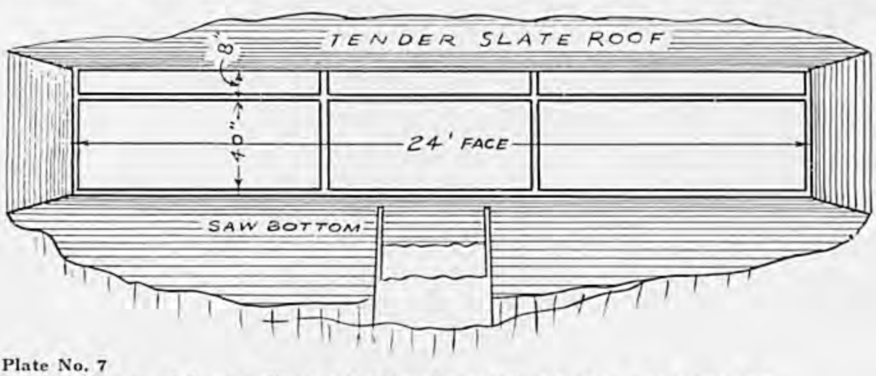


Plate No. 7

System of Sawing Illinois 5th Vein, Central Illinois, Type 6-A Track Saw, 150 Tons, 7 Hour Shift

Breaker Pad and loaded by hand.

What has been said of the shattering effects of explosives on the coal is equally true with respect to the roof. Sketch No. 8 illustrates a condition in a mine operating the Pittsburgh Seam in Western Pennsylvania. This coal company abandoned a large

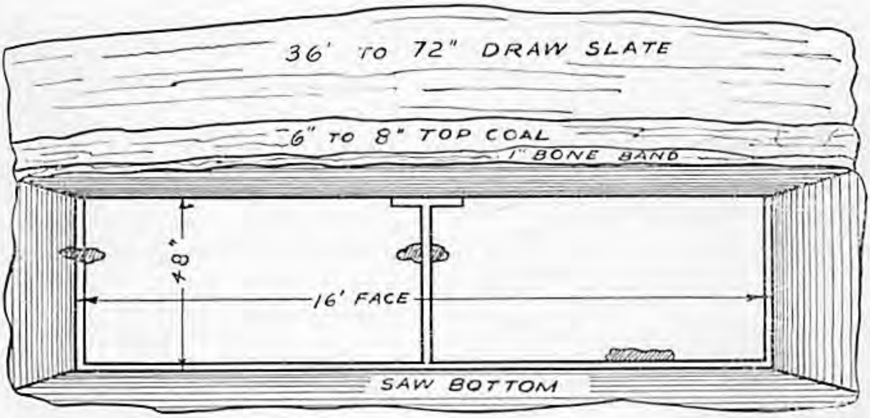


Plate No. 8
System of Sawing Pittsburgh No. 8 Seam, Western Pennsylvania, Type 6-A Track Saw, 175 Tons, 7 Hour Shift

acreage of coal 15 years ago because of the expense of handling a heavy Draw Slate which usually came down when the coal was shot. This slate ranges from 36 to 72 inches thick and when mixed with the coal it was a difficult task to clean. A type 6-A coal saw has now been operating in this mine since last August and by the method shown the Draw Slate has been held in place and the mine operated every working day since. You will notice the thin band of bone and the 6 to 8 inches of top coal are left up to help support the slate and keep the air from causing it to slack. Up to the time of this writing not a single place has been lost since the coal saw was placed in service. Hard sulphur balls are very frequent in the coal. It is seldom that a horizontal or vertical cut is made that the saw does not pass through one or more of these sulphurs. Two places and sometimes three are cut with a saw chain as compared to 2 sets of bits per place with the mining machines formerly used. The average for the saw at the present time is about 175 tons per 7 hour shift. The loading rate is 4c per ton less for the sawed coal and the rate paid the saw crew is 1c per ton less than the rate for machine cut coal at this mine. The mine furnishes railroad fuel and crushes the lumps to minus 4 inches. The only object in using the saw was to improve the roof condition.

There are many other subjects pertaining to coal saws and their application to different conditions which I believe this audience might be interested in. However, lack of time will not permit dwelling on them in detail. The principal advantage that will apply most generally is the increased realization that may be obtained from increasing the percentage of prepared sizes and improving the firmness and quality of the product to reduce sales resistance. In case of the high volatile coal seams 1¼ to 2 inch slack is generally reduced to half what it formerly was and in the low volatile seams the ½ inch slack is reduced by about ⅛ to ¼. Usually the realization increases 1c per ton on total output for each percent of reduction in slack.

The results obtained from the use of Coal Saws in other fields convinces us that these machines are destined to play an important part in the future mining of Illinois coal. We realize, however, that those operators mining the thick seams in this field and especially those operating the highly mechanized mines, desire a deeper cut of coal than our standard coal saw will permit making. There are no mechanical difficulties to hinder the production of such a machine. Therefore, its development and introduction can be realized when there is an indication of sufficient interest in the equipment to justify the expense of doing so.

C. J. Sandoe: Those of you here who were in Cincinnati saw the machine. But if there are any questions you would like to ask, I am sure Mr. Joy will be glad to answer them.

Harry Treadwell: The present type of machine is more or less rigid and swings away from the track. I am wondering if Mr. Joy's company is figuring on building a more flexible machine.

Joseph F. Joy: I think I am stating the policy of the Sullivan Machinery Company when I say that we are contemplating the building of the type of machine you speak of.

C. J. Sandoe: If there is no more discussion, the next paper will be presented by Mr. Fred Miller on "Use of Air in Breaking Down Coal."

AIR-MINING — THE USE OF AIR FOR BREAKING DOWN COAL

By FRED A. MILLER
Franklin County Coal Co., Herrin, Ill.

The Process Defined

The compounding of the two words, common to the glossary of mining terms—coins a phrase which is truly descriptive of this new development in the science of face preparation—that phrase is "Air-Mining."

Air-Mining cannot be classed in the category of explosives, yet it is used for the same purpose. Basically, the process depends upon the sudden release of a large volume of compressed air from a relative small container previously tamped in the drill hole. Pressure and volume are definitely controlled and are used only in sufficient amounts to break the coal down in a pile loose enough to be consistent with good practice.

How It Acts

The sudden release of air in the drill hole produces a shock much less severe than that which accompanies the detonation of an explosive charge. The first impulse of the expanding air is wedge-like or lever-like in action and the continued expansion literally pushes the coal away from the face. It is therefore void of the disruptive and shattering effects on a friable product such as coal.

The History of Air-Mining

Air-Mining was developed and first applied at the Royalton mine of the Franklin County Coal Company, Inc. It has been in production there for the past three years. At the present time 80 per cent of the mechanical tonnage or 40 per cent of the total mine production is Air-Mined coal.

The Equipment

The equipment as now used at this property consists principally of two parts: one, a mobile compressor capable of building and maintaining a pressure of 12,000 pounds per square inch, and two, a container or air bottle for storing the required amount of air in the drill hole.

Air-bottles may vary in size and method of air release, but must have sufficient volume and should have a discharge opening large enough to empty the bottle as quickly as possible. These two features are of paramount importance in bottle design.

Those used at Royalton are renewable disc type with a volume of approximately 400 cubic inches. They are made of 5 inch steel tubing closed at one end and are 4½ inch I. D. with 2⅝ inch discharge opening and vary in length from 12 to 38 inches. The volume of course varies with the length and this varies with the depth of the undercut and the amount of work to be done by any one hole. The discharge opening is offset in the bottle head to allow the entrance of air through a ¼ inch copper tubing.

The disc is held in place against a sharp seal ring by a clamp nut screwed into the bottle head. The clamp nut also acts as the discharge opening and is directed away from the face toward the mouth of the drill hole. The reaction of air when released forces the bottle against the solid face and thereby avoids the hazard of flying. Pressure is controlled in this type of bottle by using thicker or thinner discs as conditions may warrant. We use discs of 12 and 13 gauge metal. These shear at about 6,500 and 5,500 pounds per square inch respectively.

Method of Application

The addition of an Air-Mining unit does not change the cycle of face operation. Places are undercut and drilled in the regular manner. The number of holes and their location in the face depends upon conditions and the type of loading equipment used, and is determined by trial and error. It is our practice to use 3 bottom and 3 top holes in places 28 to 30 feet wide and 2 bottom and 2 top holes in entries and narrow places 12 to 14 feet wide. Empty bottles are placed in the holes and tamped, leaving a short length of copper tubing protruding from the hole for connection to the compressor air line. After all holes in the place are ready, the compressor moves in and stops about 70 feet from the face. The air line is connected to the bottle tubing and the compressor started. Air is forced into the bottle until the disc is ruptured and the compressed air released. This operation generally requires 2½ minutes. The compressor is stopped —the operator goes to the face, connects to another bottle and carries the discharged one back to the compressor. This cycle is repeated until all bottles are discharged and the place is ready for the loader. The second man of the crew, who also acts as trip rider and general helper, inserts a new disc in the discharged bottle and makes it ready for use again. The Air-Miner and its crew then moves to the next place, and the operation is repeated.

In our mining practice two compressor shifts keep four mechanical loading units supplied with coal. The day shift operation is continuous and serves two loading units located on opposite sides of a panel entry. At night the same compressor operated by another crew, makes coal for the other two units in different territories.

Advantages and Disadvantages

Our experience in the development and application of Air-Mining has revealed several noteworthy features which we consider advantageous to the convenient operation of a coal mine. These are probably best cited by discussing the relative merits as compared to other processes used for the same purpose. Since our experience is limited to explosive and Air-Mining methods, the comparative advantages and disadvantages are likewise drawn between these two. The disadvantages of the process are cited first.

Disadvantages

1. To begin with a capital investment is required for equipment which in all probability is greater than the investment tied up in explosives at any one time. Note—To the best of my knowledge no definite price has been placed on equipment at the time of this writing.

2. Drilling may become more complicated because the holes are larger than those required for powder. The selection of more powerful drilling equipment overcame this difficulty in our case.

3. The addition of an Air-Mining unit adds another piece of mechanical equipment to the mine and consequently means more work for the inspection and maintenance staff.

4. The compressor naturally puts another load on the power system. The demand may vary from 30 to 60 K. W. depending upon the pressure and speed at which it is developed.

5. Upon installation this additional equipment is apt to congest the haulage system somewhat, although this feature is not serious, it is inconvenient until the personnel becomes accustomed to the schedule of movements.

And now for the advantages of the process.

Advantages

1. One of the most important features of Air-Mining is Safety. In addition to eliminating the hazards and evils associated with the storing, handling and use of explosives, it is important to note that loose coal hanging to the face and ribs of an Air-Mined place is almost entirely eliminated. The danger of loose coal falling on machine men, drillers and other face employees is reduced to a minimum. The equipment is never in a charged or dangerous state when handled. It is inert until the compression period is started. There is no receiver on the compressor—the bottle tamped in the drill hole acts as the receiver. The air lines are of copper tubing or high grade alloy steel—should one of them burst under pressure the volume of air released is too small to be of any consequence. The operator and helper are protected from flying coal by shields erected at their respective stations.

2. The mild action of compressed air, as compared to explosives, gives utmost consideration to tender roof conditions. We have made no tests with precision instruments to determine the difference in roof shock, yet

FIRST TEST

Sizes	Powder-Mined	Air-Mined
Refuse	6.40%	6.10%
6″ Lump	11.55%	28.60%
6x3 Furnace	18.30%	17.85%
3x2 No. 1 N.	10.85%	8.65%
2″ Scgs.	52.90%	38.80%
Total	100.00%	100.00%

SECOND TEST

Sizes	Powder-Mined	Air-Mined
6″ Lump	14.60%	24.00%
6x3 Furnace	18.25%	21.50%
3x2 No. 1	11.45%	8.65%
2x1½ No. 2	7.75%	9.40%
1½x¾ No. 3	9.80%	10.35%
¾x5/16 No. 4	15.75%	8.60%
5/16x0 No. 5	22.40%	17.50%
Total	100.00%	100.00%

it is significant to note that Air-Mining methods reduced roof falls substantially as compared to powder-mining methods in the same territory.

3. Air-Mining produces a greater percentage of large size coal at the expense of the finer sizes. The preceding table shows results of specific screen tests and are indicative of the range of sizes which can be obtained by use of the process:

To those of us interested in increased realization by the production of more big coal, this feature is attractive.

4. Air-Mined coal is firm and subject to less degradation on handling. First, because it is dislodged in a much more gentle manner at the face and second because it is not filled with minute powder cracks which cause breakage and rapid weathering. Those of you who handle customer complaints will appreciate the fact that Air-Mined coal stores better and is therefore more desirable in domestic sizes.

5. In Air-Mining the tamping consists of moist drill cuttings; there is no ash bearing material added to the coal pile as in the case of powder-mining where incombustible stemming is recommended.

6. Air-Mining is accomplished on the working shift and where state mining laws prohibit the firing of shots on shift, this feature is especially attractive. It makes possible the advancement of a working face more than one fall per shift, which, under Illinois law, is impossible with explosives.

7. Air-Mining allows a mechanical loading unit to be confined in fewer working places. While this feature is dependent on conditions, it does offer possible savings in material by better concentration.

8. As a general rule there is less digging for the loader to do in an Air-Mined place than in a powder-mined place. In our attempt to obtain the best grade of coal possible with permissible powder, we have experienced difficulty in loading because the coal has a tendency to merely drop-down in the space formerly occupied by the kerf. This coal is thoroughly and completely shattered, yet it remains in a more or less standing condition and is sometimes hard to load.

9. Air-Mining is not a labor saving process. The greater part of the money ordinarily spent for explosives is spent on labor. This fact has a favorable bearing on the attitude of the men and the introduction of Air-Mining equipment is viewed with much less disfavor than the introduction of some other mechanical equipment.

10. Air-Mining is economical. We realize the impossibility of comparing costs on anything unless we talk of the same items and all sets of figures are reduced to a common basis. The charges which constitute our operating costs for the same work under both methods are composed of the items shown on the following page.

Total Operating Cost

Under Operating Labor, drilling in both cases is the same.

Shotfiring labor and labor required for delivering powder is chargeable only to powder-mining, while compressor labor is an item of air-mining only.

Operating Supplies in the case of powder-mining consists of powder, caps, fuse, drill bits and sundry items such as tamping bags and tools. In air-mining this same charge covers discs, tubing, drill bits and similar sundry items.

ITEMS	POWDER-MINING	AIR-MINING
Operating Labor—		
Drill Labor	X	X
Shotfiring	X	
Handling Powder	X	
Compressor Labor		X
Operating Supplies—		
Blasting Supplies	X	
Air-Miner Supplies		X
Repair Labor—		
Drills	X	X
Compressor		X
Bottles		X
Repair Supplies—		
Drills	X	X
Compressor		X
Bottles		X

Repair Labor and Repair Supplies to drills cover the same items under both processes, while Repair Labor and Repair Supplies to compressor and bottles are items of air-mining.

No mention is made of the cost of investment since this may be handled in a number of different manners.

The cost of power is likewise omitted since our costs include all power under a separate schedule.

So, without attempting to assign a dollar and cent value to any of the advantages or disadvantages of either method but pitting only like charges against like charges, the economy of air-mining is evidenced by the fact that our air-mining operating costs are not only comparable to our powder-mining costs but in recent instances we have even bettered them.

When we consider that these costs and conclusions are compiled from operating data obtained by use of the first two compressor units ever built for this service and knowing that air-mining costs are largely dependent on compressor performance, we have good reason to believe that improved compressor design and construction, together with natural improvements in process application, can and will substantially reduce these costs in future operations.

C. J. Sandoe: I am going to ask Mr. Skinner of Standard Coal Company of Wheatland, Indiana, to give us some of his views on air shooting.

S. E. Skinner: The only thing I can tell you on air shooting is just what I have observed at our own property. We have one air shooting unit at our plant. Mr. Miller uses a larger shell at his plant than we use.

We have found air shooting to be a very satisfactory method in dislodging coal. We have a 6 foot undercut in 8 or 9 foot coal, and the only difficulty we have run into is keeping our track up to the coal face, and we are attempting to overcome that by cutting our coal with a caterpillar type cutting machine.

There is only one suggestion I would want to make to the manufacturer of the air machine, and that is to make it easier to move from place to place.

C. J. Sandoe: If there is no more discussion on Mr. Miller's paper we will proceed to the third paper of the afternoon "Versatility of Permissible Explosives," by R. Y. Colclesser.

VERSATILITY OF PERMISSIBLE EXPLOSIVES

By R. Y. COLCLESSER
Technical Representative, E. I. du Pont de Nemours & Co.

As applying to permissible explosives, we would define versatility as the faculty of providing a safe force for the dislodgment of coal under the many conditions which occur in coal mining. This is indeed a wide and varied field when it is considered under just what conditions permissibles have been asked to break the coal in a manner such that it can be loaded.

In some instances, we find the coal is neither undercut nor sheared and the permissibles are used to blow the coal out of the solid. In other cases the coal is undercut. Some operations both undercut and shear. In still others the coal is top cut.

In order to fit in with the cycle of operations at the different mines, we find many different arrangements are made in the drilling and shooting: (1) The Coal may be drilled and shot by each individual loader; (2) the Coal may be drilled by the loader and shot by a shot firer who comes to the working face either on the shift or at night after the miner leaves his working place; (3) the coal may be drilled and shot by the Company men and the coal loaded by the miner; (4) the coal may be drilled and shot by the Company and loaded with some mechanical device.

In addition to all of the above, we have the seams of coal with their various heights, textures and percentages and kinds of impurities. They might even be further classified as to dry and wet work.

The explosive manufacturer in order to make the permissible really versatile in the true sense of the word to comply with these conditions has found in the first place that the explosives must be supplied in such a form that it can be placed in the bore hole to the best advantage. In other words, in each seam of Coal there is a certain length of explosive in the bore hole which is the most efficient. This can be adjusted by the different diameters of Cartridge. As commonly used, the diameter of permissible explosives varies from 1⅛" to 1¾". Where the coal is drilled by hand, this Cartridge diameter is somewhat determined by the ease with which drilling can be done. In hand drilling a piece of coal, extra labor is involved in a large diameter hole and more impurities are encountered in the drilling. Often in hand drilling the execution of the explosive may be somewhat impaired in order to cut down on the labor of drilling. Hence the necessity for the different diameters and the explosive content must be such that the permissible is satisfactorily sensitive in the small as well as the large diameter Cartridge.

Next there is the question of density; in other words, the Cartridge Count of the explosive per 50 pounds of explosive. To fit in with the different seams of coal with maximum efficiency it has been found necessary to vary the density of the permissible. Different cutting methods may require the consideration of density. Finally, actual results would indicate that, other conditions being the same, mechanical loading would require a different density of permissible when mechanical loading displaces hand loading. At the present time we are furnishing ammonia nitrate permissibiles which range in density from 100 Cartridges 1¾ x 6 to the 50 pounds to 180 Cartridges 1¾ x 6 to the 50 pounds. As originally made the permissibles were nitroglycerine types and the flame was quenched by the addition of either free water or salts containing a high percentage of water of crystallization. These were not very satisfactory in execution and the ammonia nitrate type has displaced them almost entirely. However, the ammonia nitrate type of permissible has its limitations for it is susceptible to moisture in the bore hole. A permissible list composed entirely of ammonia nitrate permissibles, is not, therefore, what could be called versatile. For conditions of excess moisture we have the gelatin type permissibles. These are water resisting and do not lose their strength or their permissible qualities when placed in contact with water. In addition these gelatin permissibles are stronger per unit of volume than the ammonia permissibles. They are well adapted to rock work encountered in coal mines. With them we have an efficient agent for shooting rock in a dusty or gassy mine.

Permissible explosives give off less smoke than any other type of coal mine explosive. This property is especially important where miners return to the face and load coal after shots fired on the shift. It is this high rating in fumes which causes many mines to use permissible which would ordinarily use black blasting powder. In order that a selection of permissibles may be made on the basis of fumes produced, the U. S. Bureau gives the ratings of A, B or C on all permissibles listed by the Bureau. Another factor which has contributed to the versatility of permissibles is the different detonating speeds. The proper detonating speed of permissible for a seam of coal is determined by trial. It is a fallacy to say that every coal seam is necessarily worked to the best advantage by the permissible having the lowest detonating speed in the Bureau of Mines list. At the present time, we are furnishing permissibles varying in detonating speed from 5940 feet per second to 14,970 feet per second.

Regarding the firing of permissible, it may be fired with either an electric blasting cap or cap and fuse. Neither method requires much equipment. In connection with electric firing at the present time, electric blasting caps are being furnished with shunt or short circuited wires to eliminate hazard from stray current in the mine. The electric firing of permissible explosives may be taken advantage of where a number of shots are to be fired at one instant in order to get best efficiency on certain types of work.

As to storage in the mine, the permissible affords a form of energy which may be stored in a very small quantity in each working place or may be stored in one central magazine. It may be carried in a knapsack by the shooter to the working face without interfering with transportation of coal or mechanical equipment.

In considering the versatility of permissible a very important item is the cost per ton of coal shot with permissible. The present permissible explosives have proven to be a very economical agent for the purpose of shooting coal. In addition the investment incurred is only proportional to the amount of energy necessary to shoot the coal in the mine for a comparatively short time.

It was the property of safety in a dusty or gassy mine which originally gave it the name of permissible explosive and in all modifications to meet varied conditions, the permissible feature is not violated. Each permissible is furnished of such quality that when loaded in the bore hole at the mine it will detonate in such a manner as to make it safe for use in a gassy or dusty mine.

In this paper I have endeavored to bring to your attention some of the characteristics which make permissible explosives a versatile force in the shooting of coal under the conditions as they are encountered in coal mining. The modern mine has shown great progress in the methods employed in mining coal and the permissible explosive has been developed and improved to keep in step with these changes.

C. J. Sandoe: Is there any discussion on Mr. Colclesser's paper? If not, we will finish our program at this session, as we have decided to continue this meeting and have everything over with this afternoon, as you know we will be unable to make the trip through the penitentiary at Chester and have plenty of time. So we will now have the presentation by Prof. D. R. Mitchell, University of Illinois, on curriculum of the University Mining School.

MINING ENGINEERING AND EDUCATIONAL PROBLEMS PERTAINING THERETO — A CATECHISM

By D. R. MITCHELL
Assistant Professor of Mining and Metallurgical Engineering,
University of Illinois, Urbana, Ill.

What is Mining Engineering? Mining Engineering may be defined as that part of the engineering profession dealing with the application of scientific and technical knowledge to the problems of discovery, exploitation, design, development and operation of coal, oil, metallic and nonmetallic mineral deposits. A well-qualified mining engineer must have abilities and training, not only in mining, but in many sciences and other branches of engineering. He must sometimes be a manager, as well, able to conduct complex and exacting business and banking operations.

Have the duties of a Mining Engineer always been broad? Yes. Agricola writing in his famous book "De Re Metallica" published in Latin in 1556 gives his opinion of "what a **miner** should know," the term miner being used in the sense mining engineering is used today. His remarks are briefed as follows:

Geology; "that he may know what mountain, what valley—can be prospected most profitably." Chemistry and mineralogy; "that he must be familiar with the many varied species of earths — metals — compounds." Mining; "he must have a complete knowledge of making all underground works." Metallurgy; "Lastly, there are the various systems of assaying and of preparing substances for smelting." General Sciences; "there are many arts and sciences of which the miner should not be ignorant. First, philosophy, that he may discern the origin, cause and nature of sub-

Assaying Ores for Gold and Silver

terranean things. Second, medicine, that he may be able to look after the health of his diggers. Third, astronomy, that he may judge the direction of the veins. Fourth, surveying, that he may be able to estimate how deep a shaft should be sunk. Fifth, arithmetical science—that he may calculate the cost in the working of the mine. Sixthly, architecture, that he himself may construct the various machines and timber work required underground. Next, he must have a knowledge of drawing. Lastly, there is the law . . ."

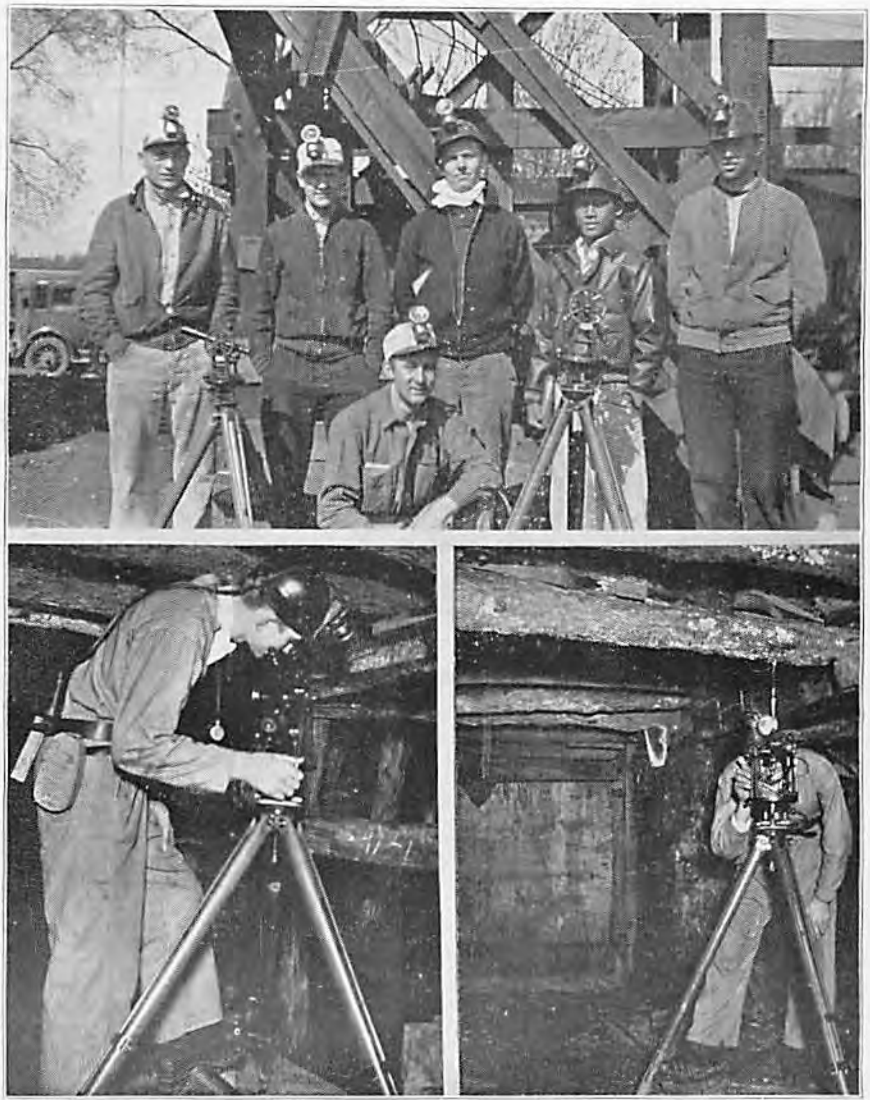
Have the duties of a Mining Engineer changed materially during the past 30 years? Fundamentally, no. Years ago it was expected that the mining engineer would do all the engineering work involved in the operation of a small property, whether it was civil, mechanical, electrical, or chemical and manage the business affairs. With the growth of large corporations many branches of engineering are used and there is an increasing tendency toward specialization in various fields of mineral production, preparation, marketing and utilization.

What Relation does the Mining Engineer have to the other engineering professions involved in mineral production? In general the use of engineering talent for mineral production can be classed as follows:

The Civil Engineer—for construction purposes.

The Mechanical Engineer—for better machinery.

The Electrical Engineer—for efficient use of electrical power.



Class Work in Mine Surveying

The Mining Engineer—to learn and operate the business.

That the mining engineer has been successful in the general field of the business of production of minerals whether it be metallic ores, nonmetals, coal, petroleum or natural gas is apparent by the fact that so many of the managers, superintendents and higher executives of mining companies are graduate mining engineers.

Are there opportunities for specialization in mining engineering?

Probably more opportunities than

in any other profession, including medicine. The general practitioner is being replaced by various specialists although the mining engineer who specializes in management must be and is particularly adapted by training to correlate and utilize the findings of specialists in various departments of his organization. However, the engineer who is particularly interested in some special technology has plenty of opportunity to specialize. Geophysical prospecting, ventilation, haulage, mining methods, mechanical and electrical applications, coal preparation and ore dressing, safety, and economics are all inviting fields.

Is there any pronounced characteristic of the field of minerals as compared with other commodities? Yes. Tryon[1] states that: "There are four distinguishing facts about minerals—localized occurrence, uncertainties of discovery, tendency to increasing cost and to a lesser degree accumulation of stocks—that cut across all problems involving the minerals. They cut across national defense, labor relations, tariffs, taxation, price movements, laws of property rights, production control, valuation and management of the public domain. Suffice it that wise decision on any one of these questions requires a peculiar type of training to understand and evaluate. It involves a knowledge of the resources and puts a premium on mining engineering, geology and mineral economics." "That is why, no doubt, the professional economist has passed the field of mineral economics by and why most of that which has been done comes from the technicians."

"We who work in the world of minerals are continually impressed with the individuality of its problems. It is a world where strong cross-currents are always flowing and he that fails to reckon with them may go far astray."

What opportunity has the mining engineer for foreign work? The current issue (1934) of the annual Directory of the American Institute of Mining and Metallurgical Engineers shows that members resided in 73 countries other than the United States. The editor of Mining and Metallurgy, in discussing this, points out the following: "It is true that 16 of the 73 countries are represented by a single member, but it is also true that 20 of them each has 20 or more resident members. This figure exceeds the corresponding number of countries that are thus represented in the membership of any of the other Founder Societies despite the fact that each of the three has a membership from two to three times that of the A. I. M. E. The following percentages show the proportion of the total membership of the four Societies that lives outside the United States: Mechanical Engineers, 5; Civil Engineers, 6; Electrical Engineers, 13; Mining Engineers, 30."

"With respect to the Mining Engineers, the preponderant number of the foreign residents are American citizens sojourning abroad in the practice of their profession, though the number of nationals of other countries is by no means negligible. The significance of these data is clear: Mining and metallurgical operations throughout the world are conducted primarily by American engineers, with British engineers (including those from the Dominions) constituting the only other group of importance. At that, they are not a particularly close second. Fortunately, and to the credit of the profession,

[1]F. G. Tryon, Mineral Ec. pp. 10 and 26.

nationality is allowed to cut little figure when it comes to the engineering side of the exploitation of minerals."

What effect has the depression had on employment? At Illinois we have had practically no unemployment of mining engineering graduates. Insofar as we know all of our alumni are working except this year's graduating class who, we believe, will all be placed during the summer months. The mining engineer has probably weathered the depression better than other professional groups.

What type of work do the graduates at Illinois usually follow? Employment by manufacturers of mining machinery and in other mine service industries, in metal mines, non-metallic mines, oil and gas production, and a few with coal producing companies.

Do most of the mining graduates at Illinois follow the profession of mining engineering? Approximately 95% of our graduates are engaged either directly in mineral production or some closely allied line such as with mining machinery manufacturers.

How does that compare with other engineering professions? Reliable estimates for some of the more popular engineering courses show that from 20-50% of the graduates follow their profession.

What is the relation of number of students in mining schools to the annual value of mineral products in the various states? Dean Steidle of Pennsylvania State College analyzed this situation in 1929 and reached the conclusion that in some sections of the United States there was a striking lack of technical students in process of being trained for mineral industry positions. His figures giving the number of students enrolled per each ten million dollars of primary mineral products in the same state, follow:

North and South Dakota	70.0
Colorado	19.8
New Mexico	18.1
Washington	16.5
Idaho	14.8
Missouri	12.0
Michigan	9.5
Montana and Wyoming	9.1
Nevada	8.0
Wisconsin	7.1
Minnesota	5.8
Arizona	3.2
California and Oregon	3.0
Pennsylvania	2.4
West Virginia, Kentucky, Virginia, Alabama, Georgia and North Carolina	2.0
Illinois, Indiana, Iowa, Kansas	0.5
New York and New Jersey	0.5

Students in metallurgy proper, ceramics, coal-processing, oil refining, mining, quarrying, oil and gas production are included in this tabulation.

Is there a need for mining engineers in the coal industry? There appears to be a need but practically no demand. Metal mining companies allow from 4 to 6 per cent of their total expenditures for engineering design, supervision and research. The building industries commonly use about 5 per cent and in some cases as high as 10 per cent. The coal industry is a highly technical industry that involves the expenditure of large sums of money and it appears to many of us that every dollar of this expenditure should be regulated and controlled by engineers, whether it be for production, preparation or research. It is true that the anthracite producers and certain eastern operators are spending probably as much for engineering services as the metal mining companies but bituminous operators in general are spending less

Laboratory Instruction in Mine Lighting and Mine Safety

than 1 per cent and some spend practically nothing for engineering.

One important oil company that operates in the Mid-Continent field and for which I have the information, is spending a little more than 6 per cent of its annual gross expenditure on engineering.

Is the field of mining engineering oversupplied? It appears not. Mr. Howard N. Eavenson, a prominent consulting coal mining engineer and President of the A. I. M. E. is quoted, on the editorial pages of the May, 1934, issue of Mining and Metallurgy: "During the past five years, and in some respects for longer than that, only one great industry has suffered more from the depression than mining. Only the farms have had greater losses and have given less return than the mines. This condition has not been an attractive one for our young men and consequently the number of students taking mining courses has decreased. The mining students of today are the mining engineers of the future, and the present situation is not a reassuring one for the older men in the profession, many of whom have been through a number of depressions and who forsee, in the not far future, a dearth of trained men capable of filling executive positions in the industry." "The Institute wants to keep those who are now taking mining courses **in the industry** and to attract more men of high calibre to our colleges and universities."

How does enrollment in mining courses at the present time compare with previous years? There has been very little change at Illinois during the last five years. In fact, at Illinois, the enrollment is slightly higher than it was in 1930 but is only half what it was 10 years ago. We have practically no one taking coal mining. Our students apparently feel that there are more opportunities in fields other than coal.

Professor Plank of Lafayette College at Easton, Pennsylvania, has made a careful study of the trends in enrollment in Mineral Technology courses and expresses the opinion that by 1937 there will be a marked dearth of competent and adequately trained professional engineers, particularly mining engineers. The following table gives the enrollment in the 46 institutions offering mineral technology courses.

Enrollment in Mineral Technology Courses

	1921-22	1932-33	1933-34
Mining	3,256	1,393	1,161
Metallurgy	239	1,288	937
Petroleum and Natural Gas	2	726	681
Ceramics	156	522	629
Geology	17	387	438
Fuel Technology	----	67	70
Not Differentiated	----	60	79
	3,670	4,443	3,995

What is the occupation of the fathers of the boys taking mining? For the year 1933-34, 24 students were registered in mining engineering at Illinois who listed their father's occupation as follows:

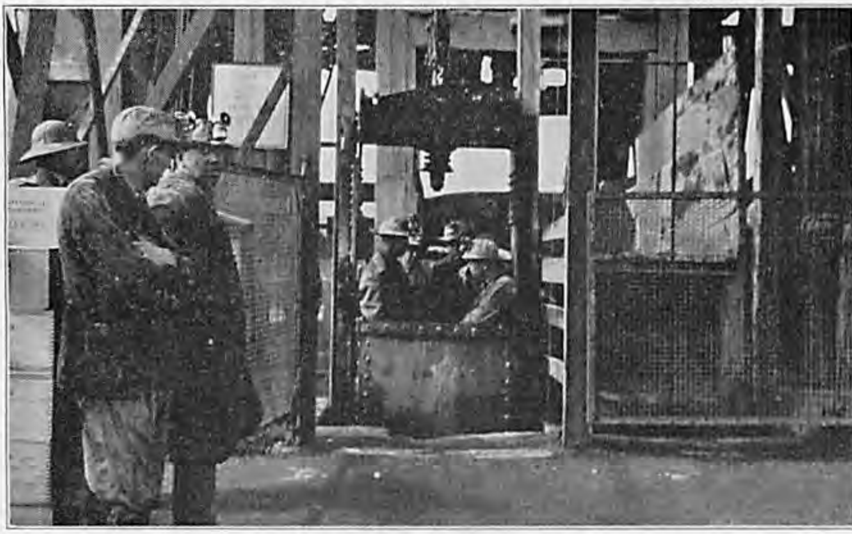
Father's Occupation	No.
Metallurgical Engineering	1
Mechanical Engineering	1
Editors	2
Real Estate	1
Clerk	1
Cashier	1
Merchant	2
Doctor	1
Skilled labor	2
R. R. Engineer	1
Barber	2
Office Manager	1
Farmer	4
Laborer	1
Mine official	2
Miner	1
Total	24

It is apparent that boys with a mining background are not interested in mining engineering as a profession.

What type of work do boys from mining families take at college? One hundred one boys were registered this year at Illinois who gave as their fathers' occupation either miner, mine official, executive or owner. They were distributed in the various colleges in the University as follows:

Mine Officials, Executives or Owners, 28; Miners, 73; Total, 101

	Med.	P. E.	Eng.	Agr.	Com.	Dent.	Phar.	Jour.	Fine and App. Arts	L. A. S.	Law	Educ.	
Officials	2	1	7	1	2	2	0	1	2	9	1	0	28
Miners	3	6	16	4	10	2	0	1	1	24	4	2	73



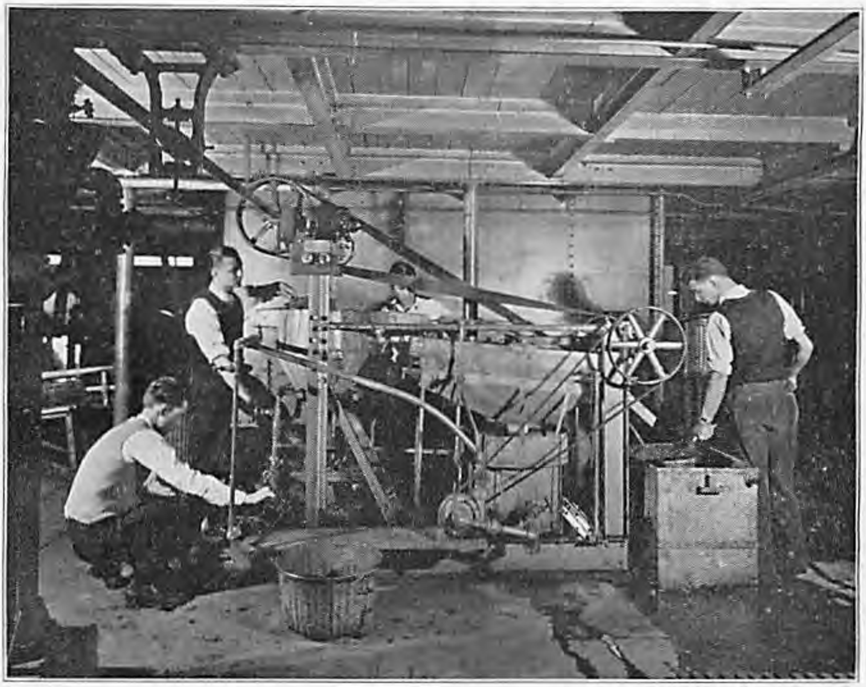
Senior Mining Engineering Students on Inspection Trip to Fluorspar Mine, Hardin County, Illinois

Is mining engineering passing? If we take the biologist's principle that the more specialized forms of life tend to disappear while the general types endure, then the mining engineer with his broad training should be particularly fitted to adapt himself to changes. Fundamentals endure while freak educational policies usually have a short life. At Illinois, we believe that we are on the right track by stressing the fundamentals with a minimum of specialization. The place for specialization is in industry or in graduate work.

What is the biggest problem of the undergraduate student at Illinois? That of finding summer employment is probably the greatest. It is very important that students have summer employment in or around the mines if possible. Some companies co-operate in this matter and are of real service to the student. It is the only chance for the student to get acquainted with actual mining operations. Most of our boys must go outside the state in order to get the experience we so much desire them to have and which they are eager to obtain. A number of our students are working their way through school and the money they can earn at labor or other jobs is usually sufficient to pay their fees and by working for their room and board they are thus assured of another year on the campus.

Most of the summer jobs are in other states and in some instances the boys have had to go considerable distances to get jobs. We have sent boys to Arizona, Oregon, Oklahoma and even to mines in Canada. In 1930 one company in Oklahoma took four boys.

During the last three years it has been increasingly hard for students to find summer jobs. We were heartened this summer by a letter from one of the fluorspar companies in southern Illinois stating that they could put two boys to work underground.



A Class in Coal Preparation

I don't believe that any of our students have worked in or around the coal mines in Illinois during the summer months in recent years. There are two coal companies in the Pittsburgh district of Pennsylvania who often take a likely young man and plan on working him into their organization on graduation.

What are the chances for employment after graduation? We believe they are better than in most professions. All our graduates have jobs insofar as we know.

In the field of coal mining, we have had three inquiries for men during the past year with no one to recommend. The year before, I recall at least one request for a man with a coal mining company for which we had no one available.

What is the nature of the present day mining curriculum at Illinois? Mining education at the present time presents something of a paradox. It is general and fundamental yet at the same time increasingly leaning towards specialization. However, specialization is obtained by using electives in an orderly manner without disturbing the comprehensive, fundamental training desirable in the sciences and electrical and mechanical engineering. In fact the student electing the coal option in mining engineering can still specialize further in either electrical or mechanical engineering using the electives available in the curriculum. One of our recent graduates, who is making good in a big way with one of the large eastern coal operators, had nearly enough credits to get a degree in electrical engineering in addition to his mining engineering degree. Four options are available at Illinois in mining engineering—coal mining, ore mining, mine administration and mining geology.

In addition, a full curriculum in metallurgical engineering was established during the past year and is now in operation.

What Fields of Work are open for the Coal Mining Engineer? Graduates may enter the employ of coal mining companies in the egineering, operation or sales departments. Service organizations for the coal industry employ coal mining graduates for sales and demonstration purposes.

What Fields of Work are open for Ore Mining Engineers? Opportunities are available in various departments with ore mining companies, including engineering, mine operation, and ore dressing. Also, opportunities with service organizations in sales, demonstration, and engineering.

What Fields of Work are open for those Graduating in the Mine Administration Option? This option gives the student an opportunity to take considerable work in economics, accounting, finance and administration which particularly fits him for entrance into sales, and administrative divisions of the industry.

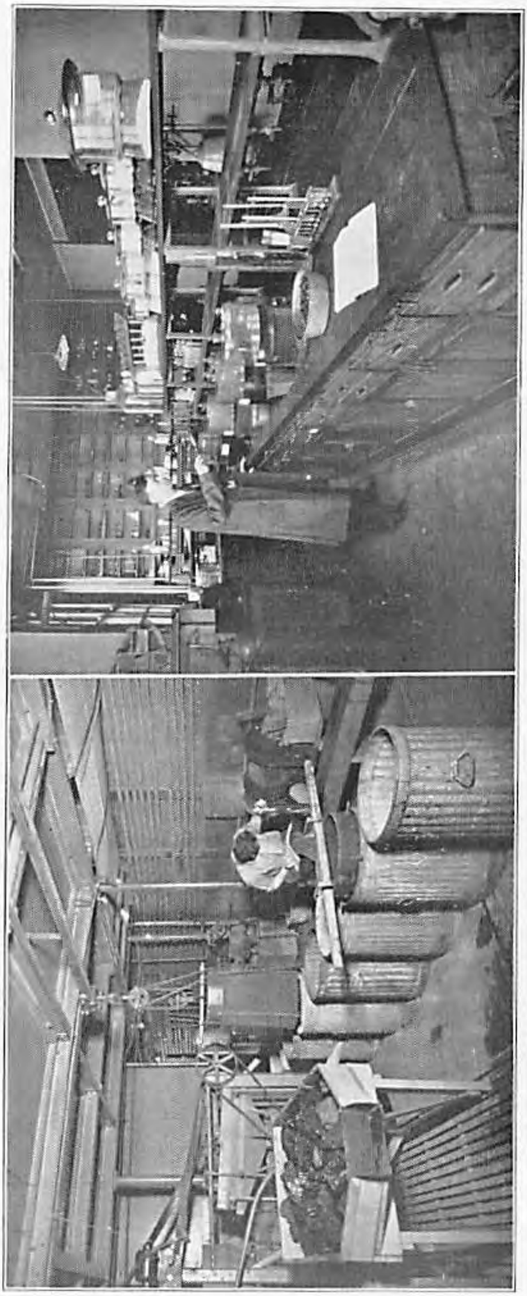
What Fields of Work for those Graduating in the Mining Geology Option? There exists now a definite demand for men who have an education in engineering along with their geological training and this is provided for in this course. The mining geologist, or geological engineer has won for himself a prominent place in many technical enterprises related to ore and coal mining, petroleum production, civil engineering and water supply.

What are the Opportunities for Metallurgical Engineers? The world is using metals as never before. There is scarcely an advance in our modern industrial civilization which has not depended on metallurgy. Aircraft of all kinds, streamlined trains, ocean liners, high speed automobiles, skyscrapers, etc., are only made safe and efficient by the work of the metallurgist. Metals are tailor-made, as it were, to do a particular job better than ever before. Hence, many lines of endeavor are available to the metallurgical engineer in metal production, fabrication and utilization.

C. J. Sandoe: Is there any discussion on Prof. Mitchell's paper?

John A. Garcia: I had felt sure that I am a mining engineer, and now I have found out what I am supposed to know. It so happens that it was just 34 years ago today that a big-bellied professor gave me a sheep skin.

As to mining engineering, I do not want to detract from Mr. Mitchell's paper, but as to a man who is capable of designing, buying and building and putting into operation a coal mine, there is no such thing. A mining engineer is a man who has a knowledge of many things, and uses his organization to do those things, and does not do it himself.



Two Views of the Laboratory at the University of Illinois Showing Some of the University's Many Facilities for Coal Analysis, Study and Research

THE ART OF CLEANING COAL

By COLONEL EDWARD O'TOOLE
American Coal Cleaning Co., Welch, West Virginia

"Coal Cleaning," or generally called "Coal Washing," is a term applied to the separation of coal from its impurities. Fundamentally, it is a gravitational process, based upon the difference in the specific gravity or weight of the components comprising the mixture. To bring about an economical separation of the light components consisting of coal from the heavier components or impurities, water was first employed as a floating medium. Since the specific gravity of water is somewhat lower than that of the coal, it was necessary to set up a turbulence in the water to keep the coal in suspension and allow the impurities or the heavy components to sink. The suspended coal is carried away by the flow of the water, while the sink is removed by mechanical means.

Coal is a rock, not a mineral, composed of combustible and incombustible substances. Oftentimes, the combustible and incombustible ingredients comprising the coal mass are so thoroughly intermixed that such coals have little or no value as fuels unless washed. In cases where the combustibles and incombustibles do not constitute a loose mixture, the coal must be crushed or pulverized in order to free one from the other to form a loose mixture capable of separation.

In mining, coal is broken into a mass that comes from the mine as a mixture. The incombustible particles are mixed in various proportions with the coal. The greater the percentage of these incombustible particles in the mixture, the poorer the grade of coal.

In the early part of the 19th century, the separation of the incombustible and semi-incombustible material from coal by gravitation was introduced into coal cleaning, and the Art of Washing Coal was born. This art has been developed by succeeding generations, until at the present time, it has reached a high degree of perfection and the terms Cleaning and Washing of Coal have become synonymous.

In order to further liberate the solid inerts from the coal, grinding and crushing the raw material to a smaller size was introduced into the art of coal preparation. This crushing process in reducing the size of the coal particles, also greatly increased the surface exposed and in the washing process the coal retained a large amount of moisture. While the solid inerts were more efficiently removed, yet the additional moisture absorbed, more than offset this advantage as moisture is also an inert.

The Art then took up the problem of removing this surplus moisture or water from the coal. Many devices have been designed, applied, and are now in use for this purpose. But they are only partially successful and even the most efficiently designed mechanical dryers still leave a greater percentage of water in the cleaned coal than the percentage of the solid inerts removed, and at present, heat is being applied to drive off the water left in the coal by the washing. The result is that the installation and operation of the plants necessary to wash the coal, together with the mechanical apparatus necessary to partially dry the coal, and finally the application of heat to complete the drying of the coal is so costly as to defeat the purpose or nullify the benefits from the art of washing coal.

The mechanical dryers used were of two forms, those for squeezing the water from the coal, and those for removing it by whirling, or centrifugal force. The result of this treatment was to reduce the coal to still smaller particles, thereby, reducing their value commercially and exposing increased surfaces to the absorption and retention of moisture. This made the coal apparently dryer, but in reality it was not. The domestic sizes, when treated in this manner, were especially reduced in value and would not be permitted to be used by any coal producer on his coal when fully aware of these facts.

In the early part of the 20th century, about 1915 to 1920, machines designed and used for the purpose of cleaning grains and other granular material, which would be injured by wetting, were applied to the cleaning of coal. This process of cleaning had the virtue of leaving the coal clean and dry and avoided the expenditure necessary for the apparatus to dry it. This dry process involved the passing of air at high velocities through the mass of coal, thereby, causing the lighter particles of coal to separate from the heavier particles of inert and semi-inert material mixed with it. Hence the Art of Dry Cleaning of Coal was born.

Machines for cleaning grains, beans, peanuts, coffee, gold, sand, etc., were designed to work on materials valued from $20.00 to $100.00 per ton and were commercially successful at small capacities (one to two tons per hour). Coal being a material of low commercial value, ranging in price from ten cents to a dollar and a half per ton, necessarily had to be treated in large quantities (25 to 200 tons per hour), in order to make the treatment commercially profitable. Such an increase in capacity necessitated many changes and improvements in the original dry cleaning machines just mentioned.

By 1921, the art of dry cleaning coal had been brought up to the stage where it was believed to be commercially successful and the writer presented a paper entitled "Dry Cleaning of Coal by Means of Air Tables," to the meeting of the American Iron & Steel Institute in New York, in May, 1921. Nine years later, 1930, the process, having been extended to about all the mining countries of Europe, Canada and Australia, the subject was again reviewed in a paper before the American Iron & Steel Institute, entitled, "The Present State of Development of the Pneumatic Process for Dry-Cleaning Coal," by Major Kenelem C. Appleyard, Birtley Company, Limited, Birtley, County Durham, England, and Colonel Edward O'Toole. At that date, it was acknowledged that the dry cleaning of coal had made as much progress in nine years from 1921 to 1930, as the wet cleaning had made in the previous century. This rapidity of progress in dry cleaning of coal was due to the fact that as both processes are basically gravitational and the wet process having led the way, made it much easier for the dry process to follow.

Furthermore, the dry method opened up new avenues in coal preparation that were entirely closed to the wet process, namely: the finely dividing of the coal for the purpose of releasing the small inerts and semi-inerts held in the larger particles; secondly, releasing the occluded water (usually called inherent moisture) from the coal. This last being accomplished by the breaking up of particles and thereby, exposing a greater amount of surface of the coal to the action of the atmosphere. This feature in itself, has the possibilities of extending the availability of coals of a high inherent moisture content, such as Illinois coals, for metallurgical and domestic coking purposes.

In connection with coals of high inherent moisture content, such as found in the No. 6 Illinois seam for instance, we note that the various layers or seams comprising the coal measures or beds vary in thickness, hardness and purity. As a matter of fact, the purest coals are the softest, break up most in handling and contain a relatively low percentage of inherent moisture. Consequently, the small or fine coal contains a large proportion of high quality coal, and therefore, easily adaptable to the Dry Cleaning Process. If properly cleaned, this small size Illinois coal can be made economically into coke or briquetted, whichever method is more remunerative.

The surface moisture which the coal has picked up in the mining is also separated and partially carried off by the air used in the dry process.

To accomplish this purpose thoroughly, if not perfectly, the separation of fine coals from fine inerts in a dry state necessitated the designing, developing, and incorporating many new features in the Coal Separation Machine.

The wide range in size and composition of the mass of coal to be treated complicated the situation. The range in the size of the coal particles has been increased from the size of various grains, beans, peanuts, etc., to particles ranging in sizes from 4" to 0", and a range in tonnage from 25 to 200 tons per hour, depending on the size of coal being cleaned. Raw coal ranging in size from ¾" to 0" may be fed to the latest type dry separator at the rate of 75 tons per hour and the separator will deliver this 75 tons per hour in the following sizes: 1st, minus 48 mesh coal; 2nd, 48 mesh to ¾" coal; 3rd, ¾" to 48 mesh refuse.

The first size, 48 mesh to 0" coal will not be cleaned, but will contain about the same amount of dirt the Raw Coal contained. The second size, 48 mesh to ¾" coal will be cleaned possibly to 1.5% of the agreed inherent ash, and the third size, 48 mesh to ¾" refuse will be cleaned to approximately 1% of its inherent ash.

The air used in the process will drive off a portion of the moisture which the raw coal contained. The inerts and partial inert separable high gravity material, consisting of slate, rock, sulphur and other high gravity material is another product. The installation and operating cost (ranging from 10c to 15c per ton) is well within the ability of the clean coal to stand.

The improvements necessary to accomplish the above results were as follows:

1. Side Discharge: The side discharging of the cleaned coal gave great range of capacity as the cleaned coal was always 85% to 95% of the material handled.

2. Return Chutes to return a portion of the coal called middlings, to the machine to be recleaned: The recleanings now amount to 35% of the whole and places the returned coal in a favorable position by mechanically stratifying the same, since the coal treated is an intermingling mass of particles varying in size, it is impossible to make a definite division of them and have two clean products,

Clean Coal and Clean Refuse. So it is necessary to make a third product termed **middlings.** It was found inadvisable to send this third product back and mix it with the raw coal and cause it to be sized and stratified again, on account of degradation. So a means was proivded to return them to the cleaning table and avoid degradation. While in some instances the degradation of the very fine coal itself was not important, the degradation of the slate and other incombustible material contained in the coal is of great importance due to the fact that it is rather difficult to remove the very fine incombustible material from the coal.

3. Feeding Regulator to regulate mechanically the thickness of the bed of coal on the table: It is very essential that the thickness of the bed on the deck of the separator be kept uniform over its entire surface, also uniform as to the size of the particles forming the mass of the material being treated, and this regulation prevents segregation and zoning of the various sized particles in the mass of material being treated.

4. Stratifying Riffle: By means of which the lighter coal and smaller coal is caused to be placed on the top in feeding the raw coal, and the heavier and larger coal on the bottom, which increases the efficiency and capacity of the machine. Keeping the Surge Bin open breaks up amalgamation of wet coal, keeps the coal mass granular and thereby, promotes separation, puts dust in suspension and facilitates dedusting before it is settled on the deck of the separator.

5. Tailing Riffle, which completes the process of dry separation, and increases the capacity of the separator.

6. Automatic Starting and Stopping Device, which assures a full bed of coal on the separator at all times: Coal tipple dumping is very irregular and it is not good practice to run the separator empty or with deck partially bedded, so a device was designed to stop the separator before the surge hopper was empty and to start it when dumping was resumed.

7. The Flake and Floater Collector of incombustible, high gravity material: Most all coal contains floaters (flaky material). Some of this is coal, while some of it is composed of inert or partially inert material. Owing to the shape of this material, it has a greater tendency to float than the cubical or semi-cubical material of the same composition, and if such shaped inert small material is not carried away by the water or air, it invariably becomes mixed with the coal. We have designed a slotted dead plate with adjustable width of slots, to remove such shaped material, when it falls to the surface of the dead plate while the table is in motion.

8. The Crimped Copper Bronze Pervious Plate to rapidly move high gravity material: When coal is passed over the surface of any known substance in large quantities for any length of time, the surface of the substance becomes smooth and less effective in imparting motion to the coal resting upon it, particularly if the resistance offered to the movement of the coal particles was greater than the functional resistance of the plate surface, so a crimped plate was designed, which has overcome the difficulty.

9. Application of Heat to expand air to increase its capacity to carry moisture: When the mass of coal to be treated or being treated, contains a large quantity of water, either as a liquid or moisture, heat can be applied to the air used by the separator

as a floating medium to rarefy it sufficiently to absorb all the moisture the coal carries. The greater the amount of water present in the coal which must be removed, the greater will be the amount of heat necessary to rarefy the air sufficiently to carry it off.

Dry separating coal machines are now built in units, each unit being a complete plant and will operate on any size or kind of coal with a slight adjustment. It is built in two sizes and will have varying capacities for varying sizes and dampness of coal, ranging from 15 to 20 tons per hour when operating on minus ⅛" wet coal to 250 tons per hour on minus 4" coal.

To understand more clearly the relative variations in fixed carbon, volatile matter, and ash as affected by the reduction of moistures, the comparative data below is given as an illustration:

Original Sample 8" Coal		Crushed Sample ⅛" Coal	Increase % Difference	% Increase
Moisture	10.00%	3.00%		
Volatile Matter	28.76%	31.00%	2.24%	7.78%
Fixed Carbon	54.74%	59.00%	4.26%	7.78%
Ash	6.50%	7.00%	0.50%	7.78%
Total	100.00%	100.00%	7.00%	7.78%

C. J. Sandoe: I will now turn the meeting over to the President. I want to thank all of you for your attention, and I hope we will all profit by what we have learned.

Harry Treadwell: We will now decide on the place to hold the Fall Meeting.

C. F. Hamilton: I make the motion that the place for the Fall Meeting be left in the hands of the Executive Committee.

(Motion Seconded and Carried.)

Harry Treadwell: This winds up our program on this trip, and I want to extend my thanks to each and every one of you for your kind attention. We now stand adjourned.

The following papers by C. J. Sandoe, Fred A. Miller, D. D. Wilcox, G. S. Jenkins, I. N. Bayless, Reamy Joyce, Walton E. Rutledge, Dr. J. J. Rutledge, and E. L. Berger—all members of our Institute—were presented at the 1934 meeting of the American Mining Congress at Cincinnati and were published in "Coal Mine Mechanization," yearbook for 1934. We are grateful to the American Mining Congress for their full permission to give these papers to you herewith.

AIR SHOOTING — AN ENTIRELY NEW PROCESS

By C. J. SANDOE
Vice President, West Virginia Coal Company of Missouri

Air shooting is a recent development in the art of breaking down coal and preparing it for loading. This process utilizes as its basic principle an old by-word—simplicity. It is, within itself, a self-contained unit, mobile and flexible, powerful and efficient, yet simple.

The word "shooting," in its true sense, cannot be applied to this process. A truer description of this air method can be attained by using "breaking" to name it. Shooting is a process which rends, tears and shatters, and its effect on coal is to prepare for loading a highly fractured product which, in this state, is readily susceptible to continued breakage on successive handlings.

The above, however, is not the case with coal which has been prepared for loading by breaking down with air. This new development takes advantage of features embodied in the coal other than its brittleness. The action of the compressed air in the hole after release is similar to, if not the same, as the more widely known Cardox. Air, under high pressure, finds the lines of least resistance through the coal, which are the natural cleavage planes. The entrapped air, on expansion, forces the coal out by constant pressure rather than by shock which has a pronounced shattering effect. This leaves the coal in what might be termed its own crystalline form rather than in a highly fractured and broken condition.

A comparison might be made with the action of shooting and the action of breaking with air, to the action of a sledge and the action of a press. The sledge is comparative to shooting as the results are, in both cases, destructive, while a press, in comparison to air breaking, exerts more pressure to achieve the same results but does not have the destructive element enter its process, as it is a smooth, even pressure applied evenly and constantly. For example, a brittle piece of metal can rarely be handled with a sledge without breaking, while the same piece of metal can be easily worked-on with a press without damage to the metal itself.

The shooting, or powder-mining method of preparing coal for loading, employs the use of explosives. This method puts to use a rapidly developed, very high pressure, while with air mining, a comparatively lower pressure and larger volume of expanding air is used to accomplish the same amount of work. The blasting shock is thus replaced by an expanding or wedging action, slowly applied, but with power sufficient to provide good loading preparation. Air mining deals with pressures far above those most commonly used, but these pressures are not beyond those impractical to attain and maintain. Air mining does not involve the use of materials beyond the natural resources of any mine; air is all it needs, thus avoiding all outside difficulties.

This process has but two parts in its self-contained unit; one a compressor, the other a cartridge or bottle. The compressor used is only of such size to be capable of producing 15,000 pounds per square inch pressure. It might be said in this connection that this high pressure is not of standard usage but is rather used only for experimental purposes. Half this pressure is usually sufficient for breaking down the coal as standard practices use pressures of from 5,000 to 10,000 pounds per square inch. Another requisite of the compressor is that it must be small enough to be mobile; thus, when mounted on trucks, it can readily be moved from one working place to another in a short time.

The cartridge, or bottle, is primarily a container having sufficient size to store in the drilled hole a relatively large amount of compressed air so that it can be released at predetermined pressures. These containers vary primarily in their method of air release. One type uses a valve release and the other a shearing disc release. The first type uses gauge readings to determine release pressures and the second uses shearing strength or standardized metals to attain release pressures.

With the type of container having a valve release, the operator puts into the container only that amount of pressure which he judges is required to break down the burden given to each individual hole. The pressure for each hole is indicated on a gauge at the compressor, and after the judged pressure has been attained, the container is discharged by the opening of a release valve in the tube leading from the compressor to the container.

With the shearing disc type container, variances are made in release pressures by changing discs or replacing discs of greater or lesser shearing strength.

The cycle of operation of air mining is simple and requires but one or two men in the actual mining or breaking operation. Preparation of a face for air mining is the same as for any other type of mining. The face is undercut, or sheared, or both, as is customary. Drilling may differ only in the size hole to accommodate the larger container, or may vary in the placement of holes after successive trials with different drillings. The containers may then be tamped in the holes and left for the compressor, or the compressor can carry with it one, two or more containers to be re-used after each successive mining or breaking operation. Disc changes are made at the compressor with one type container. In the other type, the container is re-used without disconnecting from the compressor.

Time required for the compressor at the face is about 2½ minutes to a container. The compressor then moves from one place to another, speed of its movement depending on its type of locomotion.

Safety is one of the most outstanding features of this process. All transportation dangers are completely eliminated. When the machine is in motion and when the containers are handled they are in an inert state, no pressure being applied until the container is in place and the operator is at his compressor station. At the face, after being broken down or mined with air, the overburden dangers are minimized because of the fact that air mining in its expansion of gas or air does not draw into the roof and endanger any overlying tender roof conditions, but rather does all its work in the coal itself. Containers also do not have a tendency to fly but rather roll out with the coal as it is broken down. Fires and their accompanying evils are also eliminated as there is no element entering the process to produce fire. Also, the presence of obnoxious and injurious gases in the place after it is prepared for loading is completely eliminated, and it can be said the air is better due to forcing the air to the face in breaking the coal down. For gaseous mines, in this process, there would be no dangers due to the lack of any firing element.

To the eye, air mined coal presents a different appearance. It is more blocky and has a brighter luster. The lack of fines is easy to discriminate by the eye. Also, it is to be seen that coal is not thrown from the face, as it is rare that any has traveled over the cuttings of a shortwall machine.

Costs of this process are in a greater or lesser degree theoretical and could be quoted as only those that are indicated. Actual costs at the face would not change, haulage costs would be eliminated as would be the expense of obtaining outside materials such as explosives. Indicated costs are the same and in many cases, far below those of explosive mined coal.

Thus, air mining bids fair to find a place in modern methods of coal mining and set a new standard and record for the preparation of coal for loading.

DISCUSSION ON AIR SHOOTING — THE ENERGY AIR-MINER

By FRED A. MILLER
Franklin County Coal Co., Inc.

The air mining process just described by Mr. Sandoe was developed and first applied at the Royalton Mine of the Franklin County Coal Co., Inc., where mining conditions and seam characteristics are typical of those found in most southern Illinois mines. Of the 3,000-ton daily capacity, approximately half is mined with permissible powder and loaded by hand, while the remaining half is mechanically loaded, 80 per cent of which is air-mined.

Except for the addition of the Air-miner unit the cycle of operation in a mechanical territory is not unlike that described many times before and is therefore omitted in this discussion.

After a place is loaded out or "skinned up" it is undercut and drilled in the regular manner. The number of drill holes and their relative location in the face is a matter of experience and depends largely upon conditions and the type of loading equipment used. The empty air bottles are placed in the hole and tamped, leaving a short length of tubing protruding from the hole for connection to the compressor air line. The Air-Miner unit moves into the place to within 50 to 70 feet of the face. The compressor air line is uncoiled and connected to the bottle tubing, after which the compressor is started and air is pumped into the empty air bottle until the shearing disc is ruptured and the compressed air released. The moment the disc shears the compressor is stopped—the operator advances to the face, judges which bottle should be discharged next, connects to it, recovers the discharged bottle and carries it back to the compressor. This phase of the operation is then repeated until all bottles are discharged and coal prepared for the loader. The second man of the crew, who also acts as triprider and general helper, inserts a new disc in the discharged bottle and makes it ready for use again.

Several years of experimental work together with the subsequent application of air-mining to our mining practice has established two definite prerequisites. First, the compressor should be conveniently designed, well constructed and must be of ample capacity. Second, since the positive, sudden and complete release of a large volume of compressed air from a relatively small container is the basic principle of the process; the air-bottle must embody this principle and yet be simple and rugged in design and construction.

Other interesting and noteworthy features possessed by the process which we consider advantageous to the convenient operation of a coal mine are probably best cited by discussing the relative merits as compared to other known processes used to accomplish the same or similar results.

Since our experience is limited to explosive and air-mining methods, the comparative advantages and disadvantages which I am about to discuss are likewise drawn between these two. The disadvantages of the process are cited first.

Disadvantages

1. To begin with, a capital investment is required for equipment the exact amount of which varies. While it is not excessive, it is greater than the investment tied up in explosives at any one time.

2. The addition of an air-mining unit adds another piece of mechanical equipment to the mine and consequently means more work for the inspection and maintenance staff.

3. Upon installation this additional equipment is apt to congest the haulage system somewhat, although this feature is not serious, it is inconvenient until the personnel becomes accustomed to its movements.

4. Drilling may become more complicated because the holes required are of necessity larger in diameter than powder holes. The selection of proper drilling equipment, however, will overcome this difficulty in most cases.

And now for the advantages of the process.

Advantages

1. As pointed out by Mr. Sandoe, one of the most important features of the air-mining process is safety. In addition to eliminating the hazards accompanying the handling, storing and use of explosives, it is important to note that loose coal hanging to the face and ribs of an air-mined place is almost entirely eliminated. In the case of powder-mining we have found that the coal has been disturbed back into the solid as far as two machine cuts—not so with air-mining—air either breaks the coal loose or leaves it solid. Thus the danger of loose coal falling on machine men, drillers and other face employes is reduced to a minimum.

2. The mild action of air, as compared to explosives, gives utmost consideration to tender roof conditions.

While we have made no specific tests with precision instruments to determine the actual difference in roof shock it is significant to note the fact that air-mining methods reduced roof falls almost to the point of elimination as compared to powder-mining methods in the same territory.

3. Air-mining produces a greater percentage of large size coal at the expense of the finer sizes. Specific screen tests have shown an average increase of 26 per cent in coal above 2 inches and a loss of 22 percent in coal below 2 inches. Further study showed that the greatest loss was suffered by the Carbon size (5/16 x 0"), which amounted to 21.9 percent in one case; while the greatest gain was made in favor of coal above 6 inches, the amount of which was more than doubled. Since this feature is controlled by the use of higher or lower pressures the figures just cited are indicative of the range of results which can be obtained by the use of the process. To those of us interested in increased realization by the production of more big coal, air-mining offers a welcome aid.

4. Air-mined coal is firm and subject to less degradation in handling than powder-mined coal. First because it is dislodged in a much more gentle manner at the face and second because it is not filled with minute powder cracks which cause breakage and rapid weathering. Those of you who handle customer complaints will appreciate the fact that air-mined coal stores better—not only in your own yard but in the dealers' yards as well and is therefore more desirable in domestic sizes particularly.

5. Air-mining is accomplished during the working shift. Where State Mining Laws prohibit the firing of explosive shots on shift, this feature is especially attractive because the Air-Miner is exempt from these restrictions. This makes possible the advancement of a working face more than one fall per shift, which, under Illinois law, is impossible with explosives. Hence the limiting factor on the number of falls per place in any one shift is the time required to prepare a face for the next loading cycle. Development work can therefore be greatly speeded up.

6. Air-mining allows a mechanical loading unit to be confined in fewer working places. It has been our experience that the number of working places necessary for a mechanical unit under powder-mining varies between 7 and 10. Under similar conditions we have been able to confine a unit in as few as 5 working places. This feature, while dependent on conditions, does offer possible savings in material by more concentrated workings.

7. As a general rule there is less digging for the loader to do in an air-mined place than in a powder-mined place. In our attempt to obtain the best grade of coal possible with powder-mining we have experienced difficulty in loading because of the tendency of the coal to merely drop down in the space formerly occupied by the kerf. While this coal is thoroughly and completely shattered, it remains in a more or less standing condition and is sometimes hard to load, and we are all familiar with the disastrous effects to equipment while trying to load tight coal. Air, on the other hand, not only breaks the coal from the face and ribs, but also pushes it from the face in a loose, blocky pile.

8. In air-mining, tamping material consists of moist drill cuttings; there is no ash-bearing material added to the coal pile as in the case of explo-

sives, where incombustible stemming is recommended.

9. Air-mining is not a labor-saving process. The greater part of the money ordinarily spent for explosives is spent on labor and that money in turn is placed in circulation in your own community. Where division of time is necessary because of surplus labor this fact has a decided bearing on the attitude of the personnel and the introduction of air-mining equipment is viewed with much less disfavor than the introduction of some other mechanical equipment.

10. Air-mining is economical. We fully realize the utter impossibility of comparing costs unless we talk of the same items and all sets of figures are reduced to a common basis. The charges which constitute our operating costs for the same work under both methods are composed of the following items:

Items	Powder-Mining	Air-Mining
Operating Labor—		
Drill Labor	X	X
Shotfiring	X	
Handling Powder	X	
Compressor Labor		X
Operating Supplies—		
Blasting Supplies	X	
Air-Miner Supplies		X
Repair Labor—		
Drills	X	X
Compressor		X
Bottles		X
Repair Supplies—		
Drills	X	X
Compressor		X
Bottles		X

Total Operating Cost

Under Operating Labor, drilling in both cases is the same. Shotfiring labor and labor required for delivering powder is chargeable only to powder-mining, while compressor labor is an item of air-mining only.

Operating Supplies in the case of powder-mining consists of powder, caps, fuse, drill bits and sundry items such as tamping bags and tools.

In air-mining this same charge covers discs, tubing, drill bits and similar sundry items.

Repair Labor and Repair Supplies to drills cover the same items under both processes, while Repair Labor and Repair Supplies to compressor and bottles are items of air-mining.

No mention is made of the cost of investment in either case, since this may be handled in a number of different manners. We do feel, however, that capital investment in the case of air-mining should not be spread over a period of more than 5 years.

Without assigning or attempting to assign a monetary value to any of the advantages or disadvantages of either method and by pitting like charges against like charges, the economy of air-mining is evidenced by the fact that our Air-Miner operating costs are not only comparable to our powder-mining costs, but in more recent instances have even bettered them.

When we consider that these costs and conclusions are compiled from operating data obtained by use of the first two compressor units ever built for this service and knowing that air-mining costs are largely dependent on compressor capacity, we have good reason to believe that improved compressor design and construction, together with natural improvements in process application, can and will substantially reduce these costs in future operations.

THE USE OF MOUNTED CUTTING MACHINES

By D. D. WILCOX
General Superintendent, Superior Coal Company

The use of the undercutting machines in Illinois mines began in a serious way in the Belleville District in 1878, although there was a puncher machine in use at Streator, Illinois, for some time before that. The air driven puncher as finally improved was capable of undercutting about 70 tons per day. Its operation, however, was decidedly dangerous as the runners were required to sit on a platform, or board as it was called, directly in front of and practically below the undercut coal while the noise and constant jar of the machine prevented the runner from knowing the safety conditions of his working place. At the time these machines were first installed there was in existence, as usual, a miners' organization, and an agreement was made with the miners to set up a differential between solid shot coal and machine mined coal. During all subsequent contracts this differential has remained constant regardless of the improvement of the cutting machine, either in less labor, safety or greater production. It is evident that this differential was in effect an allowance by the miner for the use of the undercutter and the purchase and development of improved types of cutting machine had to be paid for out of this differential and the advantage to the owner, if any, had to come out of the increased saving in upkeep that the newer machine would make. The fact that the newer machine could cut more coal was of no benefit to anyone but the miner, as it merely meant that there were fewer men with whom to divide the tonnage rate.

The Illinois mines became greater in extent and the loss of power due to the great distance that the compressed air had to be transported, and the constantly increasing cost of maintaining the puncher machines furnished the principal reason for the establishment of the electric breast machines, although at that time there were a few air driven breast machines in service. The breast machine was a success from the very start and has continued to be an efficient machine, in fact, its success led to the development of the Shortwall machine. But the advent of the Shortwall was another story to the owner of the mine. It had all of the properties of an improvement, but the entire advantage of its installation was absorbed by the miner. In most cases the work for the miner was easier and safer, and the machine could cut twice as much coal, but the coal operator was merely out of pocket for his improvement. Some owners went back to the use of breast machines, and it began to appear as though the development of undercutting machinery in Illinois mines had come to a standstill due principally to the unchangeable differential in the labor contract with the miners. A high wage scale, coupled with a forced lack of progress began to force Illinois coal out of the competitive coal market and consequently in September of 1928 a contract was entered into which permitted the operation of cutting machines on a day wage basis. This idea opened the door for the use of the mounted cutting machine of which there are now 66 in service in Illinois mines.

The mounted machine, which weighs about seven and one-half tons, operates directly from the track. The machines are equipped with two motors, one of 50 horsepower for cutting and one of 10 horsepower for tramming and sumping. The weight of the machine is sufficient to sump the cutter arm without using jack pipes or chains, although jack pipes are used in making the cut to keep the machine from slewing the track. Care must be taken in sumping so that that machine will not jump back when the cutter chain meets unusual impurities. This is caused by dull bits or feeding the cutter too fast. The operation of the machine is so rapid that it is necessary for one man to remain constantly at the controls. This speed also prevents the helper from keeping all of the cuttings out of the kerf when cutting on the bottom. The machines are equipped so they may be reversed to remove the cuttings, but unless care is used they carry in as much cuttings in this process as they remove.

The cutter bars used are eight feet in length compared to six feet on a shortwall, and fully extended they cut a place 30 feet wide leaving a straight rib and a rounded kerf. Of course a place can be cut as much less than thirty feet as desired and still maintain a straight rib. Our machine men have marked the revolving frame on which the cutter rests so that the width of the place is accurately measured and cut. It requires less skill to cut a straight rib with a mounted cutter than with a shortwall. The cables, which are wound on automatic reels, are rubber covered Duplex No. 2, three hundred feet long, wiring being carried for a distance into each room. The machines are equipped with trolley poles which add to the tramming speed, and as the cutting is done on the hoisting shift it is sometimes necessary for the cutting machine to switch either loads or empties out of the way to allow the cutter to proceed.

The Superior Coal Company, a subsidiary of the Chicago & North Western Railway Company, owns four mines in Macoupin County, near Gillespie, Illinois, and at this time three of the mines are being operated and are working in No. 6 Illinois seam. The operations began in 1903 and all of the coal mined (approximately 75,000,000 tons) has been undercut with the exception, of course, of short pieces of development work. The undercutting was done first by puncher machines, then by electric breasts and shortwalls, and at this time all of the coal is being mined by mounted cutting machines at the three operating mines.

The system of work is a modified panel system, and about sixty places are allotted to each cutting machine, the distance between the two extremes of a machine territory at times being as much as a mile. The coal is all loaded by means of two men pit car loaders, 27 of these being assigned to each machine and the coal is gathered by three gathering motors on each unit. The power is 250 volts

D. C. and the wiring is 4/0 except that 2/0 is used for short distances. The rooms are driven 30 feet wide, and 300 feet deep, the entries and cross cuts being 21 feet wide; the machine doing its own development work. The track is 42 inch gauge, and 20 pound iron with either square wooden ties or steel ties spaced 2 feet apart. The track switches are laid into each new place before cutting. The first cut in each place is not a full cut. In fact in room necks and cross cuts it is the third cut before full tonnage can be expected. The shooting is done once each day and permissible explosives are used. The territory is built around the cutting machine and one foreman is in charge of each territory.

Territory of a Mounted Cutting Machine.

There has been a constant attempt to balance the work done by each part of the operation so that it fits in properly with the other parts and consequently none of our mounted cutting machines are pushed to capacity as that would entail extra haulage or extra drilling, or extra loading and in the end a higher cost per ton. Our figures then are not of machine capacity but of actual operation.

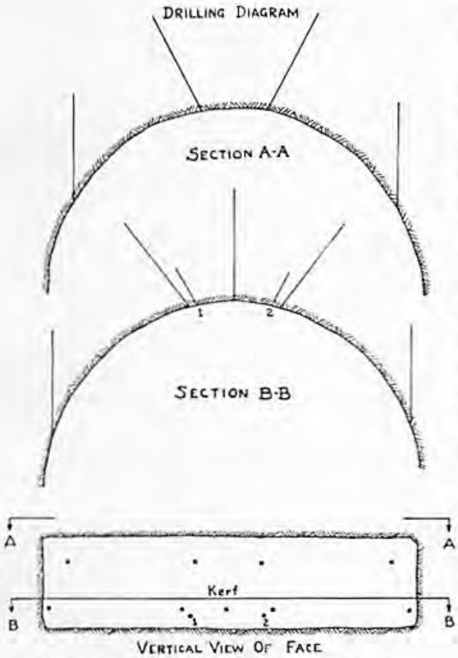
Since the purchase of the first mounted cutting machine on April 2, 1929, twelve additional machines have been purchased and have undercut more than six million tons of coal. At this time there are four of these machines operating eight (seven) hours per day at each of the three operating mines of this company, and they undercut all of the coal produced. These machines were installed gradually as in some cases it was necessary to make haulage or power line changes, and all of the mines were not fully equipped until January 1, 1931, at which time Mine No. 3 was completely changed. Our principal reason for making this change so abruptly was in order to get comparable operating costs. The cost figures used in this paper are those developed from this mine, the production of which for the year 1933 was 662,749 tons for daily average of 3,413 tons, all of which was cut by four machines never working more than eight hours in one day, and at no time being out of service long enough to impair the output. The best day's cutting was approximately 1,200 tons, but from our records the number of tons cut per day by the different type of machines is as follows:

Place Being Cut by the Mounted Machine.

Puncher machines -- 70 tons per day
Breast machines ---170 tons per day
Shortwall machines -300 tons per day
Mounted cutters ---900 tons per day

When the first mounted cutting machines were installed their production was about 500 or 600 tons per day, and the cutting was done at or near the bottom of the seam where the previous types of machines had mined. It was necessary to lower the cutter bar to begin cutting and raise it when the cut was completed. The cuttings were not all removed from the kerf and a cutter bar was sprung because the runner of the machine could not see the stress in time. Also the same impurities usually found at the bottom of the seam had to be encountered. As all of the cuttings were loaded out it was finally deemed advisable to cut in an extra clean band of coal about thirty inches up from the bottom. This was made possible by putting a shim under the cutting mechanism of the machine. The time of cutting was reduced and now each wide place is cut in from twelve to fifteen minutes.

The change brought up several new problems. While it produced a better grade of fine coal, used less power, cut 50 per cent more coal, left a kerf free from cuttings, and required less repairs, it also cost more for explosives, left a poor floor to shovel from and the drilling and shooting had to be altered. The attached sketch of our present method of drilling shows seven holes drilled in the bottom and four in the top coal or a total of eleven holes in each wide place. Three set ups of the electric drill are required for the drilling as five bottom holes and two top holes are drilled from the center position. Nine foot augers are used and the conveyor type of auger which keeps the drill cuttings out of the holes, is now being installed. Fuse is used and holes (1) and (2) are shot first. It was believed that the rounded kerf would be difficult to shoot. As a matter of fact the rounded face is an aid in shooting. In a place cut by a shortwall the miner either has to square up the corners or use excessive explosives to get it loose. Seventeen sticks of 1 and three-quarter inch by six permissible explosives are used to shoot down each thirty foot place, which is



Showing Our Present Method of Drilling.

20 per cent more than is required when cut by shortwalls, but it is believed that a cut eight feet deep in a place seven feet high and thirty feet wide would be even more difficult were it not for the rounded corners of the kerf. For loading the bottom is shot first and loaded out before shooting the top, the top being spragged before loading out the bottom. As the shooting is done but once each day and each place is shot twice, that is once for the snubbers and once for the top shots, it is evident that when a place is loaded out it is practically idle for two days. This has, at times, been a hindrance to development work. When necessary the advance work can be cut, loaded, drilled and shot in one day. This is done by putting in a double cut by the machine, the kerf then being wide enough to shoot the place without snubbing. In this case, however, the top shots are fired first.

From January 1, 1931, to March 31, 1934, Mine No. 3 of the Superior Coal Company has produced 1,809,692 tons of coal, all mined by four mounted cutting machines. For repairs, material has cost $3,083.47 and labor $1,964.72, or a total of $5,048.19, which is at the rate of $0.0028 per ton, or about one-fourth the cost of shortwall repairs, and about one-half the cost of breast machine repairs. In this amount for repairs is included $780.51 for lubrication, and $218.16 for bits, four cutter chains and five new cables, besides the cost of miscellaneous repairs. The tonnage cut by the cutter chains which were removed is as follows:

318,792 tons
207,255 tons
272,985 tons
298,561 tons

Our records of power consumed show that the mounted cutting machine cutting about 15 per cent more coal per place than the shortwall uses from 5.9 k. w. h. to 6.8 k. w. h. per working place compared to 7 k. w. h. to 8 k. w. h. for shortwall. Many of the advantages of the mounted cutter are obvious. It is not necessary to unload the machine and pull or bar it over into the corner to begin cutting. There is no sumping pan and no chains, no crow bars, no ropes, no rib hook and no skid rails, nor skid sheets. There are no tools to unload and load up. In fact, the complete list of tools is as follows:

Place After Bottom Has Been Loaded Out.

3 jack pipes
2 bit wrenches
2 lug cleaners
1 short rail
2 dutch head picks
1 shovel, and
2 oil cans,

besides, of course, the extra bits.

Place After Top Has Been Shot Down.

The mounted cutting machine, as is always the case when machines are really more efficient, is safer, it being possible to entirely eliminate face accidents to the operators. For one example of this there is the change in the handling of jack pipes, which are a prolific cause of injuries as used with the other types of machines. Eyes were injured when the machine men were picking a hole in the top to set the jack pipe upright. Then the jack pipe would fall on heads or bodies or feet. With the mounted cutters, however, the jack pipes are set to each rib horizontal and close to the bottom. It is equipped with twin headlights, one on each side of the cutting mechanism and travels across the face with it giving a plain view of the cutting face at all times. This allows the runners to speed up the machine without fear of injuring it and above all the men not only feel safer but are safer. Places may be cut thirty feet wide with the timbers within four feet of the face. Our method when timbers are close is to put the sumping cut in the center of the face and after cutting to one rib the machine is reversed to finish the place. It is not necessary to reverse the bits when this condition is met as the chain travels in the same direction at all times when cutting. Timbers along the track must be kept at least twenty inches from the rail and on turns they should be twenty-eight inches.

The success of any machine depends in a measure on the reaction of the employees toward it. The mounted cutter is built in a way that inspires confidence in its ability to do the work and it has practically removed the drudgery from the job of undercutting coal.

MECHANICAL LOADING AT THE CONSOLIDATED COAL COMPANY OF ST. LOUIS

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

About the only thing we have in common with Mr. Knox is the product. Operations of the Consolidated Coal Company are limited to the State of Illinois and No. 6 seam which dips about a percent or two to the north. While we do not have handicaps of a pitching seam we do have gas and water to a considerable degree. Of the coal produced by members of the Illinois Coal Operators Association in 1933, about 27,000,000 tons, only 22.4% was mined by hand; 24.2% by conveyors; 34.3% by loading machines; and 19.1% by strip pits.

The mechanization program of the company began about 1926 with the advent of the pit car loader. We struggled along with that program for a couple of years and in 1928 decided to try out the Mobile type loading machine. We tried out several types and standardized on the Joy Loading Machines. At present we have 26 of these machines. Our properties had been undercutting the coal since the development of the cutting machine, so that phase had already been worked out.

With the installation of the Mobile type loading machine, we found ourselves beset with several difficulties. Under hand-loading and conveyor-loading we had been taking the Coal to the fire clay floor. With the loading machine we found we had to leave 3 or 4 inches of Coal floor to facilitate machine operations and to prevent loading of fire clay with the Coal.

This meant a re-education of the under cutting machine men. Since the loading machine could not differentiate between Coal and impurities we had to erect adequate surface preparation facilities. The problem of gathering presented itself with capacity production. Mules were discarded and locomotives installed 100%.

We standardized on storage battery gathering locomotives on account of the flexibility and power demand and our experience still keeps us of the same opinion.

We operate the Joys in units of two, having one Joy on each side of a pair of entries as a general rule. An assistant mine manager is in charge of two units consisting of the two loading machines, two under cutting machines, two drills and three locomotives. One locomotive serves each Joy and the third one operates as a relay motor between the main line parting and the service motors. This relay motor is storage battery operated, but a real locomotive could always be used to advantage in territories with excessive grades when an adequate power supply is available. However, in Southern Illinois where we experience our worst grades we have no difficulty with storage battery motors. Our relay motors in this territory weigh slightly over nine tons complete with batteries and our service locomotives slightly over seven tons complete with batteries.

Storage batteries keep down the power demand and allow charging on the off-peak period. Our experience indicates that the power demand saving, pays for the batteries, and we get the flexibility of operation at no extra cost. Each two units are supplied with power by a motor generator set—installed at the territory—this insures adequate power and minimum voltage drop.

Coal is handled to the bottom with 15 ton trolley locomotives on a dispatch system, a trip of 30 cars reaching the bottom every 10 minutes. These locomotives make about 240 car miles each hour. The haul being 2% grade against the loads. It might be of interest to note that main line rails are now welded instead of bonded—the Constant Temp is ideal for this practice, and we have been able to secure a bond test of unity with this practice.

In getting the loading machines up to capacity, time studies indicated that the thing to do was to keep coal coming off of the rear conveyor. As we operate on the room and pillar system, this meant a series of car change experiments. We first tried putting a cross over switch through each cross cut, so that, as a locomoti.e pulled a car away from the Joy, a man pushed a car from this switch to the Joy. This worked out very well, except that it doubles the work of track laying and ties up too much money in rails, switches and ties.

We then tried stub switches which would hold three or four cars—the motor would back in with three or four empties and after the rear car was loaded, would pull it out and switch the loaded car into the stub, and then back the empties to the Joy and repeat this operation until only one empty was left, which would be "spotted" at the Joy while the locomotive pulled the loads off of the stub, on to the entry and came back in with more empties, and would repeat the above cycle.

The pushing of cars around curves especially in the presence of grades, caused considerable derailment—this was overcome by driving the room on a 60 degree angle to the entry instead of 90 degree and easing off the curves, so that now a motor can push a trip around the curves at full speed without derailments.

The above method provided a good car change at a reasonable expense but did not cut down the long moves, so we next tried the "checkerboard" system, modifying it to meet our top conditions and maximum allowable extraction.

On the checkerboard we get two falls in each room, i. e., the face and the cross cut. The face and cross cut are undercut without reloading the shortwall cutting machine so time is saved on that operation. On this system, the face and cross cut are cut for three cuts, and then the face and a cross cut on the other side are cut for three cuts and the cycle repeated, thus the far rib of the cross cut to the left is opposite the near rib of the cross cut to the right and vice versa. By throwing the center lines of cross cuts of adjacent rooms out of line we reduced the area of the breakthrough which tended to some degree to strengthen the top. As to the desirable room length we tried up to 600 feet, but standardized on 350 feet.

Before using the checkerboard we were in the habit of leaving 18 inches of top coal. We are now leaving the top coal in the first half of every third room. When this room is in 175 feet switches are turned left and right and the rooms on either side picked up from this coal top haulage room. The remainder of the haulage room is shot to slate like the rest of the rooms. The track is then recovered from the first 175 feet of the rooms on either side and used in the advance. The timbers are likewise recovered and used on the advance and the slate allowed to fall. This cuts down on the quantity of material in active service, and also cuts down on material delivery as it is within 175 feet of where it will be used.

In addition to the above the loading machine goes into a room for two falls of coal. Conditions have led us to adopt 24 feet as the ideal room width in the Southern Illinois field. Local conditions, of course, at times require narrowing down and on the other time permit widening out. The 24 feet width being the base line. Various room centers have been tried and 51.96 (60′ x sine 60°) adopted as standard. It might be of interest to note that the timber and track material cost on a per ton basis has been cut almost in half on this system.

As to the method of loading cars—the Joy starts into the face which has been shot down and loads out directly ahead of the track. This coal of course is necesarily loaded over the end of the car and only one car loaded at a time. When this center has been loaded out, slide rails are put down to the face. The Joy next loads out of the face on the opposite side from the cross cut—two or three empty cars are backed in and the Joy loads them over the side. When the car nearest the motor is loaded the trip is pulled up and the second car loaded, and if three empties were brought in it is treated in a like manner. The locomotive then pulls out and replaces the loads with empties, thus changing the cars in twos and threes. While the locomotive is out changing the cars the loading machine does its digging and discharges the coal across the track making a pile of loose coal. When the cars are back the machine loads into them.

Then when this side is skinned up the machine is moved into the cross cut and loads the cars over the side. During car changes the boom is swung over onto the pile and loaded from the other side. When the break through is skinned up the machine then re-loads from the pile of loose coal and then loads out the face. Local top conditions require that timbering methods be worked out along with this method to facilitate loading, also loading methods at times have to be modified to suit the top conditions.

The Face Bosses all have their papers as Mine Managers First Class and we believe them competent to modify the methods as safety and local conditions demand.

The above system where it can be applied, has worked out to be the most efficient one with us. Under this system shortwall under cutting machines are used, one for each Joy. While a track cutting machine would cut for two Joys at a saving of two under-cutting machines, it would require two additional track layers to lay the additional track and switches, and this along with the additional track material would more than offset the saving. So it is evident that this system is not adaptable to track cutting machines, but gives a result in cost to offset the gains of a track cutting machine by using machinery already available. Should a suitable caterpillar mounted cutting machine be developed it, of course, would be the desirable equipment under this system.

As you of course know, on-shift shooting is prohibited in the state of Illinois, and this of necessity requires the carrying of sufficient places on a section to insure ample coal for the following day. We have found that 8 to 12 rooms is about the ideal number—less than that incurs the risk of running out of shot coal should a break down on cutting machines occur. More than that incurs a cost that is useless, both in the material tied up and the labor required to keep them in shape.

At the present time we are doing some experimenting with air shooting which is permitted "on-shift" and should enable us to cut down the number of places to be carried on a section.

The above has all been relative to individual sections. One of the main things to keep in mind in mechanization is concentration of equipment. We have found that concentrating the machines in adjacent panels affords us an opportunity to adequately service them and at the same time cut off the maintenance of miles of territory. Supervision is easier and delivery of material less expensive. Also a section of the mine can be quickly worked out and abandoned.

CAPACITY OF MINE CARS AND THEIR RELATION TO SUCCESSFUL MECHANICAL LOADING

By I. N. BAYLESS
Assistant General Manager, The Union Pacific Coal Company

Coal mines were opened in Wyoming along the Union Pacific Railroad during the year 1868. Data and pictures show the mine car used at that time as a box on wheels. This box carried approximately 1,000 pounds of coal. From this time until about the year 1900, the drawings of the mine cars used indicate a desire on the part of the management to increase the amount of coal carried in the bed of the car. This development first manifested itself when the sides of the rectangular box about eight inches above the floor were flared from this point to the top of the car, next this flare was changed and one vertical side board was added at the top, the overall width remaining the same. The process of lowering the flare boards and adding additional vertical side boards at the top continued until about the year 1900 when the flare board was lowered until it just cleared the car wheels. The surprising thing about these cars is the number of years during which the inside length of the car body remained between six and eight feet, the preponderance of animal haulage in use during the period no doubt contributing to this result. The first cars of this type for thirty inch gauge mine track held only about 2,000 pounds of coal, bed full. By the year 1905 cars of this type for forty-two inch gauge track would hold 3,500 pounds bed full. This type of car, with few exceptions, was continued in service until mechanical loading devices became recognized coal equipment, in fact, there is a surprising number of this type of car still in service.

The opening of new mines in the vicinity of old mines, which were soon to be abandoned, resulted in perpetuating the existence of more or less antiquated mining methods and the continued use of very narrow gauge track and obsolete equipment from the abandoned mine. It was also the practice to build mine cars near the mine. Large quantities of mine car material such as car bands, wheels and axles, lumber cut to length, and other material was usually available which it would be thought advisable to utilize.

During the period mentioned above, car wheels and axles had gradually been made heavier and by the year 1900 a marked improvement had been made in the design of car wheels, axles and bearings. New wheels of the plain roller bearing type were being tried out at different operations with varied degrees of success. It had become standard practice at these mines to assume that the wheel base on mine cars should not exceed twenty-eight to thirty inches and it is surprising how some of us were led to the belief that a car with greater wheel base could not be successfully operated in these mines. The coal mined in this territory is obtained from coal seams with a maximum of 25° from the horizontal, the early mines using small rails—twelve to sixteen pounds per yard—and short stub switches were common practice. For many years empty cars on the less inclined seams (up to 10°) were delivered to the working faces by mules or horses, the loaded cars being switched from the working face by the men who loaded the coal. On the steeper seams (10° to 25°) various systems such as McGinty's or chutes were used.

Due to the topography of the country and the fact that the coal occurs in pitching seams, it is not easy to find desirable locations for opening new mines where the necessary room for railroad tracks and top works would be available. Because of this condition haulage entries in these mines were eventually driven long distances, in some cases, four to five miles, which resulted in an acute haulage problem with the small cars in use. To overcome the problem of car shortage on account of the long haul it became common practice for the hand loaders to build up, or what is usually termed chunk the car, until in many cases the coal carried above the car body equalled the amount in the body itself. This practice continued over a period of years, the managements thinking of the car as a forty hundredweight car, or two tons, and because of this practice it became the custom to compare the deadweight of the car handled per ton of coal hauled on the above basis.

After the installation of the first mechanical loading devices, an attempt was made to chunk, or build up the car, until it would carry approximately the same amount of coal as when loaded by hand methods. Managements very quickly decided this was not practicable as the machinery remained idle while the coal was built up on the car by hand, and when an attempt was made to chunk the car while the machinery was in operation, men's hands and arms were injured. The attempt to build up the coal above the car body was quickly abandoned with the result the car only carried two thousand pounds, or one ton of coal, making it necessary to handle approximately one hundred per cent more cars to and from the mechanical loader and more time was spent in switching than in loading the cars. This fact being established, engineers were placed on the job to make time studies of the different operations. Haulage was speeded up which resulted in an increased cost for haulage and maintenance. The time studies suggested the installation of large capacity mine cars as the one practical solution. This solution involved radical changes in these mines due to the fact that practically all of the operations were in old territory where close timbered, narrow entries with insufficient head room had been driven. Operations through these entries were carried on for many years on a thirty to thirty-six inch track gauge and over light rails, except on the slope and main haulage roads, where a heavier rail was used.

Under the conditions existing in many mines, the capacity of the car could only be increased by adding length to the car. The length that could be added was limited because of curves, switches and insufficient clearance. The studies disclosed that the cost of widening the track gauge in many of the old mines would be prohibitive and in such cases a new design of car was made for the existing track gauge with as large capacity as could economically be moved through existing haulage roads. In some mines a board six to eight inches high was added to the cars in use whenever the freight of roof would permit. All new haulage ways in these mines were driven with sufficient clearance to operate larger cars at a future date.

New systems of mining were studied, and different types of mechanical machinery for loading coal were examined to determine the machines best suited for the mining conditions. On seams inclined up to 15°, scraper loaders discharging on transporting conveyors have been installed, and shaking conveyors are being used successfully on pitches up to 22°. These installations allow for the establishment of a stationary loading point where trips of cars coupled together can be run under the chute and loaded, thereby eliminating a large part of the time necessary in switching individual cars.

Since mechanical loading of coal has assumed such proportions and it has been proven not practical to load cars mechanically much above the car body, we have been compelled to revise our set-up of dead-weight per ton of coal hauled in the design of modern cars and it would seem only a matter of time until mine cars will be constructed of lighter weight materials to partially offset the dead-weight ratio.

The capacity of mine cars is an important factor governing the production loading rate of a loading machine. Time studies show that the greatest loss in time with mobile type loaders is due to car changes. With larger cars, more tonnage can be loaded with fewer changes for the same tonnage and with less production loss.

The following table shows the relation of, first, car size; second, tons loaded per hour, and third, per cent

Time Loading (Minutes)	1.33	1.63	2.00	2.48	3.11	4.00	5.33
Time Changing (Minutes)	1.33	1.33	1.33	1.33	1.33	1.33	1.33
Loading Cycle (Minutes)	2.67	2.96	3.33	3.81	4.44	5.33	6.67
Tons Loaded Per Hour	22.50	24.75	27.00	29.25	31.50	33.75	36.00
Cycle Loading	50%	55%	60%	65%	70%	75%	80%

of cycle time loading.

Where the cars can be run under a fixed loading head and a trip loaded without uncoupling or switching the cars, the loss of time in changing cars is so reduced that the size of the car is not such a vital item. Using the above table, assuming the capacity rate of the loader to be the same, i. e., 45 tons per hour, and the time changing of one car to be ¼ of a minute, the percentage of loading cycle ranges from 84.4% for the one ton car to 95.5% for the four ton capacity car, a span of only 11.1% compared with 30% for the mobile loader. While production is greatly increased it is more due to the fact that the cars can be kept continuously under the fixed loader head, thereby increasing the percentage of the cycle loading time, rather than the relative capacities of the mine cars. However, the capacity of the car is a very important factor in the haulage. Assuming that a motor hauls two ten car trips per hour, the unit production is in direct proportion to the size of the car and the decreased haulage cost is roughly in the inverse proportion. With the larger capacity car there is less likelihood of delays to the loader waiting for empties due to the increased time in loading the trips.

All mining men realize each mine has its individual problems, and in considering the capacity of mine cars for any given operation consideration must be given to the height of the seam, tonnage required, grades, distances, track gauge, kind of motive power, whether working old mine territory or developing new mines, weight of rails, clearance, roof conditions, kind of loading equipment.

Animal haulage has for the most part been displaced by electric haulage and the continued improvement which is being made on mine car wheels tends to make transportation of the cars much easier. The solid body cars which are handled by rotary dumping devices has improved the method of handling coal at the tipples.

The installation of large mine cars will require better haulage roads, although good, well maintained haulage roads are desirable for any size equipment. The maintenance cost of haulage roads should be decreased if first-class tracks and rollers are in use, the wear and tear lessened on equipment such as hoists, motors, mine cars, etc. Less time will be required for changing cars, there will be fewer derailments, which, with the small cars caused considerable loss of time in rerailments. The increased safety of this improvement should not be lost sight of as the hazard from derailments is of no small consequence.

There will be less tendency to overload the cars, and consequently less spill over the sides of the car. In this connection, the steel or composite cars are better suited for mechanical loading for the reason they allow less leakage which will reduce the cost of cleaning haulage roads. In designing a car, a careful study should be made of the physical conditions of the individual mine. Within practical limits, the height of the coal seam will determine the height of the car; the character of the roof will determine the width of the haulage way and the gauge of the track, this width and gauge being the limiting factors in the width of the car; length and wheel base must be governed by the radius of the curves over which the cars must travel. With these factors known it will be possible to develop the maximum capacity car that can practically and profitably be used.

The success of mechanical loading is in keeping the loading machines operating to capacity, and in order to do this it is necessary that sufficient cars be supplied at the point of loading and that these cars be available for loading from the beginning of the shift to the end.

Properly taken time studies will develop wherein the haulage is defective in securing the maximum loading time possible at the loading face. When the haulage and loading time have been co-ordinated, the use of large capacity mine cars should result in increased morale among the employes since waiting for cars when the loading unit is in position to load coal decreases the competitive spirit which is an important factor when loading coal mechanically and especially where a tonnage rate is paid or where a combination tonnage and day wage is paid.

In the writer's opinion large capacity mine cars are essential to successful mechanical loading and therefore, the car with the greatest capacity possible which is practical for the conditions under which it must operate should be installed.

METHODS OF PERMANENT ROOF SUPPORT

By REAMY JOYCE
Chairman, Subcommittee on Roof Support, Coal Division,
American Mining Congress

The research committee on permanent roof support has an interesting and important assignment. While its work is not as spectacular as research in problems of ventilation and the prevention of explosions, it nevertheless ranks high in safety work and in the difficult job of developing a profit as the result of mining operations. The necessity of maintaining adequate roof support in main headings is fundamental. That method of construction is ideal which results in safe, uninterrupted opera-

Steel I Beams Supported on Brick Pilasters, Protected by Brick Curtain Walls, Clyde No. 1 Mine, W. J. Rainey, Inc.

tion at low cost. The first cost of construction and the annual cost which must be absorbed during the life of the mine are matters of judgment based on experience, knowledge and research.

Main Heading, Consolidation Coal Co., Mine No. 3

Of the construction materials ordinarily used for roof support—wood, masonry, concrete, steel, and combinations of these materials, each has certain advantages, as well as certain limitations. All of these materials have known working stresses and proper designs can be made for any load with certainty. The nature of the roof to be supported, the quantity of coal to be mined, the probable life of the headings, must be carefully studied when the plan of operation is laid out. Serious consideration of the types of roof support to be used to meet the widely varying conditions, not only in different coal measures but in the different parts of the same mine, is vital and necessary. No one type of construction can be expected to produce the lowest annual cost combined with adequate safety for all operating conditions. It is therefore necessary to study the properties and characteristics of different construction materials and to forecast the results of their use under definite conditions of service.

Guard Rails in Commodore No. 2 Slope, Clearfield Bituminous Coal Corp., Prevent Damage to Slope Timbers.

Wood

Wood timbers have the advantage of low first cost. Wood timbers, when sound and free from decay, possess great strength for their weight. Unfortunately, naturally durable wood is scarce.

The two woods which grow in the United States that have both great structural strength and natural durability are Bois d'Arc and black locust. To the extent that these woods may still be procured at a reasonable cost, they make ideal mine timbers.

The average woods run oak timber that is now available for mine use is not resistent to decay in the natural state; the original strength is soon lost and the presence of rotten timber in the mine constitutes a fire hazard. The other hardwoods possess even less natural durability than the oaks, and the same is generally true of the pines and various other conifers. Most of these woods, however, possess adequate strength when sound, and failure from decay may be eliminated by chemical impregnation under pressure-vacuum processes. Certain chemicals, like zinc chloride, which prevent decay, also have valuable fire retardant qualities. Chemical impregnation, using modern methods, does not change the physical properties or strength of the kind

Treated Timber Cribbing, Bell & Zoller Coal & Mining Co.

of wood treated. A very slight increase in size in the less strong woods compensates for lower working strength. For example, a round stick of timber increases in bending strength as the cube of its diameter and in stiffness as the fourth power of its diameter.

Wood is resilient and has far greater ability to absorb impact than any other material. It bends before it breaks, and the sound which may be heard and the deformation which is seen as wood takes a load are useful in gauging earth pressures. When broken through wrecks or squeezes, wood timbers are easily removed, which is not so true of

Cribbing on Steel Supports.

masonry, concrete, and steel, which often have to be shot or cut out.

It is therefore important to think of wood as being in three distinct classes:

Untreated timber: 1. Naturally durable; strong; scarce. 2. Not

Switch on First Right Heading, Consolidation Coal Co., Mine No. 3

naturally durable; strong when sound; plentiful.

Chemically treated timber: 1. Durable; strong; plentiful.

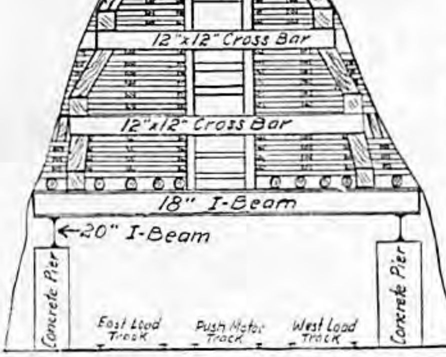
Wood timbers have a further advantage in that they may be "recovered" and reused if sound. This is particularly true of treated timber and to a lesser extent of steel timbers. Masonry and concrete are so fixed in place they cannot be moved.

Masonry

Brick walls, arches and pilasters are durable, incombustible, and most satisfactory when properly built to meet the right conditions of service. The first cost is high and skilled labor is required for this type of construction. Maintenance cost is practically nil if not disturbed by wrecks or earth movements.

Concrete

While concrete does not require the same skilled labor that masonry does, its use entails much more careful supervision and engineering skill.



Details of Timbering at Zeigler No. 1 Mine, Zoller Coal & Mining Co.

There are certain roof conditions that may be made stable by the application of from one-half inch to one inch of gunite when the roof is first exposed and before any appreciable amount of air slacking has started. Concrete may thus be used in various

Steel Cross Bars on Brick Piers

headings where a thin coat will be effective up to the heaviest types of reinforced concrete construction. Main slopes, main drifts, main bottoms, and other "bottle necks" are often sufficiently important to justify the heaviest type of construction because of the difficulty of maintaining unstable roof conditions. First cost of the type of construction selected must be balanced with the safe maintenance and dependable operation of these strategic headings.

Bad concrete disintegrates and the water in some mines seems to have this effect even on good concrete. The importance of intelligent supervision of concrete work cannot be overestimated.

Steel

Steel I beams, H beams and steel rails are successfully used as headers or crossbars for permanent roof support rather widely by coal mines. They are valuable in securing maximum head room. While the first cost of steel timber is greater than wood, the labor cost of installation is generally less. In some places, corrosion of steel timbers is a real problem, and painting is often difficult if not impossible. Steel must be cut to length before being taken into the mine. Any necessity for further sizing must therefore be taken care of by the

Main Bottom—Concrete Arch Nemacolin Mine, The Buckeye Coal Co.

shape of the heading where it is installed. To a lesser extent, steel legs are used to make three-piece timber sets, but usually wood, either untreated or treated, brick, concrete, or the coal itself is used to support the steel headers.

North Manway After Guniting, Nemacolin Mine.

Aims of the Committee

It is the duty of management to return satisfactory earnings on invested capital. Undermaintenance is expensive and often unsafe. Overmaintenance or methods requiring unnecessary capital investments are also expensive and may make the profitable operation of the mine impossible.

The challenge of operation to management requires alert thinking. Conditions are changing. Labor costs are up. Methods and materials must be studied as never before. Coal mining now has a real opportunity to

Steel Arch Roof Supports, Nemacolin Mine, The Buckeye Coal Co.

demonstrate its ability and stamina.

The committee on permanent roof support hopes to present to the American Mining Congress many good methods of roof support, together with the first cost of construction, the maintenance costs, the service conditions, the service life, and finally, the annual costs developed by the various materials and methods.

NEW COAL PROCESSING PLANT OF THE BINKLEY COAL CO.

By W. E. RUTLEDGE
Vice President, Binkley Coal Company

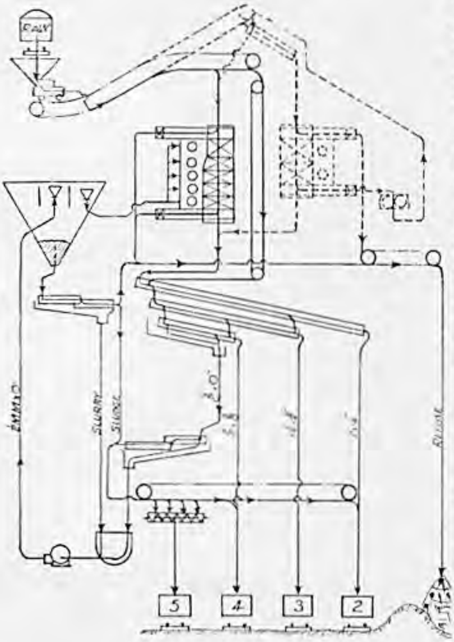
The Bituminous Coal Industry during the last decade has made very marked advancement in the production methods and in the preparation of the larger sizes of coal. During the same period many types of efficient mechanical coal burning equipment have been installed in industrial plants. Recently, this type of equipment has been introduced for low-pressure heating plants, and these installations are increasing tremendously each year. The increasing number of installations of stokers for both industrial and domestic use in the middle west has brought forth a constant demand from the coal consumers for a well-prepared, clean and properly-sized stoker coal that will give the most efficiency in the individual types of equipment.

The growing demand and the broadening of markets for properly-prepared stoker coal convinced us that the smaller sizes of Illinois coal of good quality could be processed into a positive low ash and uniformly sized product, and a processing plant to accomplish this would be a sound investment even under conditions prevailing in 1933.

An investigation was then started to determine, first, what in the judgment of various mechanical and power plant engineers, constituted an ideal stoker coal, which would give the most efficiency in the mechanical equipment installed in the middle west; second, to locate a low-cost producing field of coal with inherent qualities such that the raw coal could be mechanically cleaned economically, and the clean product meet the specifications required; (this developed that a central processing plant to serve a group of mines in the same field would be more practical than if connected with only one operation); and third, after a thorough study of all types of mechanical cleaning equipment and plants then in operation, which one would give the most efficient and economical operation with the greatest amount of flexibility to produce a uniform low-ash, proper sizing and mixing.

The Universal Coal Washing Company has constructed near Pinckneyville, Illinois, in the heart of the great coal-stripping field of Southern Illinois, one of the most modern coal preparation plants in the United States. The contract was given to the McNally-Pittsburg Manufacturing Corporation, of Pittsburg, Kansas, for the designing and furnishing of equipment. In the judgment of leading engineers and others, the coal washing, preparing and sizing equipment in this plant is the most efficient obtainable. The plant is independent of any mining company but has established milling-in-transit rates with all the operations in the field and has made servicing contracts with some of the largest operators. An outline of the operation of this plant is as follows:

The incoming raw coal is discharged from the railroad cars into a receiving hopper at the bottom of which is located a reciprocating plate type feeder. This feeder is provided with an adjustable gate and is actuated by adjustable-throw cranks to provide for positive regulation of



Flow Diagram.

the rate of feed. A scraper conveyor transports the raw coal from this feeder to the Norton wash unit. Instead, however, of discharging directly into the wash unit, the coal is deposited by the conveyor into an open launder and flushed hydraulically to the washery compartment of the Norton wash box. This provides for better distribution across the width of the washing compartment and also insures adequate prewetting.

The wash unit is of the fully automatic type with two primary and three secondary washing stages. The depths of concentrate bed carried in the primary and secondary areas are separately adjustable at will and are automatically maintained at the desired depths by means of a patented mechanism operating through a counterbalance float which may be adjusted to float at any desired gravimetric level in the washing bed. The evacuating gates are controlled by these floats. Thus the setting of the float control valves determines the depth of concentrate bed, and the setting of the float counter-balances determines the consistency of the bed. The washing impulse as well as the control of the back section is effected through separate air and water valves for each washing stage. The entire washed product is sluiced hydraulically to a 3-deck flexibly mounted classifying screen which makes size separations at one and one-quarter, three quarters and three-eights inches. The three largest ranges, corresponding to the No. 2, No. 3 and No. 4 standard Illinois sizing, deliver directly to cars on their respective tracks or optionally to a mixing conveyor which runs transversely across all four loading tracks. Gates in each of the screen decks provide for reassembly on the screen of any two adjacent size ranges, while, of course, the mixing conveyor provides for the reassembly of any two or more size ranges whether adjacent or not. Fresh water pressure sprays are provided on each deck of the classifying

View of Wedge Wire Dewatering Screens.

screen in order to remove any adhering fines or discolored wash water.

The ⅜-inch x 0 or No. 5 grade passes through the bottom deck of the screen together with the wash water and is laundered to the dewatering screens which are equipped with one-half mm. wedge wire. Each of the dewatering screens is approximately 20 feet long in two balanced sections. Fresh water sprays under pressure are applied to the coal near the end of the first screening section after the bulk of the wash water has been removed. These sprays effectively remove any adhering fines as well as rinsing off the fresh water which might discolor the coal after drying. The remaining 10 feet of each screen is utilized for the removal of the spray water. After dewatering, the coal discharges optionally into the mixing conveyor or into a collecting spiral which loads directly into the cars on the No. 5 track. The gate, however, is in four sections so that 25%, 50%, or 75% of this product may be deposited in the mixing conveyor for combination with the larger size ranges while the balance loads directly on the No. 5 track. This feature greatly increases the total flexibility of operation and makes it possible to load a wide variety of combinations and mixtures to meet the most exacting market requirements.

The slurry passing through the one-half mm. dewatering screens contains, of course a considerable percentage of fine solids. This slurry is collected in the pump sump, and delivered by a centrifugal pump to an elevated settling tank. This tank is conical in shape and the solid material settles to the apex from which, by the static head of water above it, it is forced through a pipe to the sludge screens which are mounted directly over the dewatering screens. These sludge screens are equipped with one-eighth mm. and one-quarter mm. wedge wire and the dewatered solids or sludge discharged from these screens may be optionally reassembled with the washed coal, discarded with the refuse or divided half and half between these two dispositions.

The water passing through the wedge wire of the sludge screens is returned to the circuit through the pump sump. This constitutes a closed circuit but it is a matter of record that there is no actual building of one-quarter mm. fines in the circuit. The explanation undoubtedly lies in the fact that the fines on the screen tend to constitute a filter, with the wedge wire serving merely as a supporting base and therefore very little solid material actually passes through the wedge wire. The clarified water from the top of the settling tank is returned by gravity to the wash unit for re-use and the only make-up water supplied to the circuit is the water which is applied in the form of the fresh water sprays.

A single drag type conveyor receives the rejects from both the primary and secondary elevators, as well as the dewatered sludge if it is to be discarded, and delivers the combination rejects to the refuse disposal site at some distance from the washer. At present a traveling scraper mounted on a high line and operated by an electric hoisting engine is being used to distribute the rejected material after it is discharged from the refuse conveyor.

The raw coal conveyor extends beyond the raw coal launder to discharge, when desired, upon a belt conveyor which will deliver directly to the classifying screens, thus bypassing the wash unit. This will make it possible to store unmarketable washed sizes during certain seasons of the year and then return them to the plant for resizing or mixing at seasons when they are salable.

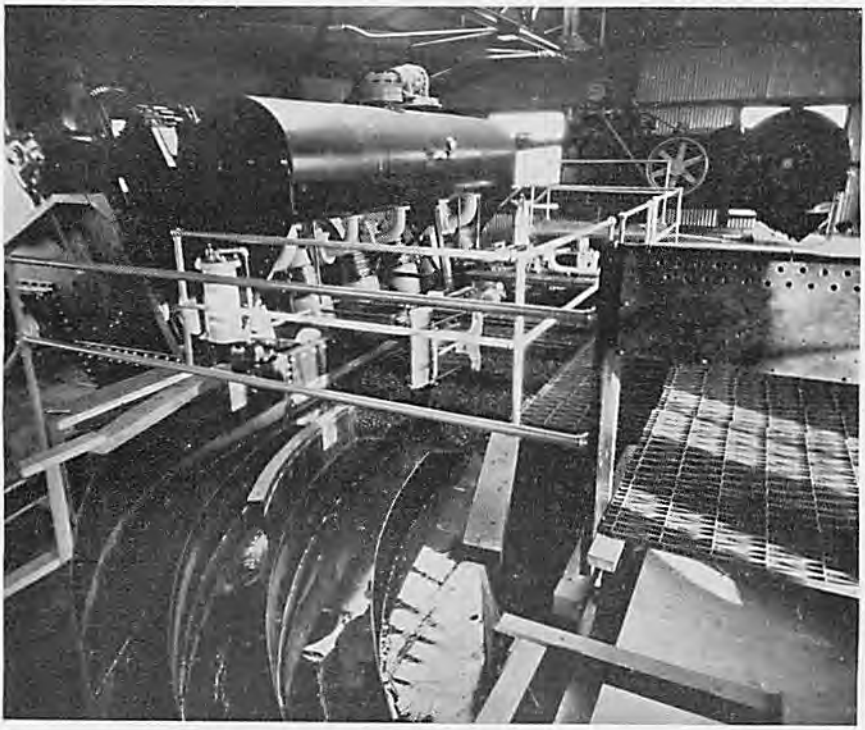
The plant has now an hourly capacity of 125 to 140 tons per hour feed, depending on the size of the raw coal, and on account of being independent of any mining operation is in a position to operate multiple shifts.

The design of this plant is for twice its present capacity, the raw coal feeder and conveyor as well as the classifying screens and mixing conveyor have sufficient capacity for the ultimate plant and the only equipment that will be necessary to double the capacity will be the addition of another washing box and battery of dewatering screens.

The entire flow as outlined above is shown on the flow sheet diagram, which also indicates the proposed extension to the plant.

A laboratory is maintained on the ground floor of the plant, where daily sink-and-float tests are made to determine the relationship of washer adjustment variables to specific gravity of separation, as well as the relationship of sink-and-float percentages to ash contents of coals treated. These data are the means of keeping an accurate check and control over the plant operation.

Where this plant is the only one of its kind now located in Southern Illinois, it is our firm belief that within a few years, the major portion of Southern Illinois coal from 2 to 0 inches will be similarly prepared.



Norton Automatic Washing Box Showing Launder.

DISCUSSION ON PROMOTING SAFETY

By DR. J. J. RUTLEDGE
Chief Mine Engineer, Maryland Bureau of Mines

Mr. Bryson said in his paper that safety is an investment. I would say that safety is an investment that is sure to yield a good profit. I notice Mr. Forester of The Consolidation Coal Company in the audience. If I could take from out of the files of that company some figures regarding their compensation costs, the difference between that company's costs and that of other companies' costs per ton for accident prevention, there would be a very handsome profit. I want to take off my hat to the Safety Department of The Consolidation Coal Company. They have been reducing mine accidents. Recently two young men who had been working in a Tyson mine of The Consolidation Coal Company, leased a small mine in the Tyson seam and began to work it on their own account. Of course, they carried accident compensation insurance and they carried into their own mine, where they were taking the money out of their own pockets to pay for timber and compensation. the same habits in which they had been trained in the Consolidation mines. The Inspector reported that when a person went into the mine operated by these two young men, they were so well timbered that one would think he was in a Consolidation mine. Of course, these two young men are making money in their coal business.

Accidents do not have to happen. Accidents **can** be prevented.

Referring to Mr. Bryson's charts, chart No. 1 is very interesting but I am a little from Missouri on this chart. Some time I would like to have a private discussion with Mr. Bryson and have him explain this data more fully. The same thing goes for his chart No. 2. Incidentally, this shows what a good, conscientious safety man can do when he is put in charge of accident prevention.

Referring to the cost of accidents —and I would say with considerable pride that Maryland was the first State to put accident compensation for mine employes on the statute— our cost for fatal accidents averages $5,000 if a man has a family, but it can be higher. It can go to considerably more than that. The average cost for burial is $125.00; medical and hospital costs can go up as high as $800 in each case. During the last few years that I have been studying mine accidents and comparing costs of compensation with my friends in other states, the records of two states have worried me considerably. One is Kentucky and the other is Alabama and I have come to the conclusion that they don't have any lawyers in either of those states; at least not in the coal fields, because I do not see any legal costs in their statements of accident costs. I know they could not keep the costs as low as they do if they have as many lawyers as we have in our compensation hearings in our State. Moreover, our Maryland law is so worded that the claimant need not be represented by counsel.

I was confronted the other day by the accident report made by a young man who had had three accidents in a comparatively short period of time. I went to the Accident Commission and said, "Here, something is wrong; this young man (I presume he is young, for he is a brakeman) has made three accident claims within a relatively short period of time. Investigation proved that in at least one of the instances not only the Mining Law had been violated but also the company's regulations. In common justice, in my opinion, when the Mining Law and company regulations are violated and an accident results, compensation ought to be denied the victim of the accident. Until the company gets behind accident prevention, it is useless to try to do anything in the way of preventing accidents. Moreover, unless you have good mine discipline, you might as well quit the fight against mine accidents.

Regarding the cost of mine accidents, our operators who are State-insured, report costs that run anywhere from 8c to 10c to 12c per net ton of coal production. Some of the figures that I have been privileged to see in the files of some of the self-insurers run anywhere from 1½c to 2c per net ton. So there is a very great saving to the self-insurer after all their expenses are paid.

There is no argument at all against safety. Mr. Bryson remarked to me just before I got to my feet that the rate in Kentucky was $9.50 per $100.00 of payroll just before some of the operators assumed their own insurance. I overheard the president of one of our largest companies talking with one of the members of the Accident Commission the other day and the president stated: "That his rate was $7.25," and he remarked, "that his present rate ought to be less as it is only seven-hour exposure now—one less than we had recently." This was a new thought to me but it is an argument to use on the compensation authorities.

The paper by Mr. Roy is very good. I have been following Mr. Roy's safety work in Ohio very carefully. Ohio has a higher rate than we have and if my memory serves me correctly—and I think it does—I think I have met Mr. Roy under other circumstances many years ago. It is a pleasure to see a man who fought so hard for the miners' interests fighting equally as hard for mine safety and it is an added pleasure to see the son of such a man up here reading a paper. It shows that he had better advantages than his father had at his age. I agree with Mr. Roy altogether in what he said that safety can only be promoted through a safety department. You will recall he said that a man in their mines is not merely a check number, that he is a man and so treated.

Incidentally, this man I referred to in our mines who had had three accidents, this is what we call an accident repeater and you will remember the trouble we used to have with the repeater in elections and polictical primaries. The accident repeater is the next thing that should be looked after. The employe or coal company that has too frequent accidents should be looked into very carefully. It took us three years to find out what was wrong with one of our largest mines where they had numerous accidents. Since a change in management this mine has had an excellent accident record.

If the rates for accident compensation continue increasing as they have, I predict that either the fund will fail and cannot be supported much longer or in some states the insurers will go back under the old common law, deplorable as that would be.

I would direct your attention to a paper read at the February meeting of the A. I. M. E. in New York by Mr. F. Robertson Jones entitled

Workmen's Compensation—a Growing Burden on Industry." Anyone who has anything to do with mine accidents should read some of these papers prepared by Mr. Jones.

CONSTRUCTIVE SAFETY WORK

By E. L. BERGER
General Superintendent, Bell & Zoller Coal & Mining Co.

Constructive Safety Work as applied to mines, means the prevention of injuries to mine workers; the elimination of removable hazards and the development of right-thinking on safety in the minds of the management and in the minds of the men. It means work; both brain work and manual work, but particularly brain work.

Most of my experience in safety work has been at the two mines of the Bell and Zoller Coal and Mining Company, located at Zeigler, Illinois. I am making no claim that the safety record of this operation is superior to that of any other operation. I do say that it is far superior to many operations and that very substantial progress has been made there in safety work in the past five years.

The Lost-Time Frequency Rate has decreased at No. 1 mine from 340 in 1929 to 74 in 1933, and at No. 2 mine, from 201 to 80. The tons per Lost-Time Accident have increased at No. 1 mine from 3,300 in 1929 to 12,000 in 1933, and at No. 2 mine from 4,800 to 9,200.

Both mines are thoroughly organized union mines which some people think retards a safety program. The men cannot be forced to wear protective clothing, but every one of the over 400 underground employes at Mine No. 1 wear safety hats, and over 90 per cent of them wear safety toe shoes. At No. 2 mine, over 95 per cent of the 800 underground employes wear both safety hats and safety toe shoes. In 1929 hardly any protective clothing was worn.

Some months ago, a few employes with political aspirations, called a meeting for the purpose of eliminating safety clothing. However, men who had enjoyed the protection of safety clothing dominated the meeting, and the morning following the meeting, thirty-five men who had not previously worn protective clothing purchased safety hats and safety toe shoes.

The men are taking a real interest in accident prevention. Some have been active in developing new safety devices. I might add, that although the American born predominate, the list of employes is made up of almost all the nationalities usually found in coal mines, and that the operation may therefore be considered as fairly representative of the industry.

The records cited previously are not perfect records. There is plenty of constructive safety work yet to be done. The records, however, do show decided progress and I am convinced that the progress is due to the safety campaign initiated about the latter part of 1929 after a year of particularly distressing accidents.

This date did not mark the beginning of safety work. A safety engineer had been on our pay roll long before that time. We had safety devices and had our mines posted with safety signs. We kept accident records. We had much of the safety paraphernalia common to safe mines and also common to many of the unsafe variety. We have had occasion to make alterations and improvements in these branches of our safety work. We had not gone far enough, but we were not wrong in the type of our safety equipment.

We were wrong in our general attitude toward safety because we then believed many things which we now know are false. We did not change all of our ideas over-night. Perhaps we are still cherishing some false notions which are preventing a better record. We are trying to keep our minds open to new ideas on safety.

We did give up the idea that accidents just happen. and now know that they can be prevented. We started to prevent them and to sell this idea to our bosses through meetings, letters and full reports on every accident. We carried the report of every Lost-Time Accident in our monthly magazine with suggestions for avoiding a repetition of similar accidents. We established a few well defined, practical safety rules.

We knew that we needed the co-operation of the men, but were doubtful of our ability to obtain it because the mines were thoroughly unionized and there was plenty of labor agitation. We started a drive to have 100 per cent of our employes trained in first aid. Almost every employe took the training. We had less difficulty in inducing the men to attend the schools than we did some of the management. We then gave up the idea that the men, particularly union men, will not co-operate. We know that they will co-operate if the matter is properly presented.

While on the subject of first aid I wish to say in passing that the State Department of Mines and Minerals and the United States Bureau of Mines, were of wonderful help in furnishing instructors and speakers for the classes in first aid.

Some one may remark that first aid is not safety work. Technically that is true, but men in first aid classes are very receptive to safety suggestions, and I know of no better way to arouse the interest of a large group of men than in safety talks and discussions in first aid classes. At these meetings the men feel free to call attention to hazards and unsafe practices which the management may have overlooked.

As the safety work continued we gave up still another idea and that was that safety destroys efficiency and increases costs. We know now that the safe way of doing a job is the efficient way and that a safety campaign costs only a fraction of the saving that it effects. Compensation for accidents is not cheap. A man on a stretcher and the men carrying him are producing no profit. A haulage road tied up for the transportation of an injured man is non-productive. Every accident has a demoralizing influence on a working crew. Accidents are expensive—safety is not.

We not only gave up old ideas, but we acquired some new ones, new at least to us.

Safety work, in order to be effective, requires equipment such as safety devices, signs, illustrations, reports and accident records. Such equipment is an important part of the successful safety campaign, but the error should not be made of thinking that equipment is the main part. Equipment bears about the same relation to constructive safety work, that tools bear to the construction of a building. Constructive work, whether applied to a building or to safety work, requires a clear thinking, authoritative, directing head and efficient workers. Without these, it is futile to even hope for much success.

Constructive safety work requires salesmanship. A man new on a job does not automatically work safely. Many experienced men continue unsafe practices until some one sells him on the safety idea. Our experience indicates that new employes are more easily sold on safety than old. During the past year we had occasion to hire many new men and we took particular pains to see that they were advised of the hazards of their work and of safe practice. We did not neglect the safety campaign as to old employes, but up to the present the new men have a better safety record as a whole than the older ones.

Continuing on salesmanship. To many men, hard hats, safety toe shoes and goggles appear as needless and uncomfortable refinements. Unless some one shows the advantages of such equipment and has the patience to see that only a proper fitting and comfortable article is sold, the men will not buy. The above statement is so obvious that I hesitated to make it. I made it only because I have heard of mine officials who have said that they thought that protective clothing should sell itself. It may sell itself, but it will be a slow process and severe accidents are likely in the meantime.

Safety work needs to be sincere. The management cannot wink at unsafe practices and removable hazards and still secure strict compliances with safety rules from the men. It must adopt practical safety suggestions if it expects the employes to have confidence in the sincerity of the campaign.

Safety work needs to be honest; honest in accepting blame when deserved. Most accidents can easily be explained as unavoidable when in fact it is questionable if there is such a thing as an unavoidable accident. An actual illustration: A main line locomotive is hauling a trip of coal cars. The motor runner is observing all safety rules. The track is in good condition, but on a curve one axle of the locomotive breaks letting the frame down onto the track. The runner is jolted off, run over and killed. That looks like an unavoidable accident. No one could be expected to know that the axle would break under ordinary working conditions.

However, special grades of steel for axles are available which are almost sure to eliminate accidents of this kind. If the accident is classed as unavoidable, nothing will be done to eliminate similar accidents. If an honest effort is made and the real cause of the accident is found, the proper grade of steel will be put in for other locomotive axles and there will be no recurrence of a similar accident, and another piece of constructive safety work will be performed.

Safety work needs to be continuous throughout the life of a mine. Special drives for no-accident months and competition for safety records in given periods are helpful in keeping the idea of safety to the front, but accident prevention should at all times be kept in mind and in order to do this, new signs, new devices and new schemes should constantly be developed. There can be no let-up in the propaganda for safety nor relaxation in the enforcement of safety rules.

Prevention of accidents is the very definite duty of every member of the supervisory force. In addition to being a duty, it is the greatest pleasure of any phase of mining work. What can bring more happiness to any man than the feeling that through his efforts he has kept death and injury away from his neighbors and friends?

THE COAL INDUSTRY AND THE GOVERNMENT'S HYDRO ELECTRIC PLANTS

By DR. E A. HOLBROOK

Dean, Schools of Engineering and Mines, University of Pittsburgh

(Reprinted by Courtesy of National Coal Association, Washington)

Foreword

At a meeting in Pittsburgh, Pa., on December 5-6, 1934, of the Coal Mining Institute of America, Dr. E. A. Holbrook, Dean of Schools of Engineering and Mines of the University of Pittsburgh, dealt with the subject of the coal industry and the government's hydro electric plants in an address which is herewith reprinted with his permission.

Dr. Holbrook is a graduate of the Massachusetts Institute of Technology and was for some years with the U. S. Bureau of Mines and Assistant Director 1920-22. He resigned from the government service to head the School of Mines of Pennsylvania State College 1922-27 and since 1927 has held his present post at the University of Pittsburgh.

The National Coal Association had no part in the recent Pittsburgh meeting of the Coal Mining Institute and no hand in Dr. Holbrook's appearance and address on that occasion. But his presentation of this subject is so timely, its concern to our industry so vital, and his factual argument so lucid and so authoritative that our association welcomes the opportunity to give it wide distribution.

Two Basic Discoveries

The greatest event of the 18th Century was the development of the steam engine by James Watt and others. He took the load of the world off the backs of men, where it had rested for untold centuries, and put in on machines. The greatest event of the 19th Century was the discovery of the principle of the electric dynamo by Faraday and its subsequent development by Edison and others to transmit power over great distances.

On these two basic discoveries has rested the material birth and the advance of the industrial civilization in which we live.

Stated in another way, we today must have power to do the work of the world. By the beginning of the 20th Century, coal had practically displaced all other fuels as a source of power. Indeed, it could be accurately stated that the amount of coal used in a country offered a good index of the relative material or comfort civilization of that nation. Mostly the coal was burned under boilers to generate steam which was used in turn to drive steam engines which gave us our power, but only at the place of generation. At about this time came the turning of the steam power into electricity by the dynamo, transmitting this power many miles by wire and again turning it into useful work by the electric motor. It is unnecessary to detail the parallel developments of electric lighting and heating through the recent decades.

Small water wheels, using the power that is in falling water, had been used in New England and elsewhere before the birth of the Steam Engine. With the coming of the railroads about 1830, it was soon found that coal could be shipped from Pennsylvania and used under boilers to make power for the New England mills, far cheaper than sufficient water power could be developed on the spot. In addition, the coal steam power could be had 365 days in the year, while with the older water power many mills had to close through the summer or dry season. Only in a few favored places did water power hold its own with coal. Thus practically all power was developed by coal up to 1900 and electricity, where generated and transmitted, depended on coal for its source of power.

Just before 1900 came the installation of the great water power turbines at Niagara Falls, the direct conversion of this power into electricity and its transmission over considerable distances. Here was an ideal place for generating water power, no expensive dam was required and there was a year around steady stream of water stored in the Great Lakes. Thus, this electrical power could be generated and sold at a cost far below the electrical power generated by any steam plant of that time.

Race Between Coal and Water

From then on we have witnessed a race, as it were, between coal and water, as to which could furnish more cheaply the increasing demand for electric power. There is nothing about a steam coal power house to excite the imagination, but the thought of that great water power at Niagara being harnessed does grip the emotions of people. "White Coal Magic"—"A God-Given Source of Power"—"Mother Nature's Gift to the People"—it has been called.

Now the story would be simple if on the one hand we had a thousand Niagaras and on the other hand if inventors and engineers had been content to let coal-driven steam engines and boilers stay in the undeveloped state of that time. The coal business largely would have passed out of the picture and we could supply our power needs easily and cheaply by water. Following Niagara, other easily harnessed streams were used to develop electric power.

No White Coal Magic

Then we came to a period where more costly work was needed to harness the water power. Now, we have to build high dams to provide the water head needed. We must buy the land we flood. In most cases the dams themselves hold only a few days' supply and when drought comes we must either have an expensive auxiliary steam power plant or must build, at large expense, storage dams and reservoirs to furnish water during low stream periods. **Whether water in a stream is a boon or a useless flow, therefore, depends upon just one question: How much will it cost to harness it for what we can get out of it? There is no magic in it, only the figuring of interest, depreciation and sinking fund on the**

investment to see if it will pay.

Now as to coal. Thirty-five years ago we used what are now old fashioned boilers and old fashioned steam engines to gain our power. During the past thirty years the improvement in boilers has been remarkable and the perfection of the modern steam turbine has pushed the steam engine out of the picture. Then a 4000 H.P. engine was noteworthy. Today the Brooklyn Edison Company in New York operates a single 210,000 H.P. steam turbine.

Forty years ago it took 10-15 lbs. of coal to furnish a kwh. of electricity. In the most modern stations it takes about one pound of coal per kwh. **Thus, coal and the power engineers have brought about improvements that today makes it cheaper to develop electricity through coal than through water, at all points** excepting those where coal takes a long freight haul, or where extremely favorable conditions occur for cheap and continuous falling water.

Political Horse Power

Above all, the question of water vs. coal is an economic and engineering question. It is not a political question and can only remain one by using public money to disadvantage. The people just have the notion that every stream represents golden dollars running away to the sea, and that a few millions of public money spent on a dam would bring them eternal peace, plenty and happiness.

I quote now from the speech of a Congressman, made some years ago, with reference to the Muscle Shoals power project:

> "The mighty and God-given waters of the Tennessee River, which, having been harnessed at Muscle Shoals by the power of man, shall subject to his mighty Will turn Sun Kissed Dixie into a land of peace and plenty, and forever free the southern farmer from the thraldom of the fertilizer trust."

I call this political horse power.

Now the facts are that the Tennessee River is a flash stream, wide and deep in spring and low in the fall. From the stream records you can find out for yourself that for several months in the year, the continuous water horsepower available at Muscle Shoals is less than 100,000. This is about one-half of that produced by a single electric turbine generator at the Brooklyn Station, previously referred to, and about one-third of that available every day at the Colfax station on the Allegheny River.

Muscle Shoals Costs

Government figures show that 47,000,000 dollars has been spent in building the dam and electric equipment at Muscle Shoals. With interest and depreciation at 6 percent, you and I are paying an annual interest charge on Muscle Shoals of $2,820,000. Now a steam plant to make the same power would cost about $8,000,000, which, with interest and depreciation at 8 percent makes the yearly carrying charge $640,000. The coal required would be about 375,000 tons at $4.00 per ton—$1,500,000. Total yearly cost of the steam plant, $2,140,000, or nearly seven hundred thousand dollars a year less than the government water power plant. You will see from this that the savings over the hydro-electric plant would pay for the steam plant in ten years, while the government plant will be paid for by our great grandchildren. I have put the coal cost at $4.00 per ton because the Muscle Shoals is within a stone's throw of the Alabama and Tennessee coal fields.

Lest you feel that this is a partisan statement, I quote from an official report of M. C. Tyler, Lieutenant Colonel, Corps of Engineers, U. S. Army, dated October 29, 1931:

"1. The Government's power plants at Muscle Shoals and the proposed Cove Creek development are not suitably located to serve as the main generating system of an extensive indepedent power system.

"2. The construction of an independent system would involve expenditures of public funds.

"3. The cost of transmitting power in such a system would be high and the reliability of service at long distances from the generating system would be poor.

"4. The construction of such an independent system would be an economic waste, in that it would duplicate transmission facilities now ample to serve the region.

"5. It may be expected that the deficit from the construction and operation of such a system which will have to be met by the Federal Treasury and by the general taxpayers, will largely exceed any savings from lower rates which may accrue to the limited local public served."

The report has been lost in the Wonderland at Washington.

It takes about two men working for a mining company to produce 1,000 tons of coal per year. Thus this one hydro plant puts out of work 750 mine employees and destroys a community dependent upon them. It takes off the railroads 150 trainloads of coal and the train crews and deprives the railroads of perhaps $750,000 in yearly revenue. Is this the greatest good for the greatest number? I submit that it is not.

But this is not the whole story. The total cost at Muscle Shoals for an auxiliary steam station, obsolete nitrate and fertilizer plants, etc., has run the cost up to $127,000,000.

TVA's 149 Dams

Now comes the Tennessee Valley Authority (TVA). They must first furnish more water for Muscle Shoals, so they are building upstream at Cove Creek, Clinch River in Happy Valley, the Norris Dam, of which the primary purpose is to furnish storage water to increase the low water flow at Muscle Shoals. A laudable effort, but adding some 38 millions of capital expenditure on which interest and depreciation and sinking fund must be paid.

The full plan of the TVA contemplates something like 149 storage and power dams in the Tennessee basin, involving a hydro-electric system whose total cost will exceed one billion dollars of taxpayers' money. Within the radius of, say 250 miles of these developments, are already private steam and water power plants with 40 percent excess capacity over requirements. At a generous rate of expansion it would take over fifty years for this section to absorb the government-generated power, even if no additional private plants were built. If the government is to give away power, mills and industries will move there, leaving us what here?

You will note that I have not discussed the cost of transporting and distributing electricity, because it will cost about the same to distribute and sell elecricity, no matter if it is generated from water or from coal. If there is a difference it is in favor of coal, because coal plants usually are erected near centers of consumption, while water power plants are where the water power is, often remote from centers of population. Actually the cost of the coal represents only from 18 to 28 percent of the cost of electricity ready to light our houses. Likewise the water-generated electricity represents not more than the same percentage of the cost of that electricity ready to use.

Recently the TVA bought out the Tennessee Public Service Company franchise and plant at Knoxville, under conditions that some lawyers have described as under duress. The citizens eagerly voted for the cheaper government power. I note, however, that the PWA had previously approved a grant and a loan to Knoxville of $2,600,000 to build a new municipal electrical distributing system. Is it right to destroy a public utility that pays taxes to give away cheaper electricity on which the taxes and interest to support the high investment are paid for by us all? In other words, **the people of the whole country will pay for the Tennessee Valley cheap electricity and with a total cost greater than coal-generated power there.**

To sum up, the proposal in the Tennessee Valley, is

Muscle Shoals cost	127 million
First TVA appropriation	50 million
To TVA by President's direction	25 million
To TVA from other government depts.	11 million
TVA estimates for five-year program	205 million
Committed for use by other government depts. in the Tennessee River basin	56 million
Total	474 million

Projected future dams and power facilities (149 in all) will add another 500 million dollars to the foregoing total.

Years ago the government properly constructed irrigation dams in the West. Then came the idea of generating electric power at these dams. If irrigation was desirable, then no one objected to the generation and sale of electric power there, especially in regions in the far West, remote from coal. But these new schemes of the government go far beyond the boundary line of good economics.

I have here a map showing the division of nearly the whole country into new authorities, among which are the St. Lawrence, the Loup River in Nebraska, the proposed Arkansas River Watershed Authority, the Wabash Valley Authority. The primary purpose of all of them is to furnish electric power at a capital and operating cost far beyond that if coal were used.

St. Lawrence Power Project

As an illustration, take the St. Lawrence Power project. If carried out, it would produce 6½ million horsepower, to be distributed largely in New York and New England at an estimated total capital cost of $350,000,000. Now, Pennsylvania coal furnishes most of the electric power in those states. This water power would destroy the market for and replace annually 58 million tons of bituminous coal, or more than two-thirds of Pennsylvania's present production. It would do away with 19,000 freight trains per year on our railroads, each train hauling 3,000 tons of coal. One hundred thousand coal mine employees and their families would have to find new homes. Actually whole counties in Pennsylvania would be left nearly without population or taxable property.

PWA'S Loup River

Early this year, when the Secretary of the Interior announced the project out in Senator Norris' territory for the development of the Loup River, the National Coal Association wrote him that the project would displace 200,000 tons of coal annually and throw out of employment a large number of coal miners and railroad employees. The Secretary made this reply:

"The statements you make in this letter to the effect that current can be generated more cheaply in the vicinity of the Loup River project by steam-generating plants; that the territory will not furnish a market for its output, and that the plant would operate at much less than its rated capacity, are all statements that have been made before. The fact that the project was approved, notwithstanding, indicates that they were found to be without merit."

Conclusion

Gentlemen, the coal industry of this country gives employment directly to more than half a million men and furnishes 30 percent of the freight for our railroads. In western Pennsylvania, were it not for our coal, we probably would be a small community surrounded by a not very prosperous agricultural district. At least six counties surrounding Pittsburgh prosper only when coal can be produced there.

Is our contention without merit when a piece of paper and a pencil quickly show in most of the projects now under way, or under consideration by the government, that electricity can be produced more cheaply there by coal; that the bulk of taxes of some of our counties comes from coal lands; that our mining population will have no other prospect of employment; that our railroads cannot exist without the freight revenue from coal; that government revenue drained from Western Pennsylvania is being used in part for grandiose projects in other parts of the country that will impoverish us?

I think the coal industry is willing and expects to meet fair competition from the government. If a great power plant can be erected and operated somewhere more cheaply by water than by coal, we acknowledge defeat. We ask, however, that the competition be put on an economic basis with all factors included. If this is done, we have no fear of the proper economic decision.

Thomas Edison, in 1929, said:

"We shall steadily require more power, but a great deal more fuss is being made over hydro-electric power than its intrinsic value warrants. The first and best source of power is coal. Water power is a political issue, not a business one. The government never really goes into business, for it never makes ends meet. And that is the first requisite of business. It just mixes a little business with a lot of politics and no one ever gets a chance to find out what is actually going on."

Last year, while in Washington, I talked with an enthusiastic government "White Water Magic" booster. "Well," said he, "you do not understand. You approach this question from your head and not from your heart. You do not appreciate its social value."

To those of you who place high stress on the social value of great quantities of electrical power from water, my answer is that it is the same kind of electricity that you get from using coal, and that we, in the coal industry, can show a population numbering millions now happily engaged in mining, transporting and utilizing what is also a "God-given source of power"—**C O A L.**

Resolution adopted by the National Coal Association at its 15th annual meeting at Washington, October 27, 1934.

Resolved, That the hydro-electric power development now being initiated by the TVA and by other government agencies, and the St. Lawrence project, which is to be revived for action by the next Congress, is without economic or social justification and on the contrary is both wasteful, extravagant and destructive and ought to be speedily halted. The consummation of this program will increase unemployment instead of relieving it; will dislocate and destroy private industry instead of stimulating it; will effect direct losses of incalculable amount upon the coal industry and related business, upon the railroads, and upon the privately owned public utilities; will impose new large and unnecessary burdens upon the American taxpayers, and, taken in its entirety, this stupendous water power development is calculated to retard rather than promote recovery.

PROCEEDINGS OF ILLINOIS MINING INSTITUTE FORTY-FIRST ANNUAL MEETING

Friday, November 2, 1934

Held at Hotel Abraham Lincoln, Springfield, Illinois

MORNING SESSION

10:00 O'clock A. M.

President Treadwell: Members of the Illinois Mining Institute, it gives me a great deal of pleasure to open the Forty-second Annual Meeting of the Illinois Mining Institute and to see such a good attendance and so many present. We have been a little late getting started this morning. I think we have a very interesting program. I believe we had better get right along with it.

Is the Mayor here this morning? He has been out of the City, and we did not know whether he would get back. If not, we will go right ahead.

The first order of business is the reading of the minutes, but as the minutes are all printed in the Year Book I believe we will dispense with that.

The next order of business will be the report of the Secretary, Mr. Schonthal.

REPORT OF SECRETARY

November 2, 1934

To the Officers and Members of the Illinois Mining Institute:

The year just brought to a close has been a very busy and highly satisfactory one, as will be noted by the reports showing the cash position of the Institute as well as its position from the standpoint of membership.

There has been quite a bit of activity on the part of the major committees, whose reports you will hear later.

The boat trip was a very successful one from the standpoint of members on board, and it showed a profit. There were 113 members on board, which is probably the largest attendance in many years.

The yearbook, through the efforts of the very active committee on advertising, turned out to be very satisfactory and quite profitable.

During the year just ended, the Secretary's office sent out upwards of 10,000 pieces of mail. This, combined with the regular work of taking care of handling dues, paying bills, and other details, entailed quite a bit of work on the office of the Secretary, but the results are very gratifying and make the work very well worthwhile.

The hope expressed in my report last year, that our membership would reach at least five hundred, has been fulfilled, due to the very good work of the membership committee headed by H. H. Taylor, Jr. We are hoping that the coming year will enable us to hold all our present members and enroll many more.

The Institute is just now beginning to realize some of the hopes that have been held for it in the past few years, in that constructive work that will be helpful to the Coal Mining Industry of the State can be accomplished. The program laid out for the coming year is most constructive, and you will be informed from time to time of these activities.

During the year we have lost two of our members: W. G. Hutton and Fred K. Clark, who was one of our first life members. Letters of condolence were dispatched to the bereaved families.

I wish to express my appreciation to all the members, the Executive Board, the Officers, and the Committees for their ever ready willingness to co-operate to lighten the burdens of the office of the Secretary.

Respectfully submitted,
B. E. SCHONTHAL,
Secretary-Treasurer.

Next in order of business is the report of the Auditing Committee:

REPORT OF AUDITING COMMITTEE ILLINOIS MINING INSTITUTE CASH STATEMENT NOVEMBER 1, 1934

Report of Auditing Committee

Balance in Bank, November 1, 1933	$1,416.34
Dues paid in 1934	1,452.00
Interest on bonds, profit on yearbook and boat trip	1,063.75
	$3,932.09
Less general disbursements: printing, postage, telephone, telegraph, etc.	1,303.10
Balance in bank, November 1, 1934	$2,628.99
Cash on hand 10-31-34, not deposited	6.00
Total cash, November 1, 1934	$2,634.99
Balance in bank, November 1, 1933, per above	1,416.34
Profit for year 1934	$1,218.65

Life Membership Account

Balance October 30, 1934	$201.97

The foregoing is found to be correct:

D. H. DEVONALD,
W. J. AUSTIN,
JOHN A. GARCIA,
Auditing Committee.

Bonds Owned by 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. Treasury Certificates, $1,000.00 each	2,000.0

Peter Joyce: I move the acceptance of the Secretary's report.

President Treadwell: You have heard the report. I believe it is in order for a motion to accept it and place it on file.

(Which said motion was duly seconded.)

President Treadwell: It is moved and seconded that the report be accepted. What is your pleasure?

(Whereupon the said motion was unanimously adopted.)

President Treadwell: We will now have the reports of the Committees. We will hear first from Mr. Taylor, of the Membership Committee.

Chairman H. H. Taylor, Jr. (Membership Committee): Mr. President, just a year ago we had 319 members, and the President expressed a desire to bring this up over 500. Thirty-nine different members of the Institute contributed during the year and co-operated with the Committee to turn in 189 new names, so that at the present time our total membership is 508. We have 479 regular dues-paying members, three honorary members, and twenty-six life members.

During the year we added the 189 regular members as mentioned, and added four life members, making a total of 508 members in good standing.

It is interesting to know that the out-of-the-State membership is approximately thirty. We have the States of California, New York, West Virginia, Pennsylvania, Kentucky, Indiana, Wyoming, Ohio and Nebraska represented, among others. An organiaztion gaining interest like this certainly ought to be worthy of support by everybody, and I would like to suggest, Mr. President, that all those attending the meeting who have not registered should do so at the noon recess. There is a desk outside, and we wuold like to have the name of every man here who has not registered.

President Treadwell: You have heard the report of the Membership Committee. Personally, I think it is a very fine report. I think it is wonderful. I think the members have taken an active interest in bringing up this membership, and have shown the true spirit of the Illinois Mining Institute. I think the suggestion of the Chairman that all those who have not registered should do so at noon is a fine idea. We owe that to Mr. Taylor.

The next Committee to report will be the Committee on Appropriation for Mineral Industry Research, Mr. T. J. Thomas, Chairman.

Chairman T. J. Thomas (Committee on Appropriation for Mineral Industry Research): Mr. Chairman and gentlemen of the Institute, at the fall meeting last year of the Illinois Mining Institute a special Committee was appointed to deal with matters affecting the Geological Survey and the Engineering Department of the University of Illinois. On that Committee, besides myself, is Mr. George B. Harrington, President of the Chicago, Bloomington & Franklin Coal Company, and Mr. George N. Reed, of the Peabody Coal Company.

The Committee held a number of meetings. On behalf of the Committee, I appeared before the Public Works Administration Committee for the State of Illinois to develop their reaction with reference to making an appropriation to properly house the Geological Survey. After much discussion, that Committee agreed to recommend to the Public Works Administration at Washington an outright cash appropriation of thirty percent of the cost of providing a building, with the understanding that the State of Illinois would provide the other seventy percent, and reach down into its portfolio and lodge with the Public Works Administration bonds or securities of the State of Illinois which would be pledged with the Federal Government in carrying out this project. We discovered after going into the matter that the State of Illinois was not prepared to lodge seventy percent of the cost.

Then after that meeting we had several conferences with Dr. Daniels, Acting President of the University of Illinois, with Dean Willard of the Engineering School of the University —and Dean Willard has since been elevated to the Presidency of the University of Illinois—with the President of the Board of Trustees, and with several members of the Board of Trustees, and with Dr. Leighton, Chief of the Geological Survey.

We came to an understanding that insofar as the University was concerned they would work in co-operation with the Geological Survey so that there will be no duplication of work or effort in carrying on the work of the mineral industries of the State, and dealing particularly with the matter of coal.

I say to you that this Committee has had something like six or seven meetings all told, maybe a few more. I am glad to say to this Institute this morning, to you, Mr. Chairman, and Mr. Schonthal, that I hold in my possession a letter written by Dean Willard, or President Willard, of the University of Illinois, to John J. Hallihan, Director of the Department of Registration and Education in Springfield, in which he calls attention to the fact that in the requests for appropriations to carry on the affairs of the University of Illinois there has been included in that request an item calling for an appropriation sufficiently large to properly house the State Geological Survey, and to pay the operating expenses from year to year in connection with that building.

If I may take just a little of your time, I would like to read a paragraph of that letter—this particular one: "In addition to the request for capital additions for strictly University purposes, there is included by request of the Board of Natural Resources and Conservation an item estimated at $82,500.00 for a new building for the State Surveys which are a part of the new Department of Registration and Education, but by direction of the General Assembly are housed at the University of Illinois. This figure covers the actual cost of the buildings, including plumbing and heating and lighting, and the cost of connecting it to the University power plant. Purchase of the site is requested in the special appropriation for land already mentioned. If the appropriation for the building is made, further additions must be made to the University Budget to provide for the expense of operation and maintenance of the building, estimated at $4,300.00."

I might say to you gentlemen one of the difficulties we ran into in the matter of getting the Public Works Administration to make the appropriation to take care of this housing facility is the fact that the State Geological Survey and University of Illinois function under separate awards of the legislature.

I might say I would like to move the adoption of the following resolution:

BE IT RESOLVED, That the Illinois Mining Institute endorses the proposal of the Board of Natural Resources and Conservation that the State of Illinois provide a suitable and adequate State Natural Resource Building at the University of Illinois to house the researches of the State Geological Survey Division;

Be it further resolved, That the Illinois Mining Institute use all of its good offices in properly achieving this objective and in securing the co-operation of all of the mineral industries, engineering organizations, and other related interests in the State, whose support will be helpful toward this end; and

Be it further resolved, That a copy of this resolution be spread upon the minutes of the Institute and a copy be sent to His Excellency, the Governor of the State of Illinois, to the Chairman of the Appropriations Committees of the House of Representatives and Senate of the General Assembly, to the Director of the Department of Registration and Education, to the Director of the Department of Finance, to the members of the State Board of Natural Resources and Conservation, to the President of the University of Illinois, to the President of the University Board of Trustees, and to other interested parties.

Mr. Chairman, I move the adoption of this resolution endorsing this action on the part of the President of the University of Illinois.

President Treadwell: Gentlemen, you have heard the motion.

C. F. Hamilton: I second the motion.

President Treadwell: You have heard the motion, which has been seconded.

(Whereupon said motion was unanimously adopted.)

President Treadwell: Gentlemen, you have heard a very comprehensive report from this very important Committee. I think this Committee has had the hardest task of the year. I imagine every man in here knows how hard it is this year to go out and talk somebody out of money. I think Mr. Thomas and his associates have done a very, very fine job, and I think the Institute is showing progress. A few years ago this Institute was instrumental in the starting of this research work. And now to come along and follow it up by advocating the purchase of bulidings and carrying it on shows we are living up to prospects. It shows the men doing this work have a very great deal of interest in it. I think it is very fine, and I thank you very much.

The next Committee will be the report of the Essay Committee, by Paul Weir. Is Mr. Weir present? We will postpone that.

The next report will be the report of the Nominating Committee.

Secretary Schonthal: I have the report of the Nominating Committee. I do not think any of them are here today.

President Treadwell: Will you read the report, Mr. Schonthal?

REPORT OF NOMINATING COMMITTEE

Read by Mr. Schonthal.

November 2, 1934

To the Officers and Members of the Illinois Mining Institute:

We, the undersigned members of your nominating committee, in accordance with the duty of nomination given to us hereby nominate the following officials and executive board for the coming fiscal year of our Institute:

OFFICERS

President—C. J. Sandoe, St. Louis.

Vice President—T. J. Thomas, Chicago.

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

EXECUTIVE BOARD

W. C. Argust, Taylorville.
W. J. Austin, Chicago.
Paul W. Beda, Chicago.
Chas. F. Hamilton, Chicago.
A. F. Dodd, Danville.
Wm. J. Jenkins, St. Louis.
Dr. M. M. Leighton, Urbana.
James McSherry, Springfield.
Fred S. Pfahler, Chicago.
H. H. Taylor, Jr., Chicago.
Harry A. Treadwell, Benton.
Paul Weir, Chicago.

Very truly yours,
JOHN E. JONES,
Chairman.
J. W. STARKS,
JAS. S. ANDERSON.

President Treadwell: Are there any suggestions or changes any of the members desire to make in the report?

E. H. Johnson: I move the acceptance of the report of the Nominating Committee. I further move that the Secretary be authorized to cast the unanimous ballot of the Institute for those nominated.

(Which said motion was duly seconded.)

President Treadwell: You have heard the motion.

(Whereupon the said motion was unanimously adopted.)

Secretary Schonthal: The Secretary, by the authority given, casts the vote of the Institute, and the Officers and Members of the Executive Board are duly elected.

President Treadwell: The next thing in order is any unfinished business. If there is none, the meeting is now ready to take up new business. If there is no new business, is there any communication to be submitted?

Secretary Schonthal: Mr. President, I have just one or two communications which I will not read. We extended an invitation to Mr. Finch, Director of the Bureau of Mines at Washington, to come out as our guest. Mr. Thomas was in Washington last week and was good enough to see him personally, but he advised it would be impossible for him to be here, since he was very busy in Washington and could not come. I have a letter of regret for his inability to be on hand.

I have a letter from Mrs. Fred Clark which we just received yesterday, acknowledging the communication sent her on the passing of her husband.

I just received a telegram from Mr. G. W. Wilson from Marshall, who states he was delayed on account of motor trouble and probably will not be able to attend. He regrets this and wishes us success in the meeting.

Those are all the communications we have to offer.

President Treadwell: This brings the business meeting for this session to a close. We will now go to the morning program.

It gives me a good deal of pleasure this morning to ask one of our Past Presidents, a man you gentlemen all know, to act as Chairman of the meeting. Mr. Charles Hamilton.

Chairman Hamilton: Mr. President and members of the Institute, I feel a good deal like a rookie trying to pinch hit for Babe Ruth this morning. Mr. Argust was to be Chairman of this morning's meeting. But having been forced into service by President Treadwell, I could not help but inflict myself on you and endeavor to handle the program to the best of my ability.

Our first paper is "Use of Airdox at Herrin No. 7 Mine," by Mr. G. S. Jenkins, Mine Engineer, Consolidated Coal Company of St. Louis, St. Louis, Mo. Mr. Jenkins.

Mr. G. S. Jenkins: Mr. Chairman and Gentlemen, we have experimented with the use of Airdox for several months, and possibly know less about it than when we started. Nevertheless, we will give you a little of our experience.

USE OF AIRDOX AT HERRIN NO. 7 MINE

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

At this mine we are working No. 6 seam, but the coal at this location seems to be of a friable nature, and tends to "chill" very easily when powder shot, which results in an excess of screenings as compared to most other mines in the vicinity. The seam itself has streaks of mother coal throughout and slips are prevalent in practically every room. A face may appear perfectly solid but upon shooting a slip will show up which will spoil the calculations upon which the shots were prepared. Often a shot will pull over cutting through an adjacent powdered hole, or on the other hand a slip may be within a few inches of the shot, thus cutting off the effectiveness of the shot and leaving an excess burden for the adjacent shot. In addition to this, the top and bottom are rolling and at times the coal pinches down to about 3 feet for a few cuts and then goes back to the normal height about 7 feet.

About 18 inches of top coal are left in most places. This is not a natural parting, but the six inch as it is called must be left to provide adequate strength. When the coal is shot to pull to the natural parting, 12 inches of top coal is left, which will come in, some week or two later, exposing a roof of shale which when exposed to the air, soon rashes and falls in pieces which vary in size from practically nothing to pieces weighing 5 or 10 tons.

This above condition makes it necessary to leave the 6 inch and to shoot an unnatural parting, which further tends to make the proper shooting of the coal a difficult problem.

Could the holes be loaded and shot single and the proper charge placed in a hole after the adjacent one was shot, this difficulty could be well overcome, but with the necessity of shooting on the off shift, and the limited amount of time due to the necessity of allowing sufficient time for the night shift, and examination of the mine,—this is not possible. The result of which being a tendency to "overshoot" the face to avoid stuck places and improper preparations for mechanical loading.

While this condition offers no problem during the summer months, it presents quite a different condition during the winter months when the market swings to larger sizes.

For the above reason we viewed with much interest the experiments of the Franklin County Coal Company at their Royalton Mine, with the use of compressed air as a means of shooting the coal. They were shooting the holes "on shift," single hole at a time, and getting a grade of coal which was low in screenings yet well shot, and suitable for mechanical loading.

About the time we began to get enthusiastic about the idea, Airdox came on the market, and we installed one of the compressor units, installed it on a territory for two Joys and removed all permissible from the section.

The fact that the strength of the charge could be varied at the will of the operator was of great importance, as it enabled us to increase or decrease the charge as was deemed necessary when a shot pulled to a slip. In speaking of the application of "Airdox," the word "shell" will be used to designate the container for the air and the word "shot" to designate the release of the air—as this will be analogous to powder discharge.

The first shell we used contained about 180 cubic inches and could be placed in a hole drilled by the No. 472 Little Giant Drill. This shell, however, was discarded some months later as it was too small to properly shoot the places unless an excessive number of holes were drilled in a place.

Next a shell with some 300 cubic inches capacity was tried—the results being better but a large number of rooms showing tight corners, so a shell of some 400 cubic inches capacity was substituted. This shell being 60 inches long, 4″ in diameter and weighs about 70 lbs. This shell really did the work, but necessitated the using of a 474 drill, which is a two man drill.

About 6 to 7 holes are necessary for a 24 ft. place and the two men are able to keep up the drilling for one Joy loading unit. The coal on this run is about 7½ to 8 ft. high and is undercut 8½ ft. The drillers drill the necessary holes and throw back the cuttings. The same two men are utilized on this work as were formerly on the run as drillers and shooters. The territory being shot with airdox having two Joy crews, of course requires 2 drilling crews. The two Joys are under one face boss and work both sides of a panel making their own entry development as they go along. When practical, a modified checkerboard system is utilized and an effort is made to provide the room face and a crosscut for the loading unit after each move. Room being driven at 60° with the entry and several rooms picked up off of one to provide car change and more suitable transportation conditions, also incidently decreasing the amount of track and maintenance of rooms.

In shooting the territory, our present set up, which necessitates purchased power, makes it advisable to do the Airdox shooting on the second shift, altho occasionally we shoot a few places on the day shift when additional falls are required for the day's loading. We are further handicapped in shooting on the day shift due to traffic problems. We are keeping a minimum of working rooms (about 6 to 10) for each loading machine.

So with 2 Joy loaders, 2 cutting machines, 2 drill trucks and three locomotives operating in a maximum of 20 rooms off of 1 pair of entries, the air compressor doesn't have much chance to get around and shoot for the whole territory during the working shift. Hence it is used on second shift altho when we complete our power plant and have an unlimited power supply we intend to provide adequate transportation facilities to shoot on the day shift, as well as on the second shift. The thought being to make a compressor unit do the shooting for 4 Joys.

The operating crew for the compressor unit comprises 2 men at shooters wages, one man operating the compressor and the other placing the shells and making the necessary calculations as to the charge required, which is from 5000 lb./sq. in. to 12,000 lb./sq. in.

After placing the shell in the hole he indicates to the operator the desired pressure and the compressor is started. The air is supplied to the shell through about 50 or 60 ft. of ⅜" copper tubing. When the desired pressure has been obtained the compressor is shut off and the line bled by means of a quick acting valve and the drop in pressure at the supply end of the shell, causes the valve in the shell to fly open so violently that the air is released with explosive force and breaks down the coal.

The face man or shell man then places the shell in next hole after observing that all tube connections are still intact, makes his calculations as to charge required for next hole, and the process is repeated.

The skill of the operator of course is limited to the gauging of the pressure, but even with the holes already located; by the use of correct pressure he can do some exceptional estimating.

This brings up the question of drilling. The proper drilling is just as responsible for a satisfactory preparation of the coal as the proper charge—perhaps just a little more so. We are convinced that the proper method is a hole straight in and within about 6" of the undercut. Gripping holes appear not to pull properly and to throw out the shell, with insufficient action on the coal. The tendency of airdox on account of its slowness is to not pull much above the hole itself, hence the top holes have to be practically to the desired height of roof. An Airdox hole on the solid tends to transform the hole into a cannon barrel and project the shell rather than break down the coal.

Standard practice is to pull the shell back some six inches from the back of the hole. This tends to produce a better coal with less chance of shell projection. As for tamping up the holes—this is impractical account of a portion of the first shot of air which seats the valve, is discharged through the valve just prior to its seating and cracks the tamping rendering it useless. As to the effectiveness of re-tamping of the holes after seating of the valve, we are not in a position to know, as the results do not indicate that the investment of another man shift on this operation is practical.

As to the mobility of the compressor; I might state that it is self-propelled by a tramming motor and is equipped with suitable brake to keep it at all times under perfect control. Further, we have equipped the machine with a trolley pole, which makes long moves of no consequence as the unit travels at a speed of some 6 or 8 m.p.h. when trolley wire is available.

The compressor motor which is 50 H. P. is started through a push button operated contactor controller, which insures quick convenient operation, with adequate overload protection. The compressor cylinders of which there are four, operating in series, are water-cooled, altho the last two are going to be replaced by an air-cooled type. The piston seals on all stages are of piston ring type and inter-coolers are provided between stages with a water cooling system consisting of an adequate automobile type radiator and belt driven fan. Maximum cycle of operation indicates ½ time for pumping cycle while in one place, i.e. approximately 2 minutes are required to pump a shell and after so doing another two minutes are consumed inspecting and replacing shell and line and in calculating desired charge for next hole.

While our experiments convince us that additional labor, expense and maintenance, offset the costs of powder shooting, and then charging off what we consider an adequate charge per ton to pay for the machine, we can still net a few cents on increased realization at the present market, which after all is the thing of first importance.

Chairman Hamilton: Mr. Jenkins, on behalf of the Institute I want to thank you for that very interesting paper. I am sure it must bring up in the minds of the men present some questions, and the matter will be open for a discussion of the paper.

President Treadwell: There is one statement in that paper that I would like to get a little more fully. I have noticed in various mines where they use Airdox, or air shooting, that in a number of instances they do not tamp their holes. In Mr. Jenkins' paper he said it was useless. I would like to know why. I would like to know whether they get better results with the hole tamped or if they do not. From the paper I would judge they do not. If we can eliminate tamping in the shooting, we have eliminated one operation which is very nice.

Chairman Hamilton: Mr. Jenkins, can you add something to that question?

Mr. Jenkins: When we first began our experience, we tamped the holes. But with this Airdox shell, when you first start to pump the shell, the first shot seats the valves and as it seats a small quantity of air goes out of the valves into the hole. If you have the hole tamped up, it cracks the tamping before the discharge. So we decided not to tamp it. We tamped some and not others, and could not tell any difference between them, so just discontinued tamping them. Does that answer your question?

President Treadwell : It does, yes, sir.

Mr. T. J. Thomas: Mr. Jenkins, did you shoot with Cardox, where the shell was charged by the mine safety company, or where you charged it yourself and transported to the face, and now are using the compression? If you had both systems at your mine, which do you think the most efficient and effective and least expensive?

Mr. Jenkins: We never used Cardox on a production basis. We had some test runs made with it, and the indication we got from the experiment with the Cardox, it is considerably more expensive than the Airdox. As for the use itself, our experiments indicate that the result is just about the same with the Airdox as with the Cardox. As I mentioned before, this comparison is just a rough observation, as we have no data of consequence regarding the application of Cardox.

Does that answer the question?

Mr. Thomas: Yes, sir.

Mr. John G. Millhouse: I would like to ask if you have any difficulty with the different shells?

Mr. Jenkins: We have had some. Occasionally there is a shell that will fly. I cannot say it is a rule. Rather it is the exception. When the shell is projected from the hole, it usually is projected six or eight feet, or falls out at the face itself. Ordinarily the shell will stay in the hole, and the operator pulls it out and puts it in the next. I would say the number of shells that would fly out of the hole would be fifteen or twenty per cent.

Mr. Millhouse: Did I understand you in your paper to say the shell hole is not drilled the length of the cut?

Mr. Jenkins: You drill it within six inches from the end of the undercut. The projection from the bottom of the hole itself is six inches in front of the undercut.

Mr. Millhouse: Is the shell pushed to the back of the hole?

Mr. Jenkins: It is, and then pulled back an additional six inches, so that the nose of the shell itself is really about one foot from the undercut.

Mr. Millhouse: Do you allow the compressor to stay in the room while the shell is being discharged?

Mr. Jenkins: The compressor stays within fifty feet of the place of the shooting. The compressor is equipped with a guard, or shield, which protects the operator from the shell flying. We have never had it come back to the compressor when it is fifty feet from the face.

Mr. Millhouse: I want to say that recently I saw a demonstration of that at the Royalton Mine, and they would stay in the same room where the shell was shot.

Mr. Jenkins: We have the same practice here.

A Voice: How long does it take to charge a shell?

Mr. Jenkins: A minute and a half to two minutes and a half, depending upon the pressure you desire to put in the shell.

President Treadwell: In pulling your shell out six inches, does it throw the coal out better from the face?

Mr. Jenkins: It appears to send it out a little more than the powder does.

Mr. B. H. Schull: Are you using one hundred per cent air shells in the mine, in shooting the entire mine?

Mr. Jenkins: No, we are shooting two units, and they are composed of Airdox one hundred per cent. We run a daily screen test on this room.

Mr. Schull: The question I wanted to bring out is, do you take screen tests?

Mr. Jenkins: We keep a daily screen test on this territory.

Mr. Schull: Then you know the difference between your screen powder shot and air?

Mr. Jenkins: Yes, sir.

Mr. Schull: That is the question I wanted to ask.

A Voice: How does the loading machine operate compared with air shooting as it would with powder shooting?

Mr. Jenkins: When we first began loading the Airdox coal we experienced a lot of difficulty, and the tonnage went down. Since that time we have become more proficient in the shooting, and the tonnage is up where it was with the other shooting. We went through a period of two or three months where the tonnage was down ten per cent or fifteen per cent, but that has been overcome now. The loading has to be gone at in a little different way than when it is powder shot. After the operator becomes accustomed to handling the larger amounts, it seems he has no difficulty.

Mr. James White: I would like to ask Mr. Jenkins how many holes he gets with a shell.

Mr. Jenkins: I do not understand your question. The same shell is used to shoot all the holes.

Mr. White: How many shots do you get with one shell?

Mr. Jenkins: You mean before the shell breaks down?

Mr. White: Yes.

Mr. Jenkins: That would vary

anywhere from one hundred to maybe fifteen hundred before the shell is repaired.

Mr. White: When the shell flies out of the hole six or seven feet, what effect does it have on your copper tubing?

Mr. Jenkins: There is a small pigtail—there is a short tubing on the shell, and this is the part which is put onto the line. When this shell flies out, any break in the copper tubing usually takes place in that pigtail. We carry a bunch of extra pigtails on the machine, and just substitute a new one for the broken one and keep on going. We repair it later by cutting off about six inches and putting it back into service.

Chairman Hamilton: Any other questions? Mr. Johnston, have you anything to add on this subject?

Mr. J. M. Johnston: I think not.

Chairman Hamilton: Mr. Taylor, will you say something on it?

Mr. H. H. Taylor, Jr.: I do not believe I have anything to say, thank you.

Chairman Hamilton: Mr. Sandoe?

Mr. C. J. Sandoe: I think the subject has been pretty well covered. While we use Airdox and Cardox both, it is just a question of judgment as to which serves you best, what type of coal you are shooting, and what the labor is. I think the paper is well given. I want to compliment Mr. Jenkins.

Chairman Hamilton: Luncheon will be served in the room across the hall, and you are urgently requested to be there promptly at 12:30 o'clock. They have a surprise for you in the way of a speaker, and outside of the very palatable food that will be there, I am sure you will all enjoy the remarks after the luncheon. But in order that the afternoon session may start promptly, they ask that you be there at 12:30 o'clock sharp.

It is rather paradoxical to say that a coal mine without coal is a failure, and we are in rather the same position in regard to progress in our Institute, because it would be almost a failure if we did not hear from Dr. Leighton. Dr. Leighton has a paper this morning on the "Developments in Our Coal Research Program," and it gives me great pleasure to present Dr. Leighton.

Dr. M. M. Leighton (Chief, State Geological Survey, Urbana): Members of the Institute and Friends, I am sure it would be ungracious of me if I were not to express my very deep appreciation of the action that was taken here this morning in endorsing the construction of the proposed State Resources Building, which is to house the State Geological Survey and the State Natural History Survey. You might like to have a word of further explanation.

In view of the fact that these scientific divisions are dealing primarily with the resources of the State and their development, the Natural History Survey dealing with the biological aspect, with the agricultural problems, problems in horticulture and so on, and the Geological Survey dealing with earth materials and mineral substances, it seems especially appropriate that there should be a building in the state to house this research work having to do with the improvement of the products and the finding of new uses for the state's fundamental resources.

I want to thank the Institute for the action that was taken, and I think you can imagine that it warms my heart a good deal to have this action taken. I cannot help but feel, however, that you perhaps took a little hasty action in view of the fact you did so before I presented my paper.

In other words, the jury acted and acquitted the criminal without hearing from him.

May I also call your attention to the display of some of our research work on coal out in the corridor on this floor? You will find there illustrated some of the things I shall mention in this paper. And tomorrow those of you who come to Urbana to attend the Game, if you have opportunity to come around through the laboratories, will find there a very hearty welcome. We would be glad to take up any matters with you that you would like to discuss or to show you any part of our work that is in progress. If you were to come there you would find a situation that from some angles you would not be proud of. For example, you will find that some of our work and some of our valuable records must be done and kept in a little old house that is a fire hazard. The fine equipment that is there has no place in such a building. Indeed, you would also find, for example, that the need for additional space has meant the moving of some offices out into the garage, the taking out of some of the cars and building temporary offices in our garage back of our laboratories. So the situation is very acute with regard to the need of appropriate and adequate facilities for the carrying on of this work on the state's natural resources.

DEVELOPMENTS IN OUR COAL RESEARCH PROGRAM

By DR. M. M. LEIGHTON
Chief, Illinois State Geological Survey, Urbana, Ill.

Someone has said, "Tell me what your resources are and I shall tell you what your society is."

The more we ponder this statement the more we become impressed with its force. Our minds immediately reflect upon those regions which differ in their resources of basic materials, of geographic location, of topography, of climate, and of human talent and skill. We recall those regions which have much, and those which have little. We picture their wealth and their poverty; their attraction for men of ability on the one hand, or men who are content to live on small margins on the other hand; their high development of all of those features which make for a progressive type of civilization with ready means of extraction and conversion of resources into energy, construction, transportation, communication, educational facilities, and human character, or the lack of such development which keeps mankind in the primitive state. It is indeed true that the sum total of the resources of a region determine the state ot society existing there.

But upon second thought, we remind ourselves that a society may cease to progress. It may become static, it may retrograde. This is likely, especially if the individuals which make up that society are content with conditions as they are, if they feel that no new knowledge lies ahead, and no new and better ways of accomplishment. Instead, therefore, of saying, "Tell me what your resources are and I shall tell you what your society is," it is desirable that we adopt another more dynamic point of view, namely, "Tell me what can be done with your resources and I will tell you what your society can become."

This viewpoint became the cardinal principle of the new program of the State Geological Survey three years ago, when with the aid and enthusiastic interest of the Illinois Mining Institute, a series of investigations was inaugurated on the coals of the State of Illinois and the other resources of this area.

Now that these researches have been under way for three years, it seems pertinent that we should review the contributions that have been made and make a report of progress. I shall, therefore, proceed to do this, with the feeling that you through your enthusiasm of spirit and your sympathetic support, have participated in the work, and helped to make possible the results thus far obtained.

Emphasis has been laid upon several lines of inquiry.

(1) The nature of coal.

(2) The distribution of ingredients in fine coal with regard to their separability and the production of specially adapted fuels.

(3) The conversion of slack coal into a marketable product.

(4) The coking characteristics of Illinois coal as a basis for satisfactory oven-design and operation.

(5) The classification of Illinois coals based on their composition, heat value, and properties.

(6) The competitive position of Illinois coals with special reference to natural gas and fuel oil.

Every line of investigation has yielded new knowledge, has given new visions as to what can be done with our coal resources, and has opened wider the doors of opportunity for the future.

1. The present lack of knowledge regarding the nature of coal is most serious. Upon the attainment of this knowledge rests the richest chances for a wider, more efficient, and new utilization. Without such knowledge any piece of experimentation is likely to be a shot in the dark.

The first step upward in the ladder of success has been, we believe, in finding the proper lines of approach, namely, the study of the four banded ingredients, or constituents, of coal—clarain, vitrain, durain and fusain. The physical and chemical composition and properties of these are being determined, including the nature of component plant parts and plant accretions such as waxes and resins. Such knowledge is fundamental to an understanding of the nature of the individual ingredients and of the coal as a whole and provides a rational basis for experiments in preparation and utilization.

You will doubtless recall that the samples for these studies are obtained in an entirely different way from the usual method of collecting a face sample for chemical analysis. Complete vertical columns of the entire coal bed, from the roof to the floor, are obtained and taken to the laboratory, with each piece labeled as to its precise position in the coal bed. Thus far, twenty-eight such columns have been taken from the No. 6 coal bed in 10 representative counties over the State, 5 from No. 5 coal, 3 from No. 2 coal, and 1 from No. 1 coal. The data obtained by this study show that there is a definite increase in the amount of vitrain in the No. 6 seam from the northwest to the southeast, and that there are local variations in amount of fusain which, of course, influence the character of the coal.

Financial aid has been obtained from the National Research Council for a study of the plant components in the coal beds. As knowledge improves, coal can be more accurately classified with respect to the contents of the plant components, and the distinctions between types of coal will have increasing significance in utilization.

The study of the mineral composition of the coal is also well under way. It was necessary to pioneer in the development of the technique of this new study because such research is new. The separable mineral particles must first be isolated, in successive small sections of the vertical column, and then identified as to mineral species under the polarizing microscope by a highly trained specialist. The information gained is very useful in the understanding of ash behavior in combustion, in problems of selective mining, and in coal cleaning. Harvard University has thought sufficiently well of the work done thus far to accept the work of our investigator as a doctor's thesis.

It is thus seen that both the organic and mineral constituents of the coal beds will be eventually known, their effect upon the use of the coal will be learned, and how to alter the coal for different uses will be determined.

2. The investigation of the distribution of the banded ingredients in the various fractions obtained by float-and-sink methods, and the calorific value of each fraction, has been initiated and further investigations will probably be carried out as a cooperative project between the State Geological Survey and the Department of Mining and Metallurgical Engineering. A preliminary study shows that there is a concentration of the vitrain in the lighter fractions, and fusain in the dust. These differences suggest the possible desirability of selective preparation for specific uses. Studies in the calorific value of float-and-sink fractions have demonstrated the fallacy of the former concept that coal is a single substance diluted by ash, have shown the significance of such information in maintaining uniformity of output of a cleaning plant with respect to heat value of the product, and provide a means of determining the practicability of producing coal of certain standard calorific quality. Some preliminary basic data have just been pubished in the Survey's Report of Investigations No. 34, on "Banded Ingredients of No. 6 Coal and Their Heating Values as Related to Washability Characteristics."

3. The investigation of the physical properties of coal under three variables—temperature, pressure, and time—had already led last year to the discovery of a method of briquetting fine coal by impact without an artificial binder, and this year the discovery was made of a method of making smokeless briquets, that is, briquets which give off only about one-fifth as much smoke as Pocahontas coal. This development, it appears, could not have taken place except by employing the impact method and by using no artificial binder. A report is now in preparation which will give the details of the process. Requests for permission to use this new process experimentally on local coals in Canada have been received from the Canadian Bureau of Mines and on coals in Utah from the University of Utah.

4. Work is also under way in obtaining basic information, particularly of a chemical nature, which has as its chief objective the wiser selection or preparation of Illinois coals for domestic or metallurgical coke manufacture, the design of ovens suited to Illinois coals, and the determination of the best practice.

During our studies on coking, it was found that the formation of fingery pieces of coke—an undesirable characteristic of some Illinois coals—could be minimized by the addition of small amounts of fusain to the charge. The addition of a small quantity of fusain, to these highly swelling coals resulted in a blockier coke of greater strength. The dust removed by mines by the dedusting process, in the preparation of stoker fuel, offers a convenient source of fusain. A report on this work will soon be issued.

5. The Classification of Illinois coals has also been given attention. The adoption by the American Society for Testing Materials of tentative specifications for the classification of coals by rank and by grade, and the pressing need of accurate classification under code regulation, has made desirable the immediate publication of a bulletin on this subject in which is being assembled all reliable information provided by various public bureaus in regard to the chemical character of Illinois coals, as that is commonly understood. It is desirable to have the information so presented that the domestic consumer as well as the dealer and producer may be able to estimate without great difficulty the relative value of coals offered at different prices, particularly the extent to which the value is affected by calorific value and ash content.

The last compilation of analyses was printed in 1923 and since that time, particularly in the last four years, a considerable number of mines have been sampled in areas previously not represented. Furthermore, the compilation of 1923 contains analyses of a considerable number of car and tipple samples not so indicated. There is additional reason for this new compilation in the need for having values expressed on the basis (moist mineral - matter - free basis) recommended by the Committee on Coal Classification of the American Society for Testing Materials.

The new bulletin will provide standard analytical information in regard to the regional variations in Illinois coals, will classify Illinois coals according to rank and grade, and will give information that will enable the domestic user to determine the approximate relative value of coals in a market which, like the present, is considerably askew with respect to prices. It will, therefore, be a contribution toward the eventual realization of a rational basis for evaluating coals.

The bulletin will contain among other data the following tabulations:

(1) A tabulation of approximately 1,000 individual proximate analyses of face samples on an "as received," moisture-free, and ash and moisture-free basis, with calorific values and sulfur values on each basis and with calorific values on a unit coal basis.

(2) A tabulation of mine and county averages of 263 mines on an "as received," dry, ash-and-moisture free, moist mineral-matter-free and dry mineral-matter-free (unit coal) basis showing proximate values for each mine and ultimate values where available. Moisture, volatile matter, and fixed carbon values will be shown

on a moist mineral-matter-free basis, and volatile matter and fixed carbon values on a dry mineral-matter-free basis (unit coal).

(3) A tabulation giving county average values in alphabetical order by county and seam. This will be a revision of the table in Bulletin 56, edition of 1932.

(4) Available data on ash-softening temperature and the occurrence of organic and pyritic sulfur will also be given.

(5) Available data on agglutinating and slacking tendencies of Illinois coals will be provided.

6. Mineral Economics Investigations. The use of minerals and mineral products in present day industrial production is so intimately interwoven with the entire industrial fabric that investigations in economic problems of the mineral industry for the benefit of Illinois mineral industries and as a guide to the selection of our research projects, necessitate broad inquiries in the related fields of manufacturing, transportation, and agriculture. Furthermore, the position of Illinois as the major mineral producing state of the Upper Mississippi Valley and also the chief source of manufactured goods for these states necessitate an extension of economic inquiries into the conditions, trends, and developments of this entire economic and geographic unit. Such studies have been energetically pursued.

The manuscript for a complete detailed report on the competitive position of Illinois coal in the Illinois coal market area, with special reference to natural gas and fuel oil, is approaching completion. This will be of great interest to operators and sales agents in analyzing the problem of coal competition and the status of the various market areas, on the basis of which sound future policies can be shaped by the coal industry.

The importation of natural gas from 1929 to 1932 has increased 177-fold, from 156,000,000 cubic feet for 1929 to 27,675,000,000 cubic feet for 1932. This represents a replacement of 1,107,000 tons of bituminous coal, for both domestic and industrial uses, the future significance of which to the Illinois coal industry, the cities and towns dependent upon this industry, the railroads and their employes, the investments in all of these properties, and the support of the schools and local government cannot be fully appreciated by the average citizen. The need for pressing on toward the goal of a wider and more efficient utilization of this, the greatest of the state's resources, is nothing short of imperative. This requires more incisive inquiry into the fundamental nature and behavior of Illinois coal, to secure the necessary information by which the present methods of coal utilization can be revolutionized and made to meet the competitive advantages now possessed by imported natural gas.

I am sure that you are all aware of the fact that the accomplishments herein described are due largely to the plan of group research, put into effect in 1931. In the operation of this plan, there is a joining of hands of the geologists, chemists, physicists, microscopists and mineral economists.

Chairman Hamilton: The report of Dr. Leighton as to his projects might possibly create in your minds some line of endeavor which you think the Institute or department could naturally follow. I feel quite sure the Doctor would heartily welcome some suggestions as to other lines of endeavor in order to follow and fill out a full program.

I think you can speak very freely about it, and I feel quite sure the Doctor would appreciate it.

Is there something to be offered along this line?

Dr. Leighton: Mr. Chairman, may I emphasize that suggestion of yours? We hold ourselves in a receptive mood as to the directions that our research should follow in order that it may be of the greatest help to the industries of the State. We solicit your thought along these lines, in the belief that by putting our heads together more can be done than if the members of our Staff are to proceed according to their own ideas.

Now, if you have any suggestions this morning they will be most welcome. Or if, when you visit our laboratories, any thoughts come to you and you have any suggestions to offer, be assured that is exactly what we would like to have, and that is one reason why we want you to come to our laboratories.

Chairman Hamilton: Thank you, Doctor, for verifying my idea. Now, you have heard the direct invitation to visit the laboratory tomorrow. It is not out of place to add that our ever-efficient and ready Secretary also has some tickets to the football game which might be an added inducement to go to Champaign tomorrow.

Earlier in the proceedings this morning there was a request made by the President for a report from the Chairman of the Essay Committee. He was engaged in another function, I believe, at that time, but has since arrived, and I would ask Mr. Weir to report upon that at this time, if he is ready.

Mr. Paul Weir: (Essay Contest Committee): Mr. Chairman, your committee reports progress. It did not feel that the time available between the opening of school and the date of this meeting was sufficient to cover the ground and get the school children properly interested in the preparation of these essays. After discussion with the other members of the committee and the Secretary of the Institute, it was decided in view of the short time available we would postpone the contest until after the first of the year, and will be in a position to report at the Spring meeting.

Chairman Hamilton: Gentlemen, you have heard the report of the Committee Chairman. What is your pleasure?

A Voice: I move that the report be accepted.

(Which said motion was duly seconded and unanimously adopted.)

Mr. Peter Joyce: In order to disabuse Dr. Leighton's mind that we acted rather hastily on the adoption of Mr. Thomas' motion and his subsequent motion, I move that we extend to Dr. Leighton a rising vote of thanks for his splendid paper here this morning.

(Which said motion was duly seconded.)

Chairman Hamilton: You have heard the motion.

(Whereupon said motion was adopted.)

Chairman Hamilton: I think that was a very happy suggestion.

Mr. Fred S. Pfahler: I want to drop back to the report of our Membership Committee. I think it is hardly fair to pass that by with a mere gesture. About a year ago when our worthy President Harry said he hoped we would build our membership up to five hundred, I believe most of us thought it was merely a dream and, perhaps in the face of the times, impossible. About a month ago I happened to be at a luncheon at which our worthy Secretary was present, and he made the statement we were only short seven of the five hundred.

I do not know who the members of the Committee were, but I think they have done a wonderful job. I often feel this: that as we increase in number we command more respect and are more powerful.

While I do not know our incoming President personally, I have it on good authority he is very energetic and capable, and with such help as that committee gave our worthy President Harry, the same help to Mr. Sandoe, our incoming President, will likewise continue to build our Institute.

I think a motion would be in order, Mr. Chairman, to accept the report—I do not believe that motion was made—to accept the report of that Membership Committee, and let the record show what they accomplished. And I so move.

Chairman Hamilton: It will afford the Chair a great pleasure to see that Mr. Pfahler meets the incoming President after luncheon. Now, I think it is proper that a rising vote be given Mr. H. H. Taylor and his committee for their splendid work during the past year. All those in favor will please arise.

(Which said motion was duly seconded and unanimously adopted.)

Chairman Hamilton: It is now just 12:00 o'clock, which gives us about thirty minutes to attend to a few little matters before we meet for luncheon. Consequently, I turn the meeting back to the President.

President Treadwell: Gentlemen, I believe that is all there is to come before your meeting this morning. We will stand adjourned until 2:00 o'clock. Please remember, luncheon promptly at 12:30 o'clock.

(Whereupon a recess was taken until 2:00 o'clock of the same day.)

AFTERNOON SESSION

2:00 O'clock P. M.

President Treadwell: I will call the afternoon session to order. We have the pleasure this afternoon of having a gentleman as Chairman who has been very active in the last few years in the Institute, and particularly active this year. It gives me a great deal of pleasure to turn the meeting over at this time to Mr. Thomas, who will act as Chairman.

Mr. T. J. Thomas: The first paper to be delivered this afternoon is to be presented by a man for whom I have a great deal of admiration. I have known him for a good many years. We have called upon him a number of times to help us with some difficult problems we have been obliged to meet.

It gives me pleasure to introduce to this body this afternoon Mr. Charles A. Herbert, Supervising Engineer of the Department of the Interior, Bureau of Mines, of Vincennes, Indiana, who will talk to you on the "Opportunities Available to Management and Employes Through the United States Bureau of Mines for the Prevention of Accidents." Mr. Herbert.

Mr. Charles A. Herbert: Mr. Chairman and gentlemen of the Illinois Mining Institute, the paper I am going to read I had mimeographed, and I prepared about one hundred and fifty copies. I did not have this paper mimeographed because I thought you would all want copies of it or anything like that, but in a great many meetings of this kind it is the practice to have the papers mimeographed, and that is the reason this paper was so prepared.

OPPORTUNITIES FOR ACCIDENT PREVENTION AVAILABLE TO MINE MANAGEMENT AND EMPLOYEES THROUGH THE UNITED STATES BUREAU OF MINES — AN ACCIDENT-PREVENTION PROGRAM

By C. A. HERBERT
Supervising Engineer, U. S. Bureau of Mines Safety Station, Vincennes, Ind.

The accident-prevention program outlined in this paper is based on the premise that a majority of all mine accidents are preventable and in most cases are due to careless and dangerous practices and conditions that, as a rule, detract from efficient operation of the mine and may well be eliminated. That this is not a mistaken premise has been amply proved at mines where accidents have been reduced materially if not to the minimum.

No claim is made that this program or plan is the only satisfactory one to bring about a reduction of accidents; it is claimed, however, that it is a workable program, and if properly and intelligently carried out in part or in entirety will bring about satisfactory results.

THE PROGRAM

1. A Study of Accident Records and Reports

Obviously, if accidents are to be prevented, some knowledge must be had as to what is causing them and who is getting hurt, in order that intelligent steps may be taken to prevent their r ecurrence. Therefore, preliminary to beginning a safety program in which the Bureau's assistance has been requested, the Bureau engineer first studies the accident records and reports, usually tabulating the accidents according to cause and occupation, if this is not already being done by the operator. The study of these reports and tabulations gives a picture of how and where most of the accidents occur. The completeness of this picture depends on the type of report required by the company. Unfortunately the accident reports and records of many (probably of most) companies are very meager in so far as details of the actual cause of the accident are concerned. The cause of the injury (fall of rock, run over by cars, etc.) is given, but little or nothing is said regarding the contributing factors leading up to the accident, information of a type absolutely necessary if steps are to be taken to prevent similar accidents in the future.

2. Safety Inspection

After reviewing the accident reports and obtaining a more or less complete picture of the type of accidents and the labor classification experiencing the majority of the accidents, a safety inspection is made of the mine to gain first-hand information on operating conditions and practices. A study of the accident reports assists the Bureau engineer in making the inspection, as it gives him an idea of the hazards to be expected. The safety inspection includes a check on the ventilation by taking air measurements and mine-air samples, and a study of the coal-dust explosion hazard, including the taking of dust samples.

A copy of the report of this inspection calling attention to any unsafe conditions or practices observed is usually sent to the operator.

3. Accident-Prevention Course for Officials

After the inspection of the mine is completed a series of meetings is held with the mine officials, usually once each week, at which the cause and means of preventing the various types of mine accidents, such as falls of roof and coal, haulage accidents, etc., are discussed. The average mine official is concerned primarily in getting the maximum production possible per man and machine and as a rule has not given very much personal thought to the question of safety, although the coal company may have instituted some sort of safety, organization or even may have employed a safety man. This series of meetings brings home to the mine officials their responsibility in regard to accidents and the fact that dangerous conditions and practices that have been permitted to exist are not necessary to obtain maximum production at the least cost.

The desired changes in practice that will bring about greater safety are put into effect as the meetings go on, so that as a rule the accident record is noticeably improved by the time the course is finished. In substance, a set of safe operating rules or standards covering the various phases of mine operation is developed and put into practice by the officials.

Any safety program is necessarily one of education. The men who are being injured must be educated and trained to do their work in the safe way, which after all is the best and most efficient way, and the mine officials who are in daily contact with the men must assume the responsibility for their education and training. However, before they can ever hope to sell the idea of safety to the men in their charge they must first be sold the idea themselves.

4. First-Aid Training

The Bureau of Mines has been training men in first-aid for a number of years, and the Illinois State Department of Mines and Minerals has been giving similar training. At first this training was given solely by Bureau or State instructors to a limited number of employees at each mine. Later, in 1926, a new plan of first-aid training was inaugurated in cooperation with the State Department of Mines to give a greater number of employees the benefits of this training. This plan consists of giving enough additional training to certain selected employees to enable them to act as instructors under the supervision or guidance of the State or Bureau instructor. This plan has operated very satisfactorily, and by this means it is possible to train all the employees at a mine in a comparatively short time. This is the plan under which most of the Bureau's first-aid training is now given throughout the United States.

First-aid training not only gives the men knowledge of what to do in electric shock, arterial bleeding, or other severe injury, but it also plays an important part in any safety program. It gives the employee the feeling that he personally is taking an active part in the program; while taking the training he absorbs accident-prevention ideas and speculates on the needless occurrence of accidents as well as on available means of avoiding them. At the same time, it puts him in a receptive frame of mind, which makes it much easier for the mine official to impress him with the thought that new safety rules that may be put into effect are for his own welfare or that of his fellow employees and should be obeyed.

First-aid training may be carried on at the same time or following the giving of the accident-prevention course to the officials.

5. Holmes Safety Chapters

To be entirely successful, any safety program must have the continued support and cooperation of the employees. It is believed that in most instances this can be accomplished best by the establishment and maintenance of a safety organization for employees—the organization to hold monthly meetings at which accidents that have occurred during the past month may be discussed and suggestions encouraged from the men as to how they might have been prevented or can be avoided in the future. Entertainment of some sort, or speakers, usually are provided for each meeting. At nearly every mine there is good musical or other talent that can be utilized. To encourage attendance, draw prizes, consisting of safety shoes, safety hats, or clothing, are furnished by the operator at many meetings of this character.

These meetings, at which the men and officials meet in a friendly and cooperative spirit, have done much to improve contract relations between the company and the local miners' organization.

A chapter of the Holmes Safety Association offers a workable set-up for such a safety organization. The Holmes Safety Association is sponsored by the United States Bureau of Mines and in several states has the endorsement of the United Mine Workers of America. At present there are about 340 chapters of this organization in the mining fields of the United States.

Safety posters, as well as some scheme to promote rivalry between the various foremen in the mine, between sections of the mine, or between mines of the same company or of a definite mining region are useful and generally productive adjuncts to any safety program.

One company in Indiana has devised a "Thermometer of Accidents" on which is shown monthly the individual records of the bosses or foremen. A sketch of this thermometer board is attached (fig. 1). This company has erected a flag pole at both mines and the mine having the lowest accident rate for the month is privileged to fly the flag for the succeeding month.

In talking to the mine operator in regard to starting a safety program at his operations, certain questions usually arise, some of which possibly have occurred to you. Some of these questions are given here, together with a suitable reply.

Question. What will this safety program cost our company?

Answer. Very little in the way of money, but much time, hard work and hard thinking on the part of every official connected with the company. The results obtained will be in direct relation to the effort put forth. If you are not altogether convinced that such a program is worth while, or are mentally or physically lazy, it probably would be best not to attempt such a program, as the results would undoubtedly be disappointing.

Question. Will the men go along with such a program?

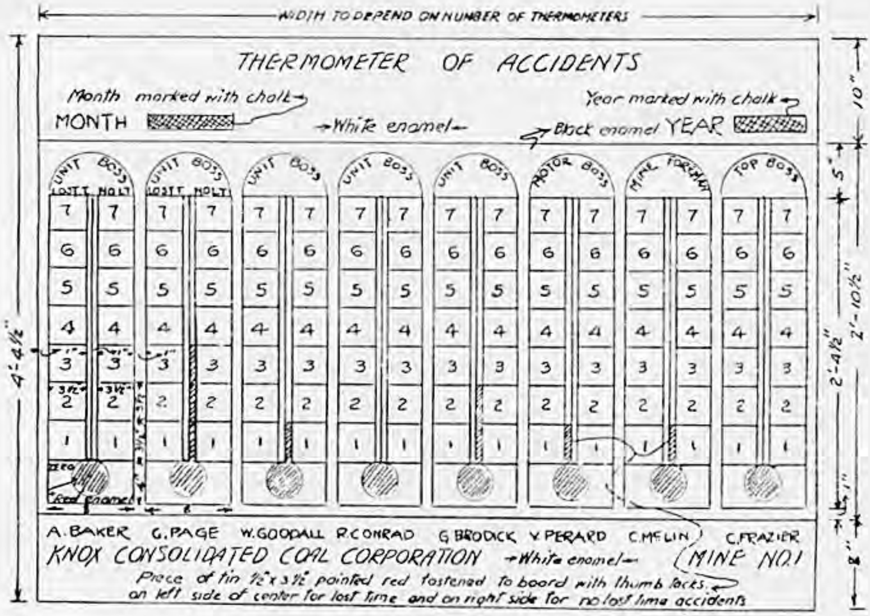


Figure 1

Answer. Yes, if you are in earnest and show them that you are sincere and are not inclined to pass the "buck" to the men; in other words, safety in mining requires co-operative effort, with no holding back by either employer or employee.

Question. How much assistance may we expect from the Bureau of Mines in putting such a safety program into effect?

Answer. The Bureau will give all the help possible with the limited personnel available. It will make the safety inspection of your mine; conduct the class in accident prevention for officials; assist with the first-aid training; and help to organize and to some extent maintain a chapter of the Holmes Safety Association. The Bureau enjoys the cooperation of the Illinois Department of Mines and Minerals and without question you may count on the assistance of Mr. James McSherry and his department. However, we wish again to emphasize the fact that the burden of making any safety work or safety program a success rests almost solely upon the shoulders of the mine officials and mine bosses. Although the State Department of Mines or the Bureau of Mines doubtless can be of assistance, unless the mine officials themselves take and keep the lead the results will be disappointing.

Question. Has a similar safety program been tried in this field, and what have been the results?

Answer. A number of operating companies in Indiana and Illinois, as well as in numerous other states, have put this or a similar program into effect either in part or in entirety and the results have been satisfactory. No attempt will be made to go into details as to the results obtained by these various companies, but instead one company —the Knox Consolidated Coal Co., of Bicknell, Ind.—will be cited as an example. This particular company was chosen because, prior to beginning their safety campaign they had a very unfavorable safety record and the results obtained are therefore much more striking than if they had had a fairly good record at the beginning; second, they put the entire program into effect.

In spite of the fact that for years the mines of the Knox Consolidated Coal Co. have been recognized as examples of well operated and managed mines, the accident rate at these mines has been decidedly unfavorable. This was particularly true during 1932, and it was because of the 1932 record and that of the early part of 1933 that decisive steps were taken by the management to bring about an improvement. The results of their efforts are clearly depicted in the accompanying figs. 2 and 3.

Figure 2

The accident-frequency rate at No. 1 mine was reduced from 187.3 for 1932 to an average of 43.6 for the 15-month period, July 1, 1933, to September 30, 1934. The accident-severity rate for this mine was reduced from 41.1 for 1932 and 62.6 for the first half of 1933 to an average of 1.3 for the same 15-month period.

At their No. 2 mine the frequency rate was reduced from 137.7 for 1932 to an average of 30.9 for the 15-month period, July 1, 1933, to September 30, 1934. The severity rate at this mine was reduced from 26.0 for 1932 to an average of 1.7 for the 15-month period, July 1, 1933, to September 30, 1934.

The accident-frequency rate is the number of lost-time accidents per million man-hours of exposure.

The accident-severity rate is the number of days lost as a result of accidents per thousand man-hours of exposure.

A lost-time accident is one in which the injured is unable to report to work on the day following the injury.

In computing the severity rate, a fatality or permanent total disability was given the standard valuation of

Figure 3

6,000 days, while in all other lost-time accidents the full period of disability was assessed against the mine, irrespective of the number of days the mine may have worked during the disability period.

The reduction in severity rates at these two mines is a very good indication of the reduction in compensation costs. It is very doubtful whether the equivalent amount of effort on the part of the officials toward the reduction of operating costs in these or other well-operated mines or in any other phase of mine operation could have equaled the savings made through their safety work. In addition, there is the very great satisfaction of having prevented loss of life and crippling of workmen.

The following is quoted from the closing paragraphs of a paper entitled "Can Coal-Mine Accidents Be Prevented" delivered by P. G. Conrad, superintendent of the Knox Consolidated Coal Co., before the Indiana Coal Mining Institute in June.

"Since this campaign our mines are in better physical condition than ever before in our mining experience. We find that what we have done, in making our mines a safer place to work for our employees, has not increased our cost a fraction of a cent per ton. On the contrary, we have found that it lowers the cost, due to increased efficiency and better co-operation of our employees, to say nothing of the greatest saving of all—that of human life and limb. As a result of our efforts and the co-operation of our employees we have reduced the accident-frequency and severity rates at our mines more than 75 per cent.

I am sure that anything that we have done, you can also do. From the results and experience of this campaign, I can say without hesitancy, accidents in coal mines can be prevented."

I do not know whether I have made myself clear or not in this paper, but one thing I do want to say, the Bureau of Mines does not take any credit for the reduction in accidents to these miners. Not only in Indiana but all over the country we have in many places done exactly as much work in helping the company as we have with this particular company, and there has not been a dent made in their accident record. It all hinges back and depends entirely upon the officials in the mines whether or not their accident rate will be improved.

I thank you.

Chairman Thomas: Mr. Herbert, on behalf of the Illinois Mining Institute, I want to thank you for this very interesting paper, so ably delivered. I am sure what Mr. Herbert has had to say should invoke some questioning from the body. If you will ask Mr. Herbert any questions you may desire, I am sure he will undertake to answer them to the best of his ability. Is Mr. Lyons here, of the Bell & Zoller Company?

Mr. John Lyons: Yes, sir.

Chairman Thomas: Haven't you something to say in this matter?

Mr. John Lyons: I might say, Mr. Chairman, that I thoroughly endorse Mr. Herbert's system here. We have had practical experience in trying practically everything which Mr. Herbert mentioned. For instance, we started back in 1929, and started first with our accident record, keeping an accident record and report, and have also used the Bureau of Mines' method of standard charges which Mr. Herbert has mentioned, that of charging three days, which is the standard charge of loss of a finger, and six thousand days on a total disability or fatality, and we have used these figures all the way through the past five years in compiling our accident record. These figures have shown us whether we were going up or down.

We first had an inspection by the Bureau of Mines Engineers, and they showed us several things we were doing wrong, and they gave us some information on just what in their opinion should be done to correct these things. We took a lot of advice from them. They did a lot of work for us all the way through the years, and have helped us any time we called upon them.

We have also adopted, as Mr. Herbert mentioned, a few of the safety rules and standards to avoid similar accidents. The keeping up of these is one of the greatest things, I think, in keeping down the accidents in any mine.

We have taken also the First Aid Training. We have had two attempts at that. Back in 1930 we had about 1435 of our men put through the First Aid course, and also this last spring we took First Aid Training at both of our Zeigler mines, and put the thing over 100%.

This in itself, of course, is a very good place to talk safety. We have a chance to talk to the men. Of course, they will come back and tell you a lot of things, which you do not always do, but it gives them a chance to voice their grievances and you get a lot of good thoughts out of that.

On the safety courses and on the safety chapter, we haven't done anything on that. We have used the safety posters and safety contests each year, which in my opinion has helped us very much.

We have one mine which is a very bad mine, our No. 1 Mine. If you will pardon me from inserting these figures—you will find them in the 1933 proceedings of the Institute, and I beg leave to insert them to show just what campaigns have done from the beginning.

This mine I am talking about now had a fatality rate of twenty to thirty, or 3.27 fatalities. The fatality was around 325,000 tons. This same mine has not had a fatal accident since the 5th of December, 1930, on the ground, and we have produced around 2,800,000 tons of coal. It shows you that a bad boy can be made good by thorough co-operation with all the safety rules and methods. We have changed the viewpoint of the bosses as well as the men on the safety work.

In 1929, this mine had a severity rate based on Mr. Herbert's figures or system he employed of 43.74. In 1930 it was reduced to 21.80. In 1931 it was 1.61, in 1932, 1.4, and in 1933, 2.08.

The same mine had a frequency rate of lost time of 330.5 in 1929. In 1930 it was reduced to 253.98, and in 1931 to 115.82, in 1933, 96.15, and in 1933 it was 74.00.

These improvements, of course, as I said, come about through the methods Mr. Herbert has suggested, and also the very excellent help and co-operation received fom the Bureau and also from the State Department of Mines and Minerals, for which we are very grateful. I thank you very much.

Chairman Thomas: Thank you very much, Mr. Lyons. I wonder if some one else hasn't something to say on this very important topic? Or if you have some questions you would like to ask Mr. Herbert? I wonder if Mr. McFadden, of the Peabody Coal Company, would care to say a word.

Mr. George C. McFadden: I only have a question to ask, Mr. Chairman. I think everyone connected with the mining industry in Illinois will readily admit and concede the wonderful aid and assistance that is always available through the Bureau of Mines and the help they have always given us.

In Mr. Herbert's paper, in one of his answers to one of the questions, he stated the Bureau will give all the aid possible with the limited personnel available. I am just wondering what Mr. Herbert meant by that statement, and whether this Institute could, if they have limited force to do anything, help his organization to give better assistance to the District in which they serve. That is the only question I have. It seems to me possibly the Institute might be able to give some asssitance. It is unfortunate indeed that Mr. Herbert's bosses—I say bosses because the Director is the boss of the Bureau—could not be here today to see this assembly and to have heard this wonderful paper as presented by Mr. Herbert.

Mr. Charles A. Herbert: Mr. McFadden, in answering your question, one of the reasons our personnel is very limited in this District is the fact that over one-third of our employes were discharged because of lack of appropriations. They were discharged a year ago the first of July.

Another reason is that, as you can probably understand, with the limited personnel for the entire country, and with the demands being made on the Bureau from various sections, we are inclined to follow the path of least resistance and move the men from the field where the least holler is being made into the field where the operators or the industry are hollering most for help. I suspect that if the operators in this field had been a little more insistent in their demands on our Washington office we would have a little larger share of the personnel in this field.

Does that answer the question?

Mr. McFadden: Yes, sir.

Chairman Thomas: I wonder if Mr. Weir has anything to say on this matter?

Mr. Paul Weir: Mr. Chairman, I think perhaps Mr. McFadden's question might have embarrassed Mr. Herbert a little. He must have a feeling anything he might say might be in criticism of the Bureau. Mr. Herbert relates to you that the personnel of the Bureau has been depleted by one-third. There are some other things in connection that I would like to call to your attention. It seems to be pretty much of a step-child. It was formerly under a different department, and it has been transferred to the Department of the Interior under the new administration. It was formerly housed in the Department of Commerce Bureau, and at the present time it is spread through several dif ferent structures all over the City of Washington.

The morale of the organization taken as a whole, I think, is at a very low ebb. The reason given for the depletion is economy. We must all realize we have to be economical, but when human life is at stake, I think it is false economy.

I have one thing in mind which I think might illustrate the attitude of our Legislators and others towards the Bureau of Mines. Formerly the Bureau was able to pass out free to miners who took First Aid instruction a small pamphlet containing First Aid instructions. I am informed they are no longer available. Yet I think those of you who read the Chicago Tribune and especially the editorial page and know the Department of Agriculture publications they issued —such pamphlets as the "Love Life of Bullfrogs," are somewhat amazed at the attitude which prevents the issuance of these free pamphlets on First Aid instruction.

The attitude of the average individual, it seems to me, is "Well, what can I do about it?" I think every one of you men is interested to some extent at least in coal mines, for that is where most of us make our bread and butter. There is one thing you can do about it. You can determine the attitude of the Congressmen and Senators, and try, to some extent at least, to impress upon them the necessity for adequate financial support of the Bureau of Mines.

Mr. Scott Turner resigned in July as Director. Dr. Finch, of Idaho, succeeded Mr. Turner. Dr. Finch has every desire to make the Bureau a real live one and to do the work that should be done. I know he is going to co-operate with the industry, but I think the industry itself has to become aroused and make known its wants through the representatives of the people, who of course are your Congressmen and your Senators. When you men have an opportunity to give them your views, do not pass it up.

To my mind, there isn't any course which has been more constructive in safety work around coal mines than the Bureau work. I do not say that because of our honored guest this afternoon, Mr. Herbert, but I have been in intimate contact with them for several years, and they do a marvelous piece of work. After all, I think one of their hardest jobs probably is to sell you and to sell me on the idea of accident prevention work. After the personnel is once sold, or after the supervisors are once sold on safety, I think the job is about 75% done. But you certainly want to be sold to the point you want it to go over so bad you can taste it, and if you cannot taste it you cannot get any place.

But I am drifting away from the Bureau of Mines. When we see the amount of money being spent everywhere by the Federal government, and then we consider on the other hand that the employes in the Bureau have been laid off and the morale of that Bureau shattered by lack of funds, and in a good many cases even though the personnel is still there the traveling expenses are not provided so that those men can get around and do the things they want to do and the things in which they believe, I think it is time for action.

The United States Bureau of Mines was established by the Federal Government at the earnest solicitation of the mining industry of the nation for the purpose of promoting safety in mining by technological research and by educational work, of assisting in the development of domestic deposits of minerals by technological research, of collecting, compiling and distributing vital statistics on production and distribution of minerals, of assisting in the conservation and proper use of natural resources and of assisting in the national defense.

The mining industry of the State of Illinois, whose mineral products averaged in value for the period 1923-1932 the sum of $186,681,000 annually, which amount is exceeded by only five of the forty-eight States, is vitally interested in furthering the work of the Bureau.

The cost to the Federal Government for the work of the Bureau has always been a very modest sum when it is considered that the Bureau serves an industry which is second only to agriculture in value of products. The appropriation of only slightly over one million dollars for 1935 has resulted in curtailment of personnel and elimination of vital work, things which are of grave concern to the mining industry of Illinois.

The Illinois Mining Institute, representing the mining industry of Illinois, in regular session in Springfield, Illinois, on this 2nd day of November, 1934, hereby records itself as alarmed at the apparent lack of recognition by the Federal Government of the importance of the work of the Bureau and of the wishes and desires and needs of the mining industry of the nation, and it further records itself as favoring the restoration of the Bureau to its former effectiveness, a thing which can be accomplished only by an annual appropriation of approximately $2,000,000.

Mr. Chairman, I would like to move that you appoint a Resolutions Committee to draft a suitable resolution in the name of the Institute which might be the means of a campaign of rehabilitating the Bureau of Mines.

(Which said motion was duly seconded.)

Chairman Thomas: Gentlemen, you have heard the motion which has been stated by Mr. Weir.

(Whereupon said motion was unanimously adopted.)

Chairman Thomas: Mr. Weir, I would like to ask you that an amendment be made to the resolution that in addition to our going on record advocating the rehabilitation of the United States Bureau of Mines, that it should be left to the Executive Committee whether they want to make a small appropriation to the work that is being done by the

Special Committee of the American Mining Congress, of which several members of this Institute are members, leaving that entirely to the judgment of the Executive Board of the Illinois Mining Institute as to whether they want to do that.

Mr. Weir: Mr. Chairman, I accept the amendment.

Chairman Thomas: You have heard the amendment as stated.

(Which said motion was duly seconded.)

Chairman Thomas: All in favor will signify by saying aye.

(Whereupon the following motion was adopted.)

On motion, it was;

RESOLVED: That the Illinois Mining Institute in regular session records itself as being in accord with the work now being undertaken by the Special Committee of the American Mining Congress in the matter of developing a plan to rehabilitate the United States Bureau of Mines, and directs its Secretary-Treasurer to send to the Secretary of the American Mining Congress, located in the Munsey Building, Washington, D. C., a nominal contribution, the amount of which is to be left to the judgment of the Executive Committee.

BE IT FURTHER RESOLVED: That a small amount of money (subject to the judgment of the Executive Committee) shall be set aside to be used by the appointed committee of the Illinois Mining Institute, for the payment of such expenses as it may incur for stenographic help, postage, etc. in bringing this matter to the attention of members of the United States House of Representatives and Senate, and other important and responsible Administration officers.

ILLINOIS MINING INSTITUTE.
Committee on Resolution for Rehabilitation of the United States Bureau of Mines.
T. J. Thomas, Chairman
Paul Weir
George B. Harrington

Chairman Thomas: Is there anything else—anyone else who would like to speak or ask some question on this important topic?

Mr. D. D. Wilcox: I merely arise to add to what Mr. McFadden and Mr. Weir are talking about, and do it principally with the idea of expressing our appreciation for the efforts of the Bureau of Mines, both State and National, in preventing accidents in our company. Mr. Herbert ended up his story in a way I did not quite approve of. He said the Bureau wasn't claiming any credit for that work. They should claim lots of it. They are deserving of lots of it. One of my most prized possessions which I have in my pocket at this time is a certificate of accident prevention which every member of our company must have and continue to carry with him all the time.

All of you people who are interested in mines know that most mine accidents are caused by what people feel to be a sort of predestination. The reason for that is most miners—most mining work, loading and every other part of the work, has been done the same way. Practically every man working in the mines has been taught to do that work by some other miner, who was taught to do it by some other miner, who believed accidents were a part of the operation and could not be prevented. In other words, every part of the operation has been brought to us by men who believe in accidents and that they were a part of the industry.

When these figures from the Bureau of Mines came into our place, we were compelled, not by force but by persuasion, to go into every particular of every piece of work the men did. For instance, the boss was followed from the time he left on the top until the day was finished, and every part of the work gone into. Not only the question of safety, but the necessity of the actions. It might be interesting to know that many parts of our work were entirely changed on account of the efficiency. We found there was no difference between the efficient way of doing things and the safe way to do them. I thank you.

Chairman Thomas: Thank you very much, Mr. Wilcox. I think those of you who have been in contact with the Bureau of Mines know of the great work they have done, and that Mr. Herbert is a very modest man for not taking the credit for the service they have rendered, he and his staff, to the mining industry.

Anyone else?

President Treadwell: Mr. Chairman, a year or so ago last Fall at the meeting we had the safety program up, and as Mr. Miller made some comments, it brought seriously to our attention the records we were having in our mines. For two or three months we studied carefully what they had said, and decided we had for a number of years tried to better our record and had not been successful, and it was time to try somebody else's method.

Along in the spring of the year we started on this program outlined by Mr. Herbert. We haven't got very far. We are not entirely through with our course of lectures to the management. So far as we have gone, we have got a great deal out of it. We have reduced accidents and we have increased our output per man. In other words, it does not cost us anything. We have not only reduced the accidents but have increased our efficiency.

I agree with Mr. Wilcox that the Bureau of Mines in our instance deserves a lot of credit.

Chairman Thomas: Gentlemen, the next paper we will have the privilege of hearing is by a man connected with the Battelle Memorial Institute of Columbus, Ohio. I have undertaken to discover just what the Battelle Institute is and what it stands for. It occurs to me you might be interested in knowing what I was able to develop.

Mr. Gordon Battelle created this institution as a memorial for his father, the father having made his money in the American Rolling Mill Company. The cause for the creation of this endorsement was brought about by the fact Mr. Battelle, as I understand it, was obliged to deal with a very difficult problem involving the matter of zinc during the War. As a result of that, this institution was founded. Young Mr. Battelle, Mr. Gordon Battelle, then prevailed upon his mother to leave her fortune to this institution, and later on Gordon Battelle died at some forty-seven years of age of appendicitis, and he left the residue of his fortune to this institution.

Gentlemen, the Battelle Institute has a staff of research engineers and scientists who deal entirely with the matter of coal and metallurgical problems.

It gives me great pleasure to introduce this morning Mr. Byron M. Bird, Chief Concentration Engineer, Battelle Memorial Institute, Columbus, Ohio, who will talk to you on "Fundamentals in the Design of Coal Cleaning Plants." Mr. Bird.

SOME PROBLEMS IN THE DESIGN OF COAL CLEANING PLANTS

By BYRON M. BIRD
Chief Concentration Engineer, Battelle Memorial Institute, Columbus, Ohio

Summary

(1) The first consideration in the choice of a cleaning process is the difficulty of the cleaning problem. This depends upon the quality of clean coal to be prepared and is not inherent in the coal.

(2) The second consideration in the choice of a process is installation and operating costs. If the run-of-mine coal is wet, these considerations favor wet methods. If the coal is dry and can be cleaned efficiently by dry methods, economic considerations favor wet methods for sizes above about ¼ inch and dry methods below ¼ inch.

(3) If a large range of sizes is to be treated in one operation, a proper gradation of sizes is essential.

(4) The tonnage of unsized feeds treated per unit of cleaning capacity depends on the smallest size to be cleaned efficiently.

(5) A uniform tonnage of a sized or a slack coal can be obtained by regulating the tonnage delivered to the sizing screen. It can also be obtained by changing the limiting size of the screen openings.

(6) A dry coal for dry cleaning processes can be obtained most advantageously by dedusting the ½ inch sizes with hot air.

(7) A uniform quality of coal involves some form of storage or mixing tracks.

(8) Dewatering of washed coal is simplified if some intermediate sizes are kept with the extremely fine sizes.

(9) The economic dividing line between centrifugal and heat drying is probably about 9-10 per cent moisture.

Introduction

In this paper I wish to deal with some problems that arise in the design of coal cleaning plants and to set up certain principles that can be used in solving them. To narrow the scope of my paper, I shall limit my remarks to the sizes ordinarily cleaned by mechanical means.

The Choice of a Cleaning Process

In the choice of a process for cleaning a given coal, the first consideration is the difficulty of the cleaning problem. This requires fundamental work of the character that Dr. Leighton and his associates have been doing for Illinois, in other words, screen analyses, float-and-sink tests of the individual sizes and visual examination of the float-and-sink products.

I wish to stress the last of these, the visual examination of the float-and-sink products, because this is not commonly made and yet it may have a very important bearing upon the cleaning problem. As far as ash content is concerned, a coal may be clean enough with a separation at 1.60 specific gravity—that is, with an ash content equal to that of the portion floating in 1.60 specific gravity—but if this separation will leave in the cleaned coal some objectional impurities from a visual standpoint, it may be necessary to clean at 1.45 specific gravity, for example, and to crush and clean the portion between 1.45 and 1.60 specific gravity. Since appearance plays such an important part in the sale of coal, I feel that visual examination of the float-and-sink products is very essential.

The specific gravity at which the given coal must be cleaned determines the difficulty of the cleaning problem. At high specific gravities, the problem is simple. At each successively lower specific gravity it becomes more difficult. In other words, no coal is inherently easy or difficult to clean. In any given case the market for the cleaned coal, and hence the specific gravity at which it must be cleaned to give the required ash content, must be known before the difficulty of the cleaning problem can be determined.

Once the specific gravity of the required separation is known, the method described in my paper, "Interpretation of Float-and-Sink Data" (Proc. Third International Conference on Bituminous Coal, 1931), will give an approximate measure of the difficulty of the separation. As copies of this paper are available to anyone who cares to write Battelle Memorial Institute, I shall not go into any details about the method except to say that I have developed a curve that can be added to any standard set of washability curves to give for each specific gravity a numerical measure of the difficulty of a cleaning problem.

Using this method I have grouped processes in the accompanying table in the range over which they are in successful commercial practice. This is only to be regarded as a rough grouping, for it is obviously impossible for me to have investigated every plant in the country.

Range of Difficulty on ± 0.10 Curve	Process
0-3	Dry Processes
0-7	Wet Processes
0-12	Wet Tables
0-20	Plunger Jigs

These figures do not mean that some process will not cover a greater range than shown. For example, we have investigated the Baum type jig on a laboratory scale at Battelle Memorial Institute and have found it to have even a greater range of application than that of the plunger type. But in general when a cleaning process is out of the range listed above, the coal company should assure itself by careful tests that the desired cleaning results are possible before installing the process.

Someone may well ask, "Why the large difference in the range of applicability of dry and wet processes; is this due to lack of development or is it inherent?" It is partially due to lack of development, for not as much fundamental study has been given to dry processes as to wet. But it is mainly inherent. Suppose, for example, we wish to separate particles of 1.50 and 1.35 specific gravities. The possibilities of a successful separation depend upon their relative specific gravities. In air, one group of particles is $\frac{1.50}{1.35}$ times as high in specific gravity as the other. In water each group is buoyed up to the extent of the specific gravity of the water, so that one is $\frac{1.50 - 1.00}{1.35 - 1.00} - \frac{.50}{.35}$ times as high in specific gravity as the other. From this it is evident that the water separation has a great inherent advantage. However, this does not mean that some dry process may not be doing better work than a wet process. Factors such as the skill of the operator play too large a part in the final results secured for any generalizations on cleaning efficiency. Furthermore a very efficient dry process may do better work than an inefficient wet process. But, all other things being equal, a wet process will give better results than a dry process.

After the difficulty of the cleaning problem, the next consideration in the choice of a cleaning process is the investment and operating costs. As far as the cost of the cleaning operation taken by itself is concerned, a wet process usually has the advantage over a dry process. Hence, if the coal coming from the mine is already wet, this fact favors the use of a wet process. But if the run-of-mine coal is dry or only slightly damp, economic considerations favor cleaning the fine sizes by dry methods. The dewatering of coarse sizes by natural drainage is simple and inexpensive, but that operation becomes increasingly expensive in each successively finer size. Finally a size is reached where the total cost of cleaning by a wet process and removing excess water from the products is greater than the cost by dry cleaning methods. To say just where the dividing line between the sizes that can be more economically treated by wet than by dry methods is difficult, but it is probably at about ¼ inch. In other words, if the dry process will give the desired quality of clean coal with a high efficiency, it will probably be economical on the sizes finer than about ¼ inch. Economic considerations on dry or semi-dry coal, therefore, would seem to favor a combination of wet cleaning on the coarse sizes and dry cleaning on the fine sizes.

Finally, there are some special considerations in the choice of a cleaning process. One of these is the percentage of "rash." This is a flaky impurity that has given a great amount of trouble in the South, and the Bureau of Mines has developed methods for its removal with the types of apparatus commonly used in that district, namely, with jigs and with wet tables. If this impurity is found in a coal, that fact constitutes a good reason for preferring those processes.

Another special consideration is clay. No one has found a really satisfactory answer to the problem of cleaning a coal containing clay, but a general principle is, as far as possible, to avoid wetting it.

Application of Process

The success or failure of any cleaning process depends in large measure upon correct application. Everyone knows, for example, that if the relative differences in specific gravity between the coal and impurities are small, he should not attempt to clean a large range of sizes in one operation. Since this principle is well known, I may pass it without discussion and go to another principle, not so generally recognized, governing the range of sizes that should be attempted in one operation.

This principle is that a proper gradation of sizes is essential. I first had my attention called to this by a friend pointing out two operations on the same coal bed, one treating 6"x0", and the other treating 3"x0", in which the 6"x0" operation was the more efficient. In fact, the 3"x0" operation was taking a heavy loss of coarse coal in the refuse. When I studied the two washeries to discover the explanation of this anomaly, I found that the essential difference between them lay in the screen analyses of the raw coal. The feed in the 6"x0" operation had a well distributed screen analysis with plenty of 5", 4", 3" and 2" sizes, whereas the feed to the 3"x0" operation consisted largely of 3"x2" and 1"x0" sizes with only a comparatively small percentage of 2"x1" sizes. Accordingly, the logical explanation of the large loss of coarse coal in the 3"x0" operation seemed to be that a bed of 1"x0" sizes could not support particles of 3"x2" coal.

Here, then, is an important principle of coal cleaning, not heretofore recognized, that applies wherever a large range of sizes is being treated. If the operation is to succeed, intermediate sizes must be present in the feed. If they are not and the mining practice cannot be modified so they will occur in the feed, it is essential to do some preliminary sizing before cleaning.

In passing, it seems reasonable that heavy media processes such as the Chance are probably less subject to this restriction than processes like jigging, which develop their beds entirely from the coal itself. I have no experimental evidence on this point, but it looks logical that the presence of a medium of relatively high density should make the exact size distribution in the coal bed of minor importance.

Another important consideration in the application of a process is the tonnage to be handled per cleaning unit. The principle involved is that capacity is determined by the smallest size to be cleaned. Take jigs as an illustration. Suppose the feed to be cleaned is 4"x0" and it is necessary to clean the -20-mesh sizes. Then the capacity of the jig to clean -20-mesh sizes determines its capacity as a whole. Accordingly, ample capacity is necessary, for it is a further principle governing this case that the smaller the size to be effectively cleaned and, consequently, the greater the number of particles per ton, the greater the number of cleaning units necessary.

Auxiliary Equipment

Auxiliary Equipment Ahead of Cleaning Units

The auxiliary equipment to go ahead of the cleaning units should supply (1) uniform quantity of coal, (2) uniform gradation of sizes, (3) proper moisture content, (4) uniform quality.

To supply a uniform quantity of coal, storage sufficient to take care of the maximum delays that may occur is practically a necessity. As storage breaks up the coal, and causes segregation, the problem involved is to minimize these difficulties. I will take up the problem of preventing segregation later and discuss here only the problem of minimizing breakage.

This is especially important when run-of-mine coal is stored. It can be minimized by having the bins comparatively shallow with the bottom sloping at an agle just a little greater than the angle of repose of the coal. Obviously, coal should slide, not drop, into the bins from the mine cars. The same care should be used in designing the facilities for handling raw lump coal as are now used in loading into railroad cars.

When a sized or semi-sized coal is to be cleaned, the problem of supplying a uniform quantity with a minimum of breakage is particularly difficult because the coal breaks more easily after the sizing and often the effectiveness of the cleaning is adversely affected by any breakage that occurs. In place of bins, I have two sugestions which can be adapted to various conditions. They are shown in figures 1 and 2.

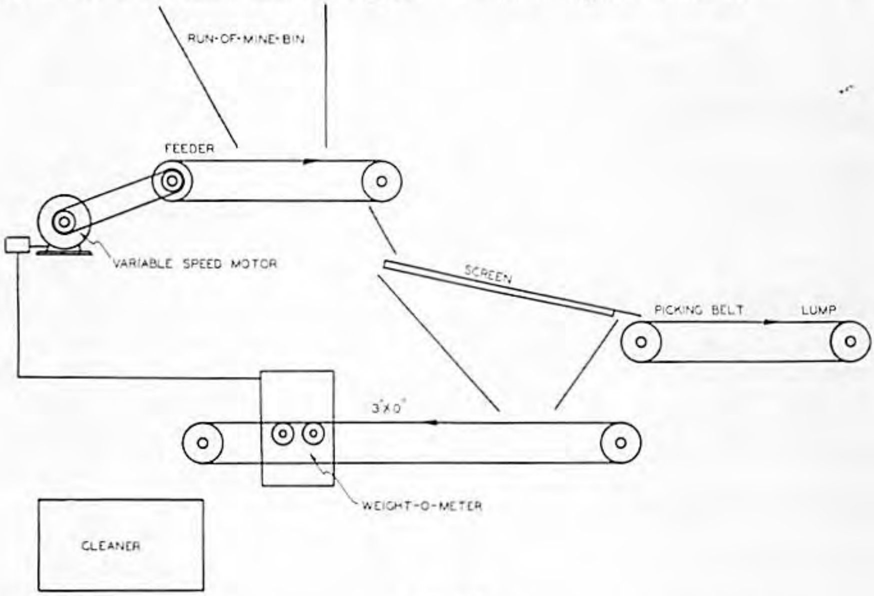


Fig. 1. Regulation of Tonnage Screened to Give Uniform Supply of Slack Sizes.

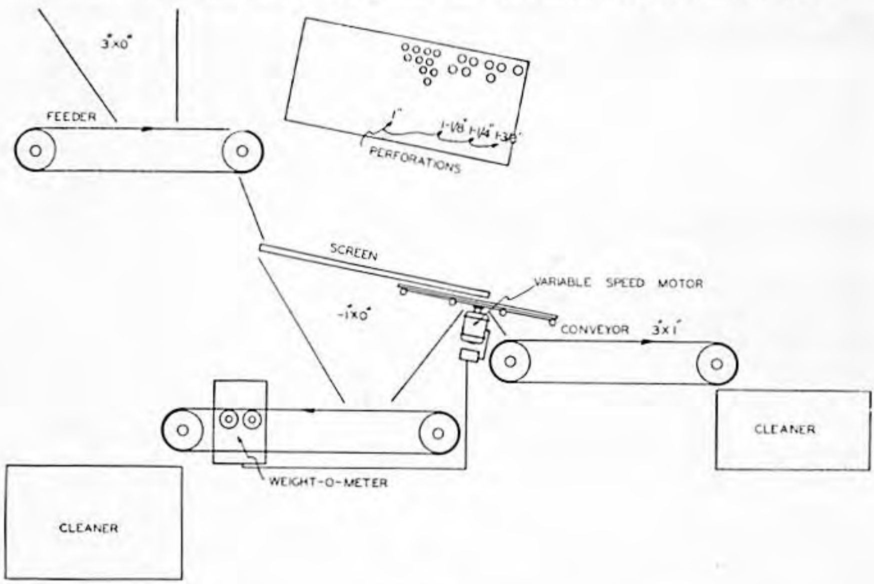


Fig. 2. Variation of Limiting Size of Coal Cleaned to Give Uniform Supply of Two Different Sizes

In figure 1 the slack coal is cleaned on one unit and the oversize goes to a picking table. In this case the tonnage of run-of-mine coal delivered from the bin is regulated by a weight-o-meter to give a constant tonnage of slack sizes. The men on the picking table take care of the variations in the proportions of lump.

In figure 2, the slack coal is cleaned on two units and the tonnage is kept constant by varying the limiting size of screen openings. The top view of the screen shows that the openings change at the lower end from 1″ to 1⅛″ to 1¼″. A sliding chute controlled automatically by a weight-o-meter determines the distribution of the coal. Suppose, for example, that the tonnage of 1″x0″ slack decreases. The chute is moved automatically to the right and some 1″x1⅛″ coal is allowed to go into the slack sizes. If, on the other hand, the tonnage of 1″x0″ slack increases, the chute is moved to the left and some of the last coal passing through the screen goes to the 3″x1″ machine. This coal will normally be 1″x⅞″ or 1″x¾″, those sizes being the last to go through the screen. These small changes in the limiting size of feed will, of course, not affect the operation of any of the standard cleaning apparatus to any discernible degree. If more than two cleaning units are used, further divisions of the tonnage can be made by extending this basic idea to additional screens and weight-o-meters.

To supply a uniform gradation of sizes, the second requirement for the auxiliary equipment ahead of the cleaning units, involves preventing segregation in the storage bins and ironing out variations in the sizes of coal coming from the mines.

The answer to the problem of preventing segregation in storage is some form of mechanical distributor to spread the coal over the surface of the bin. However, the practical difficulties of spreading coal and at the same time lowering it into a bin without breakage are very great. Another scheme is the one proposed by Marquard. (Marquard, F. F. The Effect of Coal Segregation, Mixing and Heating Upon the Quality of Metallurgical Coke. American Iron and Steel Institute 18, 1928, 83-112.) In brief, this consists of partitioning the top two-thirds of the bin so that the coarse sizes cannot separate very far from the fine sizes. If this arrangement includes a "staircase" for lowering the coal in each subdivision and a distributor to deliver the coal to each sub-division, it would be a great improvement over anything I have yet seen.

For mixing coal ahead of the cleaning units to iron out variations in the mine-run two different methods are advocated. One is a large storage pile in which the coal is laid down with a traveling conveyor in one direction and is recovered at right angles. This is necessary in an extreme case where the coal from different sections of the mine varies greatly. The other scheme, used at Nemacolin Mine, is to draw coal from several different levels in a large storage bin. For any ordinary condition this method should be satisfactory.

A raw coal of uniform moisture content, the third requirement for the auxiliary equipment ahead of the cleaning units, is particularly important to dry processes. In a dry separation the coal must be dry for effective cleaning. If coal and refuse are damp enough to stick together, it is obvious that no separation is possible; it is imperative that all particles in any separation be free to move. To meet this requirement at the average mine, where at least a certain proportion of the time the raw coal contains more or less moisture, either heat-drying of the finer sizes or dedusting with hot air are necessary. The latter of these two methods has the advantage that it adds greatly to the cleanliness of the plant. Also, the greater visibility of the cleaning operation on a dedusted coal facilitates proper adjustment of the cleaning equipment. As a rule the raw coal can be screened at about ½" and only the fine slack sizes need be dedusted.

A raw coal of uniform quality, the fourth requirement to be provided for ahead of the cleaning units, is especially important for cleaning apparatus that do not have good automatic controls. One answer to this problem is mixing bins. Another has proved helpful at at least one mine where several coals that differ markedly in washing characteristics are being cleaned in the same apparatus. The system used is much like that in large freight yards for the distribution of freight cars. Trips from different sections of the mine are run onto different gravity tracks. From these tracks cars are run onto the dumping track in rotation in proportion to the tonnage from the various parts of the mine. This method is reported to be effective and comparatively inexpensive.

Auxiliary Equipment Following Cleaning Units

In my discussion of the auxiliary equipment to follow the cleaning units, I am going to take up only the problem of dewatering and drying. Usually dewatering screens are used for the coarser sizes and so the problem really concerns the material passing the finest dewatering screens.

A general principle to be followed in dewatering is to keep some intermediate sizes with the extreme fines. This can be accomplished very readily by allowing at least some of the ½" to ¾" sizes to pass through the bottom dewatering screen with the fines and water. This coarse material acts as a filter medium to remove the fines from the water. One very good way of applying this system is found in the so-called "sludge tank." In figures 3 and 4 are two forms of these apparatus. Of the two, the one shown in figure 4, in which the flights convey the coal out of the tank and over the dewatering screen, is a much better dewatering device. As the flights drag the coal over the screen, they squeeze it and thus cause very efficient dewatering. The water passing through the screen is continually returned to the sludge tank in closed-circuit.

The sloping baffles shown are very important in obtaining the maximum efficiency from any settling device. The solids settling from the thin layer of water flowing across the tops of the baffles have only a short distance to drop before they reach the baffles where they are out of circulation. In comparative tests in the Battelle Laboratories, only one-fourth as many solids were found in the overflow with these baffles as without them. In the design of the tank as a whole, care is necessary to secure the minimum of disturbance from the moving flights. If a lower moisture content is necessary than is possible by use of sludge tanks with dewatering screens, centrifugals may be used on the slack sizes dragged from the sludge tank. The effluent may be added to the sludge tank in closed-circuit.

If an essentially dry coal is the objective, the dewatering by centri-

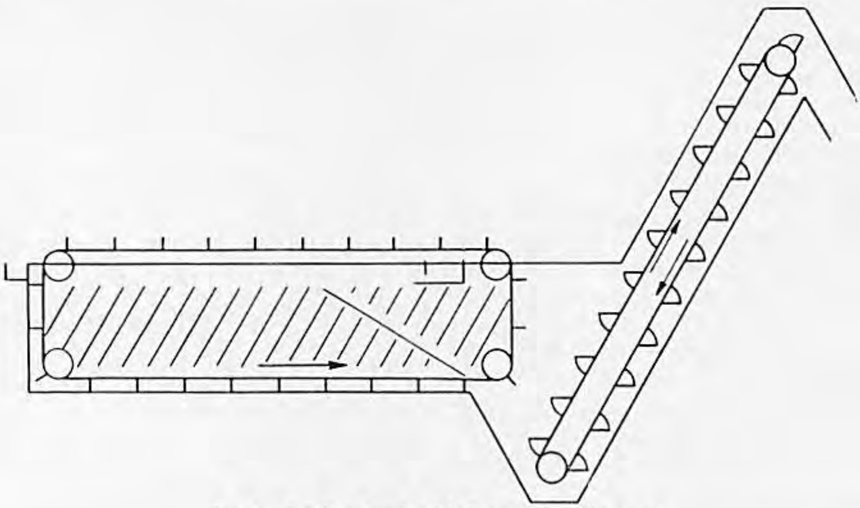


Fig. 3. Settling Tank with Dewatering Elevator.

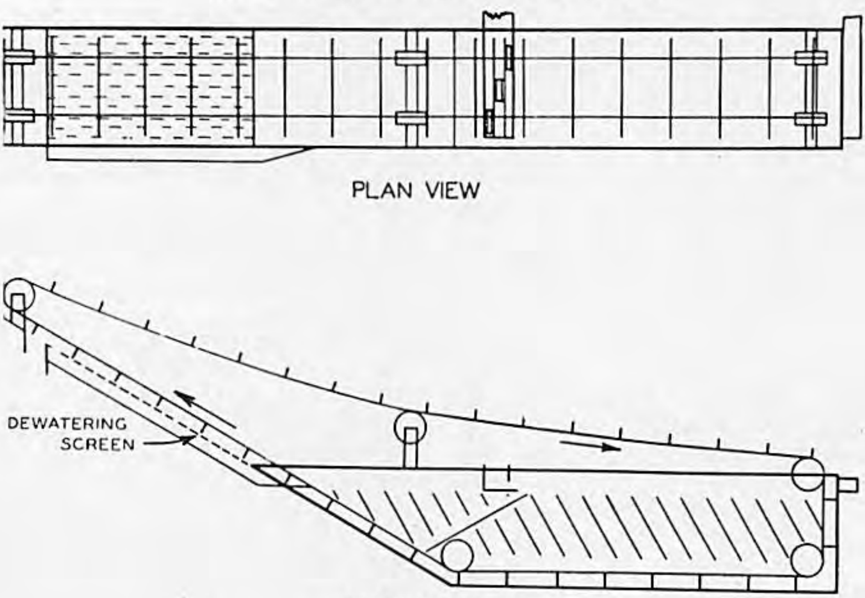


Fig. 4. Settling Tank with Dewatering Screen

fugals must be supplemented by heat drying. Theoretically, a very wet coal can be heat-dried, but it is inevitable that a large amount of heat will be required to evaporate the water. From the standpoint of the power required, it is probably economical to use centrifugal driers down to about nine or ten per cent moisture, for below that moisture content the power required per percent of water removed mounts rapidly.

Accordingly, it is probably economical to remove the balance of the water by heat-drying.

If the dewatering problem is purely one of preventing freezing of the coal in transit, an answer that many coal companies have found satisfactory is to store the slack sizes for a few hours in bins equipped with steam pipes. The heat lowers the viscosity of the water and causes it to drain below the percentage moisture at which freezing ordinarily occurs. Furthermore, even if the temperature is low enough to freeze the coal, usually only the outside of the mass of coal freezes. This frozen portion acts as a non-conductor and slows up the penetration of the freezing toward the center of the car.

A corollary to the dewatering problem is that of water clarification. If there are some dirty products, such as the overflows from refuse elevators around the plant, one excellent way of clarifying the water, if the refuse piles are nearby, is to use them as a filter bed. A portion of the refuse piles is shaped into an impounding basin and the dirty water is pumped into it. The clarified water seeping from the basin is recovered and pumped back to the washing system. Some plants with a bad clay problem have found it necessary constantly to treat a certain portion of the water from the sludge tanks in this manner.

Chairman Thomas: Thank you, Mr. Bird, for this talk. It has been ably presented. I would like to ask if there are any questions anyone cares to ask Mr. Bird at this time.

If not, I would like to make one or two announcements. Dinner tickets are on sale, or will be on sale, immediately after this session in the hall. The dinner will take place at 6:30 o'clock sharp.

I would also like to call your attention to the fact that Mr. Schonthal still has some football tickets for sale.

Also, the clerk will be on the floor for registration for those who have been unable to pay until now. So if you have not registered and made your payment, I would like to ask you to see the clerk immediately after this session.

I want also to call attention to the fact that at the dinner tonight there will be presented to each person there that booklet entitled "The Story of Coal." It is being presented to the members of the Illinois Mining Institute on behalf of Mr. O. T. Kreusser, Director of the Museum of Science and Industry, in recognition of and in appreciation also of the contribution that has been made by members of the Institute as well as coal operators in furthering the model mine which is on display in the museum at Chicago.

At this time, I would like to ask if Mr. J. B. Morrow is in the room, and if so, I would like to have him say something in connection with the matter of preparation of coal. Mr. Morrow, will you please come forward?

Mr. J. B. Morrow (Pittsburgh Coal Company): Mr. Chairman and gentlemen, it is getting a little late, so I do not think I have very much to add. Mr. Bird seems to have gone over this work very carefully. However, there is one point I would like to make. It seems that in the last few years there has been too much tendency in speaking of coal cleaning plants to talk only of what was done in the actual washing unit. In other words, we want to talk about our coal as having one-tenth or three-tenths sink and so on. In actual experience in the trade, we show that is not what the coal trade judges the coal on, no matter what kind of coal it is.

In other words, with all cleaning plants the most important part of the plant is still in the cleaning and sorting out of sizes and moisture in coal. Some time ago I checked up on complaints received from some 25,000,000 tons of coal shipped, and to my surprise only about 8% of those could be traced to the actual ash or the sulphur, or in other words washing. Fifty-five percent could be traced directly to the screening, mixing and loading. But here we talk about whether this kind of plant will be used or the other kind of plant should be used. I think it should be emphasized more than it has been that the accessory part of the plant may be in many cases more important than the technical operation of the coal cleaning unit, the jig or anything else. I think that is about the only point I want to make at this time.

Chairman Thomas: Thank you, Mr. Morrow. Is there anyone else? Any questions to be asked or statements to be made?

Mr. G. R. Delamater: There is one point I would like to make. In Dr. Leighton's talk this morning he gave us some very interesting information in regard to ways and means of using the extremely fine coal. My personal experience in coal cleaning dates back to around 1900, 1901 and 1902, a good many years spent in coal washing and Government work in connection therewith, and throughout all that experience I found that the fine coal was very largely the source of great expense and great difficulty in cleaning.

In the early days that I spoke of, for instance, here in Illinois, and in the early part around 1905 and 1906 and 1907, you were using jigs almost entirely. This State in those days, I believe, washed more coal than any other State in the United States. I think along about 1912 you had some eighty-five or eighty-six plants whereas in the latter years you practically got out of the coal cleaning business.

Those conditions were brought on very largely through the high expense of cleaning and the fact you could not get more money for the coal that was cleaned—that is, enough more to pay for the cleaning. I do not know that that condition has changed a lot except the user is demanding a better coal, and there is more of a penalty proposition than just paying men for washing coal. But we find as we trace the history of coal cleaning that in the wet washing your losses of coal were in the fine coal. Your trouble was de-watering in the the fine coal, and practically all of your higher expenses. Then when we got into the dry cleaning, it was hoped we could handle the extremely fine coal to better advantage. I think it is true that a better job of cleaning can probably be done in fine coal by water washing than by dry.

In a great many instances it has been found profitable to by-pass the fine coal around your cleaning system and try to find some other way of using it. I just ran into a case recently in Canada where they have been dry cleaning entirely and are now doing the wet washing and are are going through a system of wet washing in the larger sizes, and I believe the coal under five-eights of an inch is to be dry cleaned, and if the coal through five-eighths of an inch is extremely wet, they are going to attempt to screen out somewhere around three-quarters of an inch or three-eighths of an inch and dry it with dryers, the fine coal, and then dry clean it.

In southern Illinois a great deal has been done in regard to de-dusting coal. For awhile it was quite a problem to know what to do with the remainder.

That brings us back to the possibility of briquetting, which has not made a lot of progress in this country. In Germany they have done a great deal. It has been very interesting to me to know that today a process of briquetting is developing in which no binder is necessary, and what seems to me a very surprising statement, that the smoke is only about one-fifth of the smoke for the West Virginia and southern Illinois coal. If these new means of using the extremely fine coal are successful, it seems to me a great deal of the expense and trouble in coal cleaning is going to be removed.

There is also the possibility that in developing these new uses for the fine coal it will not be necessary to clean them—I mean the dust—as extensively as we have been doing in years gone past. I feel that anything that can be done in the study of ways and means of having fine coal and keeping it, for instance, out of wet washers and dry cleaning plants is going to be very helpful in the cleaning business.

One more word I would like to say in regard to some statements this morning, and that is in connection with the work that is being done at the University of Illinois. Mention was made of requests for funds to carry on that work. That has always been one of our difficulties in developing work. The thought has often come to me that the coal operators probably should help a great deal in taking a greater interest, possibly a greater financial interest than they have in the carrying on of the experimental work in the various institutions of the country that do have difficulty in getting funds, or even going further and carrying on that work in their own industries very much as is done in the gas industry where experimental laboratories are maintained and carried on year after year for the purpose of testing apparatus used in the burning and use of gas.

Chairman Thomas: Thank you. I wonder if Mr. Hamilton may have something to contribute in connection with this session.

Mr. Charles F. Hamilton: I do not think I have anything to offer on that particular subject, but I would arise in the matter of this rehabilitation of this Bureau of Mines. This special committee is being financed by contributions of members of the American Mining Institute and others. Inasmuch as we have passed a resolution here expressing ourselves, I think possibly the word could be emphasized by a little financial help at this particular moment. And with that in view, I would move you that the Institute contribute one hundred dollars to this committee. Or if the Board of Directors feels it is more beneficial to send fifty dollars to the committee and use the other fifty dollars for the dissemination of information regarding the work of that committee, or some members, that can be done. I so move you.

Chairman Thomas: May I call your attention to the fact—you may not have been aware—but Mr. Weir offered a resolution which was adopted endorsing this movement? Then I asked Mr. Weir if he would include an amendment to the effect that this institution in attempting to endorse the work of the special committee of the American Mining Congress, would likewise make a contribution to the work of this committee, and that amendment or contribution should be left to the Executive Board of the Institute, and both the motion and the amendment were adopted by the Institute today.

Mr. Hamilton: I was out at that time.

Chairman Thomas: Mr. Chairman, I want to say to you in connection with this matter of cleaning that we have had occasion to make quite a study ourselves with reference to cleaning plants, and there is one thing that it seems to me has not been brought out here today, or at least I did not get it.

I know of an institution burning from two and one-half to three million tons of coal per year. One of the real problems in connection with the burning of coal coming from so many places is that relating to the uniformity of the coal that may come from the respective districts. That is to say some of this coal has the ash fushion as low as sixteen hundred, sixteen hundred and fifty to twenty-three hundred and twenty-four hundred. If you reverse the process, you take coal coming from one locality with a lower point of fusion with the ash, and you get into trouble and very serious trouble. I know of this one particular coal, having a low point of fusion with ash, where particularly in the Winter time there may be introduced into the firebox cold air, and a crystallization takes place of that coal, and I say to you it is not only a problem, it is a serious problem and a difficult proposition.

So that the matter of cleaning coal and cleaning up to three or four inches in size, one of the things that occurs to me that an operator supplying a large consumer of coal must deal with and deal effectively with, is the question of furnishing that concern a uniform coal. Not a clean coal one day and a coal not so clean the next day, but coal uniformly clean.

If there is nothing further to come before this afternoon session, I want to thank you for your attention.

Mr. President, I will turn the meeting over to you at this time.

President Treadwell: I would like to call your attention to the banquet tickets on sale immediately after the close of the meeting. I would like to have you get your tickets as soon as possible, so that we can arrange to have the proper number of places at the tables.

This morning we gave a good deal of credit to different committees for their performance during the hearing. Personally, I feel that George McFadden, as Chairman of the Program Committee, and his associates have performed a wonderful job in this meeting today. I feel they should be given a rising vote of thanks. If you agree with me, let's see you stand up.

I thank you. Remember, we will adjourn now until the banquet at 6:30 o'clock sharp.

(Whereupon a recess was taken at this time, the banquet was held at 6:30 o'clock, and at 8:00 o'clock p. m. the Institute reconvened.)

BANQUET and EVENING SESSION

8:00 o'clock P. M.

(Following banquet)

Hon. Thurlow G. Essington, Chief Counsel, Illinois Coal Operators Association (Toastmaster): We will depart from our regular program for just a moment for the purpose of presenting to you men two of the honored guests of the evening who have come a long, long way for this meeting. It so happens they must leave immediately to catch a train, and I know you will want to see them and have them presented to you.

You may judge the particular conditions under which these men do their work, when I tell you they are operating in a vein of coal four hundred and twenty feet thick in places, and which has an average thickness of over one hundred and twenty feet.

I present K. Ogaki and R. Sakakibara, officials of the Fushun Collieries, Manchukuo.

We are very proud and glad to have you with us, and are sorry you cannot stay for the evening. We are happy to have had you here.

President Treadwell: Now, before we go on with the program, there is just a word I would like to say. A year ago we were here, and a great deal of water has gone over the dam in a general business way. Some think we are better off and others do not think we are as well off. It is too deep for me. I cannot tell where we are. But last year we were sighting pretty high in this organization, and I believe to-night we have reached the goal we set last year in membership and accomplishment in the general purposes of this organization. I think that goal was reached from one cause only, and that was co-operation of the membership. I think we have had co-operation in every way. If this organization is to continue and do in the future as it has in the past, let's keep that spirit of co-operation up.

We have this evening as Toastmaster a gentleman who has been very prominent in the coal industry in this State. For a number of years he has played an important part in the formation and operation of the National Code. He is well known to the majority of the members of this Institute, the Honorable Thurlow G. Essington, Chief Counsel of the Illinois Coal Operators Association.

Mr. Essington: Mr. President, honored guests of the evening, and gentlemen, I will, first of all, read this letter dated November 2, 1934, addressed to the Honorable James McSherry, Director of Mines and Minerals, Springfield, Illinois:

"My dear Mr. McSherry:

Please convey to the members of the Illinois Mining Institute my deep regret that I am unable to accept the gracious invitation to attend their annual dinner and conference at Springfield tonight. A speaking engagement at Jacksonville denies me the privilege of being with you.

Inasmuch as Illinois possesses great wealth in its mineral resources, and as mining is one of our foremost industries, the entire program of the Institute is among my paramount interests; for its activities vitally concern all of the people of Illinois. May I take this opportunity to express my deep appreciation to the members for their splendid accomplishments, and to assure them that at all times they have the support and whole-hearted co-operation of the entire State administration.

That the 1934 meeting of the Illinois Mining Institute shall be a very happy occasion, and at the same time be productive of much mutual and general benefit, is my sincere wish.

Faithfully yours,
HENRY HORNER,
Governor."

A number of us were in Washington a short time ago for a two-fold purpose. It was somewhat for the purpose of learning "Where do we go after the NRA?" and primarily for the purpose of seeing George Harrington perform at the annual meeting of the National Coal Association. At the time of that meeting, there was a story going around down there that south of Springfield an operator of a gas station was standing in front of his station one night and a man came down the road with headlights burning brightly and pulled up in front of the gas station. The driver jumped out and turned off the lights of the automobile, stopped the engine, and started out in a dead run, and as he got to the corner he stepped on a stone and fell flat. The owner of the station stepped up to him and said, "Mr. Sandoe, I am sorry about that. I hope you did not hurt yourself any." He said, "It is all right, I do not think I could have made it anyhow."

Now, if C. J. Sandoe ever arrived anywhere on time, he arrived in this position of newly elected President at an important time in the affairs of the organization. I think we might at this time hear what Mr. Sandoe has to say for himself.

President-elect C. J. Sandoe: Now, listen, fellows, this is a rough passage, and I do not want you to stub your toe when you go after members. This organization is your organization and is a post at the crossroads of the coal industry. There are many things that can be accomplished that have not been, and that is up to you. I am willing to do everything and give my time, but we must have cooperation. I would like to have as many of you on the boat trip next Summer as possible, and when next Fall comes let's try to keep up the good record of the membership. Of course, we only want the best, for I do not want to spoil you. You can rest assured I will do all I can for you.

Mr. Essington: I understand it is the custom of this organization at this time on your program to present very briefly the newly elected Officers and members of the Executive Board.

(Whereupon the newly elected Officers of the Institute were presented.)

I want to present also some of the guests of the Institute. Mr. James White, President of the Indiana Coal Mining Institute. Byron Bird, Chief Concentration Engineer of the Battelle Memorial Institute, Columbus, Ohio. George B. Harrington, President of the C. W. & F. Coal Company of Chicago and an associate of the speaker of the evening. Mr. J. B. Morrow, Preparatory Engineer of the Pittsburgh Coal Company. Mr. J. L. VanPelt, of the Museum of Science and Industry, who wants to speak to you just a moment in regard to a certain clause in "The Story of Coal."

Mr. J. L. Van Pelt: I do not want to speak to you, but I have the duty of calling attention to this booklet on the table. You remember two years ago the Director addressed you and told you about the coal mine in prospect. It has been built, and in recognition of your services in that connection he hands you herewith that booklet which tells you about that exhibit. It contains therein one or two errors, mostly of details, which will be obvious to you coal men, but which were the result of unusual haste in preparation. If you will be so kind as to overlook those, such as the spelling of a name and one or two errors of that kind, I wish to call your attention to the fact it is an effort to do something which is not done otherwise in many parts of the country, to tell the people not familiar with the industry what the history is. That is its chief purpose.

Mr. Essington: The officers of the Illinois Mining Institute have every reason to feel very proud of the meeting which they have had this week, and of the attention shown by you men. I take it that it is not an accident that there has been an unusually large attendance this year. The position of the industry perhaps might be somewhat represented by a story of the colored preacher, who having opened his services in the usual way, proceeded to read the Scripture and just as he got fairly well started on the Scripture a near-ripe tomato sailed through the air and struck him in the face and spread over his face pretty well and down his vest. He went right ahead reading the Scripture, took his handkerchief out of his pocket and mopped himself the best he could, but did not hesitate in the reading. He finished the reading of the Scripture, and then said, "Now, the congregation will sing a song. After that we will take up the collection. After that I will preach the sermon, and then we will sing another song. Then the ushers will close the windows and the doors, and we will have a hell of a fight here in this church."

It has been almost my observation during the last few years that the coal business is pretty much a hell of a fight from start to finish, all the time. But in addition to the ordinary conditions, the usual conditions that reflect the industry, there are a number of unusual situations which, as I say, are the reasons probably for your very great interest in this meeting this year.

There is the unusual and unprecedented and extraordinary competition of oil and gas, and this new menace, water power and Government financed power, and the competition within the industry which is always with us, and there is the competition from without which is known as the triple menace. In addition to that, your salesmen are approaching this new sales contract season without any assurance of what your wage conditions of operating are to be, and without any very distinct knowledge as to what Government regulations will be placed on the industry. There is the wage contract expiring March 31, there is the expiration of the Code and the NRA early in June, there is an approaching session of the Legislature, and approaching session of Congress at which all of the bills that may harass your industry will be presented, unemployment insurance, workmen's compensation, limitation of hours, old-age pensions, and all those things. There is absolutely certain to be a bill presented by one Congressman in particular and possibly others, possibly by the Administration, for the stabilization of the coal industry. There is a great deal of discussion in Washington as to the almost parallel problem of those natural resource industries of coal, oil and lumber.

Of course, there is all the time this question of the NRA which has been injected into the situation and, as Mr. Treadwell says, in regard to which there is a great deal of difference of opinion. When the first NRA came out there were various interpretations put upon those letters, and then followed the AAA and the HOLC and the other alphabet. I heard last night for the first time of the alphabet as applied to the calendar, and it ran somewhat like this: In 1932 there was the FDR; in 1933, the NRA; in 1934, the IOU; in 1935 there will be the SOS, and in 1936 the GOP. Now, not meaning to inject any politics into the situation, because of course the question is larger than any political consideration, yet for the same reason that as civilization becomes more complex, as the dealings and relations between individuals are complicated, as civilization becomes more complex we have the boll weevil, and the corn borer, and the foot and mouth disease, and the athlete's foot and all those things we did not used to have, but we have them and they will be with us forever; in the same way, during the years have grown up the Anti-Trust Act, the Interstate Commerce Commission, the Federal Trade Commission, the Federal Securities Act, the NRA and those various other Acts in the evolution of business relationships.

I do not know what our speaker is going to say, but I know it is my observation as I have studied it here at home and seen it in operation in Washington, that we are going to have the NRA in some form, or the principles of it next June. The probability is no one in this room will ever see the time when all of the principles of the NRA, many of which are not only unobjectionable, but cannot be assailed—I say there will not be any of you who will live to see the day when some of the provisions of the NRA will not be applicable to this industry and to business in general.

Now, we are particularly fortunate this evening, at this time when we all want to and must soberly reflect upon these changed conditions in these changing times, to have with us a speaker, a man who is known throughout the country as one of the Four Horsemen. He was one of those four in the east representing the north and south who in the troublesome times of a little more than a year ago represented the coal industry in the entire east in its negotiations with labor in the first place and its negotiations with reference to preparation of a Code to conform to the NRA. He is a member of the Code Authority for Division No. 1, which is this great territory to the east and south of us. He is a director of Appalachian Coals, Inc. He is the Vice-President of the Stonega Coke & Coal Company, Inc., operating at Big Stone Gap, Virginia, and Vice-President of the West Moreland Coal Company, operating in Pittsburgh, Pennsylvania. He is associated with Mr. Harrington of our own state in the operation of a coal mine in West Virginia. He is a man of wide experience, a fighter, a successful operator experienced in every phase of the operation of coal mines, not only experienced but outstandingly successful in those operations.

I am very much pleased to present and introduce to you Mr. Ralph E. Taggart, of Philadelphia.

Mr. Ralph E. Taggart: Mr. Toastmaster, Mr. President, gentlemen of the Illinois Mining Institute, you are about to be subjected to an ordeal for which no doubt you are fully prepared. I wish there was something in my past career or something in my future probabilities that might permit me to accept the kind introduction that has been given to me by the Senator without some word of protest. But it brings to my mind a story which they say occurred in the south, where we had a very trifling colored brother who neglected his mother, abused his wife, and failed to provide for his children. The poor colored brother passed to the Great Beyond at a time when the negro pastor of his flock happened to be absent from the city. It was necessary for them to bring in a new and uninformed pastor to pronounce the funeral service over the departed brother. As he waxed eloquent over the devoted son, the kind and affectionate father and the devoted husband, the bereaved widow stood it just as long as she could, and then turned to little Miranda at her side and said: "Mirandy, you jes tip-toe up to de coffin and peek in and see is dat your Paw."

As a matter of fact, there is a little doubt in my mind as to just why I should be here. In the good old days of prohibition they tell the story of a man who went to a party at Roanoke, Virginia, and in returning from the party it was necessary for him to cross a bridge. As he went across the bridge, he looked down at the river. He stopped, and he looked, and he looked, and he looked. An officer noticed this predicament and stepped up, tapped him on the shoulder, and said: "My man, you have been here a long time. Now, you must go home." The man said: "Certainly, Mr. Officer, I will go home, but before I go home will you answer me just one question?" The officer said: "Certainly, I will answer a dozen questions if you will just go home." The man said: "What is that I see down there?" The officer replied: "That is the moon." Then he said: "Now, I have answered your question, and you must go home." The man said: "Certainly, Mr. Officer, I will go home, but before I go home will you answer me just one more question?" "Certainly. A dozen questions, if you will go home." The man then said: "Well, Mr. Officer, if that is the moon down there, what in the hell am I doing up here?"

With all the capable and competent gentlemen that you might have had to address you here this evening, I naturally wonder what the hell am I doing up here.

When I was asked to make some remarks here this evening and no subject was assigned, I was somewhat familiar with the Illinois Mining Institute but not entirely so. I had heard a great deal of your activities. At the same time, I was not exactly informed as to the consist of your membership. Upon making inquiry, it developed that the active membership of the Illinois Mining Institute is largely composed of gentlemen who are engaged in the mining and preparation of coal—in fact, its production—rather than those engaged in its sale and distribution. It therefore occurred to me that if I might bring any message to you at all it might be along the line of those things that the operating men have to devote the majority of their attention to, and that is the question of producing the commodities which they have to sell.

Now, to discuss the cost of production is entirely too great a subject to endeavor to go into at such a time and place. It is a boring subject at best, and I thought from that standpoint I had best confine myself to the principle and major item of cost, and that is usually on the labor cost of coal.

As an operator operating in that section of the United States that is accredited with seventy per cent of the production of solid fuel of this country, naturally those things that have gone on and those things that will go on with reference to wage negotiations, and so forth, must have their bearing, and must have their effect upon the adjoining, adjacent and competing territories.

It is not my purpose to go into the history of the wage negotiations in the east beyond the period of the formation of the Code. It is necessary, though, to place a certain background to any discussion of this nature, and it must be borne in mind that following the crash of November, 1929, we entered upon a series of unprecedented depressions insofar as our memories go, which culminated in the national banking holiday in March, 1933. It was under these conditions that the National Industrial Recovery Act was promulgated and was passed.

We found at that time a desperate people, willing to submit to disciplinary plans and disciplinary procedure in order that any order might be brought about. It was under those conditions that we found, and under that Act that we found it was necessary, under the law, to promulgate a so-called Code of Fair Competition. We were informed and we had reason to believe that if the eastern section of the United States were to bring in as the major producer a Code of Fair Competition that could be agreed upon by that industry, it would have its bearings on other Codes of competition that might be provided for the industry as a whole. This was in the early days of preparation, and we were sufficiently sanguine to believe that the Code we might promulgate and prepare, if properly conceived and not in conflict with law, would be given a certain amount of consideration.

Proceeding upon that viewpoint, we did prepare a Code of Fair Competition. We found as we proceeded that a Code of Fair Competition was going to be provided for the entirety of the industry, and that our Code of Fair Competition was going to be lost some place. We had assumed this Code we were promulgating and preparing was going to be more or less a guide for our division and other divisions to be in a position to submit their codes. We found some thirty of them. We were rather disabused in our minds in thinking we were going to have too much to do in the promulgation of this Code of Fair Competition.

It reminds me to a certain extent of the conditions which I understand existed in a bridge game, where the dealer said he would pass and the gentleman to his left likewise said he would pass. Victor Emmanuel said "I pass." Mussolini said "Like hell you do, you bid four Spades and I double you."

We found that although we were promulgating this Code that if we put certain things in it we considered to be desirable it would not be approved.

We finally did come out with a Code. We found it was a Code that was to a certain extent sponsored by the gentlemen of Illinois, and in one of our conferences one evening on the NIRA we desired to find out just what the signatures on that Code might be. So we made inquiry as to what had become of the general Code which was submitted by so many, and we found to our amazement when we had made this inquiry that your Code had been placed in the Code file. That seemed to be a rather peculiar place to put a Code, but we found it was in the Code file and nobody knew where the Code file was, and consequently we think our original Code was placed perhaps in the Code file and got the same consideration perhaps that your Code got, and they perhaps still rest in that particular Code file.

From the standpoint of the eastern section of the United States, it must be borne in mind that following the crash of 1929 no very good basis of wage existed in the eastern part of the United States. As a matter of fact, we had no basis of wage. During that period, I may say for the benefit of the eastern operators—and it is what I believe to be an everlasting credit—whether or not that operator's decisions were right or wrong, whether he conducted his business well or poorly, he did operate and endeavor to operate for the benefit of the employes with little thought of gaining any profit.

It was in that atmosphere, at a time following a four year depression that we found after the Code had been promulgated we, too, must enter into some sort of collective bargaining. We had observed Section 7-A of the Industrial Recovery Act, but perhaps we had passed it a little too lightly. We thought collective bargaining meant collective bargaining among our own employes. At the formation of the Code, during the early phases, conferences were held with certain gentlemen of Illinois, and we endeavored to determine whether or not we should go as one group or as two groups. It was rather readily determined that the conditions that confronted the State of Illinois were different from the conditions that confronted the coal industry of the east, and perhaps under the existing conditions, for the time being, it would be best if we went our way and best if you went your way, because of the fact that the negotiations and the matter of negotiating which have been satisfactory to the Illinois operators in the past and desirable to them, that of collective bargaining with a national organization, although satisfactory to you would be entirely undesirable from the standpoint of the east.

As a matter of fact, during the early phases of the situation, there were those of us who felt, both north and south, that negotiations with the United Mine Workers of America were entirely undesirable and a proposition to which we were never going to submit. We, I believe, felt at that time, a great many of them and particularly the operators of the north, that they might secede from the Union before they would do any collective bargaining with anyone other than their own employees. We, of the south, who had already tried secession and found it did not get along so well, we were not going quite that far.

During the negotiations, however, of the Code and at the same time negotiations on wages, we rather reluctantly found we had a more or less misconception of just what the new Code of business was going to be, and that while we were busily engaged endeavoring to promulgate a Code the United Mine Workers of America were taking particular advantage of the law which has been enacted—and I do not mean by that they were taking any measure or any degree of unfair advantage, but were doing those things which perhaps they should have done and which they perhaps had a perfect right to do—while we were in the position we would not negotiate with them in any form because they were not the representatives of our employes, we of the south found they were a complete representative of our employes and we were completely organized, and were ready and willing to do the type and character of negotiating you gentlemen had shown us the way to before.

We were confronted, therefore, with a very difficult proposition, and that is that we had no basis for wage negotiations as between the north and the south. Consequently, organizations that could speak for the industries at large had to be very hurriedly thrown together. They were thrown together in the north part of thte Appalachian region, comprising those states of Pennsylvania, Ohio, Maryland, and northern West Virginia. In the south, a similar organization was set up known as the Appalachian Association, which consisted of the southern part of West Virginia and Ohio, and Kentucky, insofar as the eastern boundary was concerned, part of the state of Tennessee and the state of Virginia. We were then in a position to do some form of bargaining with each other and with the representatives chosen by our employes.

We found an exceedingly great amount of difficulty in bringing about a proper wage differential as between the northern part of our section and the southern part of our section. Finally, through negotiations and through agreements, it was determined that the proper differential of the wage basis, on a daily basis of hourly earnings, would be forty cents in the north above the south, with an intermediate wage scale for northern West Virginia.

So far, so good. We had cooperation and assistance on the part of the NRA and on the part of the United Mine Workers of America, endeavoring to permit us to a degree to establish those differentials at the time, not to be binding on any party or to be a precedent for future wage negotiations. Under that setup, through compromise, with the north continuously contending there should be no differential as with the south, and the south contending that the wage differential should be in excess of forty cents per day, we entered into the collective bargaining feature as provided for in the Code and under the National Industrial Recovery Act.

A dispute already existed as to the amount of wage differential for the hourly workers, with no solution as to what the contract or the piece workers on the hourly rate should be. It was finally determined that the Code should increase the loading rate by ten cents per ton. There was a relationship of wage as between Ohio, Pennsylvania, northern West Virginia and central Pennsylvania which made that rather easy a solution, because having previously had wage scales which were related it was not difficult for them to bring them back again into the relationship that had previously existed.

In the south, during this period of depression that I have referred to, the operator in the conduct of his business had made sales of coal and followed with the reduction of wages, or in anticipation of sales of coal had reduced his wage to such an extent that insofar as the contract or piece workers were concerned there was no uniformity of relationship of wage as between mines in the same district or as between competing districts.

It has been also necessary to promulgate and to form a wage scale. Our northern friends continued to suggest and to insist that we were holding out on them to a certain degree because we would not give them the tonnage rate. As a matter of fact, it had been the practice of our field to a very large extent to load by the car, and as a further absolute fact we did not know as districts and only knew as individuals what we were paying as a wage for contracts and dead work.

Thirteen districts were represented in the conference for the south. It was finally agreed that the average rate for the south for each of the twelve to thirteen competing districts should be calculated, and to that should be added the relationship with the north, which in this particular instance amounted to nine cents and two mills per ton, which happened to be the difference between the four dollar sixty cent basic day rate for the north and the four dollar and twenty cent basic day rate for the south. On that basis there has been some question and still is in the minds of many of the companies as to whether all the districts wanted the absolutely proper and adequate wage rate insofar as their tonnage is concerned, but the only thing that could be done was to add the nine cents and two mills to what the particular district said was their average loading rate, to which was added also a percentage to what they had been paying for yardage and dead work.

Under that condition, we naturally came out with twelve to thirteen loading rates which were not related each one to the other. It was perhaps as good a job as could be done at that time, and the wage basis for the south was put up and the wage basis for the north was put up, unsatisfactory to the south, unsatisfactory to the north. It was unsatisfactory to the north because of the difference of wage, unsatisfactory particularly to the south because of the difference in coals and the cost of coals that were highly competitive. That difference amounted to as much as fourteen cents to fifteen cents.

Ample time existed between the time of the signing of the Appalachian agreement and the renewal of the agreement in April of this year to have ironed out those differences and brought about a proper wage relationship as between competing costs. There was but little disposition on the part of those who had the advantage in the wage rates to concede anything to those that were paying the higher rates. There was little disposition on the part of those that had been securing the higher rate to accept a lower wage rate.

Consequently, in the formation of our wage scales in April of this year, through the stress of consequences and the haste of doing business, it was necessary again to add a flat amount to the tonnage rate, which permits the differentials that now exist to continue to exist, and they exist up to the present time, unsatisfactory to labor, unsatisfactory to the operators.

In order that these conditions might be corrected to a certain degree, it was determined and made a part of our last agreement that there should be a commission composed of equal representatives from the south, equal representatives from the north, and an equal number of representatives of the United Mine Workers that should make a study of the differential relationship north and south in the Appalachian territory and make a recommendation to a conference to be had in December of this year.

The progress which might be reported on that is similar to the progress so often reported in so many negotiations of this kind. Up to the present time the progress, however, on the part of the commission empowered to do this job is that very little if anything has been done along that line. If I were to be asked what is the prospect of there being anything substantial done between now and our next wage conference, I would have to confess to you gentlemen that we are doing but little as between the north and south to iron out and to satisfy those interested in the differentials study. The condition in the south, with thirteen different tonnage rates, naturally is a condition which is very unsatisfactory. Perhaps nothing better could be done in the last conference, but something perhaps should be done by the next conference, and for that purpose a committee, an inter-south wage commission, was appointed.

The progress of that commission is similar to the progress of the commission that is working on the subject from the standpoint of the north and south. It appears nothing can be done or nothing will be done between now and the next wage conference.

I bring this matter to your attention because I think you will agree with me that the question of the wage relationship east is going to have its bearing on your problem here. I want to let you understand that you are going to secure but little if any benefit from the deliberations that may be going on in the east, because it is apparent to those of us there that nothing is going to be done, and we will be in a perfectly chaotic condition when we come to the time of the next wage negotiations.

It is unfortunate that I cannot bring you a message that would be more encouraging than the message I am giving you here. And I am sorry and embarrassed from the standpoint of our industry in the east, and I lay the blame largely at the hands of the operators and not in the hands of the United Mine Workers of America that no progress is being made along this line.

I recognize that we are going to be in a great deal of haste, and will naturally be in a great deal of hurry when it comes to negotiating for our next wage agreement, without any prior work or any prior accomplishment—or practically no prior work or accomplishment—being made by the commissions that were appointed on this subject. Whether or not we can complete our work by April 1 contains some element of doubt. I hope that may not be true. I hope we have an opportunity to negotiate these matters so that we can do this thing deliberately and do it cooly, and so that we need not be in too great haste.

I am reminded of a little boy that was on his way to school in the morning, and as he walked down to school he kept repeating to himself: "Oh, God, don't make me late. Oh, God, don't make me late." All of a sudden he stubbed his toe and stumbled and fell down, and said: "Well, Jesus Christ, there's no need to push me."

I am fearful we are going to be pushed to such an extent in our next negotiations that we may stub our toes and fall down.

I do not know if there is anything more that I could say to you people except to make the report to you as to the progress that is being made along that line. It strikes me, though, that I would be more or less derelict in duty if I did not go away from the principal thing that I wanted to talk about and make a report as to what is going on in our wage negotiations, if I did not briefly call to your attention some of the things that are being done that look as though they might have a most detrimental effect upon our industry.

We cannot at any time lose sight of the competitive condition we are in, not only as among ourselves but as between competing industries and competing fuels. It is to be recalled that at the time of our negotiations for our first agreement we were told that there would be some form of legislation introduced that might place an excise tax on gas. That form of legislation has not yet come to pass.

As Senator Essington has pointed out, we are facing the next session of

Congress. It is unreasonable to me that such a great industry as the coal industry would be further handicapped by lack of control of those industries that are in direct competition with ourselves. It must be borne in mind that the railroads of this country—and perhaps they need it—are asking for certain freight rate advances that are going to place our production at a still further disadvantage with our competitors if those freight rates are allowed to become effective. I am not capable of saying whether or not the railroads are entitled to and should have an advance in rates. But I do know that if this advance—if it makes a further cost to our consumer of as much as thirty cents per ton, it is going to place our production at a very serious disadvantage with competing forms of heat and energy.

We must recall that in a period practically thirty years ago, when the solid fuel of this nation contributed about ninety percent of the Btu value that was consumed in this country, its greatest competitor at that time was oil, which contributed about four and one-half percent of the Btu consumed in this country, that natural gas came next with a contribution of about 3.3% while hydro-electric power had only slightly less than two percent converted into Btu value. The last figures that I have seen indicate that solid fuel in this country has fallen from ninety percent to fifty-six percent, that in a period of thirty years oil has increased from four and one-half percent to twenty-six percent, that natural gas has increased from 3.3% to approximately eight and one-half percent, and hydro-electric power from less than two percent to eight and one-half percent.

To say those things differently, it means that coal has lost forty-six percent while petroleum has increased five hundred percent, while natural gas has increased one hundred and seventy percent, and the hydro-electric power has increased three hundred and seventy percent.

It is perfectly apparent from those figures that coal is not playing the important part in the Nation's industrial life that it heretofore played, and that competition can be brought about, if unregulated, and unrestrained, while the coal industry is to a measure regulated and restrained, that will do further damage to the coal industry and put thousands of our miners out of work and reduce our output by thousands of tons.

Our competition, gentlemen, was sufficiently severe prior to the time that the Federal Government determined it was its place to form some kind of competition with our industry and with the utilities. It is an astounding fact that there is now under development and has been appropriated or will be appropriated the sum of $940,000,000 for the purpose of this Government getting in competition with its people, which will have the effect of placing many miners and many coal mines out of commission. The hydro-electric power—and I refer particularly to the Tennessee Valley as one of the outstanding instances that has occurred recently—is going to be of material detriment to the coal operators and coal miners of the east. Many other projects of this nature are in the course of development or have been projected, which will not only affect the operators of the east but will affect the coal operators and their employes throughout the entirety of this Nation.

Those plants that are now under development and being built have a capacity, if operated to capacity, to replace forty million tons of coal which will in turn place an additional forty thousand miners out of employment.

I am sorry that the coal industry is not organized as I think it should be, and has not taken full advantage of the opportunities which have been theirs to organize and voice their opposition to measures of this kind. Some things have been done. Good work to a certain extent has been done, but not all of those things that should be done have been done by the coal industry and its members. And I think it is the bounden duty of every man in the coal industry to inform himself of the things that the National Government is doing, to recognize the fact that the power to tax is a power to destroy, and that it is perhaps not the purpose but it has the same results that the people of this country are being taxed in order that the Government might go in competition with them, and will have the effect of putting them out of business.

It is my thought that since it is too late to do anything and get any commitment from the different Congressmen prior to their election, that it is the bounden duty of every man engaged in this industry for his own benefit, for the benefit of his family, for the benefit of his employes and for the benefit of the community which looks to him for sustenance, it is his duty to see his Congressman, to see his Senator, and prior to so doing to inform himself to the best of his ability to plead with him that there be no further legislation or no further appropriations, that there be no question in the next Congress of a shortening of the work day or things of that kind by legislation, but that those things be permitted through negotiation, and that there be nothing further done along the line and if possible stop these things now going on of the Government going into competition with its own citizens in the production of hydro-electric power, which is going to have a most detrimental effect.

Then we should insist that there be some regulation—we had assurances there was to be some regulation—with reference to oil. We had been told that oil would no longer be an increasingly detrimental proposition. I wish that might be true. But I observed recently the price of gasoline, which was recently seventeen cents in New Jersey, is being retailed at eight cents with the tax. In Pennsylvania, due to this trade war, gasoline that had been retailing for eighteen cents is now being retailed at thirteen cents, and good grades of fuel oil are now being sold at five and one-half cents which brings the oil competition back in the same relationship it was prior to its regulation being assumed by the Department of the Interior.

It is our bounden duty to plead with our Congressmen and citizens that they insist on the excise tax on natural gas, that it may make no further inroads on our industry. It is our further duty to see that this development of hydro-electric power is abandoned, which means nothing to the communities that these power plants are built to serve because in every instance so far as I am informed, and I have endeavored to look over the very good articles that have been put out on the subjects, there is no need for the additional electrical energy in the communities where these power plants are being constructed, because the power plants already in existence have ample capacity and reserve capacity to take care of the needs of those communities for some time and some years to come.

The Government, by States, has ample power to regulate and to control, and it is no function of Government nor was it the intention under the Constitution of this Nation that the Government should get into competition with its citizens. I hope that everyone here is and I hope that the industry throughout the State will organize itself to a better degree to cope with this situation, and since we have thus far failed to get our message to the people, that all of your members in the influential positions which you hold will make it your business to see your Congressmen and see your Senators prior to the time they go to the next session, and get a commitment if possible.

I was informed since I have been here today that on the Tennessee Valley Project—there are twenty-nine Congressmen, I believe, from the State of Illinois, and that when it came to the question of voting for the appropriation for the Tennessee Valley Authority twenty of them voted, twenty of them from this great coal producing State, in Congress voted for the Tennessee Valley appropriation, that six voted aaginst it, and three did not register as voting. Certainly the influence which you gentlemen have should be able to make a greater impression on the Congressmen who represent you that as a State so vitally interested in the production of coal something should be done in order to change their sentiment in Congress.

Mr. Toastmaster, Mr. President, and gentlemen, if I have brought to you any message whatsoever, I am indeed most happy. I want to take this opportunity to say that I shall be forever grateful for the many courtesies and hospitality that have been shown me on this occasion.

Mr. Essington: I am sure, Mr. Taggart, that that applause is evidence of the very great appreciation of the gentlemen of this powerful exposition of some of the problems with which they are confronted in the east, and which are very similar to and not very dis-similar from the problems confronting the operators in this State.

Now, we are just immensely pleased that Mr. Taggart kept his engagement and came here this evening and told us of the difficulties with which they are contending in the east. I thank you very much, and we appreciate it very much, Mr. Taggart.

On this subject of water power, TVA and the Government injecting itself into private business, the Institute secured some copies of a bulletin issued on that subject which will be passed out at this time, or if that is inconvenient you can each get a copy as you go out.

At this time, I turn the meeting back to the newly elected President of the Illinois Mining Institute.

President Sandoe: I would like for all of you to take heed to what has been told you relative to your Congressmen and Senators, as I think that is one of the most important things you have to do now. We must get some support. There has been some very wonderful work done in trying to hold off the competitive fuels.

I know of no further business, so we will stand adjourned.

(Whereupon the Institute meeting was declared to stand adjourned **sine die.**)

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 comomnly performed by the presiding officer and chairman. He shall sign all orders for payment of money by the treasurer, and with the executive board shall exercise a general supervision over the affairs of the Institute between sessions.

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

Section 3. The secretary-treasurer shall keep a record of each meeting, shall read and file all resolutions and papers that come before the Institute, countersign all orders for money which have been signed by the president, and shall purchase necessary supplies under the direction of the executive board.

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

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

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

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

Section 5. The executive board shall perform the duties specifically prescribed by this Constitution, act as program committee for each meeting, determine what is to 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. -- Brooks & Stewart, Inc., 53 W. Jackson Blvd., Chicago, Ill.
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BUTCHER, FRED E. ------------ First National Bank Bldg., Danville, Ill.
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Bell & Zoller Coal & Mining Co., 307 N. Michigan Ave., Chicago, Ill.
DUNCAN, W. M., Pres. -- Duncan Foundry & Machine Works, Inc., Alton, Ill.
GARCIA, JOHN A. -- Allen & Garcia Co., 332 S. Michigan Ave., Chicago, Ill.
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HARRINGTON, GEO. B., Pres. ----------------------------------
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JENKINS, S. T. -------- Goodman Mfg. Co., 322 Clark Ave., St. Louis, Mo.
JONES, JOHN E. --------------- Old Ben Coal Corp., West Frankfort, Ill.
JOYCE, A. R. --------------- The Wood Preserving Corp., Marietta, Ohio
LEACH, B. K., Pres. --
Egyptian Tie & Timber Co., 514 Rialto Bldg., St. Louis, Mo.
KNOIZEN, A. S. -------------------------- Joy Mfg. Co., Franklin, Pa.
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RYAN, JOHN T., V.-P. and G. M. Mine Safety Appliances Co., Pittsburgh, Pa.
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THOMAS, T. J., Pres. -- Valier Coal Co., 547 W. Jackson Blvd., Chicago, Ill.
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MURRAY, HUGH ------------------------------------- Equality, Ill.
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CONLEY, V. ---------- Troy Fuel Co., Troy, Ill.
CONWAY, C. C., Chief Elec. ---------- Consolidated Coal Co., Herrin, Ill.
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O'BRIEN, FRANK American Cable Co., 114 S. McKinley St., Harrisburg, Ill.
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OLDHAM, R. J., Gen. Mgr. ------------- Centralia Coal Co., Centralia, Ill.
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O'ROURKE, PETE --------------- William Hales Co., West Frankfort, Ill.
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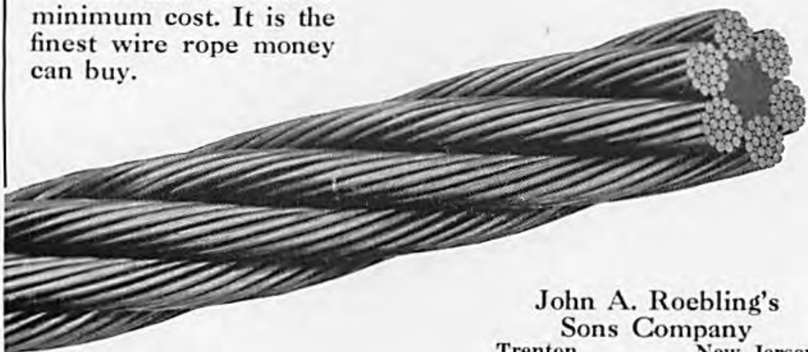

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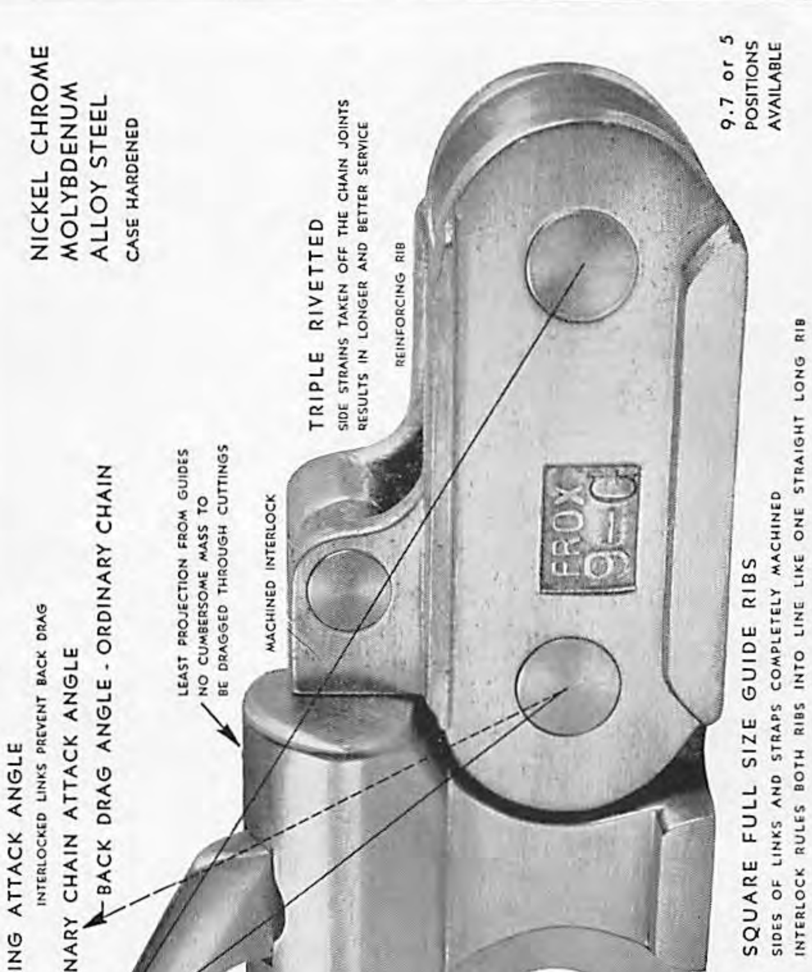

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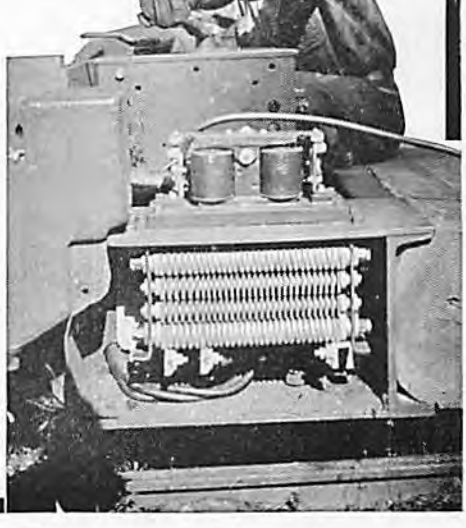

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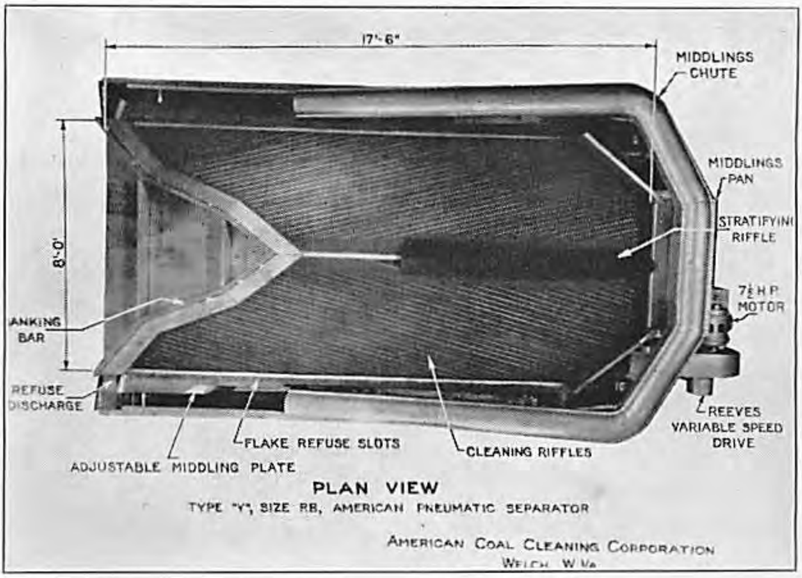

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The AMERICAN Pneumatic Process, of which we are the originators, is only 14 years old. Its growth and development has been rapid. Installations are to be found in every important coal producing State of the Union and in every coal producing country of the world, excepting China, Japan and New Zealand. The total installed capacity is 40,000,000 tons annually.

Coal producers of importance using this system have not only maintained, but actually increased their coal sales and realization, since the installation of the AMERICAN Pneumatic Coal Cleaning Process, which has revolutionized the Art of Mechanical Coal Cleaning.

The advantages derived from cleaning coal with the AMERICAN Pneumatic Process are:

FIRST: Reducing the ash to a uniform and desired percentage.

SECOND: A lowered sulphur and increased fusion temperature.

THIRD: Increased B.T.U. heat value.

FOURTH: Reduction of moisture in the cleaned product to any desired content.

FIFTH: Increased range in the prepared sizes for both domestic and commercial uses.

SIXTH: Where impurities are embedded in the coal, such as most Illinois Coals, it can be pulverized, crushed or disintegrated to a size range 1/8″ to 0″ and successfully dry cleaned, and then made into metallurgical and domestic coke.

SEVENTH: Dedusting of the coal up to 1/16″ size during the cleaning operation without additional equipment or cost.

EIGHTH: One hundred per cent dust collection. The dust collected is separated into two sizes.

NINTH: Low investment and operating costs that return a profit.

TENTH: Flexibility in control of ash content in cleaned coal governed by percentage of coal returned for retreatment with anti-gravity return chutes without interrupting the operation of the plant.

Our system is automatic in operation, and adjustments can be made instantly. Can be operated 24 hours per day. Design and construction based on sound engineering principles and more than 30 years coal betterment experience. We are prepared to make and furnish complete laboratory tests on any coal, design and erect the structure and make complete installation or adapt the system to existing facilities, and furnish you efficient cleaning at a less cost per ton than any now known method.

Dedusting, Dust Collection and Drying coal are inseparable steps in the Dry Cleaning Process.

"The Original Basic Process for Cleaning Coal Without Adding Moisture"

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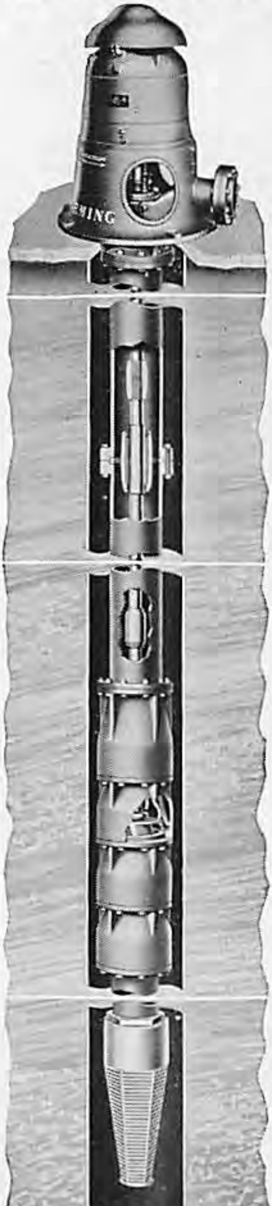

Deep Well Turbine

This type of pump is becoming increasingly popular for mine dewatering.

Whether it is a series of small gathering pumps, a large centrifugal or any size or type between—you can be sure Deming has the equipment to fit the job.

Today, Deming offers so complete a line of pumps that many mine owners are standardizing on this equipment—dealing with one competent organization which can fill every pump requirement. And, at the same time these users are getting the most for every dollar invested in pumps.

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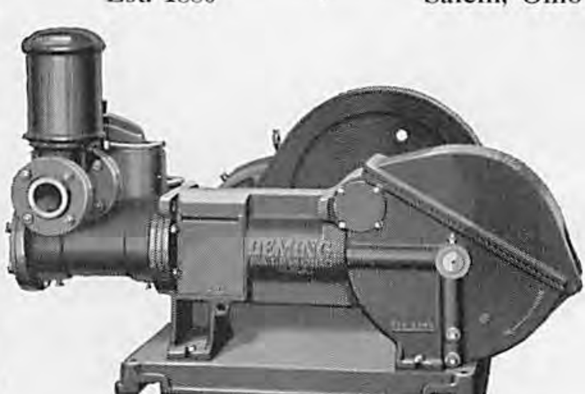

"Oil-Rite" Double Acting Gathering Pump

Can be furnished with all chrome water end for use in handling especially bad water.

The JOY 10-BU

JOY adds another important page to Coal Mining history with the Joy 10-BU Loader. This heavy duty, rugged loader offers new "highs" in tonnage loaded and new "lows" in cost of production. Guaranteed capacity *four tons per minute.* Joy service now includes a complete program cutting, loading and conveying. Consult Joy Engineers for the answer to your mechanization problems.

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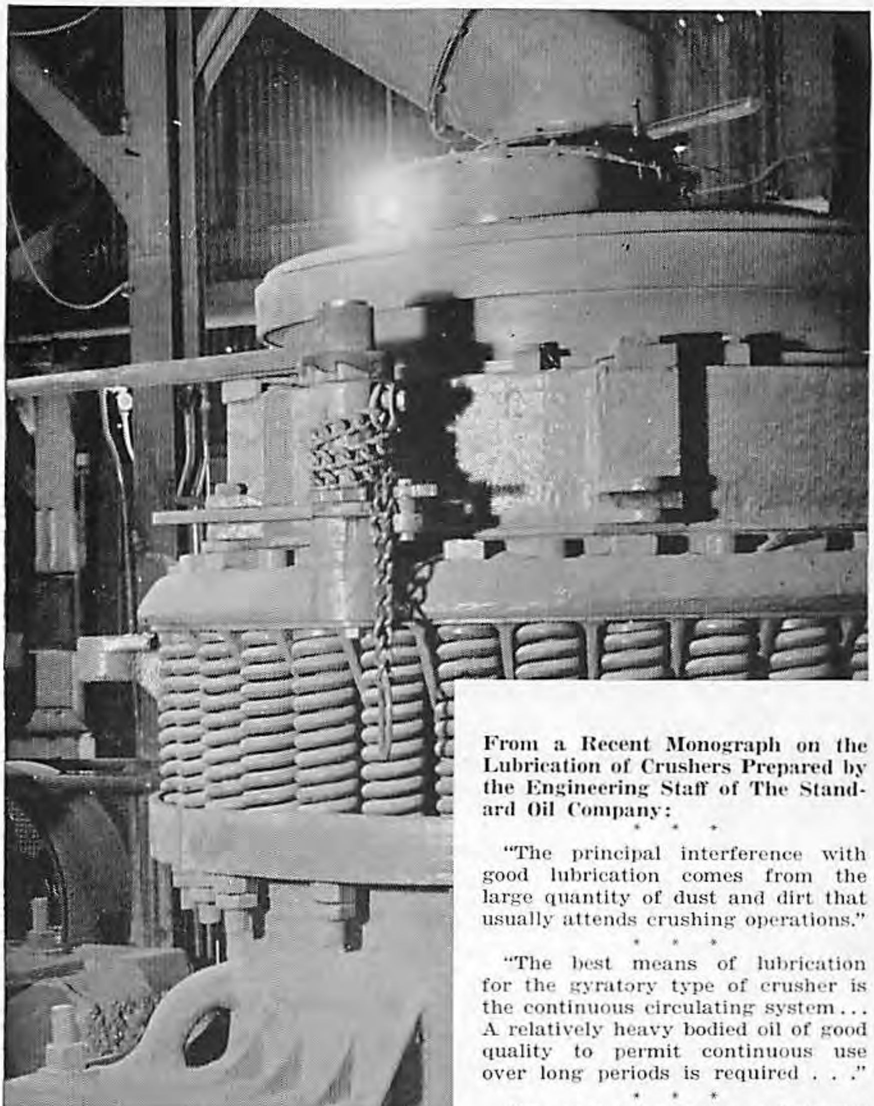

From a Recent Monograph on the Lubrication of Crushers Prepared by the Engineering Staff of The Standard Oil Company:

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"The principal interference with good lubrication comes from the large quantity of dust and dirt that usually attends crushing operations."

* * *

"The best means of lubrication for the gyratory type of crusher is the continuous circulating system . . . A relatively heavy bodied oil of good quality to permit continuous use over long periods is required . . ."

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"The particular choice of body will depend on the particular make and model of crusher involved and the season of the year, where low temperatures are encountered."

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"In cold weather it is a good plan to start up with no load, letting the oil warm up to procure good circulation before imposing heavy loads on the bearings and gears."

Wherever the odds favor breakdowns or lubrication problems are difficult, call in the Standard engineer. He cuts Costs.

For practical Monographs on your Lubrication Problems write to the

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When the mines need steel for maintenance or new construction, quick service is essential. Whether it is a large quantity or only a bar, a sheet or a few bolts, your order to Ryerson is shipped immediately. No waiting —no delay. Ryerson service also includes portable electric tools, jacks, hack saws, pipe threaders and other metal working tools.

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A complete range of both structural and bar sizes in all standard sections, also galvanized angles, ship and car channels, etc.

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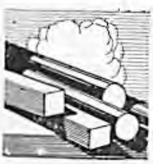

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