PROCEEDINGS

of the

ILLINOIS MINING INSTITUTE

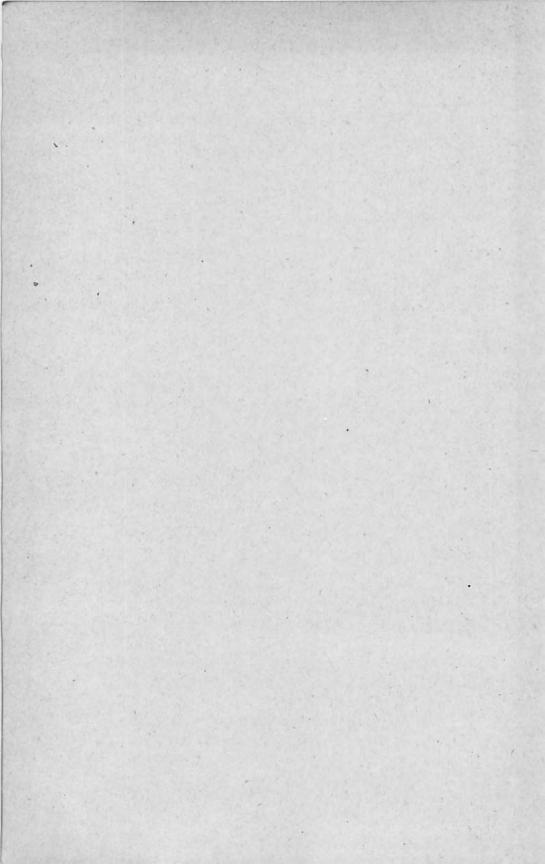
FOUNDED FEBRUARY, 1892



Fifty-Fourth Year

1946

Annual Meeting
SPRINGFIELD, ILLINOIS
November 15





Joseph E. Hitt President, 1946

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1945-46	JOSEPH E. HITT, Walter Bledsoe Co., St. Louis, Mo.

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ILLINOIS MINING INSTITUTE BOAT TRIP AND ANNUAL SUMMER MEETING

June 22, 1946

The 26th Annual Boat Trip and Summer Meeting of the Illinois Mining Institute convened at ten o'clock, A.M., aboard the Golden Eagle on the Illinois River, Saturday morning, June 22, 1946, with President Joseph E. Hitt, Walter Bledsoe & Co., St. Louis, Missouri, presiding.

ATTENDANCE

ILLINOIS MINING INSTITUTE TWENTY-SIXTH ANNUAL BOAT TRIP AND SUMMER MEETING

(Up the Illinois River and Return to St. Louis)

June 21-22-23, 1946

Name	Affiliation and Address
H. A. ALBERS	Philco Corp., 2024 Railway Exchange Bldg., St. Louis, Mo.
CLARENCE V. BEÇK.	
CLARENCE V. BECK,	JRLittle Dog Coal Co., Fullerton Bldg., St. Louis, Mo.
D. A. BENNER	Gibraltar Equipment & Manufacturing Co., Alton, Ill.
ARTHUR T. BLAKE	Peabody Coal Co., 231 S. LaSalle St., Chicago 4, Ill.
G. F. BLANKINSHIP	.Egyptian Sales Agcy., 13371/2 Walnut St., Murphysboro, Ill.
RAY BRIDGES	Southwestern Illinois Coal Corp., Percy, Ill.
CLAUDE CHAPMAN	Bituminous Casualty Corp., 720 Frye Ave., Peoria 4, Ill.
J. H. CHEVALIER	National Electric Coil Co., 8001 W. Main, Belleville, Ill.
R. R. CLAYTON	Hercules Powder Co., 332 S. Michigan Ave., Chicago 4, Ill.
C. C. CONWAY	
LEE CONWAY	Consolidated Coal Co., Staunton, Ill.

Name Affiliation and Address
WALTER COOKCentral Mine Equipment Co., 4520 Enright, St. Louis 8, Mo.
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C. S. DeWITT
HERVIE DILLINGHAMStandard Oil Co., 1108 E. Lindell, West Frankfort, Ill.
R. L. EDGARThe Watt Car & Wheel Co., Barnesville, Ohio
C. F. ELDERSBroderick & Bascom Rope Co., 4203 N. Union Blvd., St. Louis, Mo.
HOWARD R. ELLISCardox Corp., Franklin Hotel, Benton, Ill.
HARRY E. ERIXSONAmer. Chain & Cable Co., 400 W. Madison, Chicago 6, Ill.
J. H. FLETCHERJ. H. Fletcher & Co., 332 S. Michigan, Chicago 4, Ill.
ROBERT FLETCHER
FRANK FRIESArbitrator, Ill. Coal Opers. Assn. & Dist. 12 UMWA, Gillespie, Ill.
ERNEST GAMMETERPaul Weir Co., 307 N. Michigan, Chicago 1, Ill.
THOS. L. GARWOOD
S. F. GRONE Consolidated Coal Co., Staunton, Ill.
GLENN GULLEYDiamond Supply Co., P. O. Box 402, Vincennes, Ind.
PAUL HALBERSLEBENSahara Coal Co., Harrisburg, Ill.
JOS. E. HITTWalter Bledsoe Co., Arcade Bldg., St. Louis 1, Mo.
M. T. HOPGOODAtlas Powder Co., 3405 W. Main St., Belleville, Ill.
ROBERT S. HOUTSMechanization, 1712 Board of Trade Bldg., Chicago 4, Ill.
JOHN J. HUGHESThos. A. Edison, Inc., 1902 Continental Bldg., St. Louis, Mo.
JOHN C. JACKSONMine Safety Appliances Co., 1510 W. Lawrence, Springfield, Ill.
J. A. JEFFERISIllinois Terminal R.R. Co., 710 N. 12th Blvd., St. Louis, Mo.
G. S. JENKINSConsolidated Coal Co., Railway Exchange Bldg., St. Louis, Mo.
W. J. JENKINSConsolidated Coal Co., Railway Exchange Bldg., St. Louis, Mo.
W. J. JENKINS, IIConsolidated Coal Co., Lymar Hotel, Herrin, Illinois
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C. W. KUECHLER	Illinois Powder Mfg. Co., Pierce Bldg., St. Louis, Mo.			
M. M. LEIGHTON	State Geological Survey, Urbana, Ill.			
HOWARD LEWIS	Old Ben Coal Corp., West Frankfort, Ill.			
R. L. LINDSAY	Dering Coal Co., Eldorado, Ill.			
W. L. LINDSAY	Socony-Vacuum Oil Co., Benton, Ill.			
RALPH J. LOFQUISTI	Roberts & Schaefer Co., 307 N. Mich. Ave., Chicago 1, Ill.			
E. W. McCULLOUGHA	mer. Car & Foundry Co., 3095 S. 7th St., Terre Haute, Ind.			
R. M. McELWEE	General Electric Co., 840 S. Canal St., Chicago 80, III.			
GEORGE MEAGHER				
ROBERT M. MEDILL	Director, Dept. Mines & Minerals, Springfield, Ill.			
HUGH MERCER				
FRED A. MILLER	Consolidated Coal Co., Herrin, Ill.			
JAMES E. MILLER	.Mines Equipment Co., 4215 Clayton Ave., St. Louis, Mo.			
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HAROLD W. NEWTON.	Barber Greene Co., Aurora, III.			
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A. E. "RED NECKTIE" I	PICKARDThe Tamping Bag Co., Mt. Vernon, Ill.			
F. E. RHINE	Sterling Steel Casting Co., Alton, Ill.			
R. R. RICHARTMcGr	aw-Hill (Coal Age), 330 W. 42nd St., New York 18, N. Y.			
WALTER SADLER	Sahara Coal Co., Harrisburg, Ill.			
	ilbraltar Equipment & Mfg. Co., P. O. Box 304, Alton, Ill.			
	28 E. Jackson Blvd., Chicago 4, Ill.			
	Mechanization, Munsey Bldg., Washington, D. C.			
	.Goodman Mfg. Co., 825 Providence, Webster Groves, Mo.			
	Peabody Coal Co., Taylorville, Ill.			
ROY STARKS Equitable Powder Mfg. Co., Taylorville, Ill.				
HOWARD R. STELZRIEDE				

Name Affiliation and Address
H. T. SUTHERLANDTamping Bag Co., Mt. Vernon, Ill.
H. H. TAYLOR, JRFranklin County Coal Corp., 135 S. LaSalle St., Chicago 3, Ill.
DEAN CHARLES M. THOMPSONNorthern Illinois Coal Corp., Champaign, Ill.
R. A. THOMPSONKennametal, Inc., Mayfair Hotel, St. Louis, Mo.
LESLIE S. VOLTZPeabody Coal Co., 231 S. LaSalle Street, Chicago 4, Ill.
J. N. WADDELL
PROF. HAROLD L. WALKERDept. of Mng. & Metal. Engrng., U. of I., Urbana, Ill.
FRED E. WEISSENBORNIll. Coal Oper. Assn., 4266 Arsenal St., St. Louis, Mo.
B. K. WENTWORTH
WALTER H. ZIMMERBixby-Zimmer Engr. Co., Galesburg, Ill.

President Hitt: Gentlemen, there are three or four fellows still asleep but we decided not to wait for them. We are going to attempt to make this meeting just as streamlined as we can so it won't last too long and won't tire any of you.

We have adopted another innovation. Not only will the meeting be short this morning but there will be no afternoon meeting. We have been working pretty hard and didn't come down here for a lot of concentrated study, so this afternoon there will be no meeting. This will constitute the whole day's proceedings. (Applause.)

We have been holding these trips now for twenty-eight years. There have been twenty-six trips, but twenty-eight years ago we enjoyed our first trip. We had a little over a hundred and fifty reservations and it reached the point where we had to ask the companies that had been sending three or four fellows to the meeting to try to confine their representatives to two each.

Then when all this chaos came up in connection with getting our mines started and studying, analyzing and fitting in this new scale of wages for us we commenced to get cancellations because they couldn't come.

The government also served notice to us that under their new regulations we couldn't take over one hundred on the boat so it was right up our alley; just what we wanted. We have about a hundred on this trip and that is the capacity of the boat under the new regulations, so it has worked out fine, although we are sorry we couldn't have accommodated the hundred and fifty.

We had things arranged to take care of a hundred and forty. We expected to accommodate 140 this year but, when the things I spoke of arose, we were reduced to this sizable crowd. However, it makes it comfortable for all of us.

Then in addition to that, as I have told you, we decided to streamline the whole day's session and confine it all to a morning's session. Now because of that and because we are going to streamline it and are going to make it fast, I am going to ask you all to give us undivided attention as much as you can so that the meeting will move along rapidly.

The program is short. We are going to have a talk by Claude Chapman, of the Bituminous Casualty Corporation, on "Haulage Safety in Bituminous Mines." We will have a paper by Ray Bridges, of the Southwestern Illinois Coal Corporation, for which company he is combustion engineer and chemist, on the "Washing Phase of Coal Operations." Then a paper is to be read that was written by James Hyslop, who used to be associated with my company but who is now vice president and chief operating officer of the Hanna Coal Company in Ohio.

That, aside from a few extemporaneous remarks, of which there may be only two or three, will constitute our whole program and we ought to get through with it very quickly. (Applause.)

We will start the program with Mr. Claude Chapman of the Bituminous Casualty Corporation, Peoria, Illinois. (Applause.)

HAULAGE SAFETY IN BITUMINOUS MINES

By CLAUDE CHAPMAN Bituminous Casualty Corp., Peoria, Ill.

The coal industry in 1945 produced 630,615,000 net tons of coal, with a fatality rate of 1.72 per million tons, which is a reduction from 1.91 per million tons in 1944. This is indeed remarkable, since it is the lowest fatality rate of any year in a continuous series of annual statistics on coal mine injuries extending back to the early 1870's.

The greatest progress in safety during the past year is indicated in major disasters, falls of roof and coal, and electricity. Statistics provided by the Bureau of Mines which was published in the February 1946 issue of *Coal Age* indicates that 231 fatal accidents occurring during 1945 were caused by underground haulage in the bituminous and anthracite coal mines of the United States. This is unfavorably above the ten (10) year average of 221 fatalities in underground haulage in coal mines in the United States during the period of 1930-1939.

Data on non-fatal accidents occurring during 1945 in coal mines due to haulage could not be obtained by the writer. However, it is reasonable to suppose that the 1945 non-fatal accident rate in mine haulage is near that of the 10-year average of 13,111 occurring in this classification

during the years 1930 through 1939.

In preparation of an informative paper on the subject of haulage accidents it is necessary to obtain information regarding past experiences of the cause of underground haulage accidents in previous years, in order to arrive at some logical conclusion regarding what may be done in a practical way to eliminate, so far as possible, accidents to underground workers from hazards incident to transportation. A review of available accident statistical records on underground haulage indicate that approximately 44% of all fatal and non-fatal accidents resulting from haulage are caused by workers being struck, run over, or squeezed between cars or locomotives. Such accidents occur while coupling, pulling or pushing cars, switching, or spragging or blocking of cars.

Second highest cause of haulage accidents are those that are injured, or killed as a result of being squeezed between car and rib, timber, or roof. This type of haulage accident accounts for approximately 23% of both fatal and non-fatal accidents resulting from haulage in the coal

mines of the United States.

Derailments and rerailing of derailments account for approximately 11% of haulage injuries, which when added to the first two given causes, represent 78% of all mine transportation accidents. Other causes, such as lifting, pulling or pushing cars manually, animals on haulage, runaway cars on dips or slopes, etc., are responsible for the remaining 22% of the accidents.

I wish to call your attention to the fact that injuries sustained while coupling, during the 8-year period 1930-1937, and included in the first

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two principal causes of underground haulage accidents, represent 19.68% of all accidents in this classification.

The classified percentages on haulage accidents contained in this paper are taken from statistics compiled by Mr. C. L. Lutton from Bureau of Mines bulletins captioned "Coal Mine Accidents" for the years 1930-1937 inclusive, and published in the proceedings of the Thirty-Second Annual Convention of the "Mine Inspectors' Institute of America," held in Bluefield, West Virginia, in 1941.

Haulage safety begins at the mine entrance, which may be a shaft, slope, or drift opening. Accidents resulting from failure of shaft hoisting equipment are relatively fewer than other phrases of transportation, but they also can be more serious. When a cage drops, or is pulled up and dumped with men on it, or a man falls into a shaft, the results usually are fatal or serious to all persons involved in the accident. In obtaining maximum safety at shaft operations it is necessary that good equipment be used and maintained in top condition, including safety catches, bonnets, bridle chains, handholds, and enclosed sides on cages, safety platforms and railings, proper fencing of shafts, control of access to shaft landings by safety gates and attendants. Good signaling equipment and regular inspections of ropes and equipment condition are among approved safety measures. Regular inspections of shaft timbering, including guides, should be made. Hoist controls, overwind, speed limiting devices and brakes should be maintained in good condition. Engineers should be experienced, safe, and certified.

Slope hoist accidents result principally from equipment failure, lack of proper and effective safety devices such as drags, derails, stops, safety chains, and unsafe practices. Hoists should be in good condition, including brakes. Slope tracks should be maintained in good condition and equipped with derails. Refuge holes or places of safety should be provided at slope bottoms, and conveniently located so workers or others at this location can retreat to these places of safety while cars are in motion on slope. Where men are lowered or hoisted on slopes, mantrip cars of strong safe design should be used that are provided with safety chains or automatic stops. Rope car fastenings and hitching devices should be of safe practical design and of sufficient strength to provide a favorable factor of safety. Where hoist slopes are also used as a travelway, the manway should be separated from the hoisting compartment by a substantial wall or railing. Material service tracks entering slopes should be provided with stops or derails to prevent cars from running away down slope. Good equipment regularly inspected and maintained in good condition, combined with enforcement of practical safety rules, and safety devices are the main requirements in attaining slope hoist safety.

Unfavorable clearance is a contributing factor to many, and the direct cause of a great part of all haulage accidents. It is necessary that careful consideration be given to clearances in the drawing of mine plans to obtain maximum safety under the existing natural conditions. Conversion from hand loading to mechanical loading, which included the installation of larger capacity mine cars, presents varied and difficult

clearance problems in many older mines, and the cost of providing adequate clearance is sometimes prohibitive. Good clearance is desirable on both sides of haulage tracks, however, this is not practical in all mines. Where clearance is restricted to one side of the track it should be always located on opposite side from trolley wires, with ample room to permit moving equipment to pass a person at any location, and supplemented with unobstructed refuge holes at regular intervals. Where roof conditions require extensive timbering along haulage, all timbers should be set so as to provide the greatest track clearance possible, cross bars should be hitched into the ribs where practical and where legs are used as cross bar supports they should be recessed into the ribs at switches and at all other locations where clearance is limited, to eliminate derailments knocking out timbers, which usually causes injury to haulage crews, loss of production, and equipment damage. Good clearances should be provided in the vicinity of all track switches, partings, man trip stations, and at other extensive switching locations.

Poorly maintained track and equipment result in frequent derailments, with the resultant exposure to hazards connected with derailments. Mine track should be of sufficient size, well laid and maintained. Steep grades and dips should be eliminated or modified so far as practical. Curves and turnouts should be installed so as to permit safe passage of equipment as reasonable speed. All track switches should be provided with automatic or parallel switch throws located on the clearance side of roadway. Haulage should be well lighted, especially at dips, switches, turns, and other dangerous places. Safety devices such as derails, car stops, and car blocks of safe design should be provided at all needed locations.

In promotion of haulage safety it is imperative that locomotives be provided with good brakes, well protected ample size decks on each end for the operator and the trip rider or snapper, anti-climb bumpers, gongs or signals, and good headlights. Auxiliary equipment should include rerailing devices and a jack on each unit. Mine cars having defective brakes, damaged or projecting broken parts, flat or worn wheels should be immediately taken out of service and repaired. At many mines the transportation equipment is old, having couplings and bumper design that is unfavorable to safety. In such cases safety rules should govern closely hazards involved in the use of the particular equipment.

To safely control movement of trips in avoiding collisions between trips, cars or locomotives, and other equipment, it is necessary that a dispatcher or a signal system that automatically keeps motormen off sections of track where other equipment is operating, be provided. A light or marker should be used on the last car of all trips. Rules governing the size of trips should be made and enforced so that trips can be safely controlled, and also regulations regarding safe distances for following trips or locomotives.

Some of the most common unsafe practices in mine haulage are coupling from the inside of curves, riding on cars being pushed, riding front end of locomotives or other equipment, jumping off in front of moving equipment, and running in front of trips or locomotives to throw

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switches, etc. There are many other hazardous conditions that are not included in this paper which are incident to prevailing natural conditions and types of equipment used which should be fully governed by practical safety rules. The responsibility of preventing and correcting unsafe and improper practices and conditions is vested entirely in management, and favorable accomplishment can be obtained through engineering revision,

instruction and appeal, personnel adjustment, and discipline.

To accomplish a reduction in haulage accidents or general mine safety it is very important that the sincere desire and initiative for improvement to safety originate at top executive of the company, and be reflected down through management and supervisory forces to the rank and file by educational programs and by company sponsored safety meetings. Previous accident experience records should be carefully studied, and investigations made of all accidents to determine the causes so that corrective measures can be applied. No safety program is complete without the adoption of practical safety rules covering unsafe practices and operating procedures. Money carefully spent to advance the cause of safety will be returned many-fold in the saving of human lives, property, through increased production, efficiency and general morale.

(Applause.)

* * *

President Hitt: I don't think this paper will call for a lot of discussion. We all must agree that everything Mr. Chapman has said is true. If someone does want to say anything we will be glad to hear from him. We assure you, Mr. Chapman, that your paper is very much appreciated.

You gentlemen all know probably that there has been a gas hearing in St. Louis. The Mississippi River Fuel Corporation is attempting to increase considerably its facilities for moving gas into St. Louis in

competition with coal.

The Federal Power Commission is holding these meetings. They adjourned yesterday until July 8, but they have been in session now for two weeks. There are some things in connection with the meeting that I think are worth mentioning in passing.

The coal men's end of it was handled by Richard F. Wood, Commissioner of Belleville Fuels, and the Fifth and Ninth Coal Traffic Bureau. Since Mr. Christiansen and Mr. Stadell couldn't be there, he not only represented the above organizations but also the traffic bureaus, represented by Mr. A. J. Christiansen for Northern Illinois and Mr. Stadell for Southern Illinois.

I have a very brief memorandum that I wrote last night after talking with the representative of the National Coal Association—attorney George Horning. They all agreed that this hearing, out of some twenty-six held along similar lines, was the most thorough and the best one. It brought out more information, more real data, than they had ever gotten from the other meetings. For this they give the credit to Dick Wood because he had prepared the data that enabled them to proceed.

They don't expect to win this case here but they do think they have made a good enough case so they can take it into the courts and have the gas expansion stopped here by injunction or in some other manner. This hearing conducted the past two weeks in St. Louis on natural gas, arose out of application by the Mississippi River Fuel Corporation to extend its present facilities by looping its pipeline between the gas fields in Louisiana and St. Louis, so that by increased pressure the present delivery of natural gas to the St. Louis area would be increased from 133,000 mcf per day to 183,000 mcf per day.

This estimated increase in delivery of natural gas, provided the entire increase is used to displace coal, would displace approximately two thousand tons of coal per day. In addition to this displacement, the elimination of the gas-coke plant in St. Louis would cause the loss of about a thousand tons per day Eastern (coking coal) which is being delivered to St. Louis for gas-making purposes.

That doesn't mean an additional pipeline. It means they are going to increase the capacity of the present line by using the methods in vogue for increasing pressure. The application was opposed by several representatives of various coal factors plus gashouse workers, mine workers and railroad unions. The Union Mine Workers were represented by Robert Allison, and the Progressives by C. C. Dremmen. Both of these men were very helpful.

In this case the National Coal Association was represented as stated above, by George Horning, Jr., of Washington, D. C.; Illinois coal was represented by R. F. Wood in behalf of Belleville Fuels, and the Fifth and Ninth Coal Traffic Bureau. Also in the absence of Messrs. Stadell and Christiansen, he represented the Central Illinois Coal Traffic Bureau, the Illinois Coal Traffic Bureau, the Northern Illinois Coal Trade Association and the Middle States Fuels, Inc., so Wood represented the coal interests of the entire state.

After ten days' hearing conducted by the Federal Power Commission, the hearing was adjourned on Thursday evening to Monday, July 8, 1946, at which time the hearing will re-open in St. Louis for the cross examination of thirteen witnesses for the applicant, who were held over

for further interrogation.

During this hearing, coal representatives were able to procure from Mr. Ben C. Comfort of the Mississippi River Fuel Corporation, and from Mr. Robert Otto of the Laclede Gas Company, the astounding admissions that they sold gas to the industrial users in St. Louis and St. Louis Metropolitan area at a price established after determination of coal prices to industrial users and at a point which "undershoots" coal prices.

This was done in order to take business away from the coal companies. In other words, they had never been able to get in these hearings the evidence that the price was based entirely upon the selling price of coal and that their gas rates were based on that factor.

This is the first admission of the kind that coal attorneys have been able to develop in any record of some twenty-five or thirty gas hearings

which have been conducted during the past year.

That is not for the entire gas line but just the increase and also it would displace a thousand tons a day of Eastern coal, coking coal, so we can see what a tremendous factor gas is going to be in competition with us.

It is a thing with which we are confronted more than ever now because of the exorbitant increases in the price of coal. I thought it well to tell you this story because the hearing is very important and it is being well handled by the various interests for account of the coal industry.

The next paper is the "Washing Phase of Coal Preparation." This paper will be read by Ray Bridges, who is a preparation engineer and chemist for the Southwestern Illinois Coal Corporation, of Percy, Illinois.

When you see Ray you will notice his miner's haircut, but I want you to be assured that he is a graduate of the University of Michigan and he acquired that haircut after he began to associate with the miners down in Southern Illinois. Ray Bridges. Ray, I apologize for that allusion to your haircut. (Applause.)

Mr. Ray Bridges (Southwestern Illinois Coal Corporation, Percy, Illinois): I am glad I have hair to cut anyway. Now that we have settled that question about the haircut, I will start in with this paper.

WASHING PHASE OF COAL PREPARATION

By RAY BRIDGES Southwestern Illinois Coal Corp, Percy, Ill.

Coal preparation covers a diverse and interesting field of endeavor, including face preparation, pre-wash treatment, washing, size preparation, dewatering, drying, coal surface preparation, and other subjects

that might be added.

In selecting for a subject, "The Washing Phase of Coal Preparation," I was actually boasting somewhat. My actual experience is limited entirely to work with the Baum type jig and washing of Ill. Nos. 5 and 6 seams of coal. However, at the time it sounded like a good title, so now we're stuck with it.

The Elements of the Washing Phase

The elements of the washing phase of coal preparation are stated as follows:

- 1. The washing machine.
- The washing medium.
 Materials to be washed.
- 4. Forces involved in the washing process.

5. Time.

The Washing Machine

The washing machine concerned in this discussion is the Baum type jig. The distinctive feature of this jig is that the pulsations of water are produced by compressed air, being admitted and exhausted on one side of a U-shaped chamber. On the other side of the U-shaped chamber near the top is a perforated bed plate through which water is forced into the interstices of the solids lying immediately above the bed plate. The second element of the jig is the air valves above each sealed chamber. Their function is to admit and exhaust the compressed air to and from the surface of the water in the sealed chambers, thus producing the pulsations of the water through the bed-plate and the bed of coal-solid particles. The third element is a refuse ejector or gate at the end of each washing compartment which functions to eliminate surplus refuse from the washing compartments. Suitable draws or elevators reach into the bottom of the U to remove the rejected solids from the washing system. The fourth element is an automatic control device in the form of a float immersed in the jig bed. The float is simply a large hydrometer that measures the specific gravity of the solids-coal-water mixture at a selected level in the jig bed. As the specific gravity rises and falls the float rises and falls, thus affording a linkage between the float and some device suitable to actuate the refuse ejectors at the end of its respective washing compartment. When this linkage is properly fixed the float

is a good and faithful servant, maintaining the density stability of the jig within satisfactory limits.

The Washing Medium

The choice of washing medium is more or less fixed once the choice of machine is made. The great majority of washers use a combination of water and solids as a washing medium. Fewer machines use air and solids. Recently we have seen the advent of the heavy media washer where the density of the media is increased to somewhat near the density of the end-point wanted in the solid separation. In this machine the effect of the solids as an integral part of the washing medium is held at a minimum.

Materials To Be Washed

There are two main considerations concerning the materials to be

washed. (a) Density Consist. (b) Size Consist.

(a) Bituminous coal is found to occupy a density range that is rather wide compared to pure materials, yet the range is sufficiently narrow to permit its efficient washing in rather large tonnages. Coal in its purest form and lowest ash content is found at about 1.26 or 1.27 specific gravity, gradually rising in impurity and ash content so that by the time the particles pass 1.60 to 1.65 they are so banded and the ash content so high that they are not included in the marketable product. The average density of Randolph Co., Ill., No. 6 seam coal being delivered to the jigs varies between 1.37 to 1.39, depending somewhat on the moisture content and the amount of high density material being recirculated in the washing circuit. The average density of the washed product is found between 1.34 and 1.36 when reduced to moisture conditions comparable to the feed. The density of the rejected materials varies over a considerably wider range depending upon the type of impurity redominant, average density falling from 1.90 to 2.80.

(b) Size consist is a major factor in gravity concentration. As the average diameter of the particle decreases the surface per unit of mass increases. The specific surface per unit of mass is stated in the following

formula as S_w equals $\frac{6}{pd}$ in which S_w equals surface per unit weight;

p equals the particle density; d equals the particle diameter.

The dynamic behavior of the particle is affected by its fineness in the following manner. It assumes a false density when immersed in liquid. The fact that the apparent density of the particle becomes less as its Surface

 $\frac{\text{Surface}}{\text{Mass}}$ ratio increases is shown by the decrease in the terminal settling

velocities of particle of like true densities but smaller diameters. The increase of surface causes a higher viscosity in the bed of water-solids due to the added surface presenting friction in the intersticial areas. Traexler and his co-workers were led to the conclusion that "viscosities of a given liquid-solid are inversely proportional to the average void diameter of the dispersed solid and the percentage of voids represented by the volume per cent of the liquid present in the mixture."

Another important observation to be made relative to size in considering gravity concentration is that particles of a relationship such as $\frac{d_1}{d_2} = \frac{d_2}{d_1} = \frac{d_1}{d_2}$ cannot be separated in any one constant velocity of current

unless the ratios of their diameters are greater than 4.3 to 1. This fact is readily understood if one studies the lifting velocities of various sizes and shapes of particles over a range of densities. However, further analysis of this problem reveals that the ratios also increase if the density of the medium is increased. If the density of the medium be increased to the density end-point of the solid separation, the size range of the less dense particles that will separate becomes infinite. This principle is used in the laboratory in obtaining float-sink data for preparing washability curves of the coal. This is also the underlying principle of the heavy media washer.

Forces Involved in the Washing Process

The forces involved in gravity concentration are complex and so far I have found no complete set of answers to the many problems involved. There are some general statements that may be made without too much contradiction. For want of a better way of putting it I am going to quote Mr. B. D. Thomas, physicist of Battelle Memorial Inst., "The following types of forces may be distinguished as acting on the particles: (1) The forces of gravity which act on every particle in the system in relation to its mass." This force is designated as mg and is acting downward. "(2) Buoyant forces which arise from force of gravity acting on the fluid." This force is designated as vpg, in which

v, equals the volume of the particle

p, equals the mean density of the bed and

g, equals the force of gravity (32.17 f/sec.)

In direction it is found to be an upward force. "(3) Forces of resistance arising from the relative motion of the particles and the fluid, including forces resulting from interaction with neighboring particles through the medium of the fluid." This force is designated by the letter F, and

is also found upon inspection to be an upward force.

From the statement of the principle classes of forces several other general statements of fact may be made. If we refer to the mixture of the liquid-solid in the jig as the bed, it occupies volume and has mass as a unit and like any other unit which has mass and volume that can be mathematically described we are at liberty to assign a density equal to its mass/volume. It is important to note that this density is true only when the solids and water are at rest and no forces are being exerted. It is also important to notice that this is the lowest density obtained in the washing process. As extraneous forces in the form of intersticial pressures of the washing media are introduced into the bed higher density conditions pursue as particles are suspended in the media.

^{*} d, equals diameter; s, equals specific gravity of the particle; p, equals the specific gravity of the medium.

Let us consider the solids portion of the bed. We find it consists of particles of coal and impurities of various sizes, shapes and varying densities comprising the coal seam. We also find another characteristic of the particles not usually regarded:—that no matter how you pack them together they still contain open spaces in the packing which are variously called voids or interstices.

As the solid particles are placed at random in the washing media they will fall in a manner described by Arcimedes, Newton, Stokes, Rittinger, et. al., until they have either displaced a volume equal to their mass, or until they both have displaced their volume and used up the kinetic energy potential which is theirs due to position and density differential. This kinetic energy potential is absorbed by the washing media and is manifest in the form of turbulence or rising currents of water with pressures equal to the loss of relative density of the surrounding particles. The kinetic energy potential that may be transformed into pressure forces is found by inspection to be the particle density minus the media density. In the case of a particle of unit volume 1, density 1.35 and with the washing media at 1.0 the potential kinetic energy becomes .35 while the 1.0 fraction left to the particle is absorbed in the media in the form of an increased height of the column of liquid due to displacement. The portion of the bed into which this energy-force conversion is confined is the interstices of the solids, which is nominally filled with the washing media. The tendency for all objects to come to rest at a point of lowest potential energy causes an interchange of kinetic energy for position in which the liquid is forced through the interstices with a potential energy of the apparent density of the solid minus the apparent density of the media, until the difference equals 0. This force is dissipated in the form of velocities in the liquid. The magnitude of the velocities depends upon the volume of the interstices compared to the expended portion of the potential of the particles, suspended in the washing media. If the volume of the interstices is large the velocities created will be low; if their volume is small, the velocities will be high.

For maximum size range separation it has been shown that we need to keep the highest density washing medium. We reach this point when the volume of the interstices is at the lowest point that can be reached with a packing composed of the size range being washed. If, when the liquid is forced into the interstices with suitable velocities to bring the particles into a better condition in the bed, we find that we have enough mobility for the coal and refuse to be transported, we have accomplished and end worth while. If the mobility of the bed is too low the volume of the interstices must be increased at the expense of the range of sizes being washed.

Time

Being a constant, the element of time is best reflected in the many variables found in the force-density-velocity relationships, utilized in the gravity concentration of particulate matter. However, the element of time enters directly with those machines where intermittent upward and downward velocities of the media are used. By judicious timing of the pulsion and suction intervals the forces arising from densities and

velocities may be controlled to some extent.

In conclusion I would like to quote Mr. Thomas again. He says, "It may be admitted that theories of gravity concentration are in a somewhat unsatisfactory state. Speculation regarding a single sphere moving slowly in an ocean of infinite extent is unlikely to appeal to an operator who may be faced with a water shortage and who may be impelled to point out that no concentration problem exists if one is dealing with only a single particle. The only reply to this objection is that attempts to understand the principles involved may lead to new improvements in the ancient art."

(Applause.)

. . .

President Hitt: Mr. Bridges' comback after my vulgar reference to his haircut when he retaliated with a vulgar reference to our bald heads convinces me that while his knees may have been knocking together as he admitted, his head didn't cease to work. Then, too, it brought from Mr. Schonthal the suggestion that the snappy comeback of his might mean that he is either a relative of Senator Styles Bridges or of Harry Bridges. (Laughter.)

Now that was a fine talk, gentlemen. It was technical necessarily and it seems to me it should bring some discussion or suggestions from you gentlemen here who are washing coal; or, at least, some questions that you may want to ask Mr. Bridges that have not been covered by his paper.

Mr. Edwin H. Johnson (Republic Steel Corporation, Cleveland, Ohio): I would like to ask Mr. Bridges one question: I would like to ask whether this heavy media has been used successfully in washing coal in the bomb jig?

Mr. Ray Bridges: I am afraid I might have given the wrong impression. Water and solids are the only thing I know of that you use in the bomb type jigs. However, the density in a bomb type jig is higher than you normally expect from the relative amounts of water and solids that are in there.

The point I tried to make was the rising currents of the water have a tendency to increase the velocity. It is not like the heavy media wash. The heavy media wash is a wash in which commercial preparations of heavy density liquids are put into a box and the coal is separated on the heavy medium, heavy liquid medium. Do you see what I mean?

President Hitt: I sell the coal that Bridges produces. I am either convinced that he has a good washer or that he can operate any washer successfully because he does a good job. Does anyone else have any remarks to make or any questions to ask. Is that all? Thank you, Mr. Bridges, for your fine paper. (Applause.)

I should have stated in the beginning that in the effort to streamline this meeting we didn't call the roll, but it is right on the wall out here back of the office. There is a list there of those present and anyone can

examine that and pick out the fellow they want to meet.

That was done in order to save time. I should have announced, too, that our fall meeting is to be at the Abraham Lincoln Hotel, Springfield, Illinois, on November 15. At last year's meeting we had six hundred registrations, which was a record. It was the biggest we ever had and we are hopeful that we can do at least that well this fall.

You will have an announcement in due time of this meeting but I am just telling you now so you will know this far in advance. On the next day, Saturday, November 16, Ohio State plays football with Illinois at Urbana. That is on Saturday following the meeting and as heretofore tickets for that football game will be available upon application from you to the University of Illinois.

Mr. J. A. Jefferis (Illinois Terminal Railroad Company, St. Louis, Missouri): I understand the committee for entertainment is sort of working or is already working on that and anyone who misses that meeting is going to miss one of the best they have had for many years.

President Hitt: We are attempting to prepare a good program. We

have an outstanding speaker for the meeting.

Now the next paper was written, as I explained a little while ago, by James Hyslop, vice president in charge of operations for the Hanna Coal Company. This paper was read before the annual meeting of the American Institute of Mining and Metallurgical Engineers at Chicago, Illinois, on February 20, 1946.

Jim couldn't be here today. I read this paper for the first time this morning and I enjoyed it. I don't know whether or not you will enjoy it when I read it to you, but I am sure you would enjoy it if Jim were

here to read it himself, which he would have liked to do.

It is not very long and to me it was very interesting. His subject, as I think I told you, is "Psychological Factors Affecting Mechanized Mining Efficiency."

(President Joseph E. Hitt then read the paper prepared for presentation by Mr. James Hyslop, Vice-President in Charge of Operations, Hanna Coal Company, entitled, "Psychological Factors Affecting Mechanized Mining Efficiency.")

(A paper read before the annual meeting of the American Institute of Mining and Metallurgical Engineers at Chicago, Ill., February 20, 1946)

PSYCHOLOGICAL FACTORS AFFECTING MECHANIZED MINING EFFICIENCY

By JAMES HYSLOP

Vice-President in Charge of Operations, Hanna Coal Company St. Clairsville, Ohio

Mechanization of American coal mining has made, as is still making, rapid progress. No one needs to waste time stating its merits. Economic pressure will compel the abandonment of manual methods in coal production wherever mechanization is physically possible. Economic pressure will also provide the incentive needed to insure progress in the improvement of machines and mining systems. I submit, however, that it is entirely possible to make very rapid progress along strictly technological lines and at the same time to make much slower progress in approaching maximum productivity and efficiency. As a background for what I have to say, I wish to raise the question — how efficient are our mechanized mines, and to what extent is productivity affected by the

mental attitude of management and workers?

The output of any piece of mining equipment is controlled by psychological factors. The work attitude of the machine operator and the other workmen; the state of mind of the foreman and the intelligence and disposition of top management all affect production. The question is -how much? Each instance, of course, requires its own answer. In every case, however, the answer is obtainable. If the answers are not obtained and if the psychological problem is ignored, it is very likely that technical studies and mechanical alterations will fail to produce results. The machinery salesman may suggest that by discarding your present equipment and installing his machine, you can solve your production worries. Sometimes his solution works - often it doesn't. In the successful instances not infrequently the improvement is the result of an accidental correction of some psychological factor simultaneously with the change in equipment. I am all for more and better machinery, but I have been disappointed often enough to make me careful to avoid over-simplification of my problems by attempting to reduce them all to to mechanical terms.

In the manufacturing industries the effect of work attitude on production is widely recognized. Some manufacturers have made outstanding progress as a result of giving very special attention to psychological factors in production. These factors have a more marked effect on the productivity of a mechanized coal mine than the do in most manufacturing industries. This is largely the result of the fact that mechanized mining does not consist of a mere routine of pushing buttons and pulling

levers. A printing press or an automatic screw machine practically does its own thinking. Very few mining machines have this capacity built into them. Constant alertness and initiative on the part of the operator is required at all times. He must be able and willing to adapt himself to a set of unpredictable conditions. His productivity depends, for the most part, upon his skill and work attitude. If he feels that he is producing too much coal, and that he is, therefore, working himself out of a job; if he thinks the Company is making too much money; if he dislikes his foreman; if his wife happened to spend three days' wages for a new hat the day before - he may have a "what's the use" attitude, resulting in a voluntary or involuntary slow down. On some jobs, such as loading machine operator, the attitude of the workman influences. not only his own output, but also has a substantial effect on the men in various other related jobs. This situation is what makes it so easy for the slow-down to become chronic. On many jobs in the mine the worker's thinking may influence his productivity 50% or more. In support of this statement, the following examples are cited:

Time studies prove that the modern mounted coal cutter has more than twice the cutting capacity of the conventional shortwall machine. It is quite common to find that when shortwalls are discarded in favor of mounted machines that two men, with a fancy cutter costing three times as much as their old shortwall, actually cut less coal - why? usually because at the time the change in equipment was made the two machine men changed from piece work to hourly rates. On the other hand I have experienced instances where two men with an old time shortwall, consistently got the maximum output from the machine while working under hourly rates. In this case they produced efficiently simply because someone was smart enough to make them want to do so. In many mines one of the production bottlenecks is drilling. I have seen one man, with a post-mounted electric drill consistently average seventyfive holes per shift without over-exerting himself. I have seen mines in similar conditions, with two men operating the same type of machine, average less than sixty holes per shift - why didn't they drill more? - they didn't want to. I have seen a mine where the section tracklayers averaged laying three 40-lb. switches each, per seven-hour day, again without any undue exertion. I have seen other instances where it was very difficult to get a tracklayer, under similar conditions, to lay one 40-lb. switch in one eight-hour shift, as a matter of fact, it has been demonstrated that a good tracklayer, by exerting himself, can lay such a switch in one hour. Similar instances could be multiplied but these will serve to illustrate the point. It might be suggested that such differences in worker efficiency resulted from the varying amounts of pressure applied by management to force the workmen to speed up. In none of the instances cited were the results obtained by slave-driving methods. Everyone responsible for mine output today knows that the hard taskmaster method does not produce results. Today high worker efficiency is accompanied by a cheerful friendly attitude on the part of both the worker and management; whereas low efficiency is usually accompanied by poor morale and bitter quarrelsome relations all around.

It is evident that responsibility and initiative in the field of worker efficiency must lie with mine management. Only by recognition of this fact and by careful factual analysis in each individual case can success be achieved. I will attempt here to outline some of the general problems that must be faced in any attempt to improve the ability of a management organization to influence the work attitude of the mine worker:

First, it is necessary for management to know accurately the maximum potentialities of men and machines. This information is not always easy to obtain. I am not a golfer, but I presume that one of the first things I would want to know in approaching a strange course would be the established par score. Likewise, the establishment of par production performance in mine operation is a good way to approach the problem of production efficiency. If conceptions about this par figure have been allowed to develop accidently there is likely to be a very great error in the accepted figure — for example: — At one particular property it was generally believed that 400 tons in one shift from a loading machine represented peak performance - subsequently production of over 1100 tons was obtained on a series of test runs. This is not an unusually great error in popular conceptions about mine performance. The proper initial approach to the establishment of par performance for most operations is the intelligent application of careful time studies. Accurate time studies are not easy to get, nor is it easy to accurately interpret them, but both of these things must be done as a preliminary step to the achievement of efficient production. The principal value of such information once obtained, is psychological. Mine Management has no hope of success until it knows of what success consists. If people believe implicitly that they can do something - they usually can. Once top management becomes aware of the potentialities of the job, the next step is to effectively and convincingly establish this information in the minds of the supervisory personnel. Here again, this is usually no easy or simple task, but it can be done in every case and it must be done before results can come. As soon as possible, and by whatever means necessary, the accuracy of the theory being developed should be demonstrated. If time studies show that a machine can produce 150 tons per hour, the machine should be made to produce this amount at whatever cost and by whatever means.

Second, the will to produce must be developed within management personnel. This attitude of mind should be a permeating enthusiasm throughout the whole management organization. I am afraid it can never be produced by suspending a threat over each supervisor that he will lose his job, or be otherwise penalized, in the event he fails to produce. This is a weapon which may, of course, be used on proper occasion, but if it is relied upon as the primary incentive, it becomes a boomerang tending to destroy sound relationships throughout an organization. The foreman should be made to realize that he is the guardian of productivity and should be taught to regard this responsibility as a sacred trust. This calls for some study of sound economic principles and the discussion of such principles should have a place in the business of every mine management organization. Surprisingly few people have ever taken time

to think about such things, much less to study them carefully. The average American foreman is sufficiently intelligent and honest to appreciate these ideas and to absorb them if they are properly presented. It seems to me that the whole problem of industrial psychology must rest upon a foundation of the understanding of a few basic economic facts. There is now, in all quarters, a greater awareness of the importance of productivity in modern life than ever before. The part American production played in the war has awakened the entire world to the outstanding achievements made by American industry. It has also awakened our own public to some realization of the fact that the foundation of what we call "prosperity" is industrial productivity. We are all excited by the economic confusion over wages, profits and social systems, but underneath all this we possess a fundamental realization of the unrivaled importance of productive efficiency. The American economic and industrial system has provided the incentive and the means for making the most of the expenditure of human energy applied to industrial production. Immigrant workers from any other land multiply their productivity and lessen the physical exertion they are accustomed to when they take a job in the United States. A Welsh, or Scotch coal miner increases his usefulness about five times when he accepts a job in one of our coal mines. We are justly proud of these achievements, we are aware as never before, of their importance. If industrial management fails to capitalize on this favorable trend in public thinking, it will be guilty of a serious breach of duty — it will have failed to utilize a tool which might have been used to great advantage in the carrying out of its responsibilities. Every member of a management organization should be characterized by a philosophy based upon an awareness of these simple economic facts.

Third, every member of management should be made to realize his obligation to ownership. He should understand that ownership has entrusted to him the operation of its business and its hope for profits; furthermore, that his own personal prosperity depends upon the success of the business. These things seem so simple as to hardly require stating in a discussion of this kind. I am convinced, however, that we take entirely too much for granted about the thinking of the average foreman. It is unlikely that he will get these ideas straight in his mind and adopt the proper mental attitude unless somebody takes time to present them

Fourth, we Americans believe in the profit motive — we know it to be an effective means of establishing the will to produce. Every member of management has a right to expect that achievement on his part will be rewarded by an increase in his compensation. It is my belief that a Company policy, assuring him that such recognition of his achievements will be forthcoming, should be stated emphatically to him and should, of course, be carried out promptly when results have been achieved. In connection with this point, it is highly desirable that the foreman should have a clear understanding of the Company's financial position. He should be informed regarding costs, profits, competition, and general business prospects. An understanding of these things will teach him how vital he is to the successful operation of the business. It will help to keep his thinking straight.

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Fifth, work attitude within a management organization requires more than the understanding of certain theories and principles. The delicate balance of human relationships does not maintain its equilibrium without special effort on the part of someone, and general cooperation by everyone. No management is on safe ground unless the superior officials have the respect and liking of their subordinates and unless the subordinates have the trust and confidence and moral support of their superiors. This is too large a field to attempt to discuss in detail here. All sorts of excellent printed information on the subject is available. Any management organization that fails to make use of this information will fall short of its true possibilities.

Sixth, the eye must be kept on the ball. It is very easy to permit the diversion of attention from productivity to other problems. Good housekeeping is extremely important, but it is possible to make a fetish of it and to have everything in order to a nicety and at the same time experience low production performance. On the other hand, in almost every case high productivity is accompanied by good housekeeping. Safety is of extreme importance. It is possible, however, to allow safety programs, incentives, and awards to be over-emphasized and thereby divert attention from production. Here again good production performance is almost invariably accompanied by an excellent safety record. One of the tricks of those who oppose high production is to suggest that it is obtained by a speed-up system that maims and kills men. Bad management will produce accidents in any case. It takes good management to get production and a management organization capable of making a mine produce is always capable of making it safe and as suggesed above in most instances the measures taken to produce efficiency will simultaneously reduce accidents.

When management has produced within itself the proper concepts and attitude, the psychological problem is only half solved. It is the attitude of the workman that finally determines the degree of success to be achieved. The second half of the job, however, is usually much easier to accomplish. Nothing is more infectious than enthusiastic sincerity. If the management organization has indeed become enthusiastic about its job, this spirit will be caught by the workmen. This does not mean that high productivity will not be opposed by certain individuals, but if management makes a determined and intelligent effort, the influence of the opposition can be effectively neutralized. The ideas behind the attitude of management are so fundamentally sound and so understandable that it is possible to transmit them to the workmen.

If the thinking of the workmen is to be favorably influenced this must be done by the workmen's immediate superior. The section foreman and other final representatives of management must perform the task of morale building amongst the men. If these foremen are incapable of doing this, they are incompetent for their jobs. Here the leadership ability of the foreman is of primary importance. If he is truly a leader, his influence will guide the thinking of his men as well as their physical activities.

The foreman must sell himself, and his Company, to his men; he must win their loyalty; he must know how to obtain their active cooperation, at the same time maintaining their respect.

The coal miner is characterized by a very strong sense of pride in his work. This trait should be encouraged as it will prove a powerful influence toward increasing productivity. Friendly production rivalry among workmen can also be used to great advantage.

I am not going to make any effort here to cover fully the relations between the supervisor and the workman. Much has been written on the subject, abundant printed help is available. My primary purpose is to emphasize the relation of the mental attitude of management to the psychology of the worker. The miner is highly susceptible to the influence of the foreman, he is going to be influenced one way or the other. If the thinking of management is straight, if its convictions are clear and strong, a response will manifest itself among the workmen. The character of this response will be much more desirable than anything that can be produced by paternalistic social betterment schemes, or attempts to play "wet nurse" to the miner by interfering in his personal and family affairs. The worker resents this type of approach as he does not fail to sense that it has a detrimental effect on his self respect.

In the coal industry, prior to the advent of mechanization, we relied upon piece-work rates to provide the incentive for a large part of the production personnel. That this incentive didn't work very well is evinced by the fact that worker productivity reached a static level, or tended to decline. Wage incentive rates always have a tendency to associate themselves with low production rather than high production. This is particularly true in the mining industry due to the nature of the work which is characterized by factors affecting production that are altogether beyond the control of either management or labor. In hand mining, tonnage rates were elevated to protect the income of the miner working under handicap of adverse natural conditions. In this way the whole hand loading industry has become penalized by excessive tonnage rates. I am opposed to piece work or worker bonus incentives of any kind in mechanized mining because I am sure that it would have the same effect there. Unquestionably piece work rates are a powerful incentive, and in some industries where they can be effectively designed and controlled, they greatly simplify the production problem. It is regrettable that they cannot be used more effectively in our industry. I am convinced that the only guarantee of worker efficiency and consistent progress in productivity in mechanized mining lies in the ability of the supervisor to develop work enthusiasm among his men.

Another pitfall on the road to efficiency lies in the temptation to permit machines to be operated far below their potential capacity. It is sometimes argued that it is more economical to operate machines at low capacities in order to integrate their performance with other operations in the production cycle. The economies imagined are usually fictitious, but even if they were real, the demoralizing effect of permitting low productivity from any unit usually offsets any other advantages.

If worker psychology has such a marked effect on productivity, it follows that progress in mechanization will be greatly retarded by any failure to recognize this factor. The merits of any piece of machinery, any method of procedure, or any system of operation cannot be measured unless real efficiency is first established. It follows, therefore, that selection of equipment and methods will be on a haphazard basis where proper standards of productivity have not been developed.

In conclusion let me attempt to brief the answer to the question I raised at the beginning, by saying that our mechanized mines are not as efficient as they would be if we could gain the whole-hearted cooperation of the workmen and such cooperation can be obtained when management produces within itself the proper mental approach to its job. High productivity has its origin in ideas - it must begin in the imagination of alert minds.

(Applause.)

President Hitt: I might say, gentlemen, that Jim operated a mine over in Indiana for my company. It is Number 3 coal. It has miserable top

conditions and he made a very fine record there.

As a result of that fine record we couldn't keep him. He is now general vice president of the Hanna Coal Company and that rather speaks for his own theories of what should be done. I think it was a fine paper. At least I enjoyed it. I think that you, Mr. Schonthal, should write to Jim and tell him, at least, the chairman appreciated his paper. I guess we all did.

Mr. H. H. Taylor, Jr. (Franklin County Coal Corporation, Chicago, Illinois): I wouldn't want to close discussion on the paper without adding my comment to yours. I think it was an exceptionally fine paper. I think that Mr. Hyslop should be told we consider it to be a fine paper.

I think he put his finger on one of the most important problems of the day, because wage rates being at their present levels, we are going

to have to justify them by increasing our productivity.

I think his paper was very much to the point. It is the biggest problem we have ahead of us at the moment.

President Hitt: I am very sorry he could not have been here because he would have impresed you very much. He is a great fellow. Are there any other remarks about the paper?

Mr. Leslie S. Voltz (Peabody Coal Company, Chicago, Illinois): I would like to ask Mr. Taylor how he expects to go about getting that kind of cooperation. I think that after all you have to approach it from a realistic standpoint. It is a beautiful theory.

I admit that the theory is swell but I just wonder how many among the operating men here would stand up and say they could apply that

in their own operations?

President Hitt: I would say in reply that he would have to be a real operating man. I do say that in my opinion, based upon my own knowledge of what he did in Indiana, Jim Hyslop did apply it. He got the

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lowest cost of any large mine in Indiana and he had poor operating-conditions.

That mine was built for a capacity of about four thousand tons. When he left there he was getting an output greater than the expected capacity of the mine, so Jim did have something. How much of this he applied, I don't know but I am sure he applied a lot.

Mr. H. H. Taylor, Jr.: Inasmuch as Mr. Voltz mentioned my name, I don't know the complete answer but I think he is on the right track. I think it is being applied obviously because any of you who are acquainted with the various mechanics of the state know some of them are doing far more than others.

There is only one reason for it. The machines are the same and the conditions are the same so management must have something to do with it. I think it is being applied now but my point is that it is our greatest problem and we are just going to have to do better. How it will be

achieved is a question for the individual.

President Hitt: When you have two mines in the same field that are under practically the same operating conditions, of about the same capacity, and you know that one of them is making a better showing than the other mine, why, it is almost self-evident that management must have been a factor in that. Were you going to say something, Mr. Lewis?

Mr. Howard Lewis (Old Ben Coal Corporation, West Frankfort, Illinois): I think this is a wonderful paper and prepared obviously by a wonderful man. I don't know him but I was just going to say what you said, that in every field or district in the state, the conditions of management have been practically the same.

The same problems and the same difficulties have arisen from the attitude of labor in this area. You will see one mine making an enviable record of production and the neighboring mine, in the same field, in the same locality, will have its production at a minimum level. For that

reason, obviously there must be something to his argument.

President Hitt: I think you are quite right. Is there anyone else? I would like to hear from some more fellows because we are going to pass this on to Jim and tell him how much his paper is appreciated.

Mr. R. R. Richart (McGraw-Hill (Coal Age), New York City, New York): I want to say this much, that the theory is working. About a week ago I was privileged to visit Hanna Coal Co. Piney Fork Number 1 Mine, one of their deep operations and a good one. As you walk about the mine inside and out you sense a special spirit. It is really paying off.

President Hitt: Thank you. Anybody else? If that is all we will proceed. That concludes, fellows, the set program but I think you will all agree with me that this meeting would not be an entire success if we didn't call upon Dean Thompson to say a few words to us.

While we are waiting for Dean Thompson, we certainly can't neglect dear old Bill Jenkins, the dean of us all. (Applause.) Dean Thompson,

there has been a clamor for you in your absence. Come up to the front and center, please.

Dean Charles M. Thompson (Northern Illinois Coal Corporation, Champaign, Illinois): That "front and center" reminds me of an army experience I had down in Cuba. It was the most lonely place I have ever seen. We had a fellow in our company who had a sort of wabble gait. If you could have seen him walk you would have known why they called him "Wabble-gait."

I was corporal of the guard. I want to say very proudly that after much drilling, I became a corporal and I had grand ambitions to be a sergeant. Now I wouldn't be a general; there are so many of them. It was four o'clock one morning and the guard had begun to call off the stations—"Station One, four o'clock and all is well," and so on down

the line.

Wabble-gait was at Station Number Ten. His call was "Station Ten, four o'clock, mosquito and gallinippers—front and center, march."

I doubt that I have anything worth while to say except this: I may be a confirmed optimist but, like the rest of you, I suppose I have watched what is going on for a great many years. There have been times recently when I have become greatly discouraged, but still I believe in America.

I am not going to sell America short. I think the American people are confirmed in their opinion that free enterprise is what has made us great, and I don't believe that all the ideologies imported from Europe and all the "isms" that we get from there; I don't believe they are going

to change the structure of our economic society.

I believe that so firmly that everything I have is on that color. There is no doubt about the future in the coal business. You are all interested in coal, and so am I. I have a feeling on that, a conviction in fact, and I am betting my money on it, that we haven't seen this country yet at its best, nor have we seen in this country the enterprise that we are going to see in the next few years.

I am not basing that upon any pent-up purchasing power that we talk so much about. I am basing that upon the natural development of the ingenuity of the American people. There is no such thing as saturation of demand. It is utterly impossible even to conceive of economic wants ever being saturated. They may be on individual things, but as

a whole there can be no saturation of demand.

It is up to us in management — I like to put myself in that group — and it is up to us to see to it that America grows into what it should grow into and will grow into if we keep our chins up and keep optimistic.

I will never forget; I think it was when Garfield was shot, the late President McKinley was in San Francisco at the time and when it was announced he said, "The president is dead but the government still

lives." That was in September of 1881.

So I think the American idea and concept of free enterprise, competition, the government giving every man a chance and seeing that he gets a fair chance to take the decision as it comes, dependent upon his own efforts, largely is going to survive and it should be the guiding principle of the coal men as well as other investors in the country.

That is my feeling. Take it for what it is worth. You may decide that I am just a tired old college professor who lets sentiment get ahead of himself and ahead of his judgment. I don't think that is true. I think

I face this realistically.

I believe every word I have said. When we meet again next year I am sure we are going to find the atmosphere greatly cleared on a good many of the problems we have seen as so involved today. Let us go ahead resolutely together. Let us be good Americans and all go down, if we must, but let's go down fighting. (Applause.)

President Hitt: Thank you, Dean Thompson. We hope that you will be on this boat with us next year and the following years and for many years thereafter.

Now here is Mr. Jenkins. They have been clamoring for you for ten

minutes.

Mr. W. J. Jenkins (Consolidated Coal Company, St. Louis, Missouri): What for?

President Hitt: You are on the program to make a little talk right now.

Mr. W. J. Jenkins: I don't know. You know sometimes people are taken advantage of. I didn't know I was on the program. If I had I might have had something of interest but not knowing that, I don't think I could add a word to what you have already said. With that I think we will let it go. (Applause.)

President Hitt: I think it is entirely appropriate now to hear a few words from Professor Walker about the coming coal conference.

Professor Harold L. Walker (College of Engineering, University of Illinois, Urbana, Illinois):

I wish to make only one announcement. The Department of Mining and Metallurgical Engineering will sponsor the Eighth Conference in Coal Utilization, September 17, 18, 19, on the campus at the University. We have arranged an excellent program with excellent speakers. The general theme of the program will be the utilization of coal rather than operation of coal mines. Individual sessions will be devoted to Recent Developments in Coal Utilization, Coal Storage and Handling, Merchandising, Improving Heating Results, Heating the New Homes, and Stoker Coals.

I believe there will be something of interest for a large number of members of this Institute and we shall be glad to have you come up and attend the conference. The final program will be published soon and a copy will be mailed to each member of the Institute. We hope to have the new President of the University, Doctor George Dinsmore Stoddard, as our principal speaker at the evening banquet.

President Hitt: Thank you, Professor. I am not going to ask the next fellow to make a speech. We don't want to embarrass him, but I think we ought to have Fred Weissenborn stand up and let's give him a hand.

(Mr. Fred E. Weissenborn of the Illinois Coal Operators Association, St. Louis, Missouri, acknowledged the applause.)

President Hitt: We have run out of material, fellows. I think we have made this meeting snappy and we are all on our own from now until tomorrow morning at eight o'clock when we will eat breakfast on the boat and go our respective ways.

I hope we will all meet again on November 15, at Springfield. The

meeting is adjourned.

(The meeting adjourned at 12:15 o'clock.)

PROCEEDINGS OF ILLINOIS MINING INSTITUTE FIFTY-FOURTH ANNUAL MEETING

Held in Springfield, Illinois FRIDAY, NOVEMBER 15, 1946

MORNING SESSION 10 O'clock A. M.

The opening session of the Fifty-Fourth Annual meeting of the Illinois Mining Institute, convened in the Ballroom, Abraham Lincoln Hotel, Springfield, Illinois, at 10:00 o'clock, President Joseph E. Hitt, St. Louis, Missouri, presiding.

President Hitt: Gentlemen, will those in the rear please come to the front and occupy the near seats. The meeting will please come to order. If it is your wish, I would like to entertain a motion that the minutes of our last meeting be approved without reading. What is your pleasure?

Mr. J. A. Jefferis (Illinois Terminal Railroad System, St. Louis, Missouri): I move that the reading of the minutes of the previous meeting be dispensed with.

Mr. F. A. Chapman (The Ohio Oil Co., Robinson, Illinois): I second the motion.

President Hitt: It has been moved and seconded to dispense with the reading of the minutes. Unless there is objection from the floor, and

without a vote, it is so ordered.

This, fellows, is the fifty-fourth anniversary of the organization of the Illinois Mining Institute and it is a great pleasure on my part to be your presiding officer this year. I am not going to make a speech as it is customary to do, but I am very happy today and I am sure that if I start this program at once you will all be very happy, so let's all be happy and eliminate anything I might have to say. I will save that for tonight.

The first order of business is the reading of the committee reports. Is the chairman of the Scholarship Committee in the room? Professor Harold L. Walker, of the Department of Mining and Metallurgical Engineering, Urbana, Illinois, is the chairman of that committee and will

make the report.

REPORT OF SCHOLARSHIP COMMITTEE

Professor Harold L. Walker (Department of Mining and Metallurgical Engineering, Urbana, Illinois): Mr. President and members of

the Illinois Mining Institute, there are now on the campus two scholarship holders of the Mining Institute scholarship and also for the Peabody.

Both of those young men are here today. I might ask them to stand up — Bob Morris and Bob Stephens. (Applause.) Later on Mr. B. E. Schonthal, our Secretary, has a rather interesting letter to read from a prior scholarship holder, Mr. Marion Walls.

So far as this goes, that is the only report I have to make this morning concerning these two boys that are currently on the campus. (Applause.)

President Hitt: We would like to suggest again that the fellows way back in the other room should come up here. There is a lot of room up here in the front and we will get along a little better if we are closer together.

We will now have our Secretary's report.

SECRETARY'S REPORT

The activities of our organization have gone along without much fanfare during the past year.

We were very happy, of course, to have our boat trip reinstated this year. After many changes because of rulings handed down by government agencies, limiting the number of people that we could have on board, we wound up with slightly under one hundred in attendance. Everyone had a very good time and was happy to have the boat trips resumed. We look forward to a good trip again next year.

At this time I might add that the government has issued strict instructions that the capacity of the boat must be limited to the actual number of beds available for passengers. This will be about 103. We may have to ask our regular attendants to restrict the number representing each company, so as to accommodate as many as possible without "ganging up," so to speak. This will be taken care of at a later date.

Our membership at the present time is 1,054, all in good standing. You will be interested to know that during the year we secured seventeen new Life Members.

Our financial position remains good. We have on hand bonds in the amount of \$10,000.00 and cash in the amount of \$1,165.49.

In spite of rising costs, we are following the plan started several years ago of giving a complimentary dinner to our registered members at the annual meeting. We find this has proved quite satisfactory to all concerned.

We have had the misfortune to lose ten members by death during the past year. Included among these was our last living charter member, who was elected an Honorary Member at the time of reorganization — John F. Goalby. Also included were three Life Members and one member who had served in the armed forces.

In the next year we are hopeful of resuming activities in our scholarship work. As you know, this was temporarily discontinued because of inability to secure students during the war. It has been quite helpful to the secretary and his office to have the cooperation of the members, committees, and officers during the past year.

Respectfully submitted,

B. E. SCHONTHAL, Secretary-Treasurer

. . .

Secretary Schonthal: Mr. President, I move the adoption of the report.

Mr. Frank Eubanks (Old Ben Coal Corporation, West Frankfort, Illinois): I second the motion.

President Hitt: Gentlemen, you have heard the motion for the adoption of the Secretary's report. Is there any discussion? If not, those in favor signify by saying, "Aye." Opposed. The motion is carried unanimously and it is so ordered.

Secretary Schonthal: Professor Walker made reference to a letter I have here from Marion Walls, who was graduated from the University a few years ago. Many of you will remember that he was married while he was in school. Then when his wife's health failed he had to move to Arizona where he took a job with either the Miami Copper Company or the Globe Copper Company, I don't recall.

Last year, you will recall, we received from Mr. Walls a remittance of a hundred dollars. He returned to the Institute a hundred dollars of the scholarship money that we gave him. He felt that it should be put back into the scholarship fund, which it has been, and used to further

the scholarship cause.

We all, of course, thought it was a fine gesture. He is now making a further remittance and I would like to read his letter to you. He is enclosing two hundred dollars with this letter. I think it was a wonderful letter and a wonderful gesture on his part.

Mr. B. E. Schonthal, Secy. Illinois Mining Institute Chicago, Illinois

Dear Mr. Schonthal:

I received the program of your coming meeting and notice that it gives promise of being on an equal to your usual high standards. I would enjoy being there but instead must send my best wishes. I've been reading the Proceedings of the 1945 meeting and have enjoyed the papers that were presented.

Enclosed with this letter are my dues for the coming year and also two hundred (\$200.00) dollars payment on the scholar-

ship. I hope to send the remaining \$100.00 soon.

Yours truly,

Marion B. Walls

Box 1823 Globe, Ariz.

Nov. 4, 1946

Our Advertisers are our friends and fellow members. Consult them frequently.

We have a number of wires and letters of regrets from members that weren't able to be here, but I will not take up your time right now to read them. However, they will all be acknowledged in the name of the Mining Institute.

President Hitt: The next order of business is the report of the Nominating Committee. I have the written report and will read it.

REPORT OF NOMINATING COMMITTEE

"To the Officers and Members of The Illinois Mining Institute, 28 East Jackson Blvd., Chicago 4, Illinois.

"Gentlemen:

Your Committee on Nominations has given serious consideration to the question of officers for the coming year. We have the following recommendations to make to the members:

President: R. M. Medill
Vice-President: H. M. Moses
Secretary-Treasurer: B. E. Schonthal
Executive Board: T. J. Thomas
Richard Baldwin
Harold Truax
L. A. Wasson

Respectfully submitted by the Nominating Committee, Paul Weir, Chairman; George F. Campbell; F. S. Pfahler."

Mr. Peter Joyce (Illinois Coal Operators Association, Springfield, Illinois): I move that the report of the committee be adopted, and, if there are no further nominations, that the nominations be closed and that the Secretary be instructed to east the unanimous ballot of this body for those nominated for their respective offices.

Mr. J. A. Jefferis: I second the motion.

President Hitt: Gentlemen, you have heard the motion which was duly seconded. Is there any discussion? Those in favor of adopting the report of the Nominating Committee and instructing the Secretary to cast the unanimous ballot for those named, signify by saying, "Aye." Contrary. The motion is carried and it is so ordered.

Secretary Schonthal: I herewith cast the unanimous ballot for the election of those named by the Nominating Committee for their respective offices.

President Hitt: We will dispense with the customary speeches from the newly elected officers, but will hear them tonight. We will now pro-

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ceed with the program of the morning. I am going to suggest that Professor Harold L. Walker, of the Department of Mining and Metallurgical Engineering at the University of Illinois, conduct the meeting until the noon recess. Professor Walker.

Chairman Walker: The first paper on the morning's program is entitled, "Procedures of the Bureau of Mines Under the Coal Mine Safety Code." That paper was scheduled under the name of M. J. Ankeny, Mining Engineer and Coal Mine Inspector, U. S. Bureau of Mines, Mount Hope, West Virginia. It will be read by Mr. Alex Miller, Mount Hope Station, West Virginia. He is also connected with the Bureau of Mines.

Mr. Miller, will you please come to the microphone and present this paper.

Mr. Alex Miller: Mr. President, Chairman Walker, Secretary Schonthal, and members of the Illinois Mining Institute, I appreciate very much the opportunity of attending the meeting once more. It has been a long while since I have been here.

¹Presented by permission of the Director, Bureau of Mines, U. S. Department of the Interior.

PROCEDURES OF THE BUREAU OF MINES UNDER THE FEDERAL MINE SAFETY CODE FOR BITU-MINOUS-COAL AND LIGNITE MINES OF THE UNITED STATES

By M. J. ANKENY

Coal Mine Inspector, U. S. Bureau of Mines Mt. Hope, West Va.

Following the temporary seizure of a large portion of the bituminous coal-mining industry of the United States by the Federal Government under authority of an Executive Order of the President dated May 21, 1946, the Secretary of the Interior, acting as Coal Mines Administrator, entered into an agreement with the United Mine Workers of America. The terms of this agreement contained certain provisions designed to improve safety conditions and practices in the mines involved; the execution of these provisions represented a new departure in safety work in coal-mining.

This new concept of the promotion of safety in coal mining might well be regarded as "safety regulation by contract" and is intended to supplement safety regulations by State statute, which has been the sole regulatory procedure in this country almost since the beginning of coal mining. It calls for the issuance of a reasonable code of standards and rules flexible enough to be applicable to all the coal-mining conditions encountered in the United States and for the inspection of mines by coalmine inspectors of the Federal Government for the purpose of finding and reporting upon lack of compliance with the code; it places upon management as well as workers a definite responsibility to comply with the code. It authorizes safety committees of miners to inspect mines and to report unsafe conditions to the management, thus placing upon labor some of the responsibility for safety which was formerly held to be chiefly that of management. It authorizes safety committees to recommend to the management the removal of workmen from places of imminent danger and requires the management to carry out such reasonable recommendations as the committee may suggest.

Many believe that this new procedure in safety promotion, in which the employees are given a substantial part of the authority and responsibility, if kept rational in its operations, should raise the general level of safety conditions in mines throughout the United States and that a widespread reduction in the fatality and injury rates should result.

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The agreement provides that the Director of the Federal Bureau of Mines, after consultation with representatives of the United Mine Workers of America and such other persons as he may deem appropriate, issue a reasonable code of standards and rules pertaining to safety conditions and practices in the mines.

The United States Government seized the mines because of a national emergency resulting from the coal strike, which threatened to paralyze industry and commerce and halt post-war reconversion. With the mines under Government seizure, the primary responsibility of the Coal Mines Administrator was to maintain the output of coal at a high level of production. His obligation under the agreement, on the other hand, was to put a reasonable safety code into effect. It was imperative, therefore, that the code be designed to obtain a maximum of safety without jeopardizing the production of coal. The preparation of a code, which had to be reasonable and practicable, of necessity took into account the diversified natural conditions under which coal mining is done, and allowance had to be made for time in the conversion of procedures and equipment to conform to the standards set by the code. While the requirements of the code are not as severe or inclusive as the safety standards employed by the Bureau of Mines under former recommendatory procedure, it is known that application of the provisions in the code is producing farreaching effects in the general improvement of safety conditions throughout the industry.

The agreement stipulates that inspectors of the Federal Bureau of Mines shall make periodic investigations of the mines and report any violations of the code to the Coal Mines Administrator. It provides further that, in case of violations, the Coal Mines Administrator will take appropriate action. The power of enforcement, therefore, is vested in the Administrator, and no provision has been made for the Federal inspectors to have any part in the enforcement of the code. The Federal inspectors are charged solely with the inspection of mines and the reporting of violations to the Administrator. In carrying out this duty, the inspectors are following their customary policy of trying to follow maximum accuracy and impartiality in reporting. Every effort is made by Federal inspectors to assist mine workers and management to better understanding of the code and its provisions.

The agreement provides that there shall be a mine safety committee at each mine and authorizes the committee to inspect any mine development or equipment used in producing coal for the purpose of ascertaining whether compliance with the code exists. The committee is directed to report its finding and recommendations to the management, and in those special instances where it believes an immediate danger exists, the committee is directed to recommend that the management remove all mine workers from the unsafe area. It is mandatory that the management follow the recommendations of the committee in cases of immediate danger. Frequently a committee or union representative will apply to the Bureau of Mines for an inspection or submit a complaint to the Bureau that the safety committee is unable to get the management to comply with its recommendation; this procedure is incorrect under the

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provisions of the agreement. The proper procedure would be for the committee to appeal to the operating manager, and if it fails to get satisfaction, to appeal further to the Coal Mines Administrator through the area office of the Coal Mines Administration . The Coal Mines Administrator may then, if he so desires, request the Bureau of Mines for technical advice which may involve a check inspection of the mine. There is no provision in the agreement calling for negotiations between the safety committee and the Federal inspector relative to safety matters.

The Federal Mine Safety Code is now used as a standard by Federal coal-mine inspectors for inspecting mines in possession of the Government. At the completion of an inspection, the inspector posts a preliminary report at the mine. This preliminary report is not intended to cover all violations of the code but is designed to indicate only violations which involve serious hazards that should receive immediate attention. A complete report, covering all violations of the code and containing appropriate recommendations for the correction of the violations, is then prepared by the inspector and transmitted through the District and Washington offices of the Bureau to the Coal Mines Administrator. Copies of the report are forwarded to the operating manager of the mine; the local, district, and national offices of the Mine Workers, and the mine-inspection department of the State in which the mine is operated.

The code does not authorize Federal inspectors to exercise discretionary judgment in the application of its provisions. It is the inspector's duty merely to determine whether or not any of the provisions of the code are being violated and to report accurately any violations observed. If the inspector reports a violation of the code and the operating manager believes that the provision of the code is not applicable to the conditions existing in the mine or that compliance would result in irreparable damage or great injustice, he may protest the charge of noncompliance by promptly notifying the Coal Mines Administrator of his position and contentions in writing. The Coal Mines Administrator, after such investigations and hearings as he may consider necessary, may suspend or stay, for such periods as he deems reasonable, any provision of the code as applied to any mine.

The provisions in the code supplement State mining laws and are not intended to interfere with the enforcement of State statutes. Where the requirements of State law are more severe than those of the code, those provisions are enforceable by the State. Where the requirements of the code are more severe than statutes, the provisions in the code apply. Where there is a question as to which is more severe, the provisions in the code apply. The Federal inspectors do not report violations of State mining law except in those special cases where the provisions in the code specifically refer to State mining law.

The code contains fifteen articles and follows in a general way the outline of the Inspection Standards for Bituminous-Coal and Lignite Mines that was used by the Federal Coal-Mine Inspection Division of the Bureau of Mines before the code was adopted. Time does not permit discussion of all the provisions in the code, but it is desirable to consider some of the salient features.

The code requires that minimum standards of systematic timbering be adopted at each mine and that the standards be complied with by workmen and officials. Such minimum standards must include the setting of temporary safety posts, jacks, or cross bars close to the face before other mining operations are started, when necessary. It requires that workmen know how to test the roof, ribs, and face and provides that the roof, ribs, and face be tested before work is started and frequently thereafter. It also requires that mine officials examine, or cause to be examined by a competent person, roof, ribs, and face of working places and passageways where men travel, for dangerous conditions and that dangerous conditions be removed promptly.

The requirements for the storage of explosives are essentially the same as those in the standards used previously. Permissible explosives may be carried on man-trips with workmen in quantities not to exceed one day's supply, provided that they are carried in containers of substantial, rigid nonconductive material and that the containers for ex-

plosives and detonators are separate.

The code requires the use of permissible explosives or permissible blasting devices in all mines, except that blasting may be done with black blasting powder after the end of the shift when all men are out of the mine but those necessary to perform the actual blasting. Special permission may be obtained to fire black blasting powder on shift in mines in which methane is not liberated, if it can be shown that rock dusting is maintained in accordance with the requirements of the code, that the use of permissible explosives would interfere seriously with the operation of a mine or destroy the marketability of the coal, and that the physical conditions and cycle of operations are such that blasting cannot be done on the off shift.

The code requires that all main fans be installed on the surface in fireproof housings and offset not less than 15 feet from the nearest side of the mine opening and be equipped with fireproof air ducts and ample pressure-relief or explosion doors. If a fan that is now in operation is not offset, it must be moved so as to comply with the code; however, if the fan is offset any distance from the mine opening, it need not be moved. Main fans now located at the bottom of a shaft in fireproof surroundings may be continued in use, but future installations may not be made unless it is shown that such installations are necessary and would not materially increase the hazards of the mines.

The use of booster fans in mines may be continued, if the installation complies with certain stringent requirements set forth in the code; however, the code discourages any new installations of booster fans unless such installations are necessary for the safe operation and proper ventilation of the mine. The use of auxiliary or blower fans is also discouraged except to ventilate shaft and slope-sinking operations and their underground connections and the faces of rock tunnels. In mines where blower fans with tubing are now being employed to ventilate the faces of working places, the use of such equipment may be continued if certain specified precautions are taken; but such equipment may not be installed in mines where it is not now in use.

A split system of ventilation must be used in mines wherever splitting of air is necessary to ventilate all parts of the mine effectively. The maximum number of men on a split must conform to the requirements of the law of the State in which the mine is situated. The code does not stipulate any specific quantity of air entering the mine; however, at least 6,000 cubic feet of air a minute must be circulated in the last open crosscut in entries, except in entries leading to the pillar lines. In such case, not less than 6,000 cubic feet of air a minute must be delivered to the intake ends of the pillar lines. The code specifies that air in which men work or travel shall contain at least 19,5 per cent oxygen and not more than 0.5 per cent carbon dioxide and that, when air in the immediate return from a split contains more than 1.0 per cent methane, the ventilation shall be improved. If the air in the immediate return from a split contains 1.5 per cent methane, the code requires that the employees shall be withdrawn and power shall be cut off from the mine or portion of the mine affected until such dangerous condition has been corrected. Special provisions are made for those very gassy mines which cannot comply with this requirement because of the abnormally high rate of methane liberation.

The code requires that, where doors are used on main-entry and crossentry haulage roads, the doors must be erected in pairs to form air locks, unless the doors are attended. Abandoned workings are required to be sealed or ventilated in accordance with the law or practice in the state in which the mine is operated. Return air from abandoned workings or from pillar lines must not be used to ventilate live workings; however, the code provides that mines which cannot comply with this requirement may continue to operate until future mine development and ventilation can be changed to permit compliance.

The code does not recognize any classification of mines as to whether they are "gassy," "slightly gassy," or "nongassy." It does, however, exempt mines from compliance with certain provisions if gas has never been ignited in the mine and if gas has not been found with a flame safety lamp or by air analysis in an amount of 0.25 per cent or more in any open workings. Records of the discovery of methane in the official record books of the mine are considered to be ample justification for requiring compliance with all the provisions in the code.

One of the most progressive requirements of the code is the provision that all mines, whether gas has been discovered therein or not, must be examined for gas and other dangers, by fire bosses or mine examiners, not more than 4 hours before the first shift enters the mine. In multiple-shift operations, examinations for the second and third shifts may be made by any certified official or other competent person designated by the mine foreman or mine manager. In mines in which methane has not been found, a preshift examination need be made only before the first shift enters and need not be repeated for subsequent shifts.

All mines, except those that are too wet or in which the dust is too high in incombustible content to propagate an explosion, must be rockdusted to within 80 feet of the faces of rooms and entries. All haulageways and parallel entries connected thereto by open crosscuts must be rock-dusted, but back entries need not be rock-dusted except for at least 1,000 feet out by the junction with the first active entry and to within 80 feet of the faces of such entries. Bag barriers may be used in lieu of generalized rock dusting in trackless entries and air courses, if the bags are placed at regular intervals and staggered as described in Bureau of Mines Report of Investigations 3411. Mines that are now using the bag method exclusively may continue to use that method pending tests that are being conducted at the Experimental Mine of the Bureau of Mines.

The provisions governing transportation and haulage are fairly consistent with the average haulage practices throughout the United States. The code requires that all new entries, developed after the code went into effect, shall have a continuous unobstructed clearance of at least 24 inches from the farthest projection of moving equipment. Entries driven before the effective date of the code must have a clearance of 24 inches maintained, if such clearance has been made in the driving of the entry. If 24 inches has not been made, but a clearance of less than 24 inches has been made, that space up to 24 inches must be maintained clean. Shelter holes spaced not more than 80 feet apart must be provided along haulage entries driven after the effective date of the code where locomotive, rope, animal, or shuttle-car haulage is used.

The code provides that where main-line track is used as a power conductor, both rails shall be well bonded and cross-bonded at least every 200 feet, except where the track parallels a return feeder cable; in such case, the cable must be bonded to both rails of the track at least every 1,000 feet of its length. At least one rail on secondary haulage roads must be bonded and cross-bonds must be installed at least every 200 feet. All switches in bonded track must also be bonded.

Trolley and feeder lines must not extend beyond the last open crosscut and must be kept at least 150 feet from pillar workings; moreover, they must not be installed or kept in air known to contain 1.0 per cent or more methane or in air returning from pillar-recovery work or old workings where dangerous amounts of methane may be liberated suddenly. A reasonable length of time is granted, however, to allow mines not in compliance with this requirement to make the necessary changes in mining practice and ventilation. All new electric face equipment, such as cutting machines, loading machines, drills, conveyors, and junction boxes for making multiple power connections, purchased for mines in which 0.25 per cent or more methane has been found, must be of a permissible type. New cable-reel locomotives and shuttle cars used in places where permissible electric equipment is required must be explosion-tested equipment. All such equipment must be maintained in a good state of repair and in permissible condition. Nonpermissible equipment, in use at the time of the effective date of the code in mines known to liberate methane, may be continued in use in such mines, but care must be taken to protect the workmen by making frequent examinations of the air for methane content and by making such arrangements in the ventilation system that interruptions to the ventilating current will not likely occur. Electrically driven equipment, whether permissible or nonpermissible, must not be taken into or operated in a working place where 1.0 per cent or more methane can be detected in the general air of the place.

The code requires that metallic frames, casings, and other electric equipment that can become "alive" through failure of insulation or by contact with energized parts shall be grounded, and that cables for portable underground electric equipment shall be provided with suitable overload protection and power taps.

It is required that all rock drilling with percussion drills be done wet, except in cases where exposure is for short periods, in which case, permissible respirators must be worn for the protection of the persons

doing the drilling.

At least two travelable passageways, one of which shall be in intake air, must be available from each working section to the surface; travelways must be kept in safe condition for travel and reasonably free from standing water and other obstructions. One of the designated escapeways

may be the haulage road.

In mines in which 0.25 per cent or more methane has been found only permissible electric lamps may be used for portable illumination, and all persons are prohibited from intentionally creating any arc, spark, or open flame, except those that cannot be avoided in the normal performance of work. The carrying of matches or other flame-making devices into such mine is also prohibited.

Mine managers, mine foremen, and their assistants must be qualified for their positions under the laws of the State in which the mine is operated. Fire bosses or mine examiners must also be certified, or they must be qualified or competent persons appointed by the management.

It is the duty of any employee of a mine, upon the discovery of an unsafe condition, to report such unsafe condition to his immediate supervisor and, if the condition is not corrected within a reasonable time, it must be reported to the safety committee of the mine. It is the duty of the superintendent, mine foreman, or mine manager, and his assistants, fire bosses or mine examiners, and other officials to see that the provisions in the code are complied with, and it is the duty of mine employees to comply with the provisions in the code and to cooperate with management in the enforcement of its provisions. Reasonable rules and regulations of the mine, for the protection of the mine workers and the preservation of the mine property, that do not lower or impair the provisions in the code must be complied with.

The agreement of May 29, 1946, between the Coal Mines Administrator and the United Mine Workers of America provides that from time to time the Director of the Bureau of Mines may, upon request of the Coal Mines Administrator or the United Mine Workers of America, review and revise the Federal Mine Safety Code.

It is recognized that a large segment of the industry has inherited too many unfavorable safety conditions because of ill-advised engineering practices and lack of safety planning to make possible immediate drastic changes in present practices and conditions without disrupting the economic structure of the business. In many cases, too much has been taken out of the mines and too little in the way of safety improvement has

been put back in. This fact is recognized not alone by the mine owners but also by the United Mine Workers of America and the Federal Bureau of Mines. If the code becomes a permanent fixture in the industry, and there are indications that in one form or another it is here to stay, it will undoubtedly operate to bring about gradual improvement in mine safety on an industry-wide basis.

Federal reports covering inspections of mines operating under the code generally indicate excellent compliance with its provisions. Such

cooperation can have but one result.

* * *

Chairman Walker: Thank you, Mr. Miller, for reading that fine paper. Gentlemen, you have heard the reading of the paper in connection with the Coal Mine Safety Code. This paper is now open for discussion from the floor. I should like to ask John E. Jones, of the Old Ben Coal Corporation, to start the discussion.

Mr. John E. Jones: Mr. Chairman and members of the Illinois Mining Institute, I am speaking here not only as an employee of the Old Ben Coal Corporation and its subsidiaries, but also as Safety Adviser for the Coal Mines Administration.

DISCUSSION UPON PAPER PREPARED BY M. J. ANKENY

By JOHN E. JONES Safety Engineer, Old Ben Coal Corp. and Subsidiaries Safety Advisor to the Coal Mines Administration

In addition to presentation in part upon his subject "Procedure of the Bureau of Mines Under the Federal Mine Safety Code for Bituminous Coal and Lignite Mines of the United States," the author devotes a part of his paper upon the source and interpretation of the Code.

Source

Regarding the source it is as Mr. Ankeny states, a new concept which he regards as "safety regulation by contract." This, he states, "should raise the general level of safety conditions in mines throughout the United States and that a widespread reduction in the fatality and injury

rates should result."

Unfortunately, accident rates in coal mines in 1945 were the highest in severity and second highest in frequency when compared with all the other basic industries in the nation. That year in comparison was similar to preceding years; in fact, comparisons are somewhat similar since the records made by the National Safety Council first began. I will digress here to read a portion of a paragraph from my address given last month before the Coal Mining Section of the National Safety Council on this subject which emphasizes the need of more successful action toward safer coal mining.

". . . the severity rate for coal mining in 1945 was 11.94 days lost per 1,000 man-hours; a figure more than twice that for the next worst industry which is 'mining, other than coal.' The composite severity rate for all industry is 1.16, just a little less than one-tenth that for coal mining. The frequency rate given for coal mining is 63.06 disabling injuries per 1,000,000 man-hours while that given for the lumbering industry, the only industry which ranks worse than ours, is 64.65. The composite frequency rate for all industry is 13.63, just a little more than two-tenths that for coal mining."

"The source of the information is the reports from 6,262 industrial units to the National Safety Council, including 147 coal mining units. Forty general industries are considered."

"In 'frequency' coal mining ranks 39 and in 'severity' it ranks 40."

Gentlemen, we are at the foot of the class.

Interpretation

In his interpretations Mr. Ankeny has, in general, correctly explained what the Code means. Complete, detailed agreement, of course, is hardly to be expected so soon. The discussion he arouses could result in better approach to correct understanding of the Code with regards to certain controversial details.

These details include:

1. The interpretation that responsibility rests now upon the management and the employees but not upon the inspectors. The author confuses rather than clarifies the allocation and degree of authority and of responsibility.

2. The former inspection standards the author refers to as having been generally followed is probably a more specific statement than the author intended. These former standards in their entirety were too impractical to be followed as may be readily ascertained by comparing

them with the Code.

3. Inspectors occasionally err in copying a section of the Code in their mine reports as Mr. Ankeny has done here. This is probably natural with such a young document. One illustration is noted where he says, "Such minimum standards must include the setting of temporary posts, jacks, or crossbars close to the face before other mining operations are started, and as needed thereafter." This is substantially a copy of Section 1b under Article III (page 5 in the printed Code) except that the words "where necessary" are omitted. Such omission usually changes the meaning. In this instance there is confusion introduced since his interpretation first says the timbering must be done before other work starts, and adds as needed thereafter. It is both a "must" and a "proviso" in the same sentence. It is clear as given in the Code.

4. I am glad Mr. Ankeny states that "Special provisions are made for those very gassy mines which cannot comply with this (1.0% and 1.5% methane) requirement because of their abnormally high rate of methane liberation." There are some eleven ultra gassy mines in the United States. Most of them are now in the low volatile coal field in southern West Virginia. None are in Illinois. These special provisions were to be made later in each Bureau of Mines district having such ultra gassy mines since to consider such a few of them among the hundreds of other mines would be confusing in the writing of the Code. These special provisions are not in the Code. They have not yet, to my knowl-

edge, been explained to the federal inspectors.

Explosion hazards are usually fairly well understood. It is application of that knowledge that is too frequently omitted.

Better application of safety knowledge in examination and ventilation in all the coal mines is the prime motive of the Code. There is need of more practical rock-dusting knowledge and especially when all bituminous and lignite mines are concerned. Money has been appropriated by the Coal Mines Administration and is being used for present added mine development. This is for early tests at the U. S. Bureau of Mines' experimental mine broadening their scope. Tests should be continued to establish amount of rock dust required and the best means of application if necessary in typical mining fields using their own coal dust and as close as possible their own mining conditions. Ample rock dusting for safety is unanimously agreed among all mining employees and management.

The author touches upon electricity and other salient parts which

also are important subjects for discussion.

In conclusion it is gratifying that a Safety Code was prepared that is practical covering such a big variety of mining conditions for that massive area and which was adopted with no loss of tonnage and adding, as stated by the author, "a new concept in the promotion of safety in coal mining."

* * *

Chairman Walker: You have just heard a study and a studied discussion of the paper previously read by Mr. Miller. I should like to ask Mr. Miller if he would like to comment upon the discussion.

Mr. Alex Miller: I have nothing to say at this time.

Chairman Walker: Are there any other discussions from the floor on the paper regarding Mine Safety? If not, we shall proceed with the program. I should like to ask if Mr. Thomas Allen has shown up. When

the meeting was called to order he had not been heard from.

I believe he is not yet present, so we shall pass the second paper and go immediately to the third paper on "Belgian and German Coal Mining During the European Campaign." This is to be presented by Dr. Louis C. McCabe, your friend and my friend, an old Illinois boy who had a very active and very distinguished part in the past war.

He is now Chief of the Coal Division, U. S. Bureau of Mines, Washington, D. C. He has an interesting slide to be shown. Dr. McCabe.

Dr. Louis C. McCabe (Chief, Coal Division, U. S. Bureau of Mines, Washington, D. C.): Mr. Chairman and gentlemen. It is certainly a pleasure to be back again to a meeting of the Illinois Mining Institute.

I think it has been four or five years since I attended such a meeting.

Actually 1940 was the last meeting I attended in Springfield.

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BELGIAN AND GERMAN COAL MINING DURING THE EUROPEAN CAMPAIGN

By LOUIS C. McCABE

Chief, Coal Division, Bureau of Mines, U. S. Department of the Interior, Washington, D. C

In the first hundred days after D-day the allied forces had swept through France from the west and the south and, by mid-September 1944, the armies were lined up before Germany in this manner: In the north, the American First Army was five miles inside Germany, north of Trier in the Saar Basin; the Third Army had opened a new offensive along the Moselle River south of Nancy, having gained several new bridgeheads below Metz; the Seventh Army had joined with the Third west of Dijon after invading France from the south. The northern wing of the First Army was driving toward Aachen. Liége had fallen. More to the north, the British Second Army had advanced into northeastern Belgium and southern Holland. Canadian troops were operating along the coast to capture ports for supplying the allied armies.

The small coal basins in the south and the Pas de Calais coal field in northern France, the South and Campine Basins of Belgium, and the Limburg field of the Netherlands were overrun quickly and with little damage.

In August, SHAEF had ordered all available personnel, American and British, with coal-mining or distribution experience to Supreme Headquarters near London in preparation for taking over the mines on the continent as they were liberated. Colonel Robert P. Koenig, who in civilian life was President of Ayrshire Collieries, Indianapolis, Indiana, came from the Mediterranean theater to command this Solid Fuels Section of G-4 SHAEF. The staff was gathered from British and American army units in the C.B.I., the Mediterranean, Alaska, the British Isles, and the United States. All of us were assembled at General Eisenhower's Headquarters at Versailles on September 25 to get our assignments to the Solid Fuels Headquarters Section or to be subsections that were to administer production and distribution of coal in the liberated countries and Germany. Initially, Major Don Buchanan commanded the French Subsection, Major Frank Hubbard the Netherlands Subsection, and I the Belgium-Luxemburg Subsection.

On October 1, Major Hubbard and I, with our staffs, formed a jeep caravan and drove from Paris by way of Compiègne, St. Quentin, and Mons 210 miles to Brussels. Part of this distance was over the one-way

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Red Ball truck supply route to the fighting fronts. Everywhere the roads were littered with burned German vehicles caught from the air or by our tank fire. On every hillcrest, blasted Tiger tanks and some Shermans were testimony to the fighting there. In many places our bulldozers had pushed the wreckage from the roads or plowed a village street clear of fallen buildings.

Brussels was celebrating. For the first time in 4½ years the Belgians were a free people, able to fly the flag of their own country. The mines did not work in September. Between the Antwerp-Brussels-Charleroi line and the German frontier, the German army had dynamited railway bridges and the bridges over the canals to slow pursuit. Rail and canal transportation had stopped. The miners, well-armed through the Allied underground activities, were enjoying a rest from their labors under German occupation. The forced labor the Nazis had sent to the Campine coal field, mostly Russians, and many Belgians who had gone into the mines to escape deportation to the Reich, deserted the mines entirely. Altogether, 40 per cent of the labor supply was lost to the industry.

The free governments of the western European democracies had agreed before D-day that their coal resources would be at the disposal of General Eisenhower for furthering the war. On instructions from SHAEF, one of my first official acts after entering Belgium was to organize the Combined Coal Committee (CCC) constituted of representatives of the SHAEF Mission to Belgium, the Belgian Military Mission, the civilian coal and coke production and mine supplies organizations of Belgium, and the Belgian Solid Fuels Administrator. The CCC met twice weekly in October and once a month thereafter under the sponsorship of the Belgium-Luxemburg Solid Fuels Subsection to coordinate the various facilities for production and equitable distribution of the coal of Belgium,

Coal requirements were submitted to Majors J. Price Walters (Br.) and George C. Brady (U. S.), the Requirements and Allocations officers of the Section, two weeks in advance of the CCC meetings for review and preparation of the allocations. Priorities were: (1) military railways, (2) other military, (3) essential civilian (utilities, industries on war production, food industries, etc.), and (4) other civilian, for disposal by the Belgian Minister for Economic Affairs. As requisitions in the first three priorities seldom left a balance, we had the difficult task of reducing the requirements of the military railways engaged in moving munitions, food, and clothing to the troops, the troop requirements for heating and cooking, and the requirements for industrial production so necessary to speed arms and equipment repairs to the armies in the field, in order that the civilian population might receive some fuel for cooking, hospitals, and electricity for a few hours of light and transportation each day.

In mid-October, Major General G. W. E. J. Erskine, head of the SHAEF Mission to Belgium and General Eisenhower's representative to the Government, said, "The three most important and almost primitive requisites are (a) food, (b) law and order, and (c) coal. Coal is closely concerned with law and order." On the 3rd of September, the various

resistance groups in Belgium were estimated at 200,000. On October 8, they were estimated at 85,000. Many of the 200,000 were temporary volunteers who soon returned to their work or business. The 85,000 was the hard core of the movement. Throughout October and November there was considerable interference with the working of the mines because of the arrest by the risistance group of key men accused of collaboration, but this activity died away as the Government collected the arms.

In a very few days it was apparent that the major problems affecting coal production were (1) lack of food for the miners, (2) shortage of

mine timbers, and (3) inadequate transportation.

In conference with the Belgian Cabinet Ministers on October 5, the Labor Minister stated that the miners' food allotment was lower than under the Germans and that the principal staple items of food now lacking were butter and meat. On October 6 the Government increased the bread ration to the entire population, and potatoes were to be removed from ration control.

The transportation situation was particularly difficult in the Campine coal field near the Netherlands and German borders. The seven mines in this district in normal times produced 500,000 tons of fat coal (volatile matter 30 per cent) per month. Some 20,000 miners were employed in these mines and most of them lived at some distance from the works, but all lived within a radius of 20 miles. Transportation to and from the mines was nonexistent. Formerly, there were busses, rail transportation, and bicycles to transport the men, but the Germans had requisitioned all serviceable motor vehicles and bicycles for their withdrawal and had immobilized the work trains by dynamiting the bridges. Similar conditions existed in other mining areas of Belgium, alleviated to some extent by the availability of street cars.

On October 7, I wrote to 21 Army Group as follows: "Production of coal is an essential requirement of the war effort. Physically, the Belgian coal industry is prepared to satisfy the coal requirements the Allies have placed upon her. However, there was essentially no coal production in Belgium in September. Lack of transportation for miners to and from the mines, lack of sufficient food supplies, and lack of transportation for essential mine timber have delayed renewed operation of the mines. Every possible action is being taken to return the mines to production within the next week. The Armies and essential civilian operations in Belgium have, for the past five weeks, drawn upon stocks above ground. Only two weeks coal supplies are now available on the surface. Army requirements for the next 30 days are in excess of anticipated production. There is no possibility of moving coal for military or civilian use from the U. K. or the U. S.

"The Campine coal fields, now producing approximately 4,000 tons of coal daily, can increase their production to 15,000 tons daily if transportation for the miners to and from the pits is supplied. . . .

"It will require 84 five-ton trucks, or their equivalent in personnel hauling capacity, to fully satisfy the transport requirements in this area. . . . In view of the urgency of the requirement from the military as well as the civilian viewpoint, it is urgently requested that the Army

Group make available a minimum of 50 per cent of the transportation indicated (42 vehicles)."

Within four days, 21 Army Group informed me that they would furnish the full 84 vehicles. The mines sent civilian drivers to take the trucks to the Campine where they were used for movement of personnel and mining materials until the spring offensive got underway in February.

When operating normally, the Belgian coal industry imports 50 per cent of its mine timbers from Portugal, France, and Norway. During the German occupation these sources were cut off and the Ardennes Forest was severely overcut to furnish the necessary wood. When we entered Belgium, the mines had three weeks timber supply, but by the middle of October many of them had exhausted some sizes. It was necessary to move in a supply of timber quickly, and the only adequate source was the Ardennes. After meeting with the timber merchants in Brussels on October 11, I obtained from 21 Army Group the assignment of one truck company of 100 six-ton trucks and a Canadian Forestry Company capable of cutting and moving 1,500 tons of timbers to railhead or directly to the mines each day. Movement began October 14 under the supervision of Lt. W. E. Pritchard of Huntington, West Virginia, of my staff, and continued well into the Spring of 1945.

It was desirable to get the civilian timber market operating to supply as least 500 tons of timber daily, but the merchants needed tires for their automobiles to travel through the forests to arrange with the farmers for cutting and hauling, and the farmers needed tires for their trucks and horse-drawn vehicles. Both needed gasoline. I wrote 200 permits to draw gasoline from military stores, and we distributed 400 sets of discarded American Army tires for the farm carts. In a warehouse in Brussels, two of the Section's supply officers, Major Jerome C. White (U. S.) and Captain Vernon L. Gaspar (Br.), discovered 90 tons of German synthetic rubber which was being held as enemy war material. We requisitioned this and put it in the Engelbert tire factory at Liége for the manufacture of 400 sets of automobile tires and 20,000 bicycle tires for distribution to timber and mine trucks and for miners' and woodsmen's bicycles.

The supply of meat and butter rations to the Belgian miners was initially left to the civil authorities, but by November 4 such a rash of strikes had broken out and so many miners were away from the mines looking for food in the farm areas that it was apparent that indigenous food was not available. The Belgium-Luxemburg Solid Fuels Section recommended and SHAEF directed 21 Army Group and the American Zone of Communications (COM Z) to supply meat and fats (butter, margarine, or lard) from military stores. In all, 82,000 workers, including sick and injured, received 245 tons of fats and meat from the American and British Armies each month. This food was distributed each week at the mine. Underground workers received 80 grams of meat and 40 grams of fat for each day worked, and surface workers received half this amount. If six days were worked without lost time, there was

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a bonus of one day's ration. This materially helped production and reduced absenteeism.

In warfare there is intense competition among elements for the all too meager supplies and, regardless of the controls set up by the Supreme Commander, the enthusiasm of subordinate formations to do their particular job sometimes causes considerable embarrassment to the common effort. Requisitioning of coal by combat supply organizations initially upset the master allocation programs of a number of Belgian mines. This first came to our attention as the weather grew cold. Operators reported officers coming to the mines with convoys to requisition coal in 500- and 1,000-ton lots. Typical signatures on the requisitions were, "Will U. Bendover, 1st Lt., 8th Mississippi Foot" or "John Doe, Capt., 9th Baseball Company." Military coal was supplied by Belgium under reverse lend-lease, but such requisitions as these could not be honored. We closed these leaks by making a single American officer responsible for signing for all deliveries to American troops and a single British officer responsible for deliveries to British troops. The operators were provided with faesimiles of the signatures of the supply officers and their requisitions were balanced against their monthly allotments at the end of each month. There was no carryover in allotment from month to month to military or civilian consumers. All unused balances were canceled at the end of each month.

By the third week of October, the Belgian mines were producing 25,000 tons of coal daily; by the end of November, this had gradually risen to 40,000 tons a day, where it had leveled off due to the shortage of transportation; 1,700 tons of coal daily was going into storage at the mines, and they were threatened with curtailing production for lack of storage space. Twenty per cent of the production, or 8,000 tons a day, was being used at the mines, leaving 32,000 tons for military and essential civilian use. Daily movement by rail was 15,000 to 20,000 tons by the 21st of October. Road transport was moving 7,000 tons daily and water transport approximately 5,000 tons daily. It was apparent that Belgium must produce more than a million tons of marketable coal a month to meet the military and essential civilian requirements during the winter months. The heavy demand for coal by the industries having military manufacturing commitments made this essential.

November was a month of uneasy political events of a nuisance value out of proportion to their real significance. The Government fell on December 14, and the Battle of the Ardennes began on the 16th. Attack by V-1 and V-2 weapons disrupted transport at Antwerp and was responsible for a great deal of absenteeism in the Liége coal fields. On December 20 the canals froze, immobilizing 80,000 tons of coal in barges.

For four years Belgians had been living on a misarably low food ration supplemented by the black market. Belgians were now living on approximately 1,400 calories a day. Since this had been going on for four years, it was not surprising that food was considered the most important single factor in Belgian life. Two thousand calories a day was regarded as the target for liberated countries. Political unrest, lack of

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food, and insufficient coal, together with reverses at the front, gave the Belgians a pessimistic view of life.

During this time, Belgium was supplying the Allied military forces with 4,000 tons of fruit and vegetables a month; \$40,000,000 worth of industrial products, such as tank treads, steel rails, trench mortars, and automatic weapon replacement parts; 75,000 tons of coal a month for military and essential civilian needs; 130,000 tons of potatoes; complete control and use of transportation by railway and canal; the full requirements of civil labor for docks and other military requirements; and housing on a generous scale for military purposes. Against this, the Belgian Government had received little more than 4,000 tons of food from the Allies since the liberation.

The German offensive caused dislocation of coal production and loss of the Ardennes as a source of mine timbers. The British transport company hauling mine timbers and Canadian forestry company cutting in the Ardennes were withdrawn across the Meuse. The Canadians lost their power saws and other woodcraft tools. This had a serious effect on coal production. We set to work immediately to find other areas where cutting could be renewed. In cooperation with the Belgian Forest Service, parks and small wooded estates were requisitioned and cutting organized anew. By the middle of January 1945, 1,000 tons of mine timbers a day were again being delivered to the mines.

As the winter weather became more severe, coal losses in transit mounted. By December 7, 1944, the loss of coal in transit was 10 per cent of the marketable production. It was decided in a meeting at Versailles that military guards would be placed on all trains carrying coal, the guards to be supplied by 21 Army Group and Com-Zone, and that static guards would be provided for all railway yards. All consumers were directed to reduce consumption 15 per cent. Supreme Headquarters approved the transfer of 75,000 tons of coal from stockpiles in the Netherlands mines to the Belgian economy. 21 Army Group assigned four forestry companies to cutting forests west of the Meuse and two transport companies to move the mine timbers to the mines.

Because of icy weather, delivery of mine timbers in the 10 working days from January 6 to 17, 1945, was only 6,700 tons, which was not sufficient to sustain the coal production. The four forestry companies and the two motor transport companies of 21 Army Group were cutting 80 per cent of all the timber supply, and civilian organizations were pro-

ducing the remaining 20 per cent.

There was considerable labor unrest in the mining region at this time. The entire Southern Basin did not work on January 23 and 24, 1945. The main controversial issue hinged about the recognition of a new Communist union. In the last week of January and the first week of February, labor unrest in the mines was responsible for the loss of approximately 150,000 tons of coal to consumers. The unrest at no time had the appearance of a general strike, and no basin was entirely idle on any working day. Loss of production in the Southern fields ranged between 30,000 and 90,000 tons from day to day and averaged 33 per cent for the country during the period. General unrest rather than specific

grievances appeared to be the basis for the strikes. Recognition of the CLS (Communist Union), special clothing allowance, allocation of coal for the population, payment of salaries to delegates supervising distribution of extra food rations to miners, dissatisfaction with minimum wages, and increase of old miners' pensions were given as causes of strikes. One skirmish with the gendarmes was reported, but the strikers were generally extremely quiet.

As the strike lengthened, the position of essential railways, utilities, and military supply took on a serious aspect. In all categories, stocks were measured in days. In December, railroad consumption was currently 5,500 tons per day. In the period January 29 to February 3, 1945, the railroads received only 3.000 tons daily from the mines. On February 5, Major D. E. Wilson (U. S.), Section Transportation Officer, reported that if this rate of delivery of railroad coal continued, stocks would be exhausted by February 12. Further reduction of railroad fuel stocks was stopped February 6 by denying all coal to civilian and army use. Power plants throughout Belgium had approximately a five-day supply of coal at reduced consumption levels. Gas plants were dangerously low on coal supply. On the weekend of February 3 and 4, it appeared that fires would have to be drawn from some of these plants and a year would be required to repair the damage caused by cooling them. During this critical period, the price of coal in the black market had risen to \$2,000 a ton.

On February 7, 95 per cent of the workers on strike returned to the mines. Reports from the five coal fields suggested that the unrest was dissipating. Radio appeals by General Erskine and the Belgian Minister of Labor were effective. Changes in the Government likewise had its effect. Whatever the cause of the workmen returning, the fuel picture had brightened considerably.

The miners' strikes, which began January 22, ended February 7 after 14 days duration. The loss of production during the period was estimated at 157,000 tons. The recovery after resumption of work was encouraging. The first day after full resumption, the production rose to 43,000 tons daily, surpassing the daily target established for February. Mine timber receipts likewise reached new heights during this period. 7,600 tons reached the mines in the week ended February 10, and 1,650 tons were delivered on February 8, establishing new ceilings for the week and for a single day since the liberation.

The railway's stock position was materially improved by diversion of all suitable coal to its use on February 7, 8, and 9, 57,000 tons of coal were delivered to the railroads during this period, an average in excess of 14,000 tons per day. The current consumption remained at 5,500 tons per day and the reserves were materially improved. Utility stocks were increased by measures of conservation and improved deliveries.

By the end of February 1945, coal production had reached a new high, averaging 48.900 tons per day for the nine working days February 17 to 27 and totaling 440,200 tons. On February 24, 51,000 tons was produced—the highest single day's production since the liberation. The receipt of mine timbers continued to improve; for the week ended February 25.

ruary 17, the receipts were 8,100 tons and for the week ended February 24, 11,600 tons, the average daily receipts for the period being 1,640 tons. The highest day's receipt since the liberation occurred on February 24, when deliveries were 2,900 tons. Improved transportation, warmer weather, distribution of some items of clothing to the miners, and a general expression of confidence in the Government resulted in a reduced rate of absenteeism. It declined from 23 per cent on February 10 to 15 per cent on February 24. More coal was mined during March than could be transported. It appeared that the coal industry had passed its initial difficulties and that long-term plans for production and utilization could be made with more assurance of fulfillment. Domestic consumers and the armies received only 55 per cent of their allocation during February owing to the shortages caused by strikes. In spite of this fact, more families received their ration of coal than in any month since the liberation and some time before it. During the month the railroads received 98 per cent of their allocation, the highest proportion for many months. For a long period, great reliance had been placed in dispatches by rail because of the low stocks held by consumers and the greater speed of rail traffic. The build-up of stocks made it possible for more coal to be transferred to barges, which were arriving regularly.

In November 1944, Colonel Koenig set up the administration of the Aachen mines under Major T. N. Williamson of Bluefield, West Virginia. It was from Aachen that the first German solid fuels moved to the liberated countries; several cars of electrode coke were shipped to France early in January 1945. Only 600 miners of 22,000 normally employed in these mines were left when the district was captured, but Major Williamson was able to pump the mines and supply coal to troops in the forward areas from surface stocks.

Our armies began to move in March, which was the signal for forming the German Subsection at full strength. I assumed command on March 16 and joined the American, British, French, Belgian, and Netherlands officers who had reported to Aachen for duty. During the month, the Cologne brown-coal fields and the Ruhr mines west of the Rhine were overrun. The Saar fell to the Third Army toward the end of the month, and the Ruhr was encircled by armored spearheads of the Ninth and First American Armies. The last resistance in the Ruhr pocket was cleared before May 1.

Our purpose in Germany was to provide centralized staff supervision of solid fuels during the military phase, to coordinate and supervise mining, to collect bids and allocate solid fuels to meet military and essential civilian requirements, and to assure mine supplies and repair parts for machinery required in production. Unit headquarters were established at Aachen, Krefeld, Essen, Cologne, and Heinitz (Saar) to accomplish this purpose. Guarding, day-to-day supervision of mining operations, and the execution of our allocation orders were the responsibilities of provisional troop organizations, which were called Rhine Coal Control in the Aachen, Cologne, and Ruhr fields and Conad Mining Group in the Saar.

German coals are divided into two general classes, Steinkohle and Braunkohle. Steinkohle comprises the coals of anthracite and bituminous rank, and Braunkohle (brown coal) corresponds to American lignite. The Steinkohle are classified as to volatile content as follows:

	Volatile matter Per Cent
(1) Anthrazit or Magerkohle (lean coal)	5-20
(2) Fettkohle (fat coal)	
(3) Gaskohle (gas coal)	
(4) Gasflammkohle (free-burning coal)	

In western Germany the Steinkohle are found in highly folded and faulted sedimentary formations. The coal beds are plentiful but seldom exceed 40 inches in thickness. Some beds as thin as 16 inches are worked. The average depth of shaft is 2,250 ft, 90 to 180 feet being coal. Throughout the Ruhr, coal is hoisted from six levels, on the average, and each level may provide a different rank and a different purpose coal. Backfilling is required to prevent or control_surface subsidence.

The German underground mines employ the advancing longwall system for the most part and are poorly mechanized by American standards. Pneumatic picks are almost universally used by workers at the face, and hand-shovelling on belt or chain conveyors is general practice. Immediately before and during the war much attention was given to power loading on longwall faces. In 1940, the Bergbau Verein (Mining Association) organized a contest and gave prizes for new mechanical equipment that would have more than three man-shifts per hundred tons of coal. The most important machines produced by the content were the cutter loader and the coal plow. In the four years of development preceding our occupation, more than 2,000,000 tons of coal had been loaded with this equipment. Coal plows produced more than half of tonnage, cutter loaders about 40 per cent, and other types of loaders the balance.

In meeting world competition and exacting industrial requirements, the German coal industry found it necessary to build great surface preparation plants. Many mines were equipped with complete units for cleaning each rank of coal mined and had elaborate arrangements for blending their coals. Closely allied installations, such as electric power plants, coke ovens, hydrogenation, and briquetting works, were normally built on the mine site. The coke ovens fed their gas to the central grid, and the power stations were interconnected to make these services available to all of western Germany.

The brown-coal beds vary between 20 and 330 feet in thickness and are shallow enough to be stripped over large areas. Before the war, 85 per cent of the production was from open pit. As mined, they contain 40 to 60 per cent moisture and a heating value of about 7,000 B.t.u. Their sulfur content is less than 1 per cent, and the ash content varies from 3.5 to 6.5 per cent.

Buch, J. W., Design and Operation of the Coal Planer, Ruhr District, Germany: Bureau of Mines Inf., Circ. 7377, 1946, 20 pp., 34 figs.

In 1938, 50 per cent of the brown coal was consumed in generating electric power at the mine site. Fortuna No. 2, in the Cologne field, burned 10,000 tons of raw brown coal per day for power production. The briquetting industry used 23 per cent of the total output. Because of the high bitumen content brown coal can be briquetted without binder after the moisture is reduced to 12 per cent. In the war years these briquets were the only solid fuel available to most German households and were shipped to France, Belgium, and the Netherlands to supply the domestic market while the metallurgical and byproduct coals of these countries were drawn off to supply the German war industry. Brown coal was an important raw material in the synthesis of fuel oils and gasoline before and during the war; 21 per cent of the production was used for this purpose. Miscellaneous chemical and general industry consumed the remaining 6 per cent of 1938 production.

It is interesting to compare the coal production of the major fields of western Germany for 1938, the year preceding the outbreak of hostilities in Europe, with 1943, the last year that all the fields were under

German wartime administration.

Production of Steinkohle in Western Germany

(In 1,000 short tons)

Year	Ruhr	Saar	Aachen	Total
1938	140,012	15,832	8,529	164,373
1943	137,845	17,415	8,069	163,329

It is significant that the mines of western Germany were able to maintain production at pre-war levels throughout 1943. At this date our bombing attacks did not have the crippling effects of the mass raids in the winter

of 1944 and spring of 1945.

Output fell throughout the war from 1.5 tons per man-day in 1938 to 0.8 ton per man-day in March 1945. Between 1939 and 1944, 210,000 young German miners were drafted into the army. Those drafted were replaced by slave labor and prisoners of war; the latter were largely Russians. The last census of miners in the Ruhr immediately preceding the Allied occupation showed 381,000 men, of whom 58 per cent were German and 42 per cent foreign. The numbers above and below ground were in about the same proportion.

Toward the end of the war, when food became scarce, both German and foreign workers were given extra bread, butter, and meat rations to stimulate production. Germans who worked two Sunday shifts per month received 1 bottle of schnapps, 3 cans of sardines, and 24 cigarettes in addition to their regular rations. Medical services were set up at the

mines to catch illness early and reduce sick leave.

Lack of food, manpower, and transportation, the same problems that plagued renewal of mining in the liberated countries, faced us in restarting the German mines. Also, we were operating in enemy territory with no clearly defined policy toward the industrial machine served by the coal industry and on which the very existence of the mines depended. The three schemes advanced for solution of the problem were: (1) Sep-

aration of the Ruhr from the rest of Germany and operation under international control, (2) dismantling factories and mines and turning the industrial area to farming, and (3) resumption of operation on a limited scale under Allied supervision. At the end of the SHAEF period, the third scheme came into operation through the Allied Control Council.

The Aachen, Ruhr, and Cologne fields passed to British Zone control on June 15 and the Saar to French Zone control on July 17, 1945.

The net pithead coal production during the SHAEF period in occupied Germany is shown below:

German Coal Production, April - June, 1945

(Thousands of short tons)

Month	Ruhr	Aachen	Saar	Cologne (raw brown coal)
April	741	23	34	101
May June	$741 \\ 1,508$	26 40	83 150	184 331
TOTAL	2,249	89	267	<u></u> 515

At this time 3,250,000 tons of coal and 3,500,000 tons of coke were in storage at the mines. There was no immediate possibility of moving these stocks because barge transportation on the Rhine was stopped by fallen bridges, and the railways, brought to a standstill by Allied bombing, were operating at 5 per cent of normal.

The slave labor was liberated from the mine stockades as we overran the mines. Germans now made up the working force, reduced by 40 per cent. On June 15 there were 193,000 workers in the British Zone and 16,000 in the Saar. The British reported 30 per cent absenteeism among these miners and 19 per cent among those in the Saar. The extensive aerial destruction of housing and transportation in the Ruhr and the extreme shortages of food that developed in this densely populated area may explain the differences in absenteeism.

Germany exported 24,000,000 tons of coal in the 18 months immediately following the First World War, exclusive of the Saar. In the same period after VE-day, less than 1,000,000 tons was exported from the same fields. The recovery of Europe and in many ways the readjustment of all the industrial countries of the world are affected by German coal production. The United States may continue to supply some coal to Europe for a few years but it cannot be regarded as a permanent market. There is some evidence that the Silesian mines will expand rapidly under Polish operation; but, if this does come about, the demand of adjacent states will readily absorb this output. The British mines are passing through a critical period and are now unable to meet the requirements of the home industry. There never has been such a shortage of coal in the world before and search for a supply leads back inevitably to the Ruhr.

Chairman Walker: I don't believe a discussion is necessary, but if you want to take on some questions we have a little time. If anyone

would like to ask a question of Dr. McCabe, now is your chance.

I had my troubles in Europe with coal mines. That was mostly in Austria. They were still trying to get the railroads running when I left. In Austria they were trying to supply four pounds of fuel per day per family. That doesn't take much coal.

I would like to turn the meeting back to President Joe Hitt for this

morning. (Applause.)

President Hitt: The afternoon's session is at two o'clock and I earnestly urge you all to be here on time. We will now adjourn until two o'clock.

The meeting recessed at 12:00 o'clock, noon, to reconvene at 2:00 o'clock, p. m.

AFTERNOON SESSION

2:00 O'clock P. M.

The Friday afternoon session of the Fifty-fourth Annual Meeting of the Illinois Mining Institute convened at 2:00 o'clock in the Ballroom, Abraham Lincoln Hotel, Springfield, Illinois, President Joseph E. Hitt presiding.

President Hitt: Will you be seated, please, gentlemen. We don't want to hurry the program this afternoon. We want to do what we do right, and yet we want as much of an interval between the closing of this session and the opening of the session tonight as possible because that is where we get acquainted.

For that reason we will start right now although the boys are coming in slowly. The first paper this afternoon is "The Development of Electric Locomotives for Use in Coal Mines," and is a subject that I am sure you will be interested in.

I am going to ask Mr. Frank Eubanks, the organizer and former president of the Mining Electric Group, and now the electric maintenance man for Old Ben Coal Corporation, to preside as chairman. Mr. Eubanks, will you take the chair?

Mr. Frank Eubanks (Old Ben Coal Corporation, West Frankfort, Illinois): Our first paper this afternoon is on the "Development of Electric Locomotives for Use in the Coal Mines," by John S. Beltz, of The Jeffrey Manufacturing Company. Mr. Beltz, will you please come forward?

Mr. John S. Beltz (Chief Engineer, Mining Department, The Jeffrey Manufacturing Company, Columbus, Ohio): Mr. President and members of the Illinois Mining Institute, before I start on this paper, I would like to make a few remarks.

One is, do you men ever think what it would mean if suddenly you were deprived of your electric locomotives underground? You can get the coal cut in other ways, maybe; you can get it loaded in other ways, but how are you going to get it from the face to the bottom?

The electric locomotive is such a simple, reliable, every-day piece of apparatus that it is rather hard to make a talk that is really interesting about the development of the locomotive. It sort of grew Topsy-like.

However, I have written a resume that may be placed in the Year Book, of the major developments that have taken place. Nevertheless, I find myself in a sort of position of a historian that is writing history right in the middle of the battle.

Anything you say, somebody is liable to pick it up and say, "Well, that didn't happen just that way"; so the main highlights of the early development I am going to read because there are some basic figures.

Then for the rest of it I am just going to talk and sort of cover the subject in a general way and just hit the high spots.

DEVELOPMENT OF ELECTRIC LOCOMOTIVES FOR USE IN COAL MINES

By JOHN S. BELTZ

Chief Engineer, Mining Department, The Jeffrey Manufacturing Company, Columbus, Ohio

Underground transportation in coal mines has been one of the major problems of the entire Mining Industry. Before the advent of electric haulage, human muscles and animal haulage were the principal means employed to move the coal. Animal haulage necessarily limited the length of haul. Mechanical haulage of various kinds was adopted in order to handle more tomage over a greater distance. Specially designed steam locomotives were used in some cases. The compressed air locomotive, which was basically a steam locomotive with a high pressure storage reservoir and suitable reducing valves was quite popular in the larger mines in the 1880's and 90's. Another form of mechanical haulage was rope haulage. Two systems of rope haulage were in general use: the endless rope, which is still quite popular in England, and the main and tail rope. Once installed these systems were rather inflexible and the problem still existed of getting the coal from the various working places to the rope.

The first account that we have of an electric locomotive being used in a coal mine in the United States was one built and installed in an anthracite mine owned by the Pennsylvania Railroad Company in 1887. It is interesting to note that this first locomotive was built by a coal company. They evidently were dissatisfied with the systems of haulage available, and inasmuch as there was nothing better available on the market, they set about to produce the article themselves. Fig. 1 shows the general appearance of this old locomotive, which was so aptly named "The Pioneer." I could find no definite information as to the construction of this locomotive but from the photograph it appears that a single motor was used, which drove to a jack shaft. Chain and sprockets engaged this jack shaft to the cross shaft between the locomotive wheels. A gear on this cross shaft drove gears on each axle. It appears that the frame was made of wood and then in order to get sufficient weight to pull any appreciable load, various pieces of scrap iron were then piled on the locomotive. It is believed that the electric equipment was supplied by one of the predecessors of the present General Electric Company.

Fig. 2 is a photograph of the first locomotive built by a manufacturer and used in a bituminous coal mine in the United States. It was built by the Jeffrey Manufacturing Company and sent to the mine of the Upson Coal Company in 1888. It was also a single motor locomotive and

was gear driven throughout.

These early locomotives were called upon to negotiate curves, which were laid out for animal haulage. This made the wheel base rather short

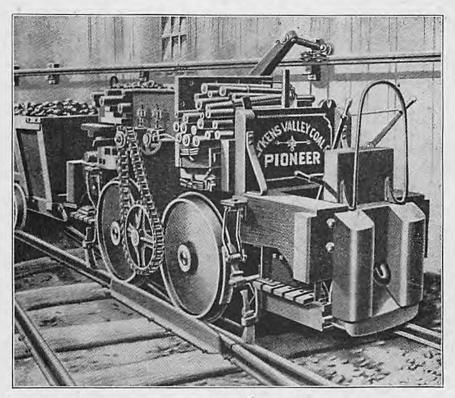


Figure 1.

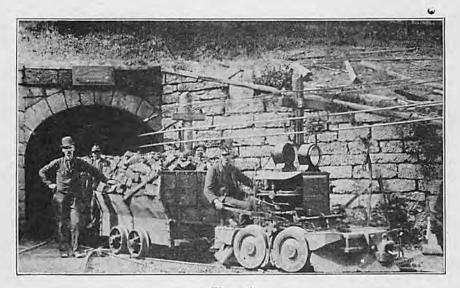


Figure 2.

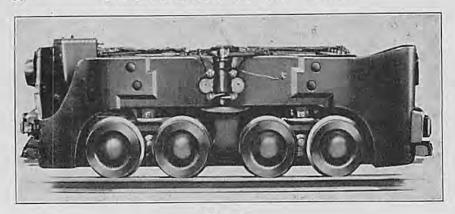


Figure 3.

and limited the size and weight of the locomotive. In order to overcome this objection, Mr. Elmer Sperry conceived the idea of a double truck locomotive. This locomotive was equipped with one motor and a rather ingenious set of gearing, which allowed each set of trucks to pivot about the midpoint of the locomotive. Several locomotives of this general design, Fig. 3, were built in the early 1890's by the forerunner of what is

now the Goodman Manufacturing Company.

It is interesting to note that all three of these original locomotives used one rather high speed motor, which was connected to the axles through double reduction gearing. Also the single motor made the use of idler or reach gears necessary in order to drive both axles and that this construction practically eliminated the use of springs and floating journal boxes as we know them today. In 1885 a patent was granted to Mr. Frank J. Sprague of New York, N. Y., covering a traction device in which one side of a motor was hung directly on an axle and the other side suspended from the truck frame by a suitable suspension nose. The armature was connected to the axle using suitable single reduction spur gearing. By using a motor on each axle, power was applied to each set of wheels and since it was no longer necessary to maintain fixed center distances between axles, spring mounted journal boxes could be used. This made a better riding locomotive, and since the axles were not rigid in the frame enabled the locomotive to follow uneven track much better. Fig. 4 shows one of the larger haulage locomotives built in the 1890's, this locomotive used 3 single reduction motors, semi-eliptical leaf spring and equalizers between each set of trucks. By 1900 locomotive design had been more or less standardized using the following general features: cast iron side frames, single reduction spur gearing with motors hung directly on the axle and magnetic blowout drum controllers. Some manufacturers still used single motor, double reduction gearing particularly on the narrow gauges, which allowed more motor capacity than could be obtained with two smaller motors mounted between the wheels.

As the mine operator became convinced of the superiority of electric haulage on the main line, his thoughts turned to supplanting animal

haulage for gathering and secondary haulage. This brought about the gathering locomotive, which was a small single or two motor locomotive of four to eight tons weight equipped with an automatic cable reel, which would pay out the cable when going beyond the trolley wire and automatically reel it up when approaching the wire. In some mines with the rooms going to the dip, wire rope or crab reel locomotives were used. Such a locomotive was equipped with a small motor driven hoist; the empty car would drift downhill to the face and the snapper would drag the wire rope in to the face and attach it to the loaded car; the locomotive remaining out on the entry. The motorman would then start the hoist and pull the car out of the room.

In the early 1900's considerable effort was expended on trying to get more draw bar pull out of the light locomotives then in use. In many mines the grades were excessive and the weight of the trailing load that could be pulled up these steep grades was very limited. The rack rail locomotive was tried out in order to overcome this objection. By suitable arrangement of clutches the motor could be arranged to drive the locomotive as an ordinary traction locomotive through the wheels, or as a rack rail locomotive through the rack gear, which engaged the rack rail on the hills. Fig. 5 shows a tandem rack rail locomotive. Inasmuch as the slipping of the wheels is the only safety device that really works, to prevent overloading of a locomotive, and since the rack rail drive could not slip, the electrical equipment on the rack rail locomotive did not have a chance to protect itself. Also maintenance on the rack rails was expensive and several years before the first World War practically all rack rail installations had been discontinued.

In the old days the insulation on the trailing cable of gathering locomotives was composed of rather poor material compared by present

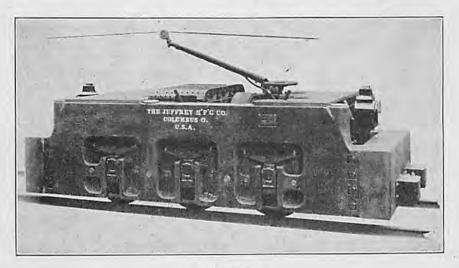


Figure 4.



Figure 5.

standards. This insulation was then covered by a braided jacket which wore out rather rapidly. This led several people to think about making a gathering locomotive which did not require trailing cable. Electric storage batteries had been developed to the point where their use became practical on mine locomotives about the year 1910. From the period of 1912 to 1923 or 1924, storage battery locomotives were very popular for gathering service. There was no trailing cable to bother with, and while they ran at slower speeds, if the haul was not too long or the grades too severe, they gathered just as much coal as the higher speed cable reel locomotives. In November of 1919 the U. S. Bureau of Mines set up a schedule for granting an approval plate for storage battery locomotives and to date it is the only underground electric locomotive which bears an approval plate of the U. S. Bureau of Mines. There are still a great many storage battery locomotives in use, particularly in gassy mines or where operating conditions are favorable to their use. With the introduction of rubber clad cable with tough long life jacket and improved cable reels, the cable reel locomotive seemed to regain its popularity. Also the use of mechanical loading, larger and heavier cars, and working in lower seams, all tended to give the cable reel locomotive an advantage in many installations.

In many so-called gassy mines it was desirable to use cable reel locomotives. This led to the development of what is known as the "explosion tested" cable reel locomotive. All electrical compartments such as motors, controllers, resistor cases, headlights, etc., are totally enclosed and built in accordance with the recommendations of the U. S. Bureau of Mines. When running beyond the trolley wire power is taken through a twoconductor trailing cable. All ground returns are removed from the locomotive frame and the machine runs on a full metallic copper circuit the same as a coal cutter.

The electric motor used in underground haulage has basically been the series wound, direct current motor. The basic design of such a motor is fixed. Between 1900 and 1910 the one change in electrical design was the introduction of interpoles. This gave the designer more latitude in motor dimensions and proportions. Most of the improvements in motor design have been of a mechanical nature. The earliest motors had cast iron frames. These were superseded by east steel frames. Many of the earlier motors used a ring winding, this was superseded by the drum winding using formed coils. All the original motors had the armatures running on bushed bearings. Many motors were destroyed due to bearing failure allowing the armature to rub on the pole shoes and grease or oil getting into the motors and soaking the windings. About 1908 some traction motors were mounted on ball bearings as an experiment. It was found that the ball bearings did not require near the amount of lubrication that the sleeve bearings did and that its life on the whole was longer. This meant less grease in the motor and less likelihood of poling, which greatly increased the armature life. Also since the ball bearing did not require as much axial length as the bushed bearing it enabled the designer to get larger motors in the same minimum gauge. The introduction of ball bearings on locomotive motors was one of the most important advances in motor design.

At about the same time rolled steel slabs began to take the place of cast iron for side frames and end frames. Cast iron did a very good job until the locomotive got in a bad wreck and the result was often a broken side frame. About 1915 or the beginning of the first World War locomotive design had pretty much settled down to steel side frames and end frames, armatures mounted on ball bearings, two and three motor locomotives with a motor hung on each axle driving through single reduction spur gearing. The standard speed for gathering locomotives was about 6 m.p.h. and for haulage locomotives about 8 m.p.h. Drum controllers were standard and only on special occasions were power brakes specified. Practically all of the locomotives that were sold thirty years ago are today still hauling coal, which speaks pretty well for a design that had evolved in a period of about twenty-five years.

During World War I the demand for coal rose to unprecedented heights. Many new mines were opened and the demand for electric mine locomotives was so great that all emphasis was placed on production of existing designs rather than improvements and refinements or new designs. In the period between 1920 and 1930 many refinements were incorporated in locomotive design but the same basic design in the main remained. One of the most important of these refinements was the adoption of contractor control to the larger mine locomotives. This system of control had been in use for several years on main line railway electrification and multi-car train subway and electrical lines. The space required for this additional equipment and the extreme variations in mine voltage

were obstacles, which prevented the earlier use of contactor control on mine locomotives. However, the development of contactors which would operate satisfactorily over a wide range in voltage, and the changing conditions underground which made it possible to use longer and wider locomotives, enabled the manufacturer to install satisfactory contactor control. This lessened controller maintenance expense and at the same time made more practical the use of larger higher speed locomotives. Locomotives having full load speeds of 10 to 12 m.p.h. came into use with loading per axle as high as 12 tons. Since the controller is no longer a limiting factor over the amount of power that can be handled by one master controller, any speed that is practicable for underground work may be used; and by connecting two or more units in tandem, locomotives of almost any weight can be furnished. As a matter of fact the limit now may be the amount of current that can successfully be collected from the trolley wire with a single current collecting device and the total peak load thrown on the power house when such large high speed units are operating fully loaded. A 40-ton unit traveling at 11 m.p.h. pulls about 2000 amperes from a 250-volt trolley. The conventional trolley wheel was not suitable for such loads and speeds. Considerable experimentation was done to improve the current collection capabilities of this device but the sliding shoe proved to be the most satisfactory means of current collection and was generally adopted for large high speed locomotives. The tonnage available from any given parting and space available on the bottom also tend to limit the size of trips it is desirable to haul.

Another development of this period was the wider use of anti-friction bearings in locomotive construction. The ball or roller bearing had been accepted as standard for armature bearings and it was only natural that its adoption to journal bearings should follow. The main advantage of course is not the slight reduction in rolling friction but the longer life inherent in this type of bearing. The anti-friction bearings have also been adapted to the suspension bearing, that is, the bearing by which the motor is supported on the axle. The main advantage to be gained by this construction is the longer life of the anti-friction bearing and the fact that the gear centers are accurately maintained with a consequent increased pinion and gear life.

Improvements have been made in the bushed bearing suspension construction so that the bearing surface is completely enclosed and the ends of the linings are made with labyrinths. By using a suitable grade of grease this labyrinth seal can be packed with grease, which prevents the entrance of sand and brake shoe dust. This construction greatly increased the life of the axle linings when compared to the old open oil-lubricated type.

As speeds and weights increased the matter of what type of spring suspension to use became increasingly important. Practically every manufacturer has used leaf springs, coil springs, and often times a combination of these two types. The same thing applies to the matter of equalizers, which came into general use on mine locomotives in the 20's. Some locomotive designers made use of complete longitudinal equalization such as shown in Fig. 4. Other designers used the tranverse

Mentioning this publication when writing Advertisers puts friendship into business.

or cross equalizer. The goal we all were striving for was to provide a locomotive which would ride smoothly over rough track and keep all four

wheels in contact with this uneven rough track.

As locomotive weights and speeds increased it required more effort and time on the part of the motorman to adequately brake the locomotive using hand brakes, particularly if the grades were severe. During this period the use of dynamic braking became quite popular where severe grades were encountered. The use of air brakes was generally accepted as standard on locomotive weights of 20 tons and over.

By the end of 1929 the standard haulage locomotive might be said to have a weight of 15 to 20 tons or two such units in tandem, a speed of 8 to 12 m.p.h., contactor control, anti-friction bearings throughout, fully equalized spring suspension and equipped with air brakes. Fig. 6 shows a 40-ton locomotive equipped with four 150-hp. motors and having a full load speed of about 11 m.p.h.

Since 1930 many of the thicker seams of high grade special purpose coal have been practically worked out, which means that it was necessary to work many of the thinner seams. Fortunately most of the low vein mines have comparatively wide track gauge so it has been possible to lengthen out the motors to get sufficient motor horsepower and at the same time make the locomotives lower, using the same basic construction of single reduction spur gearing with the motor hung on the axle. Another solution to the problem has been to make use of double reduction motors of smaller physical dimensions while still maintaining a high horsepower rating. As locomotives became lower the space available for air brake equipment became more of a problem. This brought about the introduction of hydraulic brakes, which provided power braking but did not require as much space for installation as the air brakes.

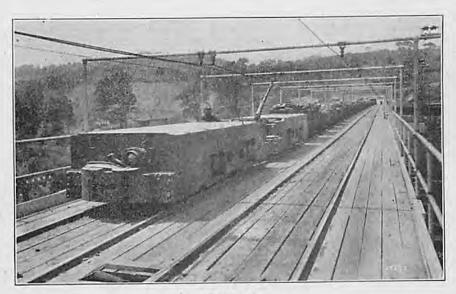


Figure 6.

There are now available gathering locomotives 23" high and 15 ton

haulage locomotives 26" to 30" high.

Previous to 1930, single shift operation was the accepted standard for coal mines. At the present time double and even triple shift is very common. In order to handle this more severe duty practically all locomotive motors today are built with Class B insulation, using glass, asbestos and mica instead of cotton.

Another common practice particularly on haulage locomotives is to

force ventilate the motors.

This brings us down to the present time. The basic haulage locomotive of today has two single reduction spur gear motors with Class B insulation and arranged for forced ventilation, all bearings are antifriction arranged for gun lubrication. The locomotive will have contactor control and be equipped with steel strip resistors. It will have power brakes and fully equalized spring suspension.

It is hard to predict what the locomotive of the future will be; but I will hazard a guess that it will be the same basic locomotive of today in which have been incorporated those improvements made possible by the advancements made in the general engineering field, especially in metal-

lurgy and chemistry.

* * *

Chairman Eubanks: Speaking of the old cast iron frames on locomotives in the past, we have in operation in our four or five mines in Southern Illinois twenty-three locomotives that are thirty-four years old. They are all of the sleeve type of bearings.

You would hardly know they are in the mine as far as down time is concerned. It is marvelous what some of our designing engineers have done with mine locomotives in the last ten years. We started from a five and one-half ton locomotive and worked up to twenty-four and a half tons.

Incidentally, our twenty-four and a half ton is a very fast one. It has a very fast motor. At top speed it runs two miles per hour. Of course;

it has a special job to do.

Now are there any questions you gentlemen would like to ask Mr. Beltz pertaining to some of the continuous trip resistance or horizontal hydraulic controls, on both the controller and also the brakes? May I hear from some of you? What is the matter with the Mining Electrical Group this afternoon?

Captain Nyland: May I ask if there is any definite way to use alternating current locomotives in a mine.

Mr. John S. Beltz: That has been proposed a great many times but inherently you are up against something that doesn't make the game worth the candle. On any main line alternating current electrification that I know of 25 cycle current is the maximum frequency used. Some European countries use 16 cycle current. Our standard frequency in this country except for one or two isolated sections, is 60 cycle. The frequency changer is rotating apparatus, which would have to be used instead of motor generator sets or rotary converters. When mercury are

rectifiers are used to convert the alternating current to direct current, all rotating conversion apparatus is eliminated. I am sure the mine electrician would rather take care of alternating current to direct current conversion apparatus and the simple direct current locomotive motor rather than frequency changers and the more tempermental series wound alternating current traction motor.

There are a few small metal mines that make use of 3 phase motors with double reduction gearing. Two phases of the 3 phase circuit are connected to individual trolley wires and the third phase connected to

There have been a few very small locomotives made using the repulsion alternating current motor. The repulsion motor has the characteristic that you can reverse it and vary the speed by shifting the brushes. It can be stalled on the line with the brushes in the neutral position like the old single phase printing press motor but motors of this type in general are not suitable for locomotive work.

Mr. F. E. Weissenborn (Assistant Commissioner, Illinois Coal Operators Association, St. Louis, Missouri): When did we get the first locomotive in Illinois?

Mr. John S. Beltz: I asked that question and the reply I got from the manufacturers was in the early '90's. I didn't get the exact date, but it was '91, '92, or '93 — somewhere along in there.

Mr. F. E. Weissenborn: About '92.

Mr. John S. Beltz: Somewhere along in there.

Mr. F. E. Weissenborn: That is right.

Chairman Eubanks: Does anyone else have a question on this paper? Mr. Beltz, we certainly thank you for the wonderful paper that was so well presented.

Chairman Eubanks: Our next paper is on "Improved Methods of Drilling High Wall Rock," by G. H. Kilpatrick, Mr. Kilpatrick, will you come to the rostrum?

Mr. G. H. Kilpatrick (Drilling and Blasting Superintendent, Fidelity Mine, The United Electric Coal Companies, DuQuoin, Illinois): Mr. Chairman and friends of the Illinois Mining Institute, I am happy to be with you. This is one of my first opportunities to be at a meeting of this kind.

I don't have a long paper here but will try to give you a few ideas on drilling from the time I first started out.

USE OF CHURN DRILLS FOR DRILLING OVERBURDEN AT STRIP MINES

By G. H. KILPATRICK Drilling and Blasting Supt., Fidelity Mine, The United Electric Coal Companies, Du Quoin, Ill.

I first started working with overburden drills in 1923 at the Pike County Colleries which was owned and operated by Gray & Williams of Evansville, Indiana. We had one Cyclone Drill which was equipped with a one-cylinder gas motor to operate the drill stem. To move this drill from one location to another we had to set deadmen and use a double block and line. We wrapped the line around a spool on the jack shaft three or four times, then hold to the end of the cable until the drill was moved to the next hole to be drilled. In order to turn the drill we had to set deadmen in different angles and use the block and line until it was turned on a new row of holes. We then got a new cyclone drill which still had a one-cylinder gas motor but which was geared with two wheels for moving on its own power. This drill was used for about 6

months and then the company contracted the drilling done.

This contractor bought 6 Loomis drills with four cylinder gas engines and equipped with Caterpillars on the rear and which propelled on their own power. I continued working on these drills until 1926, when I started working for the United Electric Coal Companies at Farmersburg. I set up the first drill at this mine and drilled the first hole that was drilled for the company at that time. We still had the Loomis machine in 1930 when this mine was abandoned and I was given a job as Drill Foreman at their Fidelity Mine at DuQuoin, Illinois. At the time I came to Fidelity mine the company had six Armstrong No. 29 drills. These drills were greatly improved over the Loomis drills in that they had Caterpillars on them 10-ft long and 14-inch treads, a 15-HP electric motor, wire lines for drill cables and all steel frames. These were very good drills and were used for five years to drill 6-inch holes. We then decided to drill a larger hole and equipped these drills with a set of tools for drilling a 9-inch hole. We bought 6-inch drill stems 16-ft, long and used 9-inch diameter bits which gave us more weight for drilling the hard rock strata at Fidelity Mine.

We used these Armstrong drills until 1939 when the company purchased the Bucyrus 42-T Churn drills which had an all steel frame with a 57-ft. telescope derrick. The Caterpillars were 14-ft. long and 36-inch tread, a 40-HP electric motor that handles a 33-ft. drill stem with a 5-ft. drill bit giving a total weight of approximately 4,000 pounds in the drill

tools.

We used screw jacks to steady these machines while in operation, however in most cases the drill was never setting solid on these jacks and we could not get a perfect blow on the rock. I then advanced the idea of using hydraulic jacks for leveling the machines and keeping them solid while drilling. So with the aid of our Superintendent, Mr. Eric Laurell, Mr. H. A. Reid, Vice-President; Mr. Kolbe, President, and Mr. E. E. Schooley, our Consulting Engineer, and our good friend, Mr. Robert Hepburn, our Purchasing Agent, we had Bucyrus Erie build the hydraulic jacks. These hydraulic jacks are the greatest improvement in the drilling operations that we have found. We also have the adjustable stem guides, another great advantage for drilling different depth holes.

It is a great pleasure for me to be at such a meeting as this, and I

thank you all for your time.

Mr. G. H. Kilpatrick: If any of you have questions I will be glad to try to answer them.

Chairman Eubanks: Do any of you gentlemen have a question you would like to ask Mr. Kilpatrick? I am sure that some of you gentlemen here in the meeting are interested in some of the things that they are doing there and we would enjoy hearing from you.

I believe they are all satisfied, Mr. Kilpatrick. I know that they have

enjoyed hearing from you. If there is nothing else I will turn the meet-

ing back to our President, Mr. Hitt.

President Hitt: Mr. Allen hasn't shown up this morning with his paper and I would like to ask if he is in the room now, If he is, we will hear it this afternoon as we still have a little time.

Before we adjourn our Secretary has some announcements to make.

Secretary Schonthal: If anyone wants a ticket or two to the football game I believe he can find them at the registration desk. Miss Brail told me a little while ago that she expected to have a few turned in. If you are interested you might inquire.

I would like to mention something about this evening. We are expecting to have a very big crowd and I recommend that everybody get down here promptly. I think you will all find you have quite a treat in store

for this evening. That is all I have right now.

Persident Hitt: We would like to start the dinner tonight as early as possible so we will adjourn now. I am sure that you are going to have a nice entertainment and that you will all be pleased with it.

The meeting will now stand adjourned.

The meeting adjourned at 3:15 o'clock.

EVENING SESSION

6:30 O'clock P. M.

The Friday evening dinner session of the Illinois Mining Institute convened at 6:30 o'clock in the Ballroom, Abraham Lincoln Hotel, Springfield, Illinois, Dean Charles M. Thompson presiding as Toastmaster.

President Joseph E. Hitt: Gentlemen, your attention, please. If you will all be seated we will start our program. Members and guests, in 1892, fifty-four years ago this month, this Institute was organized and received its charter.

Today we have the largest membership of any institute of its kind in the United States. The registration today up to six p.m. was 578, and we also received today 157 new members (Applause.) This makes a total of 1,208 members in the Institute. In addition we have received applications for eight new life memberships, so I would say that all is well.

I feel very happy tonight, although this is my swan song. I was thinking today and all afternoon, as I did last year, what this organization stands for. We can think of a lot of things, a lot of benefits we may receive from it, but most important of all, as I see it — and I reiterate what I said last year — is that it is the one opportunity in the year for all of us from all over the state, from companies that are even close together where the fellows never see each other, to get together here, fraternize, talk it over and exchange ideas.

I think it does make for us a great opportunity to do these things and it does make the Institute a great success. We hope next year to have our boat trip again. We expect that because of the government regulations we can't take as many people on the boat as we have in previous years.

That regulation may be lifted, but at the present time the capacity of the boat is only about a hundred people, so when the requests for reservations come in it will have to be a case of first come, first served.

I am going to turn the meeting over to another gentleman and he will take over the job of toastmaster. He was the former Dean of the College of Commerce at the University of Illinois. That identifies him.

He is also a coal operator, but more than that, today he is a gentleman farmer. It is my pleasure to introduce Dean Charles M. Thompson as your toastmaster. Thank you, gentlemen. (Applause.)

Toastmaster Thompson: You know, fellows, we can hear you talking there in the back of the room and it is quite annoying. Will you please come in and sit down?

I appreciate the honor of being toastmaster of this meeting. I always enjoy these meetings, except when I am taking part, because you fellows are always too durned smart for me. I am always afraid I will do the wrong thing and say the wrong thing.

You know with the doors closed, I am reminded of what Bo Zuppke said about one of our fair cities. He said it was the only cemetery he had ever seen with electric lights. I think, however, that we will be able to get on.

I started to say to you that I am always afraid you will outfox me somewhere along the line. There is always danger of one not saying exactly what he intends to say, or what he has in mind isn't conveyed

properly.

Let me tell you of an experience of mine once. (Cries of "Louder" came from the audience.) I can't talk louder. I grew up calling hogs but never called louder than that. I am going to tell you about an experience I had in one of our neighboring cities at about the time Iso-Vis was introduced by the Standard Oil Company.

Wanting to make conversation I said to the station man, "How is this Iso-Vis oil?" You will recall that this was being advertised as the

anti-sludge oil.

He leaned over to me and said confidentially, "Fellow, that is the best damned stuff in the world to keep the anti-sludge out of the engine."

Well, his intentions were good and so are mine. Now before we get started on the program as advertised we want to introduce to you some of the people up here at this table. I will, however, warn them in the beginning that all the speaking will be by people on the advertised program, so they are to get up and be seated.

The object of this is that if anybody starts anything when the meeting is over, we don't want any innocent people hurt.

Sitting down in front of this audience are five men. I was going to say they were helping to operate or that they are operating their coal mines, but after reading the evening paper I am not so sure.

Bale said they are new members of this organization and of course we want to welcome them. They are from our armed forces. I am going to read the names and I would like to have all five of them stand up and remain standing until all are introduced.

Apparently they are on the seaboard somewhere. I am not going to be responsible for it. We will take those up later. Bale says that they are outdoors. However, we do want some of the people at this table to stand up. Some of them have just been made members of the Board; some were reelected and others are here for different reasons.

One of the incoming members of the Executive Board is Loren Wasson, of Harrisburg. Another incoming member of the Board is Richard Baldwin, of St. Louis. Now this says that he is a new member of the Board, but certainly he isn't a new member of this organization. I have been seeing him ever since I have been coming which has been many years.

The next in line there is Mr. T. J. Thomas, of the Valier Coal Company, Chicago. He may be a new member of the Board, but he is not an

infant by any means.

Now I want to call attention to the fact that the next man I introduce occupies a unique position in the coal industry of the state. I hardly know how to pronounce the term but I will do the best I can. He is the

oldest of the "Jenkinses." He is one of three generations. We have a member of the second generation here, and a member of the third generation. The three Jenkinses are W. C. Jenkins, S. T. Jenkins, and W. J. Jenkins, II.

Next we have Fred Wilkey, of the Illinois Coal Operators' Association, Chicago. On this card I also have the name of Joe Hitt, but you

have seen enough of him.

We have a guest tonight from out of the state. I take it that he is not a coal operator, but he is not far from it. His work is about as hard as ours. He is Mr. A. L. Cole, business manager of the Readers' Digest.

At this time we also have Lieutenant Commander Fitzgerald, of the Coal Mining Administration. Also we have Captain Nyland, of the Coal

Mining Administration.

I am introducing one man who isn't here, but I have a feeling he has worked himself out of a job. That is Harry Moses, the incoming Vice President of this organization. He is unable to be here as he is in Washington at a conference on the coal wage situation. I am wondering how he is getting along.

Next we have Frank Moran, of the American Mining Congress, Chicago. Then we have Mr. William Bradbury, of Washington, D. C. It said "Mechanization" here. I was afraid I couldn't pronounce, so

I didn't use it.

We have a man here with whom I have been talking this evening. I talked with him although I had never met him before. However, he comes from my favorite spot — Duluth. His name is David W. Skillings, of Skillings Mining Review, Duluth, Minnesota.

Now I should go into a good deal of detail on the next introduction because that man may be a stranger to many of you, but I give you

Bale Schonthal. (Applause.)

The next gentlemen is R. R. Richart, of Coal Age., New York. If I have missed anybody get up and introduce yourself. I am not surprised if I have missed someone because Bale gave me these cards.

I have played cards with him a few times and I always get about the same kind of a deal. That is what he usually gives me. The good

cards are all out.

Now we have come here tonight, not to hear a lot of nonsense, but to listen to a speaker. Ordinarily on such an occasion it is proper for the

toastmaster to expand on the virtues and vices of the speaker.

I couldn't find any virtues of this man, so it doesn't seem fitting and honest and proper to talk about his vices. I am going to give you Kenneth McFarland, from way out in Kansas. He was born there, educated in New York and California and is making his livelihood in Kansas and elsewhere. Dr. Kenneth McFarland.

THE "U" IN BUSINESS

By DR. KENNETH McFARLAND Superintendent of Schools, Topeka, Kansas

I guess all the little fellows are through with this now. (Elevating the microphone) Dean Thompson, Mr. Hitt, Mr. Cole, Mr. Medill, Mr. Schonthal, head table guests and gentlemen; that was all the introduction I wanted.

I have been in this sort of thing enough now that I don't want any buildup. I want to get up before I am ruined. That is about all a man has a right to expect. I find if they take in too much territory and build you up too high, they invest you with virtues you don't have and you know everyone is going to know it in just a few minutes.

When they take in too much territory in the introduction you can't get organized, find your sense of direction and start out as you think it would. On the contrary it rather causes you to lose your sense of direction.

During the course of the year it is my privilege to speak to quite a wide variety of groups. Last year I talked for everything from the Live-Wire Insurance Men's Club up in Michigan to the Kansas Convention of Morticians and Embalmers, and that represents quite a spread. Every once in a while one of my good friends will say to me, "How can you speak to such a wide variety of groups representing such a span of business, professional and vocational interests, when you haven't amassed any too much evidence that you are any too well informed on your own business yet?" Now I would not pose as one who could successfully speak to so many different kinds of meetings. I think it could be successfully done by one person for several reasons. In the first place, personally, I never try to tell them how to run their business because I don't know. The government has taken that over anyhow. I don't know any reason why a person should pay taxes for that service and have to pay a fee for it, too.

The second reason I think one person might conceivably make a small contribution to most any meeting comes in the fact that the principles of organization are essentially the same no matter what business you are in. The Board of Education in our particular city has gained rather nation-wide recognition in the past few years for a remarkably simple thing. The Board merely applied good principles of good corporation government to the big business of running a school system. The biggest business in America, judged by any standards that you wish to judge it, is the business of public education. Yet it has been and is now being run in an un-businesslike way in most places. I don't mean dishonest. The cleanest-handed public bodies in America are the Boards of Education. But when we get to the record of business efficiency it is not quite so good. Standing committees are frequently spending money in opposite directions, and while each one concentrates on a small segment of the school

business, the big ideas sometimes go on by like an express train. Our Board of Education members said, "Why should we run the schools at all? We do not run the corporations where we serve as members of the Board of Directors. In the corporations we merely formulate the policies by which the business shall be managed. We employ professional management to manage in accordance with those policies and we hold the management responsible for results. Why don't we run the business of education the same way?" And they did. A very simple thing, but it worked so well that it brought our Board national recognition.

A couple of years ago the Chamber of Commerce in our city gave a dinner honoring the top seven executives of Goodyear Tire and Rubber Company. They had just gotten through spending twelve million dollars for a new tire plant in our city. We were entertaining P. W. Litchfield, Chairman of the Board, E. J. Thomas, president of the company and the next five ranking officials. E. J. Thomas, president of the Goodyear Tire and Rubber Company, which had 125,000 employees at that time, made a speech that night in which he said this: "People are asking us where are you going to get rubber? How are you going to do this? How are you going to do that? Let me say this to you. You give us good personnel and give us good organization and we'll answer all the rest of the questions. Give us those two factors and you can mark us off your list of worries. We can take care of everything else." I have never yet seen a business, and I have seen a great many of them, where that same rule could not be applied. Give us good personnel and give us good organization (and by good organization I mean, among other things, surrounding the personnel with the policies that will let it do its best), and we shall answer all the rest of the questions. Yes, the principles of organization are essentially the same no matter what business you are in.

But it is the third reason why one speaker might conceivably make a small contribution to nearly any kind of a meeting, that I should like to dwell upon for a little while today. That is that the human element is a much greater factor in anybody's business, vocational or professional success than we usually think. And if a person can comment effectively upon that fact he actually can add a little something to any kind of a gathering.

In the school system where I was six years ago, we opened up and dedicated a new trade school. If that new trade school has any claim at all to distinction it is not in its name, because they named it for me. No, the distinction of that building comes in the fact that we studied for three years before we built it. We studied for three years to determine what we wanted to teach in it. If we could answer about four questions we had the building. (1) What trades do we want to teach here? (2) To how many people do we want to teach these trades? (3) What kind of equipment and how much equipment would it take to teach that many people that many trades, and (4) How can be best house that much equipment for that many people and that many trades? Since this was a trade school, the "64-Dollar Question" was, What do people need to know to succeed vocationally? Is it a matter of skill? Is it a matter of skill alone? If not, what are the other factors?

We were amazed as we got into that study to find out how very rarely people fail vocationally because they lack skill. Actually, in better than nine out of ten cases where they failed, they failed for reasons which do not in any way pertain to technical "know-how." In the great south Chicago industrial district for a period of three years prior to the war, a study was made of all the men and women who get fired in a selected number of industrial plants. The purpose of the study was to find out why people get fired off of industrial jobs. In this particular study a little more than nine out of each ten people who were fired got discharged for reasons which did not pertain to skill. What were these reasons? Here are some that are high on the list. These are not necessarily in the correct order of frequency but all of them are high. These people were lazy, there is no skill whatever about that, just plain lazy. They had poor health, poor personalities and bad dispositions. They were dishonest. That was a frequent cause of failure. They were immoral. Strangely enough, immorality turns out to be bad business. These people were intemperate. Extreme intemperance is also bad business because it so frequently takes all the money a man can make and keeps him from making any more.

These people were disloyal. That reason was such a frequent cause of failure that it was stated in all capital letters. Loyalty is an oldfashioned virtue for which there is a greater market today than ever before, because the supply seems to be the smallest in our history and the demand is the greatest. Many years ago Elbert Hubbard said, "If you work for a man for heaven's sake work for him. If he pays the wages that supply you with your bread and butter, why work for him, speak well of him, stand by him and stand by the institution that he represents. I think if I worked for a man I would work for him. I wouldn't work for him a part of the time, I would work for him all of his time. I'd give him an undivided service or I'd quit. When put to a pinch, an ounce of loyalty is worth a pound of eleverness. If you must vilify, condemn, and eternally disparage, why quit your job and when you are on the outside, then damn it to your heart's content. But I pray you, so long as you are a part of an institution do not disparage it, not that you will damage the institution - not that, but when you disparage a thing of which you are a part, you disparage yourself." Hubbard called that horse sense, and the records show it is the kind of horse sense that will make you dollars and cents when you follow it.

"THEY TALK TOO MUCH." That reason for vocational failure was listed in all capitals because of its high frequency. It seems that a great many people exercise the right of poor judgment and called it the right of free speech. A great many people are so anxious to exercise their constitutional rights to say what they please, that they get it confused with their other constitutional right to make fools of themselves.

In this whole list, and for others I could add to it, there is not a word about skill. Skill is not something that can be substituted for, but it certainly is something that must be supplemented by other things. These other things will not take the place of skill, but skill will not take the place of them either. We have to have both.

The same situation prevails in the business field to a striking degree. We are making studies now which are montonous in the regularity of their results. People are not failing in business because they do not know their merchandising or do not know their production. In nine out of ten cases again, they are failing for reasons which do not pertain to anything but human failure. They do not know people. They don't know their customers, their public, their employees, themselves. How else would you account for the fact that the man on the one side of the street succeeds and the man on the other side fails, when the man on the other side is frequently not only selling the same thing but sometimes even the same brands of the same thing.

The same fact is strikingly true in the professional field. Nearly every investigation that has been made shows that the vast majority of professional failures are occasioned by weaknesses in the human equation. I do not have time to develop that particular phase in this connection, but I can stand on a mountain of scientific evidences. I ask you to accept this fact.

All of this leads us up to a conclusion which is both homely and profound. I hope you will think it no less profound because it is homely. It looks like before a man can be a good professional man, a good business man, or a good tradesman, that he must first just be a good man. It appears that he must be a pretty good man in general before he can start being a good man in particular, and wherever you find a man who thinks he can divorce himself from the job he is doing; where he thinks he can be one kind of a fellow and run another kind of a place; where he thinks he can build a wall between what he is and what he does; there you have a man for whom I can marshall all the scientific evidence in the world to show that the odds are better than nine to one against his ultimate and final success.

What kind of people are we going to have to be then in this rapidly changing world ahead of us. Please be sure we are not going to have fewer problems in the future, we are just going to have different problems. In case any of you have forgotten, we are now in that wonderful post-war world toward which we were looking during the four years of war. This is it, and it seems that we still have a few problems. I hope no one here is counting on any return to some sort of a mythical "normaley." We shall be following a much safer course if we develop ourselves into the kind of individuals who can succeed in a highly competitive and rugged world. What kind of people are we going to have to be to make it in any kind of business in these tough years ahead? Well, it appears that we are going to have to be large personalities. How shall we know these people? What are the qualities which we should strive to develop within ourselves? I am sure there are many people here this afternoon who are much better qualified to describe big personalities than I could possibly be. I shall, therefore, play the safe course and try to describe a few characteristics of these people upon which we could agree.

The first thing we must say about a big personality is that he is gracious. I like to put that one first because to me it is first. To me it

makes no difference what else a man has — if he is not gracious he is not big.

When big people have other people working for them they do not try to make it constantly obvious who is the boss. On the contrary, they like to get that completely out of the picture, if for no other reason than to permit their employees to relax enough to give back the most work for the money they are paid. Unfortunately, a great many people do not understand this. As soon as they get a title they think they have arrived. A title does not prove that man is a leader. It merely proves that he has an opportunity to be one.

It has been my privilege to tell groups of employees all over this country this thing: It doesn't take any ability to fire someone. It just takes a little authority. You don't have to have any particular gumption—just a title. When you get right down to it, you don't have to have any sense at all. Just sit in the right chair at the right time and you can fire the best man in the world. But it takes something to take the mediocre people and make pretty good people out of them. If you and myself can take the pretty good people and make mighty good people out of them, then they might have called the shot when they put the titles around our necks.

The second thing that marks big personalities is the fact that big people are not defeated by the yappings of little people. Someone has said that when you climb out of a rut you want to brace yourself for a lot of bumps. Big people won't stay in the rut so they do take the bumps, but it is how the bumps affect them that marks the difference between them and the smaller souls. Little men are flattened by the blows and they never get up. They stay down. We call that type a "stick-in-themud." Big people are moulded, tempered, and shaped by the same blows until they become those great, rugged giants that you see standing out separate and apart on every hillside. I have never seen a community so small that it did not have some big people in it. In fact, some of the very biggest people that I have ever known lived in very small places, and some of the smallest people I have ever known lived in very large places It isn't where a man lives, but it's how he lives that I am talking about. It isn't where he is, but it's what he is that marks the difference.

Time is such a limited product in this old world that each one of us has to decide what he is going to do with the portion that is dealt him. None of us can have a calendar so large that we will have time to do all the big important things we ought to be doing, and also all the ornery little mean things we should not be doing. So we have to make a choice. What are you going to do with your time? The answer to that question will determine very largely your caliber and stature in the final rating.

Finally, big people take time to be human. And I add very reverently, "God bless them for that." We do need that quality in American life today. Do you realize that in back of all the work that is done in this world there is a human motive? Without that, the work simply would not be done. Then in doing the work of the world if we forget to treat one another humanly, can we say we know what it is all about? We don't know the first thing that it is about. That is number one.

I am not trying to tell you today how to run your business, because I don't know and you do. You must know how to run your business or else you wouldn't be in it yet after these last few hectic years. I have not posed as one who knows the answers to the problems you are going to meet. On the contrary, I shall tell you very frankly that I do not even know what the problems will be, to say nothing of the answers. But the encouraging message which I bring to you is that it is not necessary for you to know the problems you are going to meet in order to have the answers ready, because if you will follow policies of the kind that abide and endure; out of those policies will come answers that are good enough when you need them. The thing I want to say to you is an extremely encouraging message. That is, that the old Golden Rule stuff is scientifically sound. It not only enables you to lead a much more pleasant life, but it is actually your best bid for success in any field of endeavor. If Hitler had won this war we would have a new order in which lying, stealing, and double-crossing were the vogue. But Hitler lost the war - the old stuff beat him, and you can count on it to beat down any opposition which stands in the road of the man who faithfully follows that policy through the years. This is the homely fact but the wonderful fact that I should like to leave with you.

You have been wonderful to me tonight. I appreciate it. It has

been a lot of fun to help you with your program.

I don't know what to wish you in closing. I would like it to be something very nice because you have been nice to me. I might wish you wealth or I might wish you health, or the good fortune that would caress you, but wealth might bring sorrow, health could fail tomorrow, so I will simply say, "God bless you." (Applause.) Thank you very much.

Toastmaster Thompson: A good many things are in my mind but I don't care to speak because I don't want to have an anti-climax. I suppose some of you might want to defend your Phi Beta Kappa key. I will do that some other time. I am just hoping that none of you know what it means.

However, I think I might add this one thing: You know that man from Stanford must have been well trained because I recall vividly a few years ago about the time he was a student, a faculty man of Stanford wrote a book on railroads.

It was reviewed in the American Economic Review and the reviewer ended by saying, "It is a good book, but it would have been much better

if the writer had ever seen a railroad."

I am going to turn the meeting back to Joe Hitt. As I do, I want to thank you for the courtesies you have extended to me tonight and that you have extended to me over the years. I only feel my limitations keenly. I wish that I might have been of more help. All right, Joe, it is all yours. (Prolonged applause.)

President Hitt: I cannot add a word to what Dean Thompson said about the wonderful speech we heard tonight. I think it should be an

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inspiration to all of us. I know it is to me. I am going to carry a lot of it home.

In fact, I made a few memoranda that I am going to tell my wife and kids about of what I have learned here tonight. I am grateful again for

being here for this alone, if not for any other reason.

Now I have a very pleasant duty to perform. Forty-one years ago I worked in an Association with Duncan Medill. Duncan Medill was the father of the Medill you know. Between the father and son I have been associated with them one way or another for forty-one years, so it is particularly befitting and it is a great pleasure to me to introduce our new president, Mr. Robert M. Medill — Bob Medill to us. (Applause.)

President Robert M. Medill: Gentlemen, I know that you have had enough speech making tonight. I just want to thank you all for the honor that you have bestowed upon me today. I am following a very, very good man and it will be hard to keep up with him. Thank you. (Applause.)

I am getting my instructions. That is how much I know about it. If there is nothing else before the meeting or unless anybody else has something we ought to hear, we will adjourn the meeting until our next meeting in the summer on the boat, when I hope to see most of you again.

The meeting adjourned at 9:30 o'clock.

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SHUTTLE CAR OPERATION UNDER ADVERSE NATURAL CONDITIONS

By FRED A. MILLER

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The scope of this paper is to discuss shuttle car operation with primary regards to the adverse natural conditions as encountered in the various properties of The Consolidated Coal Company. The title may, perhaps, lead some to believe that all problems in this connection have been solved with satisfaction but this, I assure you, is not the case because there are still many problems confronting shuttle car operation which lack the correct answers.

Our company operates five (5) mines in Illinois — four mine the No. 6 coal where the seam ranges from 6 feet to $9\frac{1}{2}$ feet in thickness. Two of these mines are located in Central Illinois where the seam is predominately level and the grades are long and gentle. The other two, located in Southern Illinois, are just the opposite with both long and short grades of considerable magnitude. The fifth mine operates in the No. 5 seam and lays approximately 40 feet below the No. 6, which averages 48 inches in thickness. All coal seams are underlain with fire clay varying in thickness from a few inches to several feet — this important will be discussed later.

Altogether we have 50 shuttle cars of two general types in operation and while it is not my purpose, nor my intention, to discuss the relative merits of each type of unit to the detriment of either any discussion of their use under varied conditions would be incomplete, in my opinion, without some reference to their respective capabilities.

The first type is storage battery propelled — two wheel drive and two wheel steer — with a fixed, flat conveyor throughout the length of the car comprising its bottom. This unit is not capable of discharging directly into a mine car or onto a belt conveyor without the use of suitable ramps or unless the track or belt is sufficiently depressed at the discharge point. Our usual practice is to discharge these units into an elevating conveyor from where the coal is loaded into a mine car. There is, of course, no problem with trailing cables here and as a result more than one shuttle car may be used behind a loading unit and all discharge their loads at the same unloading station with a minimum of trouble and confusion. A battery charging station equipped with suitable charging equipment and adequate space for extra batteries must be provided in the immediate working territory. This is sometimes considered as a handicap but we have found that charging stations can be moved readily

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and without too much trouble if they are built with that purpose in mind. We consider the battery type shuttle car a very useful and versatile piece of equipment in territories which are conducive to their use!

We use the second type of shuttle car, commonly referred to as the cable-reel type, in both high and low coal although the cars are built to suit the seam in which they operate. This car is a four wheel drive — four wheel steer — unit and is equipped with an adjustable elevating discharge head as an integral part of the continuous conveyor forming the car bottom. This discharge feature allows the unit to load directly into a mine car or onto a belt without the use of ramps in most instances and thus allows more flexibility in placing unloading stations. Here, however, the length of the trailing cable limits the area of travel from a given point with a single hook-up and this in turn requires more cable handling.

In the interest of clearness and for convenience these two types of shuttle cars will be referred to in the remaining part of this discussion

as the battery-car and the cable-car, respectively.

We feel that both types of cars have their place in our operations. Analyzing the adverse conditions effecting shuttle car operation we may first classify them into natural and man-made. The natural adverse conditions can be further sub-divided into

1. Bad or tender roof

2. Soft uneven bottoms

Excessive grades
 Excessive water.

yet all of these are merely components of the one big problem — haulage roads.

Haulage Roads

In my opinion haulage roads are the greatest single factor in shuttle car operation. Basically the shuttle car is nothing more than a large truck built for underground service. We are all familiar with the part good roads play in our everyday life and how impossible it would be for us to enjoy many of the things we now do if poor roads were the order of the day. Driving a shuttle car requires skill and judgment and driver comfort on a shuttle car is just as essential as driver comfort in a large transport truck. So, there being no built-in shock absorbers on shuttle cars to date, I think it behooves us to maintain our haulage road as straight, as smooth and free from obstructions as economically possible.

The man-made adverse conditions might be divided into

1. Actual operation of the shuttle cars

2. Maintenance

3. Power

and possibly many other subdivisions, but I shall leave most of these subjects for oral discussion!

Timbering

Several timbering plans have been devised for shuttle car operation under poor roof conditions — one plan is conventional where props are

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set on both sides of the haulage way that runs down the center of the room using cross-bars where necessary and collar bars with cross-bars at roadway turnouts. Another plan locates the roadway on the left hand rib with multiple rows of props set from the right hand rib out to the center of the room as required. In any event adequate space must be provided for safe shuttle car operation and we like to maintain 10 to 12 feet width for straight roadways and about 16 feet for turns. In bad top permanent entries we like to hitch steel H beams in the ribs if seam conditions permit, otherwise we endeavor to recess the legs in the ribs in order to decrease the chances of their being dislodged by the shuttle car.

Soft Bottom and Water

As previously stated — all our coal seams have a fire clay bottom and as long as this bottom remains dry and firm no trouble is experienced. In one mine which is dry with long gentle grades, we have used a section of 60# rail permanently chained to the rear end of the car, to act as a drag — this keeps the roadway in excellent shape as far as ruts and holes are concerned although occasional sprinkling and/or an application of calcium chloride to allay the dust is desirable.

At another mine, still under development, considerable water was encountered — our entry work was very wet and as the fire clay became moist and later thoroughly wetted. Only a few trips with the car reduced it to a regular "loblolly" too thick to pump with anything except a mud pump, yet too thin to shovel. It is not difficult to visualize how the condition became aggravated by the action of caterpillar treads on other pieces of equipment traveling the same roadway. Not only did the units become mired, but this mixture found its way past the best devised seals and fouled the gear trains in the wheels — made brakes ineffective — clogged the chain drives on the reels of the cable cars and damaged other less well-protected parts, including the controls until continued operation under such circumstances became impossible.

In order to circumvent this condition we started leaving a few inches of bottom coal in place. We soon found that it required 8 to 10 inches of bottom coal to keep the cars from breaking through and even then soft places occasionally showed up due to an unusual bottom condition or because the machine man misjudged and did not leave enough bottom. We tried filling these holes with mine rock, excelsior and even crushed road rock with very meager success and finally resorted to wooden roadways or bridges.

These were built of props or cross-bars laid parallel to the roadway as stringers on about 18-inch centers and after these were under-filled 2-inch thick boards of available widths were nailed securely across the stringers. This made a satisfactory temporary roadway for entry work and since we were moving along fast only a temporary roadway was required.

It has seldom become necessary to resort to bridges in room work mainly because most of the water seemed to have been drawn off in our entries and for the most part of the room floor held up well.

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Offsets in the mine floor made by the cutting machines offered still another proolem in maintaining smooth roadways. Concerted effort on the part of the management and cutting machine operators helped decrease the size of the offsets to a fairly satisfactory degree.

In addition to making the shuttle car more difficult for the driver to handle, rough roadways cause spillage and unless this spillage is cleaned up in short order there soon develops an intolerable dust condition in a dry mine or a sloppy, mucky roadway condition in a wet mine - neither is desirable.

For the most part, these haulage roads last for only a short time so their construction and maintenance is one of economics, but generally speaking, the better the haulage way the better the shuttle car operation.

Grades

Our first step in combating excessive grades is to operate the cars below rated capacity. This means more trips to produce the same amount of coal and is often uneconomical. Whenever we encounter grades against the load which completely exhaust the batteries in less than a shift we feel the cable car is to be preferred. Even here we have experienced grades which necessitated partially loaded cars. In permanent entries it was often necessary to grade as we went along - but grading generally lagged behind the operating territory. In room work we usually by-pass severe grades and head off the rooms at convenient points. It is sometimes necessary to change loading points before rooms can be worked.

Where the grades are in favor of the load good brakes are essential and our latest cable cars are equipped with a greatly improved type

air-brake.

Since all shuttle cars are equipped with rubber tires - tire care and maintenance is important. We have experienced no unusual tread wear but for a while our casings were injured beyond repair long before they should have been discarded simply because of side wall failure. This was not due to tire imperfections or overload but largely by carelessness on the part of the driver in running over obstructions, tools, etc.

At one mine seam characteristics were such that the center bench rashed badly leaving an overhang at the top and a protruding series of ledges at the bottom. In negotiating turns these protruding ledges snagged the casing side walls and damaged the tires to an alarming extent. Vigilance on the Management's part to keep the ledges clear and care on the driver's part eliminated most of this kind of tire damage.

Recently one tire manufacturer developed and recommends the use of what are called "shin guards" for sidewall protection. These consist of a circular metal protector about 3/2-inch thick which fits directly on the outside of the rim and shields the flexing area of the tire. We have such guards on some of the most recently built shuttle cars but our experience with them is not extensive enough to say more than that we believe they do help decrease tire damage.

Proper inflation is also important. In the case of the cable car air is furnished by a compressor mounted on the car itself. This also provides air for brakes, the booster steering aid and the discharge elevator. While with the battery-car a street-car type compressor mounted on pipe

skids, which act as the receiver, is provided and usually kept handy at

or near the battery station.

As previously mentioned, shuttle car driving requires skill and judgement. A good driver is an invaluable asset and can improve a poor operation by his own actions alone, while a poor driver can make the most favorable setup look terrible by the same token. In most instances mishandling is due to inexperience but we have had cases where deliberate mishandling required the driver's removal in order to keep the car running.

Proper maintenance — always in order — must be given to shuttle cars of any type. Present day controls for instance, are complicated and their maintenance requires the services of a first-rate electrician. Proper lubrication must not be overlooked but with multiple shift operation

this feature is sometimes neglected.

No shuttle car operates well without good power. The battery car must be provided with a battery of adequate capacity yet its size must be kept within respectable limits—first because of the dead weight it adds to the car itself and secondly because excessive weight and size complicates quick battery changes.

In the case of the cable car good voltage must be maintained at the nips of the trailing cable, otherwise the controls will not function prop-

erly and unsatisfactory operation results.

In closing I risk unnecessary repetition by stating again that, in my opinion, good shuttle car haulage roads are the most essential of all the factors entering into shuttle car operation and I venture the belief that before long we will have developed underground road maintenance equipment similar in many respects and used for the same purpose as our surface highway crews have in use today!

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MAINTENANCE OF UNDERGROUND AND SURFACE EQUIPMENT

By WM. BURNETT, JR! Electrical Engr., Peabody Coal Co., Chicago, Ill.

It is generally agreed that people can be divided into two classes; namely, promoters and caretakers.

The subject of maintenance of equipment assures me that I have been chosen as a caretaker; past experiences prove with certainty that I am not a promoter. The maintenance of equipment underground and on the surface is a large subject to discuss. There is no definite place a person can start, because any one phase is very closely related to some other.

Most men who are responsible for the operation of machinery—like other lines of endeavor—look to organization. This certainly ranks high in the essential requirements and must be regimented to work as a whole. We will therefore set organization forth as the first item to be considered. Closely related to this item is number two: the problem of ways and means of doing the necessary work; and probably as a third heading, the determination by the management as to the per cent of perfection of maintenance that is desired, or the percentage of perfect performance demanded.

Therefore, this discussion has been broken down into the following major parts:

- 1. Organization
- 2. Ways and means for doing work
- 3. Determination of degree of perfection to which equipment is to be held
- 4. Maintenance procedure
- 5. Problem of lubrication to insure life
- 6. Manufacturer's responsibility before and after equipment is delivered to customer

As a word of information, this paper is a concerted idea of many who deal with this subject and, as noted in the opening of many motion pictures, is not necessarily the ideas of those living or dead, even though there is some attempt to relieve personal grievance wherever possible.

The repair man can be likened unto the doctor; he is of little use unless trouble exists. The doctor if he is unable to solve his case, lets it pass to the great unknown, but the maintenance man has no alibi in repairing his problem; each and every one knows it can be repaired, and the good Lord cannot be expected to step in and save the day, as in the doctor's case.

The man doing the actual work is the one in which I am interested. I am interested in seeing that he has the tools to do a job, the *time* to do this job, and that he receives the *credit* for doing this job, other than the remuneration.

1. Organization

We will start with organization. You probably recall that this was said about the make-up of the Mexican Army: nineteen generals and one buck private. Regardless of all the planning of the higher-ups, we know that some one person has to do the actual work. This person who does the actual work certainly should not be the head electrician or master mechanic. I believe that this thought brings forth one prerequisite for the head of an organization: Pick out a man who knows how, and who has the ability to direct and instruct men under him and to get them to do the actual work. This head should not be burdened with routine duties. He should have time for planning, inspecting, instructing, and reminiscing on events and jobs of the present, past, and future.

The head of a maintenance crew has to show ability, in order to inspire his men. He should surround himself with key men specializing in different types of repair work. As an example, for an underground head man, we know that the successful chiefs have men who excel in locomotive repair, others in mining machines, loading machines, power generation, etc. If you break this down, thinking over the various divisions of work below, you will find seven or eight major assignments.

Years ago, with only locomotives and mining machines to be maintained below, and hoisting engines, shaker screens, and picking tables on the surface, the head of the organization could easily know the details

and requirements for all repairs.

The story today is vastly different. Without reviewing, we all know that complicated, important, and exacting repairs are necessary because of mine mechanization, both top and bottom. No one person can be expected to know all the answers or ways and means of bringing about continuous operation. The tendency is to pick out men as specialists.

For organization there are distinctive thoughts on how to arrange

the division of work.

Years ago repair men below worked out of a central point, being called to troubled locations. No one location had enough equipment to require continuous care. Then, with the coming of mechanization, it required that one man, or sometimes two repair men, stay in a given territory or location to enable more rapid correction of trouble and to check on mechanical and electrical operation.

It appears that the general tendency now is to plan the bottom

organization as follows:

1. Chief Electrician

- Two Assistant Chief Electricians, or a man in charge throughout the twenty-four hours
- 2. Key Man
 - a. Locomotives
 - b. Mining Machines
 - c. Loading Machines

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d. Power

e. Wire men, bonders, telephones

f. Supply men

 Section repair men capable of replacing unit assemblies and making minor repairs, but at the same time being able to call on the shop for expert or additional help in case of major difficulties.

To continue, with excerpts from men who have assisted in gathering

information on this subject, I quote:

"Men trained for maintenance work have several jobs to do; namely, they must be able to operate electrical machinery, inspect, test, construct, and do inside and outside work well. Some men are good at almost anything you put them on, and these as a rule will find a way to do the work and can lead others. Other men, however, are not so well fitted for maintenance work. These can be put on some job found by trial and in a great many instances they become quite efficient in that particular job. There are men who do not want to accept any responsibility. The right and wrong way of training men rests to a great extent with the foreman or head electrician. Sometimes he fails to show the man how a job is done and how it is safe to do it that way. The electrician or foreman in a great many cases must take the first step.

"Training men for work is, in my opinion, one of the most important questions confronting the coal mining industry today if they intend to reap the benefits of mechanization. My idea is that mining companies should take the initiative in a program for the training of their employees: if possible, with the assistance of some outside source; if not, through their own endeavor. Of course, after we train these repair men, there is nothing to keep them from leaving us for other employment. But, taking it all in all, the improvement in their work as the training goes on will be to an advantage, also the majority of them are going to stay where they were trained."

While on this subject we should take a lesson from large manufacturers who a long time ago arranged for school training, test and shop work for their incoming employees — thereby giving them the training required and needed. Any manufacturer will tell you it has paid large dividends in eliminating loss through the trial and error system of letting

each employee shift for himself.

Improving the ability of maintenance men and determining how they should and could be trained, brings up the possibility of a central shop for a system of mines. Of course, the central shop again presents a problem of transportation of equipment back and forth to the mines. However, the present trend, after many years of argument, is to send certain repairs—either electrical or mechanical—to foreign, outside shops, in order to obtain a better, more workmanlike job than can be done at the mines, even though the mine top shop is above the average.

Only through organization and loyalty, and determination not to be licked on this maintenance problem, have the various mine crews finally molded themselves into a working team. Most of the credit for this goes to the top sergeant—the chief electrician, and little if any to the generals. The organization below has been assisted some by the necessity

on top to maintain and keep in repair new, complicated, and expensive preparation plants. Sympathy brought about by similar problems has made for a working unit, both top and bottom, that surely did not exist years ago.

2. Ways and Means for Doing Work

Now let us look into the subject of ways and means of getting the

organization to work.

So far little has been said about anything but underground. Years ago the bottom problems and top problems were connected only by the hoist shaft. That, however, is not true today. The top foreman and his organization have been called upon to assist in major repair jobs and rebuilding programs. We follow the old setup. Our shops on top as a rule are superior to those below; therefore, when doing a major job, we pick out the place most likely to get it done — together with the advantage of better tools, and, as a bottom man would explain, it gives them a better chance to "holler" about when and why the job is unfinished.

This then throws the underground men, especially the head of maintenance, in touch with master mechanics and top foremen. Major jobs of mine repair and rebuilding go to the surface, and as a result, the head man on top begins to build up specialists on locomotives, mining machines, loading machines, etc. As time goes on, it is noticed that the top

organized personnel is patterned after that of the bottom.

Strange as it seems, but running true to form, mechanization came to the mine underground before it came to the surface. Expensive units were purchased and put to work underground, placing undue responsibility on the maintenance organization below, and only God knows the cost of educating this force by the cut and try and failure method of repair.

A central repair shop is concentrated power. It is the ideal arrangement, usually with more and better equipment and better working conditions, and is essential in overhauling modern precision machinery. It leads to specialized workmen, with a consequent saving of man-hours.

Here in the central shop we find training possibilities and chances for apprentices before transfer to mining organizations. In this way we are able to determine aptitude, ability, and energy, so that when we place a man on a job, we can expect to receive maximum benefits for wages paid.

The central shop can be enlarged upon, but before leaving the subject,

there are several points to be cited:

It is a place for training men — a very desirable need.

It is a place for better jobs, both electrical and mechanical.
 It is a place for more accurate records, relative to costs, etc.

 It is the machine unit build-up location with skilled machinists, machines, etc.

It is not hampered by the use of its men for operation or directly getting out coal.

6. It should not be a production center for repair parts.

It should be other than single mine control and not even on the property. An organization, head and helpers, needs mental tools — probably a smattering of arithmetic and mechanics. It also becomes necessary to give animate tools to the repair men, such as hammers, chisels, wrenches, etc. There are several ways to repair or make ready to operate a machine or unit. Some men are rapid at makeshift; others are slow or appear slow to the management because of the repair man's anxiety to do a nice job — and I mean Webster's definition of nice.

Under the ways and means subdivision of this maintenance subject, besides suitable small tools, there is a need for larger tools such as adequate main shop and auxiliary repair spots in the mine, which enable the repair men to have the facilities of crane hoisting, machine tools, etc. In the past because a great portion of our workman's energy had been expended in physical lifting or continuous muscular effort, by the time he was ready to get at the heart of the trouble, he was exhausted and required rest. One of the things that has helped recently is the idea of assembly unit change, as follows:

There is now a great tendency in case of armature failure in a locomotive, to change the entire motor for one already assembled and tested out, rather than to change the armature only. Some attempt along the correct lines was to have the armature assembled with end frames and bearings, to hurry the job in case of failure. Even though this is done. you still have the problem of brush holder adjustment, field lead connections, and possible damage of winding. It appears - and has been proved — that we can change an entire motor unit just as fast and with less chance of damage than changing an armature with split-frame field case. The motor has been assembled on top under suitable conditions not hurried in assembly, and tested electrically, so that the repair man has the maximum assurance the job will roll when completed. Unit assemblies as provided in total design have been a great help and a decided advantage to mine men. I believe that several of the leading manufacturers of mining equipment have caused this to come about; however, I do not want to give them all the credit, because many repair men had the idea years before the manufacturers made a move in this direction.

It is recognized that a man working underground, regardless of facilities, is at a disadvantage as compared to working on the surface. Therefore, the underground man should be a fitter or connector of assembled units only, the detail repair of the assembled units to be taken to a mechanic or skilled machinist who has the time and understanding of a nice job.

Rather than discuss at length the subject of ways and means of maintenance of surface and underground equipment, I wish to refer the organization to an excellent paper delivered before this assembly in 1939, on Machine Maintenance Practice, Procedure, and Records, by Mr. Ernest Prudent of Bell & Zoller Coal & Mining Company. This I believe is a masterpiece and the expression of a true maintenance man's desires—if it can be accomplished.

Every job of repair has certain characteristics, but there are a few fundamental ways of attacking the job:

- 1. Educated guess or decision on work to be done.
- 2. Whether new or reconditioned parts are to be used.
- 3. Detailing the proper person to do the work.
- 4. Completed job and inspection thereof.

Men on rebuilding of machinery, etc., should not be disturbed for normal repair work. There is too much time lost in jumping from one job to another. This other work could be done by someone less competent than the one required for the rebuilding program. Jumping around from one job to another often gets men aggravated, especially those who are really interested and want to do something to make a showing.

The use of labor-saving tools is all well and good if used by the right men, but they are a waste of time and money if used by men who are awkward and who have only one way of doing a thing, and that the old way. Labor-saving tools as a rule fit only into production jobs and are not of much benefit to a maintenance man whose jobs are ever changing.

Determination of Degree of Perfection to which Equipment Is to be Held

The third part of this discussion is the determination or desires of the management on how near perfection they wish the equipment to be held. This of course brings in a money problem. As was once said, anyone can keep a thing going if he is furnished with new parts at all times; but a maintenance man who can use the old parts to the maximum condition of wear, and keep the machines running, is the one in demand.

There no doubt is a standard value of perfection of any machine. This is a human decision and has to deal with ability to judge how far to allow depreciation so as to eliminate failure. Also, it is necessary to judge when to spend money to prevent failure. No doubt supply rooms are overloaded with items, stocked by the right and wrong judgment of the mine personnel, including Superintendent, Supply Clerk, and Head Electrician.

Fear by the underlings of criticism, because of the mandatory attitude of the heads, that equipment must operate at one hundred per cent perfection, has caused overstocked supply rooms, with slow turnover of material.

Probably the one lesson along this line should prove the intelligence of this one hundred per cent operation idea.

You know cost does play, or will in the future after we get out of this spending spree, an important part in determining what per cent of perfection of equipment is wanted. When it becomes necessary to reduce costs, then there will be a tendency to allow equipment to depreciate to a lower value, therefore with less assurance of one hundred per cent operation. Strange as it may seem, the same people or authorities who run this risk during tight financial times are the ones who change personal automobiles every year, even though the near past war effort has proved their judgment very bad. If we had a sales force in the mining machine business as effective as the sales forces built up by the automotive industry — where they can sell an individual a new machine when the one in use is only five per cent depreciated instead of fifty per cent (no reflection for this on the author of the Blue Book Value) — then we could operate at a one hundred per cent time, with a reduction of maintenance, and with the exception of a couple of flat tires at intervals.

When the day comes that we will trade in mining equipment with the same percentage of depreciation that the automotive industry recognizes — thereby classing as obsolete a year-old model — then the maintenance problem both underground and surface will be a boy's job and it can be expected to obtain this one hundred per cent assured operating time.

4. Maintenance Procedure

Throughout the beginning, I doubt whether or not the subject of this paper has been considered. Therefore maintenance procedure should be given some thought before we leave this discussion.

Maintenance is work, performed manually or mechanically.

Manual maintenance is the proper use of tools, which enables replacement of worn or discarded parts due to damage.

Mechanical maintenance can be broken into three fundamental parts:

- a. Machine work lathe, drill, milling machine, etc.
- b. Welding work, which requires as a rule machine work.
- Metal spraying a branch of welding, which also requires machine work.

It is at this point that it is necessary to decide upon maintenance possibilities, and, as mentioned before, to determine the degree of perfection to which a machine is to be held.

If the problem is to be solved by the purchasing or stocking of new repair parts, then the supply room becomes all important. Because of the wide variety of machines - cutting, loading, haulage, etc., with numerous types of the same machine, the stock room becomes a sizable operation at any property. However, this supply should not be the first line of defense. If the problem is to be solved by the ability of mankind and mechanized repair, then a suitably equipped shop on top, and as Senator Claghorn says: I say on top, should be provided. It will of course be necessary to refer to the stock room, as it cannot be eliminated if we are to carry on work in the shop; and it is for this reason that the main shop should be on top if the supply room is on top - otherwise, the supply room should go below if the shop is below. I still wish to refer to the top shop as being the major institution rather than a shop below. A shop on top is fixed as to location; if below, it requires moving as the mine expands or needs to be broken up into more and smaller shops to be placed in the various mine sections. It so happens that at mines with washing and preparation plants, all the work is not below, as in the past, and as the bottom crew thinks. It would be unreasonable to

maintain two fully equipped shops—one on top and one below. If the main shop were below, then certain repair work would have to be sent from top to bottom. This could be done, but the extraordinary cost of building a large shop below and the fact that over thirty-three per cent of the work is now top work, causes me to recommend that the shop be on the surface.

This, however, demands a way to get larger equipment needing major repairs to the surface, and that is some job around the average mine. If the head electrician has worked and made possible a hoisting job of equipment, it takes only the man cleaning the sump or repairing the shaft at night to defeat well-laid plans.

A few far-seeing souls have solved this problem by dividing the coal shaft from the material shaft, and have even gone so far as to make the material hole a slope, so that equipment, as a unit, can be lowered into the mine without disassembly and reassembly. All this has to do with maintenance, because a great percentage of the immediate trouble with new machinery lowered into the mine, requiring disassembly and reassembly, is caused by inadequate provision and time or know-how in the reassembly period.

So far maintenance has been thought of as an underground subject. By comparison, the top has called for attention. Recent installations of preparation plants have required a review of necessary jobs. Many years ago most pumps of any size and importance were located underground. The pump man below was an individual in his own right. *Today* the top in many cases handles much more water than is handled below. Skilled machinists are required because of the transition of power drives from open gearing to complicated antifriction bearing speed reducers. Unit machine assemblies are being developed for top work, with the same idea in mind for replacement as has been developed below.

As much as the writer has tried to stay on the subject of maintenance, he finds himself drifting off the beam and talking about allied problems.

The program of periodic rebuilding practiced by many is to be commended, as it has proved successful. Many ideas and improvements at the rebuilding time have given us better equipment because of the advantage of long period tests, which the manufacturer is unable to prove out.

It is recalled that years ago with locomotives and mining machines as the only units below, all the alibis on low production were, as a rule, heaped upon the undercutting machines, sometimes the locomotives. It has been interesting to watch the alibis in the last twenty-five years. With the coming of pit car conveyors and power loading machines, there was a gradual shift of alibis to the new equipment. After the loading machine, the pneumatic mounted transfer was developed. Now pneumatic mounted cutting machines and shuttle cars hold the limelight and all alibis refer to them. This must prove that the manufacturers never do anything exactly right and that the reduction of delays on long time operated machines has been brought about by the mine personnel. Therefore the alibis on old equipment pass into oblivion. At this point I wish

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to apologize to the manufacturers for the aforementioned statement, but I did want to get this in the record. Needless to say, it is easy for those not having ability to promote or build, to criticize a machine after it is built. This proves the caretaker in me.

To conclude the subject of maintenance men, I believe that their work should be divided as follows: the installer of units, requiring little mechanical ability; and the assembler of parts to make up units, which requires the maximum mechanical ability and expert experience.

Certainly the maintenance man should not be required to use rebuilt, repaired, or reconditioned parts if this procedure has reached a point where the part should be junked and new parts used.

5. Problem of Lubrication to Insure Life

It was the request that some mention be made on lubrication in this paper.

This is a delicate question to bring up at a meeting like this, but we all know that the life of machines is greatly dependent upon lubricants. Lubrication years ago was a never-ending vigil. Each and every moving bearing or frictional contact requires either oil or a grease. Grease is, and has been, the lazy man's method of lubrication. Grease only increases the time delay in supplying additional lubrication.

With the coming of inclosed units and antifriction bearings, the lubrication problems have lessened. If and when oil instead of grease can be used, then many of the troubles of the past will cease to exist.

From my past experience on lubrication, do not ever become so lazy on the lubricating problem that an attempt is made to install systems lubricating from one central point. The so-called "greaser" is one of your best inspectors. Lay out a route for him, time his visits to certain points, and he is one of your most useful employees. This has proved out on top, and if it were not for starting an argument, I would recommend it below.

Regarding the dispensing and use of oil below, I am in hopes that some day we may have package lubricants. The automotive industry is to be given a lot of credit for the know-how and for demanding canned oil at service stations. Of course, one reason was to eliminate contamination; the other, to give a definite proof to the general public that they were getting what they paid for.

For years several companies have attempted to keep track of lubrication costs, both below and on top. Transfer of lubricants as practiced around mines gives the greatest opportunity for contamination regardless of care. By the purchase of packaged oil (tin containers — size, one quart to three gallons) at a higher cost, it is the belief of the writer that the saving would be noticed in the reduction in wear now brought about by dirty lubricants. Coal mines are the greatest wasters of lubricants. We should ask the steam railroad companies how to save on this problem. Lubrication is one of the chores we least understand, but all of us seem

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to know more about it than anyone else. I for one would like to see some oil company step forward with unit-container lubrication, rather than trying to sell our purchasing department in tank car lots.

6. Manufacturer's Responsibility Before and After Equipment Is Delivered to Customer

Manufacturers certainly play a most important part in a discussion on maintenance. It is their ability to design and build that puts grey hairs in a repair man's head. Manufacturers can be very helpful by furnishing books of instructions pertaining to the operation of the machine, the making of repairs, performing tear-downs, putting assemblies together, and giving methods and points to watch for in order to obtain a finished job. This printed instruction should not follow production shop practice, but should refer to the methods applicable to the job at the mine. Many ways and procedures of repair are changed by mine men because the manufacturers' shop practices cannot be used. As an assistance to mine maintenance men, most of the manufacturers have service men frequently visiting the mines and giving useful and willing help in solving some of our problems. These service men are held in highest esteem. Assuming that the manufacturer pays for this service, often this service man who has the closest contacts, receives the most negligible consideration from the manufacturer's engineering department. It is for this reason that I believe a few of the designing engineers ought to fill the service man's shoes for a time. They should be compelled to repair and get to some of their slap-happy designs. Gentlemen of the engineering and designing profession, I hasten to apologize, but I did want to put this point in, if not over.

Conclusion

In conclusion, and as stated in the foregoing, the remarks in this paper are not entirely of my own making. It has befallen my lot to assemble them and divulge the repair or maintenance man's viewpoints.

I assure you, and as many of you know, that the maintenance of equipment would be a dull business for a promoter. Only a fool willing to work hard and for long hours would be caught at this kind of job. There is, however, a great deal of satisfaction in seeing a mechanical wreck roll again, and in some small sense we as repair men enjoy the same satisfaction that a doctor does when his patient is well again.

Reprinted from Coal Age, January, 1946

BETTER TRACK THROUGH TURNOUTS AS TRANSITION ELEMENTS

By NORMAN B. GURLEY Civil and Mining Engineer, Huntington, W. Va.

"Where do we set the frog?" might equally well be the title of this article. It is a question that often confronts mine and industrial-plant operating and engineering offices when the objective is the best possible track. In this article I am attempting to approach it by considering turnouts as transition elements, thus borrowing from the calculation procedure for the railway spiral. The methods that will be suggested eliminate rough graphical solutions, which often are disappointingly inaccurate. It also will be noted that they are the key to more intricate track layouts, such as wyes and the like.

The information in this article has been prepared primarily for the use of engineers charged with laying out and installing trackwork and therefore assumes a working knowledge on the part of the user of the fundamentals thereof and the mathematics of circular curves. Only turnouts made up of straight frogs and switches are considered, since, because they may be laid either right or left and to a considerable extent are stock items with the manufacturers, they tend to wider use and avail-

ability, as well as to greater ease of replacement.

The "center-line-value" calculation methods given herein are accurate and universally applicable irrespective of frog numbers or curve radii and, it is hoped, will be found useful in standardizing track-layout procedure. They are applicable only to turnouts from straight track.

For convenience in calculating, and for practical considerations in laving out in the field, all the dimensions incorporated in the formulas hereafter given are expressed in feet and/or decimals thereof. All manufacturers' information, including track gage, should be reduced accordingly. It is suggested that when dealing with short-radius turnouts the user have in addition to the appropriate manufacturers' trackwork catalogs a copy of "American Recommended Practices - Frogs, Switches and Turnouts for Coal-Mine Tracks," published by the American Mining Congress, Washington, D. C., under date of July, 1936.

Where no special considerations are involved, a good track installation will present, as nearly as possible, a uniform radius of curvature through the turnout itself and the subjoined lateral curve. To this end, attention

is called to the following facts:

For any straight frog and switch turnout, one theoretical or "replacement" radius and only one can be drawn joining the principal and frog tangents, which also will be tangent to the latter at a predetermined distance beyond the heel of the frog.

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Selected radii for A.R.E.A. turnouts taken to nearest even minute of degree or curvature. Organizations are abbreviated as follows: American Mining Congress, "A.M.C."; West Virginia Steel & Mig. Co., "W.Va. S.&M."; American Rallway Engineering Association, "A.R.E.A." Frog angles are purposely shown to nearest minute on relatively short radius curves. . (Col. 10) no allowance required for joint-bar lengths on long-radius curves.

This theoretical or "replacement" radius always exceeds and therefore is inappropriate to the center-line radius of the curved portion of the turnout under consideration. For proof of the foregoing statement, two examples are given below, with basic data from Cols. 2, 3, 5, 6, 13 and 16 of Table I:

No. 2 TURNOUT, 42-IN. GAGE	
Selected radius	20.00 ft.
Theoretical Radius:	
8.86xCot. 14 deg. 2 min	35.45 ft.
4.17÷Vers. 28 deg. 4 min	35.46 ft.
No. 5 TURNOUT, 42-IN. GAGE	
Selected radius	150.00 ft.
Theoretical Radius:	
22.50xCot. 5 deg. 42½ min	225.09 ft.
4.45 ÷ Vers. 11 deg. 25 min	224.91 ft.

Hence, if an arc of the lesser and appropriate radius, with a central angle equal to the frog angle, be drawn to satisfy the desired conditions adjacent to the heel of the frog, this arc will terminate in a tangent parallel to the principal center line and offset a determinate distance on the turnout side. This offset, hereafter referred to as the "shift," together with location in the parallel tangent of the point of curve of the appropriate radius, is determined by a later given method of comparison of rectangular coordinates.

If the circular curve that adjoins the turnout is not shifted (i.e., is drawn tangent to the principal center line) a sharper turnout must be used. Some examples are:

Selected	Appropriate	Resultant Frog
Center	$Frog\ If$	If $Curve\ Is$
Radius	Shifted	$Not\ Shifted$
25 ft.	No. 2	Impracticable
60 ft.	No. 31/2 or 3	No. $2\frac{1}{2}$ or 2, any gage
100 ft.	No. $4\frac{1}{2}$ or 4	No. $3\frac{1}{2}$ or 3, any gage
150 ft.	No. 6 or 5	No. 4, 36- or 42-in. gage, no wider; or
		No. 3 ½, any gage

The test and/or proof of this statement is as follows:

 $\begin{array}{c} \text{If} & \frac{\text{R. vers. Frog Angle}}{\text{Sine Frog Angle}} \end{array}$

is exceeded by Ga. x Frog No. + Theo. Pt. Len. + 1 ft., the turnout cannot be installed tangent to an unshifted curve of that radius.

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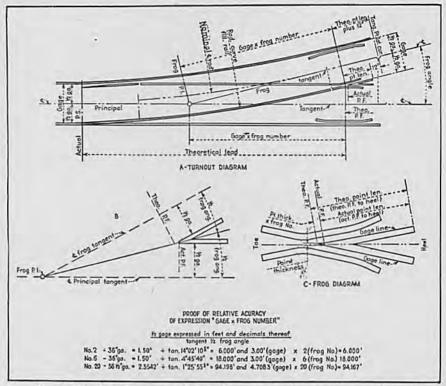


Fig. 1-Specimen turnout and frog diagrams showing the elements involved.

Selecting the Turnout

After selecting the radius of the circular curve to be used, proceed as follows:

- 1. Choose from a manufacturer's catalog a straight frog and switch turnout of the proper gage and rail weight the center-line radius of the curved portion of which most nearly corresponds to the radius of the selected curve.
- 2. Calculate the distance along the center line of the frog tangent from its intersection with the principal tangent (hereinafter called the "frog P.I.") to a point 1 ft. beyond the heel of the frog, as follows:

Multiply track gage expressed in feet and decimals by the frog number chosen in accordance with Item 1. To this add the distance from the theoretical point of frog to the heel thereof as determined from the manufacturer's catalog data (or measured on the frog itself) plus 1 ft. (see A, Fig. 1). This 1-ft. allowance is made to permit the use of straight splice or angle bars at the heel of the frog and also recognizes the fact that rail cannot be curved in the field with an ordinary bender less than 12 in. from the end. The 1-ft. allowance can be increased to 2 ft. or as

desired. However, the tabulations herein are based on 1 ft. except as noted. On long-radius turnouts, this 1-ft. allowance becomes meaningless and should be omitted. For proof of the relative accuracy of the expression "gage times frog number" see B, Fig. 1.

3. Multiply the distance obtained under Item 2 by the sine and cosine of the frog angle to obtain the coordinates X_t and Y_t of the point 1 ft. (or as determined) beyond the frog heel as referred to the frog P.I.

4. Multiply the selected radius of the circular curve to be used by the versed sine and sine of the frog angle to obtain the coordinate X_c and Y_c

of a point on the circular curve as referred to its P.C.

5. Since the points X_c and X_t must coincide to have the arc tangent at that point, the circular curve must be shifted away from the principal tangent a distance of X_t minus X_c , or "shift," and its P.C. will be in a parallel tangent and pulled back a distance of Y_c minus Y_t , or "pull

back," from the frog P.I.

In certain cases Y_t may exceed Y_c, in which case the curve P.C. will fall Y_t minute Y_c ahead of the frog P.I. (see Table I for typical examples; also Fig. 2). It is suggested that the user prepare a tabulation similar to Table I, which will be found very convenient in assembling the necessary information and will serve as well as a permanent record for future reference.

6. To determine the frog location with reference to the lateral-track center line, since the location of the principal P.I. of the lateral-track center line with the principal tangent always is known, calculate the distance back to the frog P.I. per the diagrams covering the three probable conditions at the bottom in Fig. 3. The "known" is always the distance calculated under Item 2 plus the semi-tangent distance of the curve selected, which corresponds to the total central angle less the frog angle. Thus, A-B equals

 $\begin{array}{c} \text{Item 2 Dist.} + \text{R Tang} \ \frac{\text{Total} \ \Delta - \text{Frog} \ \Delta}{2} \end{array}$

Solve the appropriate triangle for A-C, thus determining the distance from the principal P.I. to the frog P.I. Thus, the theoretical point of frog is located at A-C less gage times frog number from the principal P.I., and the actual point of frog at A-C less gage plus frog-point thickness times the frog number from the same point.

Field Layout

Underground — Measure back from the principal P.I. a distance of A-C plus or minus "pull back," as the case may be, and set a temporary point in the principal tangent. From this temporary point set over at right angles toward the curve center the "shift" distance to set P.C. Knock out the temporary point and establish a parallel tangent through the P.C. Then follow usual curve layout procedure.

On the Surface — Measure back from the principal P.I. the distance A-C and set frog P.I. Set over the frog P.I. and turn frog angle. Intersect the frog and lateral tangents, thereby locating the secondary P.I. (Point B, Fig. 3). Set up over this point and measure the semi-tangent

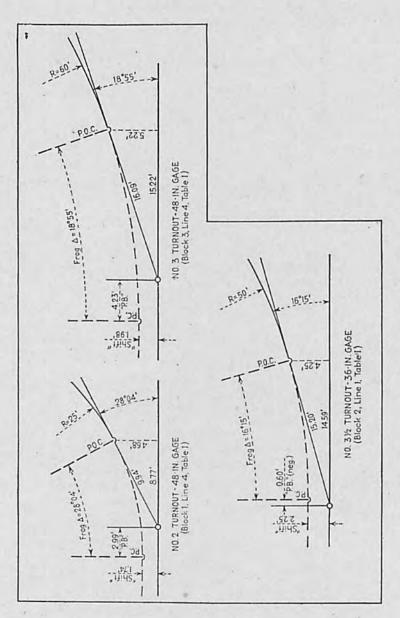


Fig. 2—Examples of "shift" and "pull back" in turnout installations based on data from Table I.

distances of the body of the circular curve to locate P.O.C. at or adjacent

to the heel of the frog and P.T. in lateral tangent.

Where less precision is required, set up over the frog P.I., turn the frog angle and measure forward the distance calculated under Item 2 to set P.O.C. Run curve in as usual. The latter method could, of course, be used underground, but frequently there is not enough room and other considerations (such as short backsights) are involved.

The relation of the theoretical point of frog and the actual point is important and should be considered in all calculations to obtain accurate alignment of finished track (see C, Fig. 1). Cast or manganese steel frogs tend toward smoother turnout curves, especially where radii are short, due to the relatively short arm lengths. Manufacturers' catalog data on straight frog and switch turnouts give radius of curved filing rail, not center-line radius. Deduct one-half gage for same.

The principal railroads have their own standards on turnout details, which may or may not correspond to those of the American Railway Engineering Association, and this should be kept in mind in preparing layouts of trackage over which railroad equipment is to be operated.

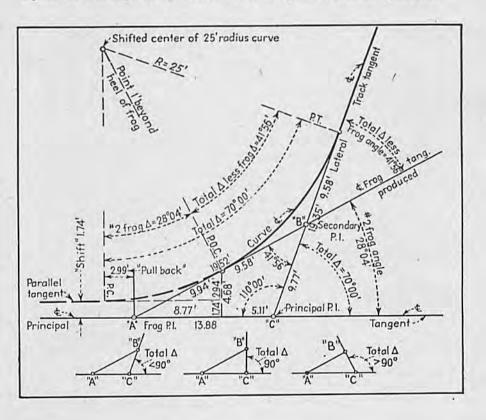


Fig. 3-Tlypical turnout layout diagram.

CONSTITUTION AND BY-LAWS

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

ARTICLE I.

NAME AND PURPOSE.

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

ARTICLE II.

MEMBERSHIP.

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

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

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

Section 4. Any active member may become a life member by the payment of \$50.00. 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, pro-

vided that anyone can be nominated on the floor of the meeting for any office for which an election is being held.

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

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

three years.

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

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

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

ARTICLE IV.

DUTIES OF OFFICERS.

Section 1. The president shall perform the duties commonly performed by the presiding officer and chairman. He shall 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; it shall supervise the expenditures and disbursements of all money of the Institute, and no expenditure other than current expenses shall

be authorized without first having the approval of the Executive Committee; it shall act as program committee for each meeting to determine what is to be published in the proceedings and shall perform such other duties as may be referred to them by regular or special meeting of the Institute.

ARTICLE V.

MEETINGS.

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

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

ARTICLE VI.

AMENDMENTS.

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

ARTICLE VII.

Order of Business.

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

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

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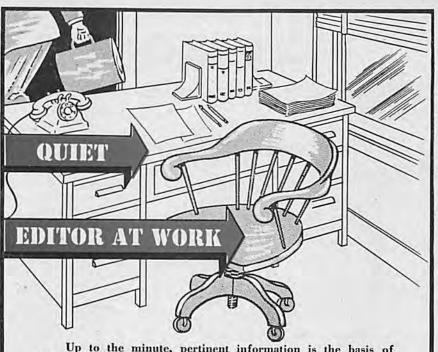
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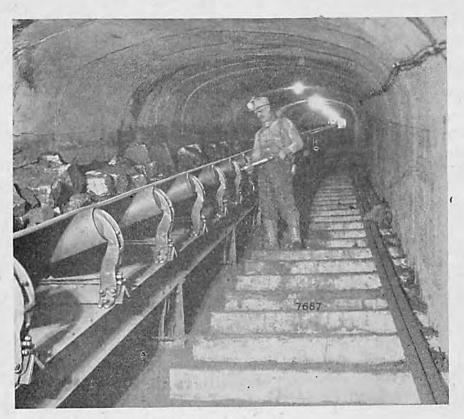
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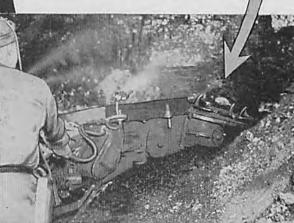
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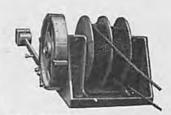




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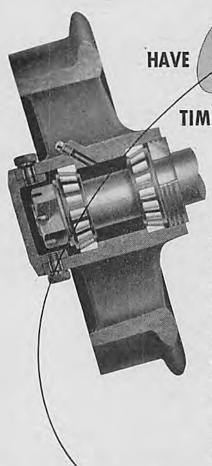
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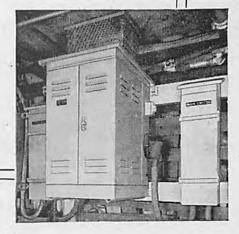
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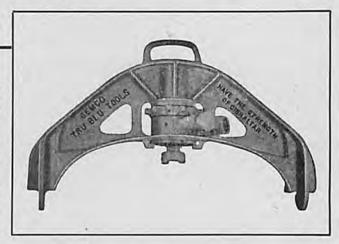
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BETHLEHEM PRODUCTS for the Mining Industry

Prefabricated Track

Every item for a complete mine-track set-up. After studying a blueprint or sketch of your layout, Bethlehem will figure the trackwork, cut the rails to length and precurve them in its own plant, and ship the entire outfit ready to assemble—rails, steel ties, switches, switch stands, turnouts, frogs, guard rails, joints, bolts, etc. A prefabricated track job saves installation time, cuts maintenance costs, reduces derailments.

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Bethlehem ties are made in a wide range of sizes and weights to suit individual conditions. Slip them under the rails, tap the clips into place with a hammer . . . that's all there is to it. No gaging, no spiking. Removal is just as easy. Install them for long-range economy; they outlast several sets of wooden ties and save maintenance too.

Wire Rope

For shafts, slope operations, incline planes, machine feeds, slusher hoists, conveyors, dragline excavators, power shovels. Bethlehem wire rope is available in all standard grades, sizes, and constructions, either preformed (Form-Set) or non-preformed. Also recommended is the Bethlehem Lay-Lock Safety Clamp for shaft hoists. This device is bolted to the hoist rope several feet above the cage. Heavy chains connect the clamp to the cage so that, in case of rope failure at the socket, the cage is prevented from dropping.

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AUTOMATIC RECORDER FOR SHAFT MINES

TYPE MT-14. In the tipple or at the bottom if the mine shaft, Type MT-14 can be attached to the weigh hopper under a rotary or crossver dump. On a mine track scale it weighs oving cars coupled in train or singly at praccal speeds. Motion weighing not only increases eighing speed many times but saves wear and aintenance of rolling stock and weighing quipment. Vibration of a tipple does not affect the accuracy of this machine.

Printing Mechanism: Can take abuse, is simle to maintain, and the mechanism is readily ecessible through front or rear doors.



Type MT- 14 Automatic Recorder

Printed Record: Eliminates guess work and human errors. The record can be on either tape or tickets available for filing. On tipple machines, the weights of the last three loads are both visible and accessible for additional notations. The printing function is automatically actuated.

Beam: A beam with graduated bar, slide and counter-poise weights is connected directly to the scale levers. By its movement the type-wheel and indicator are positioned.

Tamper-Proof: This is a special feature used by operators who have uniform tare weights. After the tare has been set off, the Tamper-Proof housing is locked and sealed. The net weight is automatically printed.

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TYPE W. This sturdy scale is ideal for mine use. Combined with Type MT-14 the best possible motion weighing results will be obtained because proper concentration of mass has been



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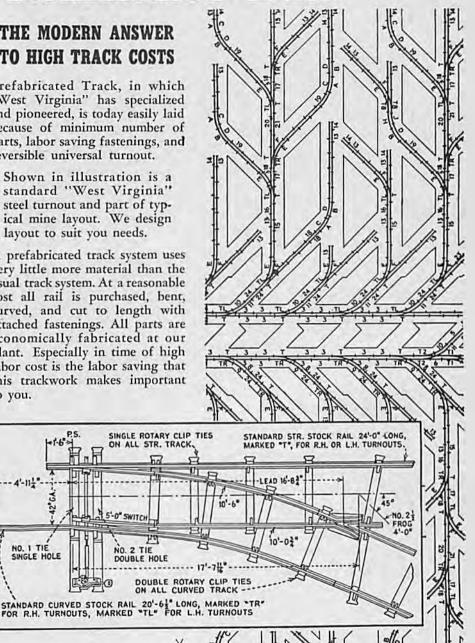
A prefabricated track system uses very little more material than the usual track system. At a reasonable cost all rail is purchased, bent, curved, and cut to length with attached fastenings. All parts are economically fabricated at our plant. Especially in time of high labor cost is the labor saving that this trackwork makes important to you.

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for low seams

High seam operations can use the high tonnage producing, low cost features of three other Joy Loaders, depending upon conditions. The 8-Bu is primarily for narrow places (56" wide), but has a capacity of 1½ tons per minute. The 7-Bu is a 48" seam machine; while the 11-Bu is the real tonnage mover for 60" seams, as its capacity is 5 tons per minute.

JOY 11-BU LOADER

for high seams

Especially useful for driving development headings when top or bottom must be taken. This loader fills cars to capacity without conveyor belt or hand shovel for spreading rock in car.

SULLIVAN LOHITE SCRAPER LOADER

for removing rock and overburden

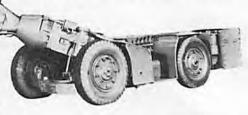
JOY MINING EQUIPMENT MOVES

SULLIVAN CUTTING MACHINES

SULLIVAN 10-RU

Trackless Cutting Machine

Designed specifically for trackless mining, this versatile machine will top cut, middle cut, bottom cut and shear. Horizontal cuts made from 5" below floor level to 71/2' above bottom. Hydraulic steering, short wheel base and ability to turn sharp corners is incorporated in this cost-saving unit,



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SULLIVAN 7-AU

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With its long reach, this machine will cut and shear room necks from straight track, making two cuts with one laying of track. Universal cutting positions, and its ability to keep approximately a square face and straight rib, aid faster mechanical loading.

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Lowest cutter in its power range that discharges cuttings to the rear is the 11-B. It is one of three Sullivan shortwall models, this one designed primarily for conveyor mining. The 7-B has a greater cutting capacity for heavy duty work ... while the 5B-1 is engineered for light duty.

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Sulmet bits have a cutting life many times greater by actual test than the hardest alloy steel bit. They consume less power when cutting; retain cutting edge longer; give more footage with less bit changing.

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TONNAGE FAST ... at Low Cost

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for low seams

32" JOY 6-SC FOUR WHEEL DRIVE One of the several variations of the Joy Shuttle Car used in low seam operations. Makes 90° turns easily; has hydraulic steering; low, wide loading end; 3 ton capacity; cable reel power only. Other 32' models available with cable reel or battery power.



for high seams

JOY 42"5HUTTLE CAR There's rapid and economical handling of coal from loader to main haulage system in average height coal with this 42" car. Regular and hydraulic steering; two or four wheel drive; high or low loading and discharge ends are features of the various models in this size (including the 5-SC). Will haul 5 to 8 tons, depending upon model.

e Joy 60E is an extra-large capacity Shuttle Car engineered for use in ore mines and very high coal seam operations.

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JOY AND LA-DEL CONVEYORS

Belt types



TROUGHED BELT CONVEYORS

Two series of belt conveyor designs are available . . . each engineered for the particular type job demanded of it. La-Del Belt Conveyors feature low belt tension; low power consumption; positive belt alignment without guides; sealed-for-life bearings on idlers. Joy Belt Conveyors have inverted steel trough pans that rigidly support return idlers and protect belt; low power consumption; sealed-for-life ball or tapered roller bearings. Both designs furnished in sizes to meet power demands, depending upon length, gradient, tonnage, etc.



Chain types

CHAIN CONVEYORS

For underground use where severe grades are met, Joy and La-Del Chain Conveyors are available in a variety of sizes and powers for face loading, room and gathering work.

Cushion-Drive

SHAKER CONVEYORS

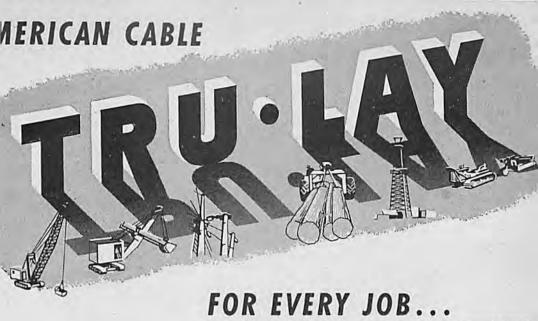
La-Del Shaker Conveyors will move coal in inclines up to 15% over rolling and dipping mine bottoms without spilling. Cushion Stroke reduces shock loads on all parts, adds greatly to life of each unit.



Shaker types

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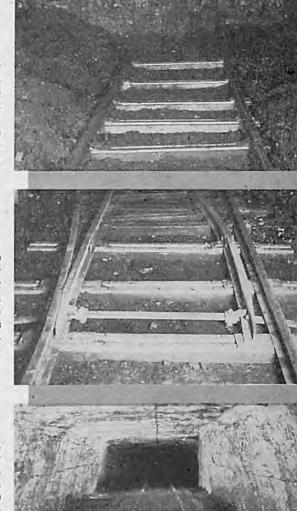
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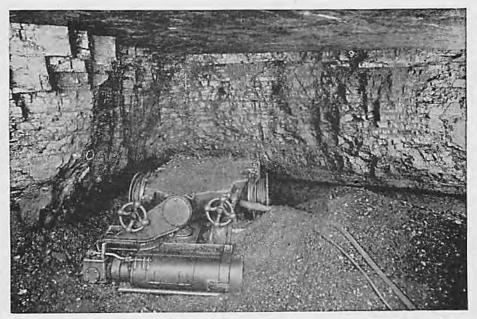
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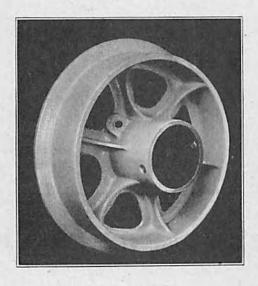
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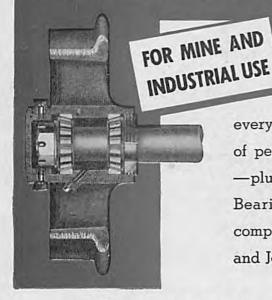
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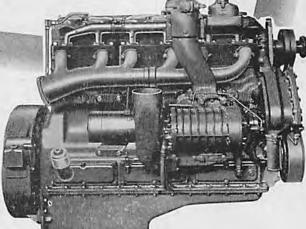
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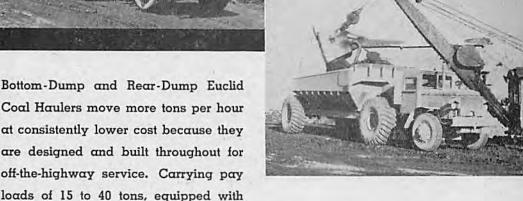
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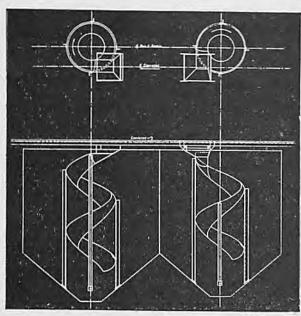
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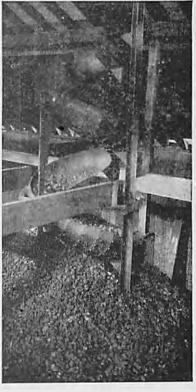
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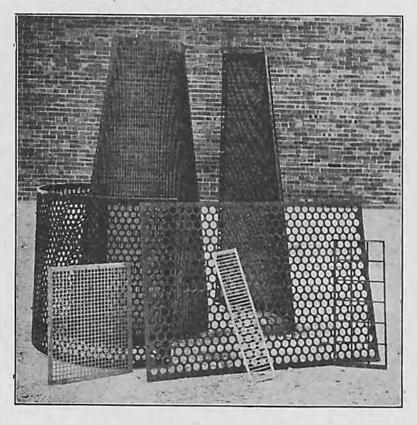
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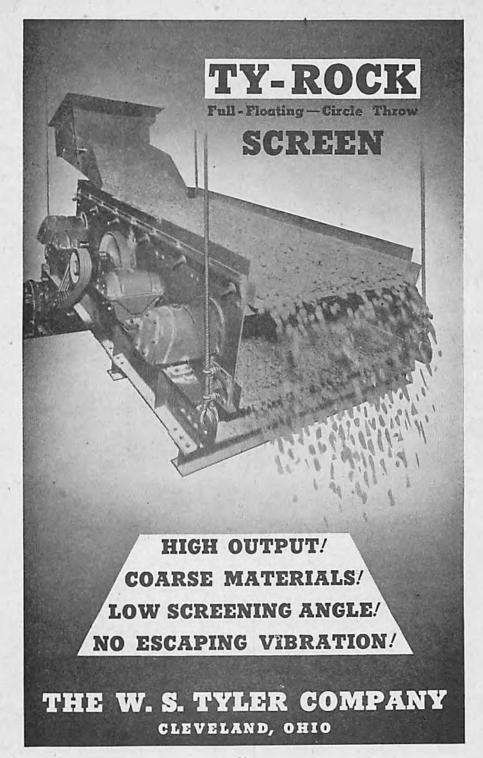
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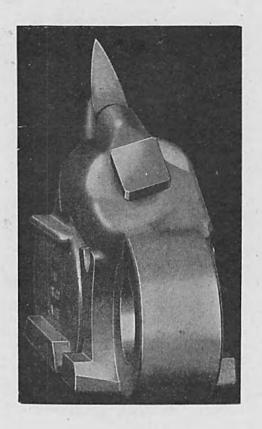
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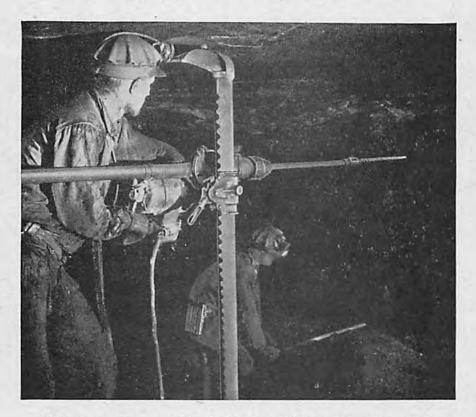
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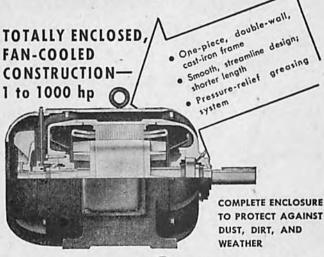
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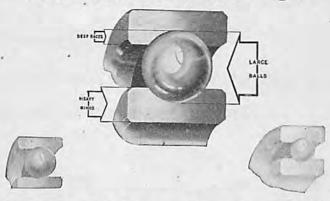
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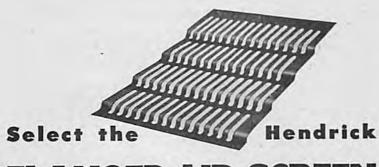
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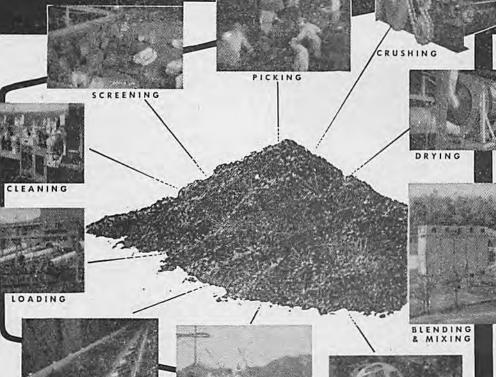
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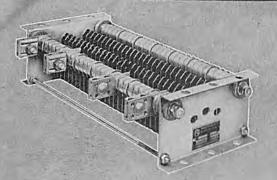
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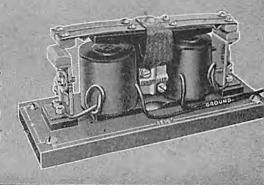


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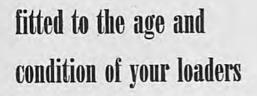
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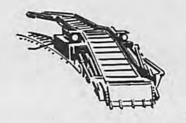
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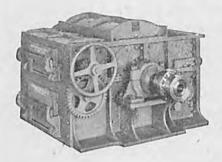


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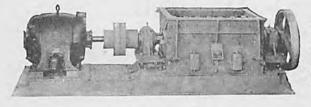
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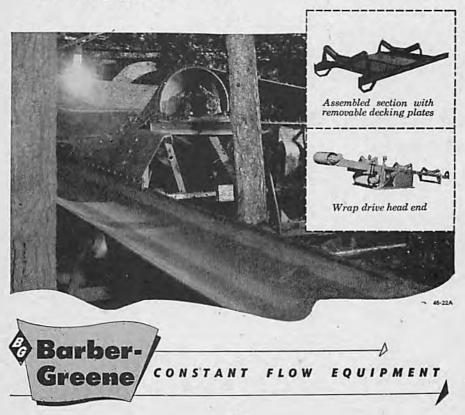
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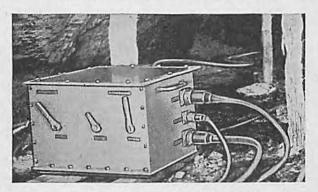
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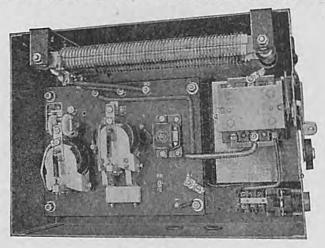
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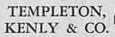


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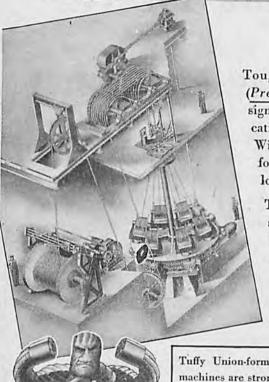
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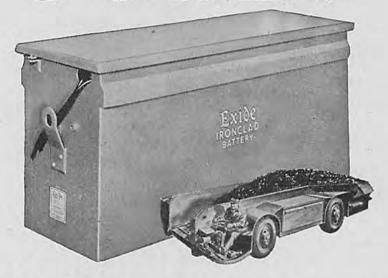
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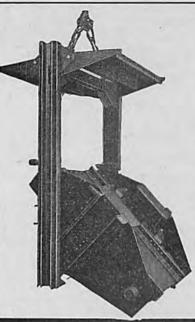
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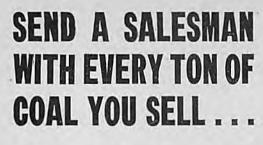
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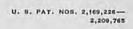




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