

DEPARTMENT OF THE INTERIOR
BUREAU OF MINES

JOSEPH A. HOLMES, DIRECTOR

OIL AND GAS WELLS THROUGH WORKABLE
COAL BEDS

PAPERS AND DISCUSSIONS

BY

GEORGE S. RICE, O. P. HOOD
AND OTHERS



WASHINGTON
GOVERNMENT PRINTING OFFICE
1913

First edition, March, 1913.

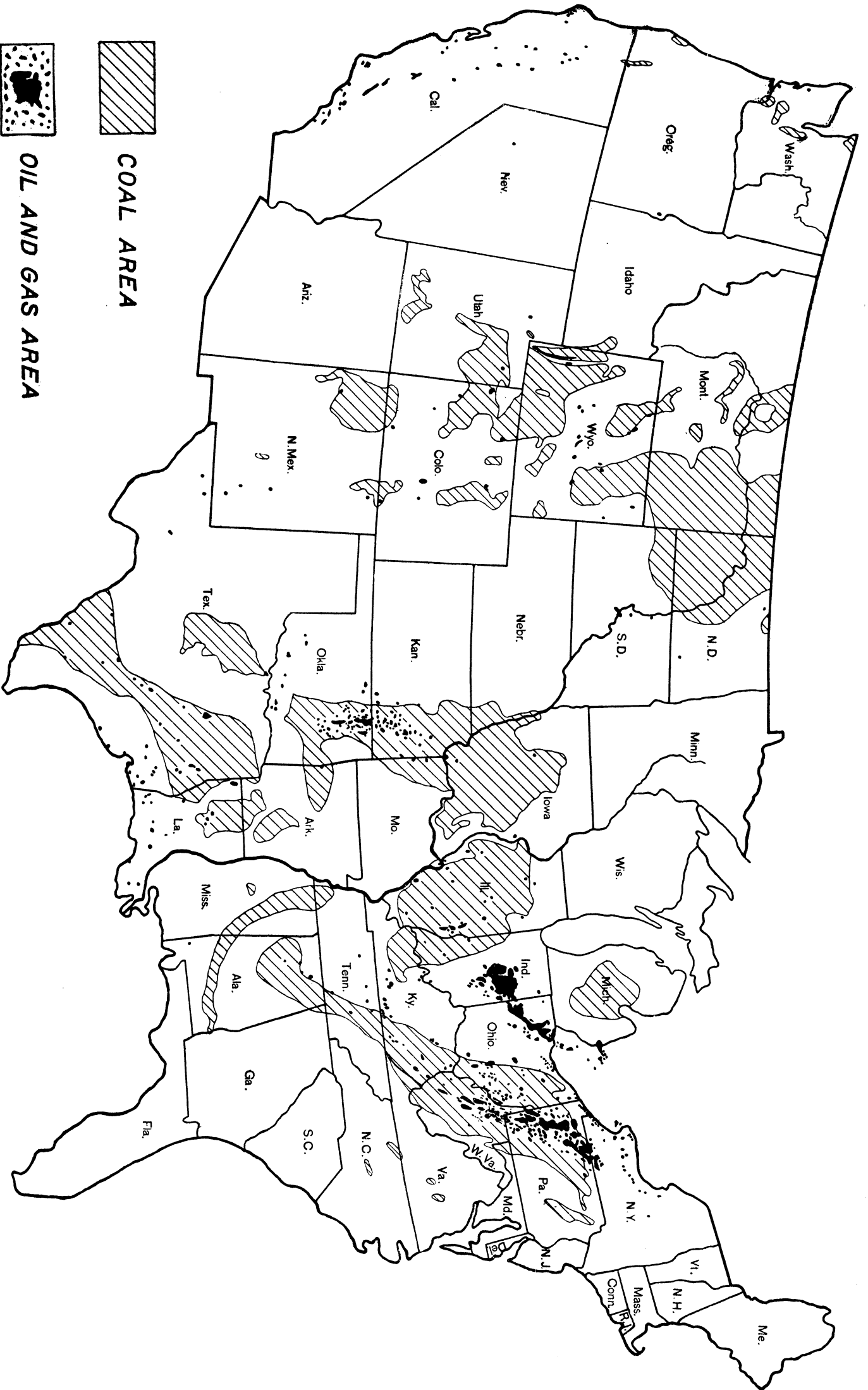


PLATE I.—Sketch map of United States, showing area containing coal or lignite and those containing oil or gas.

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PREFACE.

During the past few years the Bureau of Mines, in its study of problems relating to safety in coal-mining operations, has been considering the increased risks of mine explosions and the waste of coal that result from the present system or lack of system in drilling oil and gas wells in the coal fields. From time to time requests have been received from mine inspectors and other State officials that the engineers of the bureau investigate this subject and recommend such changes in common practice and such changes in State legislation as will help remedy both the increasing hazard and the waste of coal. Meanwhile, others have been studying the same problems, and at a meeting held in January at New Haven, Conn., the Association of State Geologists appointed a committee of its members to cooperate with the Bureau of Mines in developing remedies for this situation.

In this investigation, as in other of its investigations of mining conditions, the Bureau of Mines has adopted the practice of conferring with representatives of all parties at interest, with a view to procuring information concerning all phases of the subject, and also with a view to being able to develop and recommend for general adoption such changes in practice as well as in legislation as might prove to be effective by being both reasonable and enforceable.

In carrying out such a policy with reference to the subject under consideration, the Bureau of Mines invited the State geologists, mine inspectors, and a number of coal operators and oil and gas well drillers from the States interested to meet representatives of the Bureau of Mines in Pittsburgh, Pa., for a discussion of the subject during February 7 and 8, 1913. As a result of this conference, a committee representing all the interests concerned was appointed to consider all phases of the question, and to report its recommendations back to an adjourned meeting of the conference. This adjourned meeting of the conference will be held at an early date and its report will be printed in a later edition of this bulletin, with such additional suggestions as may be received by the Bureau of Mines. The bureau will be glad, therefore, to receive at the earliest practicable date any additional suggestions or any additional information throwing light on the matters discussed in this bulletin.

It is clearly understood that the inspection and control of all such operations as mining and well drilling lie within the province of the State. The work and the plans of the Federal Bureau of Mines are properly limited to inquiries and investigations and the publication of the results. Between State mine inspectors, State geologists, coal operators, well drillers, etc., in the different States, the bureau acts in these matters as a medium for the exchange of ideas, with a view to obtaining uniform legislation and methods in the different States.

JOSEPH A. HOLMES.

INTRODUCTORY STATEMENT.

By GEORGE S. RICE.

The need of protecting mines from the danger of inflow of natural gas from neighboring wells has become more apparent each year since it was found that oil and gas underlie the productive coal measures of Pennsylvania, West Virginia, Ohio, Indiana, Illinois, Kansas, Oklahoma, Colorado, and Wyoming, and, to some extent, the coal measures of other States. The proximity of the known gas and oil areas in the United States to the coal fields and the manner in which the fields overlap in certain States are shown in the map comprising the frontispiece (Pl. I).

As the result of many requests received from various sources a conference to consider the protective measures necessary to insure the safety of mining operations in gas and oil fields was called by the Director of the Bureau of Mines to assemble in Pittsburgh, Pa., February 7 and 8, 1913. To this conference were invited a considerable number of gas-well, oil-well, and coal-mine operators within convenient distance from Pittsburgh, as well as State geologists and State mine inspectors from a distance.

Gas and oil wells are also found near other kinds of mines, such as shale and limestone mines in western Pennsylvania, but these cases are so few that for this and other reasons it was deemed best to confine the present inquiry to the consideration of the questions involved in connection with coal mines.

It was also not thought advisable to consider the protection of mines from other kinds of bore holes than those for gas and oil, such as coal-prospecting holes, drilled either with churn or diamond drills, or salt wells and artesian wells, because little trouble has been experienced in mining operations from these classes of wells. Therefore the following papers and discussions concern almost entirely the following relations between coal mines and gas and oil wells:

(1) Protection of coal mines from gas and oil wells penetrating through: (*a*) Open workings; (*b*) inaccessible spaces or goaves; (*c*) pillars, or coal which may be left as pillars.

(2) The manner of drilling gas and oil wells passing through workable coal beds so as to provide protection for future mining.

The preliminary inquiries of the engineers of the bureau had disclosed that there was no uniformity in the methods of protecting mines against the leakage of gas from wells, that thousands of wells in coal fields are abandoned yearly without adequate plugging, and without surveys or records being kept to show the location of the holes, from which the casings are generally pulled. According to the State geologist of Pennsylvania, as many as 3,000 wells are being drilled annually in Pennsylvania, 2,000 of these holes being abandoned within a single year. It is such unplugged, uncharted wells that are the greatest menace in mining. The quantity of gas that the wells produce, although not sufficient to be commercially avail-

able, is enough, if it were to leak into a mine and be ignited, to cause explosions or fires, with possible loss of life.

The matters mentioned were fully considered in the papers read at the conference and embodied in this report. The papers outline the preliminary inquiries and examinations of the engineers of the bureau, and much of the discussion thereon by the members of the conference is considered worthy of inclusion.

In order that definite action on the protection proposed might be possible, an outline of suggested legislation was formulated by the engineers of the bureau and presented to the conference. It is embodied in one of the papers comprising this report. The outline should not in any way be considered as expressing either the conclusion of the conference or even of the engineers who presented it, but was intended merely to suggest topics for systematic discussion of the problems involved.

As will be seen from the report of the proceedings, it was decided that in order to obtain further suggestions for legislation along practicable lines, with a view to obtaining a maximum amount of protection for the minimum amount of expense, further consideration of the various questions involved should be given. The bureau was asked to submit a full account of the proceedings to those present and also to those unable to attend the conference. This publication is prepared in order that the data obtained may be distributed among those interested in this subject, either for action or for further consideration.

As will be noted from the report of the proceedings, the conference before adjournment planned the appointment of a committee consisting of the officers of the conference *ex officio* and three representatives from each of the following bodies: Gas-well operators, oil-well operators, coal-mine operators, State geologists, State mine inspectors, and officials of the Bureau of Mines. Each of these bodies was requested to appoint on this committee representatives who, so far as possible, would fully represent the industry in all parts of the country. In the event of failure to fill vacancies, the chairman (Mr. W. E. Fohl) was empowered to appoint persons to fill these vacancies. A temporary committee of one member from each body was appointed to assist the chairman in arranging for the general committee, which is to assemble in Pittsburgh on February 26, 1913. This committee is to give consideration to all the proposals made at the meeting herein reported, and to such as may be submitted by correspondence, and is to draft a tentative outline suitable for the groundwork of future legislation in each of the various States concerned.

The reader of these proceedings must bear in mind the difficulty in getting an exact report of what was said by each speaker. Frequently the discussion was of a conversational nature and at times was illustrated by chalk sketches on a blackboard, so that correct interpretation by the reporter and editor was often impossible, requiring the omission of some of the statements. Owing to the urgency of getting out the proceedings, it was not possible to submit the manuscript to the respective speakers. It is expected that reports of omissions of an important character and new matter will be submitted to the committee either by those present at the conference or by others. Therefore anyone who may desire to do so is invited to contribute suggestions bearing on the subject, which may be sent to O. P. Hood, secretary, care Bureau of Mines, Pittsburgh, Pa.

OIL AND GAS WELLS THROUGH WORKABLE COAL BEDS; PAPERS AND DISCUSSIONS.

By GEORGE S. RICE, O. P. HOOD, AND OTHERS.

OPENING OF CONFERENCE.

The sessions of the conference were held in the assembly room of the Engineers Society of Western Pennsylvania. At the opening session in the morning of February 7, Mr. Rice, on behalf of the Director of the Bureau of Mines, who was unavoidably detained in Washington, welcomed the members, briefly mentioned the suggestions received, especially those from a committee of the State Geologists' Association of America, that were evidently the outcome of a general desire for more satisfactory and uniform legislation concerning the drilling of wells and the reduction of the risks from mine explosions caused by the escape of the gas into the mine workings.

Those who registered at the conference were as follows:

- Irving C. Allen, chemist, Bureau of Mines, Pittsburgh, Pa.
- C. W. Baker, secretary and treasurer, Greensboro Gas Co., Pittsburgh, Pa.
- L. F. Barger, general superintendent, Peoples Natural Gas Co., Pittsburgh, Pa.
- A. C. Beeson, chief engineer, Pittsburgh-Buffalo Coal Co., Pittsburgh, Pa.
- John W. Boileau, Pittsburgh, Pa.
- A. P. Cameron, general superintendent, Westmoreland Coal Co., Irwin, Pa.
- B. H. Canon, United Coal Co., Pittsburgh, Pa.
- John B. Corrin, assistant manager, Hope Natural Gas Co., Pittsburgh, Pa.
- E. E. Crocker, vice president and general manager, South Penn Oil Co., Pittsburgh, Pa.
- J. W. Devison, superintendent, Federal Coal & Coke Co., Grant Town, Pa.
- F. W. De Wolf, director, State geological survey, Urbana, Ill.
- W. C. Edwards, Parker & Edwards Oil Co., Pittsburgh, Pa.
- W. E. Fohl, mining engineer, Pittsburgh, Pa.
- John Gates, attorney, Philadelphia Co., Pittsburgh, Pa.
- R. D. Hall, associate editor, "Coal Age," New York, N. Y.
- A. G. Heggen, petroleum engineer, Bureau of Mines, Pittsburgh, Pa.
- R. R. Hice, State geologist, Beaver, Pa.
- O. P. Hood, chief mechanical engineer, Bureau of Mines, Pittsburgh, Pa.
- L. M. Jones, engineer, Bureau of Mines, Pittsburgh, Pa.
- G. L. King, division superintendent, South Penn Oil Co., Cameron, W. Va.

M. B. Layton, assistant manager, Manufacturers Light & Heat Co., Pittsburgh, Pa.

E. D. Leland, superintendent, Philadelphia Co., Pittsburgh, Pa.

W. L. McCloy, general superintendent, Philadelphia Co., Pittsburgh, Pa.

E. B. Moore, chief engineer, Consolidation Coal Co., Fairmont, W. Va.

A. J. Moorshead, president and general manager, Madison Coal Corporation, representing Illinois Coal Operators Association, St. Louis, Mo.

T. A. Neill, division superintendent, South Penn Oil Co., Mannington, W. Va.

W. C. Neill, attorney, Manufacturers Light & Heat Co., Pittsburgh, Pa.

John Rees, mining engineer, Youghiogheny & Ohio Coal Co., Pittsburgh, Pa.

George S. Rice, chief mining engineer, Bureau of Mines, Pittsburgh, Pa.

George W. Schluederberg, general manager, Pittsburgh Coal Co., Pittsburgh, Pa.

E. J. Taylor, chief engineer, Pittsburgh Coal Co., Pittsburgh, Pa.

C. B. Turner, superintendent, South Penn Oil Co., Mannington, W. Va.

E. A. Watters, chief mining engineer, Hicks Coal Co., Freeport, Pa.

W. A. Weldin, assistant chief engineer, Pittsburgh-Buffalo Coal Co., Pittsburgh, Pa.

David Young, State mine inspector, Freeport, Pa.

A number of other persons who arrived after the beginning of the conference did not register.

Mr. William E. Fohl, of Pittsburgh, was elected chairman, and O. P. Hood, of the Bureau of Mines, secretary. The formal organization of the conference having been completed, the first paper on the program, a general introduction to the topic to be discussed, was read by Mr. Rice.

GAS AND OIL WELLS IN COAL FIELDS.

By GEORGE S. RICE.

INTRODUCTION.

The problem of gas or oil wells sunk through or near coal mines and through the future coal reserves has gradually become more and more serious, not only because of the danger to the miner but also because of the increasing loss of coal left as pillars about the wells, and this loss will increase in the future unless means are found to insure safety to the miner and permit the coal to be extracted.

A prominent engineer told the writer recently that he has been obliged to report unfavorably to his client upon the purchase of a certain tract of coal land which he was examining on account of the numerous oil and gas wells on the property, which would seriously interfere with mining operations. Diagrams and plans will be presented showing how very close together wells have been drilled.

DANGER TO MINERS FROM GAS WELLS.

Fortunately, thus far there has not been a large loss of life in mines through explosions or fires caused by leakages of gas from wells, but there are several cases on record in which lives have been lost, and the possibility of disaster has been present in a number of instances. One special case, which has been frequently mentioned, is that of the Middleton and Enterprise mines, near Fairmont, W. Va., where natural gas under high pressure leaked from a well and entered the two adjoining mines, leading to local explosions in each mine and to the death of three miners. Fortunately this in-leakage of gas occurred at night when but few men were in the mines, and the company that owned the mines had taken excellent precautions to keep the coal dust wet. Consequently the explosions were of small extent. This case is particularly interesting because the well was surrounded by a 100-foot pillar, and there was a coal barrier 100 feet thick between the two mines. Therefore the gas entered the mines not through the coal but through the floor and along a line 2,300 feet in length, according to Mr. Tarleton, general superintendent of the company, who described the explosion in a paper that appears in the Transactions of the West Virginia Mining Institute for 1911.

Deep wells are constantly being drilled in the coal fields of this country and are very numerous in the coal basins of Pennsylvania,

West Virginia, Ohio, Indiana, Illinois, and Kansas, as is shown by the accompanying map of a part of Greene County, Pa. (fig. 2). In Pennsylvania and West Virginia, mines not infrequently strike abandoned, unmapped wells. Many of these wells have been found filled with gas, and in some instances the gas has been lighted. Recently a serious fire was caused in a coal mine in the vicinity of Pittsburgh through burning gas which had been ignited when an unknown well was struck in mining. Fortunately this fire was not attended by an explosion, but it led to the mine being shut down for a couple of weeks, and the bureau's engineers and rescue crew, equipped with breathing apparatus, had to be called upon to investigate behind the fire stoppings. In a number of cases where wells have been encountered there have been narrow escapes from explosions. It would therefore appear that the mining industry hitherto has been more lucky than farseeing in failing to take precautions to make abandoned wells secure and to record the situation of these wells, which, though not giving gas in commercial quantities, make gas enough to be a serious menace in mining.

NEED OF SUITABLE LEGISLATION.

The dangers that threaten have frequently been pointed out by Dr. I. C. White, of West Virginia, president of the Association of State Geologists. At a recent meeting of this association a committee was appointed to confer with Dr. Joseph A. Holmes, Director of the Bureau of Mines, on this subject. Director Holmes also received requests from other persons to take up the question with a view to formulating suggestions that might lead to uniform legislation regarding oil and gas wells in the various States in which gas or oil underlies the coal fields.

Hitherto, legislation on gas and oil wells in all the States, except Ohio and Indiana, has dealt with the subject only from the standpoint of protecting the wells from one another. The Ohio laws, and to a lesser extent the Indiana laws, take some cognizance of the danger to mining from the proximity of wells, but the laws of both States are considered inadequate in this respect.

The problem of formulating laws is not one that concerns alone the coal operator and the inspector, for it also concerns the gas and oil well operators. The latter must be given the opportunity to search for and obtain the gas and oil they hold under option or ownership. It is manifest that they wish to take reasonable precautions for safety, but do not wish to be put to unnecessary expense or to be prevented from drilling wells in coal fields; therefore some means must be found by which the wells can be drilled through or in the vicinity of the coal mines without creating dangerous conditions. Three parties are therefore vitally concerned;

the gas and oil well operator, the coal operator, and the miner, whose safety is looked after by the State mine inspector. The State geologists are interested because of the desirability of conserving oil and gas as well as coal. The United States Bureau of Mines is concerned both in the conservation of all mineral resources and in the safety of miners. Hence it is desirable to have good as well as uniform rules and regulations throughout the country.

PRELIMINARY CONFERENCES.

As a preliminary to this general meeting, it was thought advisable to confer with those interested in the questions involved; consequently a conference was held a few weeks ago with some of the coal operators who had had experience in dealing with gas and oil wells drilled through mines; then followed a conference with representatives of the gas-well interests; and more recently a conference was held with a number of State geologists, representing several of the leading coal-mining States in which gas and oil wells have become or are becoming important.

After these preliminary meetings, those members of the Bureau of Mines who had been charged by the director with this investigation prepared a tentative outline of rules and regulations that might serve as a basis for possible legislation on oil and gas wells through coal beds. This outline was formulated to harmonize as well as possible with the ideas presented in the several preliminary conferences by representatives of different interests involved, regard being had for the fact that it would be wise to have such rules and regulations of a general character suitable for a basis for possible legislation in each of the States—the rules to be amended or modified in detail to suit the particular conditions that prevail in any particular State. These proposed rules and regulations, and the interpretation prepared by other members of the Bureau of Mines, will be read at this meeting.

Several features that were discussed at considerable length in the preliminary conferences have not been incorporated in the rules and regulations outlined, as it was felt that their incorporation would not be wise, and, in fact, would have to be rather a matter of gradual development and, in certain cases, of private agreement between the parties at interest. These questions are discussed here.

SIZE OF COAL PILLARS THAT SHOULD SURROUND GAS AND OIL WELLS.

Investigations and inquiry show that the pillars that have been left around gas wells in Pennsylvania and West Virginia vary from 40 feet in diameter or 40 feet square to 200 feet in diameter or square, the well being at the center of the circle or square. Inquiry

has been made as to the reasons underlying the determination of the size of these pillars, but it was found that there was no scientific basis for such determination, and that the various sizes of pillars merely represented the opinions of the parties concerned or compromises between interested parties. The courts, in rendering decisions, seem to have determined arbitrarily the size of pillars that must be left in certain cases, the size specified in each specific case presumably representing the concensus of the testimony that was presented.

In the preliminary conferences it was unanimously conceded that pillars of coal of any reasonable size did not prevent leakage of gas into the mine when there were defects in the well casings, but that they served to support the overlying strata and thus prevent fracturing or breakage of the well casing anywhere from the coal seam upward to the surface.

PILLARS AS ROOF SUPPORTS.

Regarded from this point of view, the question of the proper size of pillar around a well is a problem somewhat similar to that which has arisen as to the proper size of pillar to be left surrounding a mine shaft. Inquiry by the bureau has not disclosed any uniform system of determining the size of a shaft pillar, but a number of empiric formulas have been used by mining engineers in the various mining countries. These formulas are usually based on the distance of the coal bed from the surface. The ratio of diameter of the pillar to depth from the surface in the formulas noted is from $\frac{1}{4}$ to 1 to $\frac{1}{2}$ to 1; that is, if the coal is 400 feet below the surface the pillar should be 100 feet to 200 feet thick.

A formula that is used for barrier pillars in the anthracite fields, by a number of prominent companies and is approved by the mine inspectors of eastern Pennsylvania, takes into account the thickness of the coal. The formula is as follows:

The width of the barrier pillar is equal to the thickness of workings multiplied by 1 per cent of the depth below natural drainage level, plus the thickness of the workings multiplied by 5.

The drainage level presumably is at or near the surface. If a seam were 9 feet thick and 300 feet below drainage level then the thickness of the barrier pillar would be

$$(9 \times 3) + (9 \times 5) = 72 \text{ feet.}$$

Although this formula seems chiefly for protection against inrushes of water, it is manifest that the effect of crushing is also involved, for if the pillar were crushed it would not furnish the necessary protection. "The Coal and Metal Miners' Pocket Book" offers this formula for shaft pillars deeper than 700 feet: $r=3\sqrt{D \times t}$, in which r equals the radius of the shaft pillar, D the depth of

shaft, and t the thickness of seam. For example, in a shaft 900 feet deep and the coal bed 8 feet thick, the radius of the pillar should be 255 feet, or its diameter should be 510 feet.

The necessity of protecting a shaft is doubtless greater than that of protecting a gas or oil well. The shaft is the means of egress, and it is not simply the protection of the shaft itself that must be considered, but also the support of the surrounding buildings, including the engine and boiler plant; hence there is greater need in having large pillars around shafts than around wells.

It is manifest that the varying character of the strata in different districts affects the determination of the size of mine pillars to be adopted for oil or gas wells—that is, on the assumption that it is necessary to prevent any movement of the ground surrounding the casing all the way to the surface. If the roof over the coal bed breaks easily the fractures will probably extend upward in more or less vertical planes. On the other hand, where the roof is strong sandstone or limestone and the fall occurs on only one side of the well first, which is usually the case, there is a possibility that there may be a considerable pull toward that side which may carry the break diagonally upward, so that the plane of fracture may intersect the well before reaching the surface, in which event there might be danger of rupturing the casing, or at least of swinging it out of line.

It was pointed out by Mr. S. A. Taylor in the first preliminary conference (that with the coal operators) that where the cleavage of the coal is very marked, as in the Pittsburgh bed, a pillar should not be square, but should be rectangular, in order to get equal strength—that is, the pillar should be longer across the faces, or in a direction parallel with the butts.

The Consolidation Coal Co. in the Fairmont district, W. Va., is considering the necessity of leaving 200-foot pillars around the wells. Figure 1 shows gas wells drilled in a certain area and a projected plan of working with 100-foot pillars surrounding the wells. There are also indicated 200-foot square pillars, which would require revision of projected plan of workings, and shows how serious this requirement may be when the wells are close together, either as regards the laying out of the mine or the loss of coal in the pillars. A map (fig. 2) is presented of a portion of Greene County showing oil and gas wells. This brings up the question whether or not it is necessary to retain the pillar permanently.

EXTRACTION OF COAL SURROUNDING A WELL.

In the preliminary conferences the writer suggested that it might be possible to dispense with a coal pillar around an oil or gas well, provided an artificial pillar was substituted. This proposal is hardly

so radical as it may seem at first. The coal surrounding shafts has been extracted without detriment in some of the longwall mines in Great Britain, and, the writer was informed, in one longwall mine in northern Illinois. Where this plan has been employed the section

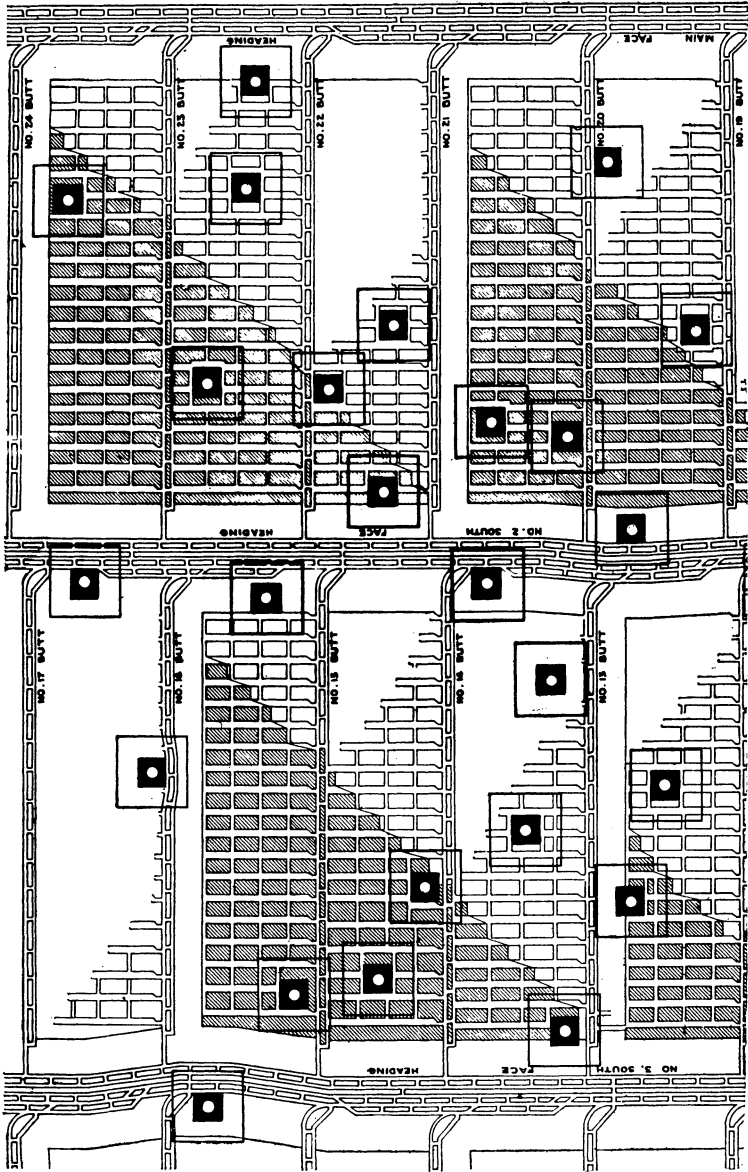


FIGURE 1.—Projected plan of mine workings with gas wells surrounded by pillars of coal.

from which the coal had been excavated has been carefully packed with broken rock and dirt, as is usually done in “longwall advancing,” so that the movement downward is very gradual and regular, the strata all the way to the surface subsiding evenly and

without damage to the surface buildings, provided the longwall face advances regularly. The final surface subsidence, where the goave has been well packed with dry packing, is about 50 per cent of the thickness of the excavation—that is, in a bed of coal 6 feet thick the subsidence would be about 3 feet.

PROTECTION OF CASING WITH CLAY.

To suit the conditions of room and pillar mining, the writer suggests the following plan (see figs. 3 and 4): Lay out a room so that the drill hole will be approximately in its center. In drilling the well, make its diameter several inches larger than that of the outer casing, so as to leave a space of 1 to 2 or more inches surrounding

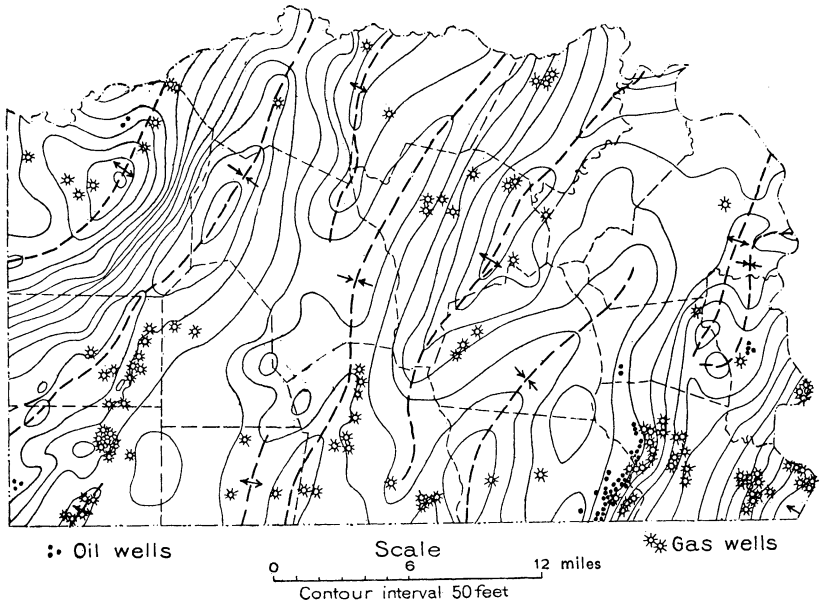


FIGURE 2.—Map of a part of Greene County, Pa., showing numerous wells, all of which penetrated coal beds. [From U. S. Geol. Survey Bull. 304.]

the casing. On the assumption that the outer casing is to go 30 feet below the coal bed, then the hole of the diameter stated is to be drilled an additional distance equal to the thickness of the seam, below where the shoe of the casing is to hang. The casing is then to be lowered and hung from a cross beam supported permanently at the surface. These cross beams should be steel channels or girders, 9 or 10 feet or more in length and strong enough to hold the weight of the casing. Before lowering the casing a gasket of rubber or canvas is to be fastened around it just above the shoe, so as to fit snugly against the rock or shale when the casing has been lowered to place and hung from the beam supports; a grouting of clay is then to be run in between the casing and the walls of the hole so as to fill completely this space from the gasket to the surface. The purpose of the

grouting is to allow the casing to slide freely, either at the bottom or the top, if the coal is excavated and the ground subsides. After the casing has been grouted, drilling and the putting down of the inner casing are to proceed in the usual manner. When subsidence of the ground occurs the arrangements spoken of will be equivalent to an expansion joint in a steam line. The inner casings and the gas tube, being rigid and fixed below, when the subsidence takes place will merely project that much farther above the surface of the ground, and will not be affected by the subsidence.

It is of course assumed that an opening will always be left at the top between the largest and the next inner casing to permit the

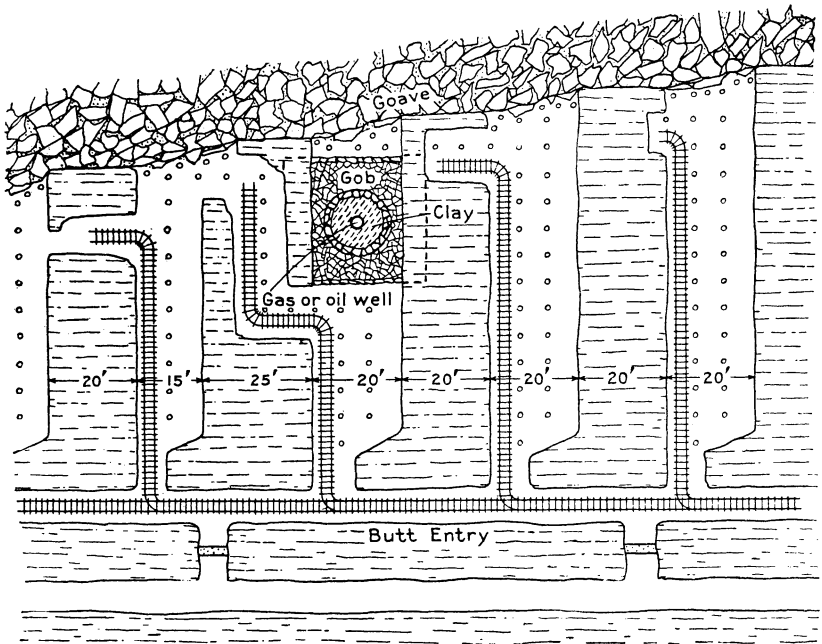


FIGURE 3.—Proposed method of protecting well where coal pillar has been removed. Plan.

escape of any gas that leaks into the space between the casings, in accordance with the plan employed in recent wells, where by agreement with the coal companies various precautions have been taken.

When the room mentioned above has reached the well, the casing should be protected from injury from cars or blasting by timbering; and if the roof is very poor, a timber cog should be carefully built around the well and packed tightly with clay. When the rooms in the vicinity are "up" their proper distance, before the pillars are withdrawn, clay should be brought from the surface (any ordinary clay will do), placed around the well casing, and tightly packed so as to make a cylinder from 6 to 8 feet in diameter. It will not be necessary to withdraw any of the timber to do this. The space sur-

rounding this clay cylinder back to the ribs should be filled with mine waste obtained from lifting the bottom or from fallen roof rock. When the ribs have been drawn back to a point opposite the artificial pillars, a thin curtain wall can be retained on either rib, merely to hold the gob in place. The purpose of the "gobbing" is to allow the roof to come down evenly, as the clay packed around the

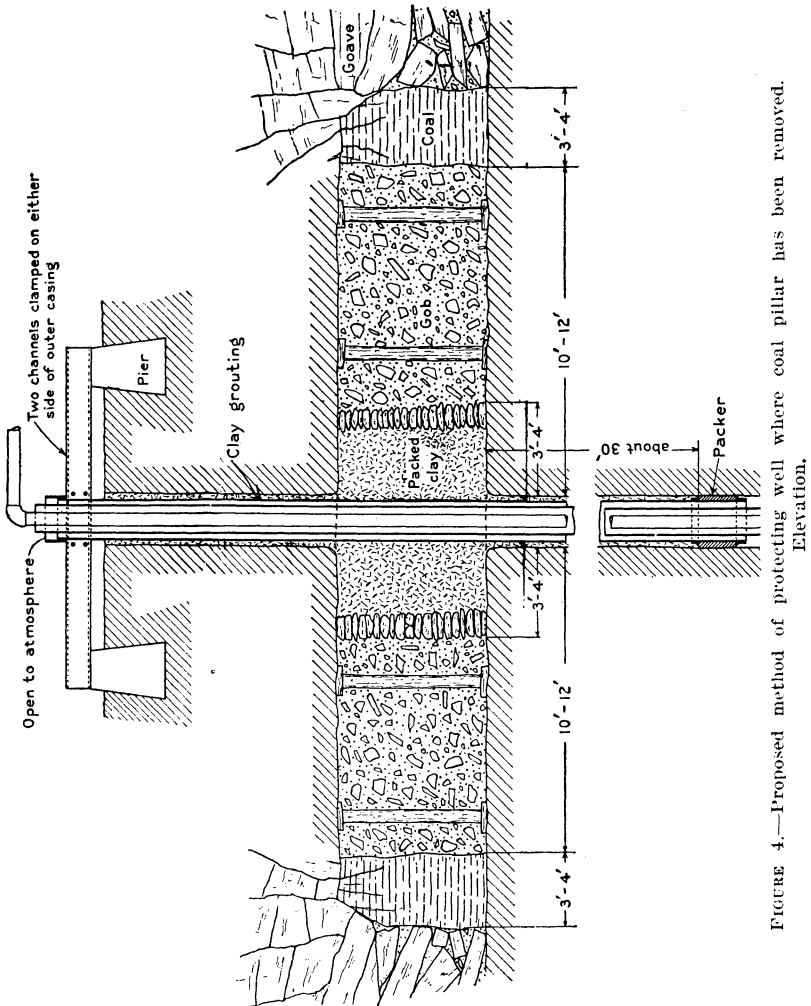


FIGURE 4.—Proposed method of protecting well where coal pillar has been removed.
Elevation.

hole will prevent undue pressure at any point, and thus prevent distortion of the casing. Since above and below the coal bed the casing is surrounded with a layer of clay the roof may slip down without injury to the casing, or, if all the strata above come down and grip the casing, the latter will slide further down into the hole, which was previously drilled large enough to receive it. With such a plan properly carried out, the writer can see no serious

risk in not leaving a coal pillar, for even if a break of the outer casing occurs, which seems unlikely, there is at all times a vent to the surface between the inner and the outer casing.

LOWER COAL BEDS.

If abandoned wells are properly plugged from bottom to top, there would seem to be no need for other special precautions for deeper coal beds. It is manifest that in the great majority of cases these coal beds will not be worked for many years to come, perhaps 25, or 50, or as much as 100 years. It is manifest also that no casing would resist corrosion for such long periods, therefore it is believed that the project of restoring the strata to practically the same strength and impermeability that they had will be the best method. All the geologists in attendance at the recent meeting agreed that this was the best solution of this problem.

PLUGGING ABANDONED WELLS.

The geologists agreed further that the simplest and safest way of handling abandoned wells through coal mines will be to plug them tightly all the way from the bottom to the surface. (See fig. 7, p. 21.) The proposed details of plugging will be given in an accompanying paper. If holes are plugged so that there is no leakage of gas, there would seem to be no danger in laying out or working a mine without regard to an abandoned well, except that the well should be approached carefully, and tests should be made to see whether there is any sign of leakage of gas. Such lack of other precautions assumes that the plugging of abandoned wells in coal districts shall be done with an inspector present, preferably a gas and oil well inspector appointed by the State, and that a certificate showing that the plugging has been done properly has been duly recorded.

MAPS OF PROJECTED WORKINGS.

It is undoubtedly a most excellent plan for the gas and oil operator and the coal operator to come together and agree upon the suitable placing of holes. To do this intelligently the coal operator should furnish the gas and oil operator a plan of his projected mine workings. It is assumed that the site of the proposed well shall be carefully surveyed to and located, and that the map of the location and the record of the casing at least as deep as 30 feet below the coal bed that is being worked shall be matters of public record.

DRILLING GAS WELLS THROUGH INACCESSIBLE MINE WORKINGS.

The question has arisen in several cases as to the protection of a mine from gas leaking from a well drilled through an inaccessible opening or excavation, as, for example, where pillars have been

pulled. In the event of such leakage there would be danger of the goave filling with gas which would escape into the active workings. The writer does not attempt to discuss the relative merits of the two sides to the controversy, but as the courts have held that the parties owning the gas have the right to drill it is necessary to consider how drilling can be done with minimum danger. All have conceded the necessity of having at least one outer protective casing open at the

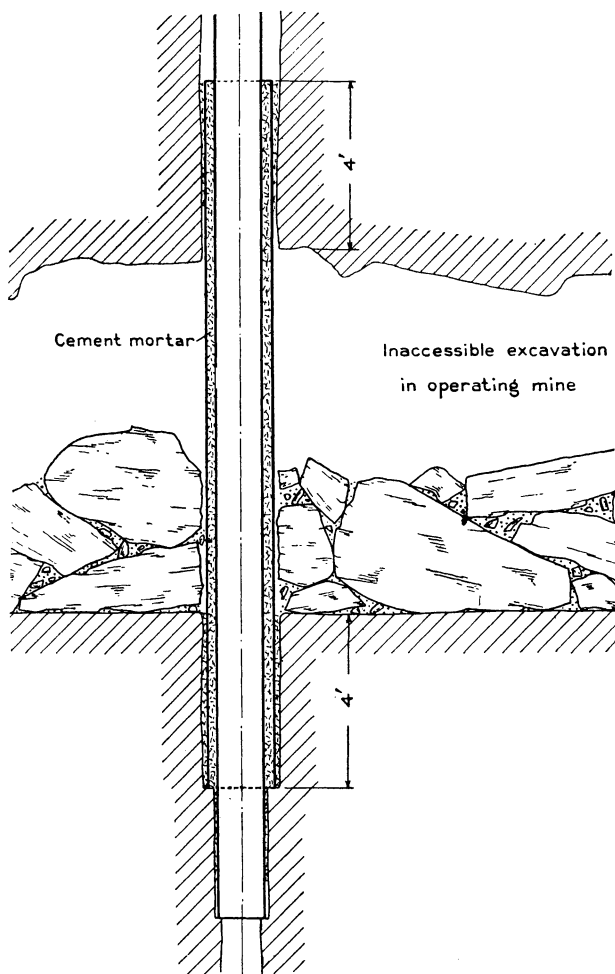


FIGURE 5.—Proposed method of protecting casing by use of cement mortar.

top to the atmosphere, but in the event that acid mine water may corrode it additional protection is necessary. One plan, proposed by Mr. McCloy, of the Philadelphia Co. (see fig. 5), is to make the hole large enough to insert an outer pipe opposite the coal bed and fill the space between it and the casing with cement. This plan seems to be excellent and worthy of trial.

An alternative scheme (fig. 6) offered by the writer might be used where the mine excavation is not too much filled with débris, and in some cases might be used to supplement the method previously described. The plan is as follows: After the drill has entered the excavated space and has passed through any loose rock to the bottom, fill the space with wet concrete composed of crushed rock or gravel, sand, and cement thoroughly mixed. This concrete is to be put in rapidly and will, if of proper consistency, form a conical heap with the apex at the top of the open space. A conical bit or tool fixed on the end of the string of tools should then be immediately lowered and used to spread out the top of the heap. More concrete should then be put in and should be spread out by the conical tool. After the concrete has been allowed to set, a hole can be drilled through it

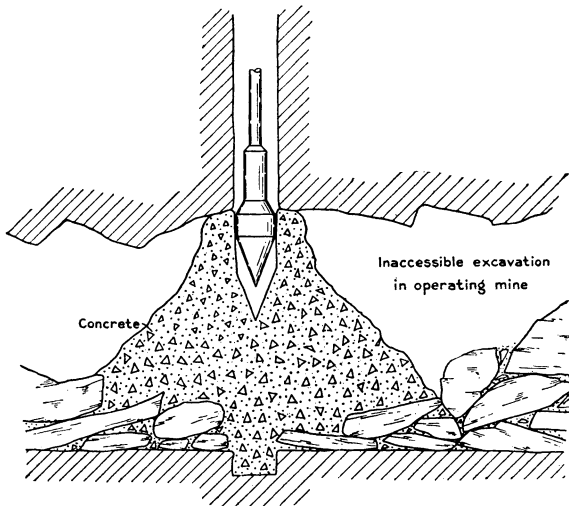


FIGURE 6.—Proposed method of protecting casing in inaccessible workings.

in the usual way. This hole may be a small one. Then liquid cement can be run in and forced under pressure to fill the interstices. After this has set it is anticipated that there will be a strong concrete column in the mine excavation. This column will be practically impervious to the mine water, and a hole of full size can be drilled through it as through solid rock and the casings inserted in the usual manner.

DISCUSSION.

A MEMBER. Referring to figure 5, do you fill the hole with concrete or with cement mortar?

Mr. RICE. It is filled with liquid cement and an inner casing to be lowered while it is still liquid. The surplus cement would then be removed from the inner casing.

Mr. McCLOY. The object is the protection of the inner casing from the mine water.

A MEMBER. [during the exhibition of fig. 7, relating to plugging an abandoned well]. Is this designed primarily to save the value of the coal, or to prevent the oil settling or otherwise moving into

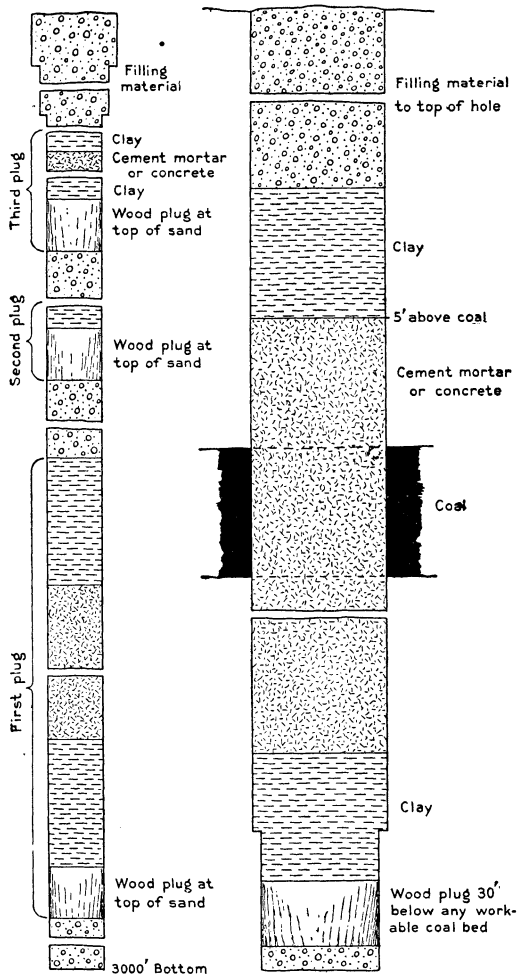


FIGURE 7.—Proposed method of plugging abandoned well.

other strata which might be detrimental to a large portion of the land?

Mr. RICE. It would lead to the same end in either case, I think, but primarily it is to avoid leaving a pillar. When the well is still producing oil or gas the plan presented in figures 3 and 4 might be employed.

A MEMBER. There is no doubt that the value of the coal recovered would fairly offset the cost of such a plan as this?

Mr. RICE. The cost of the coal recovered might not pay in the case of a single well, but I think it would pay where there are a large number of wells; so that it might be very difficult to mine the coal at all.

Mr. BOILEAU. Take the cheap coal, like some Illinois coal, \$20 to \$50 an acre, that would not be worth the saving, would it? I have seen an instance of gas coal where a man paid \$200 for a 40-foot pillar around a well; that is, the man that drilled the well had to pay \$200 for a 40-foot pillar around the well. I would rather have left the coal there in that case.

Mr. RICE. It is not a universal proposition in its application. I would like to see it taken under consideration. It might be found entirely impracticable.

Mr. WATERS. I think that is a good scheme for a single well, but I do not think that it would be in all cases. For instance, suppose the well was drilled by a company in a new gas or oil field in which pretty rich wells are being struck, and suppose that the property line is 10 feet from a well, and an opposition company wanted to drill another well to get that gas, and they drilled a hole within 10 feet or 20 feet, how would that be protected?

Mr. RICE. That is rather too intricate to take up at this time.

A MEMBER. That will come up every day in good gas and oil territory.

Mr. RICE. My point of view is that if you protect with a pillar of coal that you have got to leave a big pillar, and if you are removing or pulling the room pillars the presence of a pillar around a well will interfere with the regular subsidence, which is essential in systematic pillar withdrawal.

Mr. FOHL. Then it is your view that the leaving of that comparatively large pillar would interfere with the subsidence of the strata.

Mr. RICE. That is what I was trying to bring out. In longwall work, if on account of property rights you have to leave a pillar, it usually causes more trouble to surface improvements than where you can take it out and let the settlement take place regularly.

Mr. MOORE (referring to figs. 3 and 4). That artificial pillar would be a sort of pedestal that would to some extent support the roof?

Mr. RICE. It would be an elastic support; it would gradually pack down to about one-half its original height.

Mr. MOORE. Suppose on that butt entry you have three wells, possibly not as close as the gentleman suggests, which you say are 300 feet apart; and if those three artificial supports tend to hold up the overlying strata to any great extent, wouldn't that be a source of a squeeze?

Mr. RICE. That would be a danger that would have to be taken care of as far as you could by making that support elastic. So it

settles sufficiently to allow the roof to break at the edge of the pillars being withdrawn, I think a squeeze would be avoided. To make it very elastic you would allow the clay and other material to be squeezed out laterally and perhaps omit some of the curtain pillars. The proportions of these as shown in figures 3 and 4 are not to be taken literally. It is just a suggestion of what may be done.

Mr. HALL. Hadn't that pipe better be held by something that would move in the hole instead of by something that is in the roof? The material which is to keep the clay in place, moving in the hole, instead of being underneath the roof?

Mr. RICE. We are providing that the hole below the casing be drilled large enough so that the casing can slide either down or up.

Mr. HALL. If the clay layer were thinner, you could put another pipe on the outside, and let the casing run up and down in that, and so need nothing more to protect it inside of the mine.

Mr. RICE. The object of this scheme is to provide a cushion for the roof, to prevent it swinging to one side and rupturing the casing. It is to make the strata in the vicinity descend evenly when the adjacent coal pillars are pulled, and I think that an outer casing suggested by Mr. Hall will be unnecessary if the holes are drilled somewhat larger than they are ordinarily, and are filled outside the casing with clay grouting.

Mr. FOHL. Have you stated the approximate dimensions that you would have for this artificial pillar?

Mr. RICE. I have in mind that the clay pack surrounding the hole would be about 8 or 10 feet in diameter, and outside of that would be built up a gob wall. You would pack the clay as the wall was built, and perhaps wet it; much depends upon the circumstances in each case. From experience in northern Illinois, where you pack with rough shale material, the subsidence is about 50 per cent, and that is obtained in a year or two. Most of the settlement underground takes place in the first two or three months; but the surface is affected more slowly, depending on the depth.

Mr. HALL. Is it the idea that there is another butt entry parallel with that?

Mr. RICE. Yes. It is intended to represent the ordinary conditions in the Pittsburgh field. The dimensions (fig. 3) may not be quite right as to width of rooms and pillars, that is immaterial; the scheme is simply presented as a general plan.

Mr. FOHL. We are certainly greatly indebted to Mr. Rice for the time he has spent in the preparation of this subject, and we hope that a little later these illustrations and this paper will receive a full discussion. We will proceed with the next paper on the program: "Mine Troubles Due to Proximity of Gas and Oil Wells," by Mr. L. M. Jones.

MINE TROUBLES DUE TO PROXIMITY OF GAS AND OIL WELLS.

By L. M. JONES.

INTRODUCTION.

The relation of gas and oil wells to nearby coal mines has been investigated by inquiring into the past and the present practice of operating each and by noting wherein accidents and troubles have resulted or are likely to result. Published references to several sources of trouble have been found, and as many as time would permit have been investigated in the field with a view to determining causes and remedies. The cases on which information has been obtained have been classified according to the cause of the accident or trouble and are discussed below.

ABANDONED WELLS UNCHARTED AND IMPROPERLY PLUGGED.

Until very recently there has been no legislation in any of the States requiring the filing of a statement giving the exact location of a drill hole, and the legislation covering plugging has for the most part not covered the matter thoroughly, and has been difficult to enforce.

Consequently in some of the old oil and gas fields many of the wells drilled have been uncharted and have been ineffectually plugged or not plugged at all. Where these wells have passed through coal beds that at a later period have been opened, several accidents have been caused by the unexpected piercing of the wells and the resulting liberation of large volumes of natural gas.

MINE FIRE CAUSED BY PIERCING AN UNCHARTED ABANDONED WELL.

A serious mine fire was caused at a mine at Vandergrift, Pa., on July 30, 1912, by the lighting of gas that entered the mine after the striking of an abandoned gas well.

A machine runner and a scraper were undercutting the coal with a chain machine at the right corner of the face in a room about 11 o'clock in the morning. The machine cut into the uncased well hole and a large volume of gas immediately entered the mine. The gas was lighted by the open lights of the miners and they were forced to run from the working place. As they ran out of the room the flaming gas followed just beneath the roof. Several unsuccessful attempts were made by the foreman and others to reach the face to get the mining machine.

At 4 p. m. brick stoppings were started at the mouth of entries 19 and 20. They were completed that evening.

Later by digging on the surface the top of the well hole was found. It was cleaned out to a depth of 715 feet (500 feet below the coal), where there seemed to be an obstruction. The hole was then cased in the following manner:

An 8-inch pipe was inserted to a distance of 4 feet below the surface; then 4-inch pipe was inserted to a point 8 feet above the coal and at its end a 3 $\frac{3}{8}$ -foot by 7 $\frac{5}{8}$ -inch sleeve wall packer was placed. Inside the 4-inch pipe a 2-inch pipe was inserted to a point 150 feet below the coal, and a disk wall packer was placed at its end. This arrangement allowed a free vent from below the coal to the surface.

After an investigation with helmets inside the sealed area had indicated that the fire was out the entries were reopened.

SEEPING OF OIL INTO MINES.

In a number of coal mines oil has oozed from the coal from wells whose position was not accurately known, the surface indications having entirely disappeared.

In one mine in the Pittsburgh district, after two rooms off a certain butt entry had passed through a clay seam, oil oozed from the coal face. Work in the rooms was immediately discontinued, and samples of air were taken at the face to determine whether any natural gas was leaking into the mine. The samples failed to show the presence of any natural gas, although three abandoned wells were near the point of sampling. Two of these were within 250 feet from the points where the oil appeared, and the third was about 400 feet distant. All three wells were supposed to have been plugged before abandonment.

There have been other cases where oil from a neighboring well has entered a mine through the coal. In one mine the quantity so entering necessitated the installation of a pump for its removal.

WELLS WITHOUT VENT FOR CASING GAS.

A second group of troubles arises from wells that have been improperly cased and sealed, some of which have no vent to the surface for gas collected within the outside casing.

MINE EXPLOSIONS CAUSED BY NATURAL GAS FROM WELLS.

EXPLOSIONS IN CONSOLIDATION COAL CO.'S MINES NOS. 47 AND 49.

Probably the most serious accident that has yet occurred from natural gas entering a mine resulted from an improperly capped well that had been drilled through mine No. 47 of the Consolidation Coal Co. in West Virginia. This accident occurred December 19, 1910, and was described by C. H. Tarleton before the West Virginia Min-

ing Institute in 1911. The well in question was so small a producer that it had been closed in, as its commercial value was questionable. It passed through the mine at one end of a coal pillar 125 feet wide and 380 feet long. In some manner not definitely known the gas from the tubing leaked into the casing, which was closed at the surface. The high pressure, said to be possibly 1,000 pounds to the square inch, forced the gas through the rock strata underlying the coal, and the gas entered mines Nos. 47 and 49 at a number of points in practically a straight line extending southwest parallel to the coal contours of the Pittsburgh seam for a distance of 2,300 feet from the well. As these mines were nongaseous, open lights were used; the gas in both mines was lit by the open lights, explosions resulting. Fortunately the coal dust in both mines was damp, so that the explosions were not so widespread nor so violent as they might otherwise have been.

In mine No. 47 the explosion occurred at 6.50 a. m., while the men were going to work. Three of them lost their lives owing to inhalation of flames; the others succeeding in getting outside without being caught in the afterdamp.

In mine No. 49 gas blowers in rooms 10 and 11, off the third right butt entry, off the main south face, were lit about 8 o'clock p. m., December 18, by a pumpman, who was the only person in the mine. He succeeded in putting the fire out with his coat. At 5 o'clock the next morning he lit the gas in the third face entry and an explosion resulted. Fortunately the explosion ruptured an overcast near where the pumper was thrown, and the short-circuiting of the air prevented his suffocation by afterdamp.

The explosion in this mine caused considerable damage in by the point of ignition and started a mine fire in room 5, on the first left butt entry. Eight stoppings were required to seal off the fire area.

Samples of gas were taken in both mines, and the analyses indicated that natural gas was present, as a considerable percentage of ethane was found. When the well was opened the gas blowers in the mine began to diminish and eventually almost entirely disappeared.

PEORA EXPLOSION.

Another mine explosion, due to the lighting of inleaking natural gas, occurred at a country mine on the Mary Chalfont farm, at Peora, Harrison County, W. Va., November 22, 1912.

A man and two boys entered the pit, which has only a single entry, between 6 and 7 p. m. As they were going in they met a neighbor coming out with a wheelbarrow load of coal. It is reported that the neighbor had fired a shot just before he came out, but he did not say anything about it. When the three reached the face the man noticed that the roof was not in good shape, so he asked one of

the boys to raise the open light in order that he could see it better. As soon as the boy raised the light an explosion occurred. The man managed to get out, but the two boys were burned to death. The neighbors say that the flame extended 100 feet from the opening and was 40 feet in height. A wheelbarrow was thrown from inside the pit over 150 feet from the opening. Some timbers from the mine were also blown 150 feet from the opening. There was considerable gas coming from the ground around the outcrop and this took fire. Some person went to the gas well about 500 feet from the opening and opened the valve to the casing. The pressure was immediately relieved and the flame died down at the pit mouth and along the outcrop.

The explosion started a fire in the mine and it burned from November 22 to 24, when it was put out by Mr. Tarleton and some other men.

At some previous time the casing had been pulled out of the well, but the tubing had been left and the well remained in use. Only a little 6-inch casing had been left and this had been capped at the top and the valve had been closed, as had also the valve on the tubing. It is probable that the casing had been closed for some time and that the gas had broken into the mine as a result of the firing of the last shot. When Mr. Tarleton was there on November 24 there was still 2 feet of gas at the roof. By January 18, the pit mouth had been partly filled and water had backed into the mine so that it was impossible to get in very far. Two samples of gas were taken 10 feet inside the opening, but in the half light no gas cap could be seen. The well is supposed to be just 515 feet from the mine opening and the single entry of the mine is reported to have advanced to a point within a few feet of the well, but it is uncertain just how far the entry is in, since, so far as is known, no accurate measurements have been made.

REYNOLDSVILLE EXPLOSION.

Another instance of gas leaking into a country pit occurred near Reynoldsville, W. Va., on the Parkersburg branch of the Baltimore & Ohio Railroad. A man had gone to the face of the entry, 80 feet from the opening, and had lit a shot. He then went outside and waited until the charge had fired. The shot caused a violent explosion which blew two cars standing in front of the mine a considerable distance. After the explosion it was found that the mine contained large quantities of explosive gas. A well 1,000 feet from the opening was opened, but the gas still seemed to leak into the mine. A well 1,500 feet distant and in direct line with the entry was then opened and immediately the gas ceased coming into the mine.

CLARKSBURG EXPLOSION.

In the proceedings of the West Virginia Coal Mining Institute for 1911, Mr. Frank Parsons, district inspector in West Virginia, told of a mine near Clarksburg, W. Va., which had had an explosion, probably caused by the lighting of natural gas that had leaked in from a gas well. His reason for believing that the gas was natural gas is given below:

The mine was in only 80 feet from the outcrop. A mine only 80 feet distant had been opened out completely and abandoned without ever detecting gas. Since abandonment of this mine four gas wells had been drilled in the neighborhood so that it was probable gas was leaking from one of these wells.

LEAKAGE OF GAS FROM WELL.

In another mine in southwestern Pennsylvania there is an abandoned well located in a pillar near the forks of two entries. Air samples taken two years ago in an air current from this section showed 0.87 per cent of natural gas, which was equivalent to 252 feet of natural gas a minute. Analyses made recently indicate that gas is still being given off but in decreasing volume.

The instances cited show that greater precautions should be taken to seal properly all wells from the coal beds and to provide a vent to the surface for any gas that may collect in the casings.

UNPROTECTED CASINGS.

There is always a possibility of danger from wells that pass through the workings of an operating mine if the well casings are unprotected. I have heard of no case where serious accident has resulted in the mines from such a condition, but many such wells are a constant menace to the safety of the mine on account of the fact that the exposed condition of the casings renders them more likely to be injured than if they were inclosed by a protecting wall or pillar.

BRIER HILL MINE EXPLOSION.

In the bituminous report of the Pennsylvania Department of Mines for the year 1895 James Blick, State mine inspector, reported an accident at Brier Hill mine, October 17, 1895, in which three men were badly burned, one of them dying 12 days after the accident.

The accident was due to the lighting of natural gas that had leaked into the mine from an oil well. The well had been drilled through one of the rooms about 2 years previous while the pillars were being drawn. The remaining pillars in the immediate vicinity had been left standing in order to support the strata and to protect the well. By reason of the fact that part of the coal had been taken out, the part remaining was not strong enough to carry the weight of the overlying strata, the result being that a creep had begun to overrun

that part of the mine. The continued subsidence of the strata finally broke the casing of the well, allowing the gas to escape. Three men were working only 300 feet away and the gas was lit by their open lights. Inspector Blick considered it very fortunate that the gas was lit so soon and so gave warning, as a short time later it had spread through a considerable part of the mine. There were 160 men in the mine at the time of the accident.

As the mine was ventilated by means of a furnace, the fire was immediately put out, so as to prevent ignition of the gas in the return.

An investigation indicated that the pump rods, tubing, and casing of the well were broken near the coal bed. The casing had been bent considerably out of line before being ruptured. The casing at the surface was connected to a gas line that supplied gas for firing some boilers. The inspector was uncertain whether the gas that entered the mine had come up the casing from the gas sands or had come down the casing from the pipe line, which was also connected to other wells.

BENDING OF CASING.

In a western Pennsylvania mine, where the casing of an oil well passed through a mine working, after the room pillars had been pulled, subsidence of the overlying rocks bent the casing to such a degree that the rods in the well could no longer be operated. In cases of this kind it would probably be impossible to plug the well effectively on abandonment, so that the well would remain a menace both to present mining and to future deep mining.

CASING BENT BY WRECKS.

In another mine near Pittsburgh the casing of an abandoned well imperfectly plugged is between the haulage tracks on a parting, and wrecks of trips have hammered it to such an extent that the casing midway between the bottom and the roof is 7 inches out of line. The inside of this casing is plugged with concrete for 50 to 60 feet below the mine floor, but some gas and salt water rise on the outside of the casing into the mine. The plugging of the well is not satisfactory, because, although little or no gas rises through the casing to the surface, the gas does come up outside the casing. The well should have been plugged below the casing and the casing sealed with cement.

PROTECTION OF EXPOSED CASINGS.

Several methods are used to protect casings exposed in mine workings. One large company has adopted the plan of building around the well a 13-inch wall of brick set in cement mortar.

Concrete walls have been built around many wells to protect them from injury.

If pillars are to be withdrawn, G. S. Rice, chief mining engineer of the Bureau of Mines, has suggested that a pack wall of slate be built around an interior filling of clay (fig. 4). This wall would partly support the roof and prevent the severe bending or rupturing of the casing by sudden falls of great weight.

DANGER FROM DRILLING OPERATIONS.

The manner of drilling certain oil wells has been a source of annoyance and of disagreement between mining and well-drilling companies. The drilling has been so conducted as to inconvenience the operation of the mine and even to endanger the safety of the miners and mules.

In some especially aggravating cases the well has been drilled irrespective of whether there were mine workings beneath or not.

MULES KILLED.

I have heard of no case in which a human being has been injured as a result of inconsiderate well drilling, but I know of two instances where mules were killed.

One of these occurred in Illinois 15 or 20 years ago when a string of tools in an oil well over a mine broke through into an underground stable and killed a mule. More recently in Pennsylvania well-drilling tools broke into an entry and killed a mule.

LEAKAGE OF GAS AND OIL DURING DRILLING.

A well drilled through the Rice mine near Bergholz, Ohio, some time ago gave trouble. The drill passed through a room and the casing was driven down 10 feet below the coal. The hole was then drilled to a depth of 700 feet to the Injun sand, where oil and some gas was struck. The oil and gas came up outside the casing and, although a cement block had been built in the mine around the casing, entered the mine through crevices.

Mining and drilling were both suspended until changes could be made. A second string of casing was placed in the well with rubber packers above the oil-producing sand and 60 feet below the mine floor. Between the original and the new casing liquid cement was run from the packer to the surface. No further leaks were found in the mine.

INFLOW OF SURFACE WATER.

Another possible source of damage from drilling operations through mine workings is the inflow into the mine from the drill hole of large quantities of surface water. Such a case occurred in

an Ohio mine. The well had been cased to a point below the coal and a concrete block had been built around the casing, but the flow of water could not be stopped. The casing was pulled out and the hole filled with cement to a point above the roof. The casing was then lowered into the liquid cement and the cement allowed to set inside and outside the casing. Afterwards the hole was drilled through the cement inside the casing. This method stopped the inflow of surface water.

DRILLING THROUGH ABANDONED WORKINGS.

It has sometimes been difficult for the gas or oil company and the coal company to agree as to the safety of drilling through abandoned mine workings.

In the case of the Monongahela River Consolidated Coal & Coke Co. against the Greensboro Gas Co. the coal company desired that the drilling of a well through abandoned workings of the Snow Hill mine be enjoined, contending that such a well would be a danger to the Snow Hill mine and to neighboring mines connected with it. As the well passed through inaccessible workings no protecting barrier could be built around it, and consequently it was liable to be injured by the subsidence of overlying strata or by the corrosive action of acid mine water on the casing.

A temporary injunction was later dissolved on the ground that the gas company had a legal right to drill the well through the coal stratum. The gas company was instructed, however, to fill with liquid cement the space between the 10-inch casing and the walls of the well and the space between the 8-inch and 10-inch casings.

DESIRABILITY OF AGREEMENT.

The instances cited show the desirability of an agreement between a well-drilling company and a mining company as to the location of wells through mine workings, also the desirability of an agreed method by which such work shall be done so as to safeguard the mine from inflows of gas, oil, or water and so as to safeguard the wells from damage due to mining operations.

FIELDS HAVING MANY WELLS.

In some fields the wells are very close together, being only 100 to 400 feet apart, and in such territory mining development is very difficult.

In the Canonsburg, Pa., field and in the Scio, Ohio, field some of the wells are very close together. A photograph of a district in Greene County, Pa., also shows there are many wells. Mr. I. C. White, at a West Virginia coal mining institute meeting in

1910, stated that similar situations exist in Wetzel County, W. Va., where some farms had 200 to 300 wells; about one-fourth of these had been abandoned without being charted.

LOCATION OF WELLS WITH RELATION TO PROJECTED MINE DEVELOPMENT.

A plan (fig. 1) showing a projected mine development in West Virginia gives an illustration of the seriousness of the problem when coal pillars must be left to protect wells in the territory to be developed. In this case the projected underground development work was staked out on the surface and the wells were located so that 100-foot pillars surrounding them would not necessitate curving the entries. When the mine development is actually undertaken, it may be found advisable to increase the size of the pillars to 200 feet so that the entries will have to be driven differently from the manner indicated.

In the case last cited the drilling company was willing so to locate its wells as to inconvenience the coal-development work as little as possible. Most of the large coal and gas and oil companies in Pennsylvania and West Virginia have been willing to cooperate in this manner so that the development of either would inconvenience the other as little as possible.

When a gas or oil company desires to drill a well in a certain place it furnishes the coal company with the proposed location to determine whether there is any objection on the part of the mining company. Where wells would interfere with projected development work or would be difficult to protect, changes in location are made to meet these objections.

After Mr. Jones had read his paper, on motion, the conference adjourned from 12 o'clock until 1.30 o'clock p. m.

The afternoon session was called to order at 2 o'clock by Chairman Fohl, who called for the next number on the program, "Suggestions for Legal Regulations of Bore Holes Passing through Workable Beds of Coal," by Messrs. O. P. Hood and A. G. Heggem.

Mr. Hood stated that before starting to read the paper he wished the members to understand that it was the opinion of the Bureau of Mines that these suggestions should be left in the hands of the members. The whole object of the conference, he said, was to get the help and suggestions that are so useful and are so much needed in every way by the bureau in its endeavor to collect information. It was for the members, he said, to discuss this information, and, to use a rough phrase, "to rip it up the back" if they saw fit, and there should be no hesitancy on the part of anyone to give all the criticisms that he might feel moved to give.

Mr. Hood then read the paper.

SUGGESTIONS FOR LEGAL REGULATION OF BORE HOLES PASSING THROUGH WORKABLE BEDS OF COAL.

By O. P. HOOD and A. S. HEGGEM.

In the following suggestions for regulations in the matter of bore holes passing through workable beds of coal as herein presented, an attempt is made to harmonize as far as possible the information and advice that have so far been available to the bureau. Suggestions have come from those interested in the safety of miners, those interested in mining operations and in the boring of gas and oil wells, and those interested in geology and the conservation of the coal, gas, oil, and other mineral resources of the country. In the suggested regulations the authors have not attempted to adopt legal phraseology nor to offer an entirely complete set of rules. The proposed regulations are expected to form a basis for discussion and further suggestion by this conference, to the end that suitable laws may be suggested to the various States in order to make mining safer and to prevent mineral waste.

It seemed to be the general opinion that some form of inspection is necessary in order to make operative any laws to be enacted that require specific methods and results. It is therefore suggested that there be a chief inspector of gas and oil wells; that he have sufficient help of a permanent and temporary character to meet the exigencies of the well-drilling business; and that these officers have certain duties prescribed.

In order that it shall be possible to locate accurately a well that goes through a workable coal bed and may at some time be within a mine area, it seems desirable to require a license to drill, this license depending upon the filing of proper maps and records. In case a location is proposed that may be detrimental to a coal mine, either from the standpoint of safety to the miner or that of the economical working of the mine, provision is made for a conference between the three parties interested in such location, these parties being the mine owner, the well owner, and the miner as represented by the State mine inspector.

The inspector of gas and oil wells is given power to change the proposed location within reasonable limits to the end of insuring a safe and equitable condition. It is also required that the inspector shall keep records in his office so that at any subsequent time it will be possible for a mine operator to locate accurately abandoned wells and not have to proceed in ignorance of their existence.

In order that the wells shall be properly plugged when they are abandoned it has been suggested that the well driller shall furnish a bond, which is to be returned to him when the plugging has been properly done. The inspector is required to supervise this plugging, so that a record becomes available of the method employed and the satisfactory accomplishment of the operation.

In making a provision that wells that have suspended operation shall be maintained in a safe condition by the well owner, it is believed that formal abandonment rather than neglect will naturally follow.

The suggested regulations cover only those wells that are put down through workable coal beds. A definition of "workable coal bed" is so difficult that it has not been attempted, and the responsibility for a reasonable interpretation of this term is placed on the State geologist whenever the matter becomes one of dispute. It is believed that some such official would be expected to interpret this term in view of the intention of this act, namely, to protect the miner while working beds of coal that may be used during the reasonable life of any well. It is not the intent to require special protection for a seam of coal that is physically workable and yet whose exploitation is probably so remote as to make it more than probable that the well will have been abandoned and properly plugged before there is need of the bed.

The location of a bore hole should be so accurately determined and recorded that the well can at any time be relocated, even after all surface indications have disappeared. For this purpose it is necessary to have the survey made by competent persons and to refer to established boundaries, which can be located only by reference to at least three monuments or reference points. It is also desirable that there should be uniformity in the matter of the scale of the maps submitted.

In order that gas may not be drawn into the ventilating system of any mine, a minimum distance from a mine opening has been provided, and a similar minimum distance to those buildings that are vital to the safety of operation of a mine, so that in case of fire at either wells or mine buildings the risk shall not be increased.

It seems evident that a bore hole should not go through any mine haulage-way or airway, and in order to prevent this occurrence, requirement has been made that the well shall be 15 feet from such mine haulage-way or airway. If pillars are considered necessary about such a bore hole it is believed that the supporting power of the haulage-ways ribs will be sufficient, as it seems to be generally admitted that a coal pillar surrounding a bore-hole casing can not be made to serve the purpose of keeping out gas that may leak around the casing.

In requiring casing from surface water, it is believed that after the casing that goes through the coal seam has been properly placed and packed as required, the casing used for excluding the surface water may be withdrawn. The double casing required through any coal

seam is deemed necessary in the event that a mine should be opened and the casing possibly exposed to corrosion or to injury from the movement of ground. In order that the ground pressures may be applied over a considerable surface of the casing, it is required that the double casing extend into the floor a sufficient distance; that it be surrounded with a clay pack; and that the second casing shall be brought into play through a similar clay pack. (See figs. 8 and 9.)

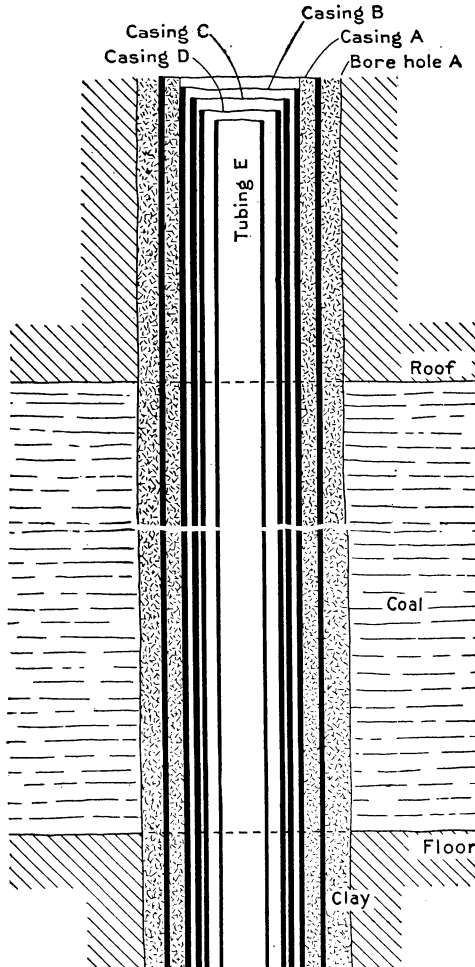


FIGURE 8.—Proposed method of sealing casing passing through solid coal.

The use of clay rather than cement for a packing material was preferred in order to avoid possible cracks through which corrosive water might enter if the outer casing was penetrated, and also to prevent the localizing of stresses on the second casing by a hard connection between the two casings. The packing material also serves to prevent leakage of gas into the casing space even if the casings are deformed by ground movement.

The second casing, which is required through any coal seam, may

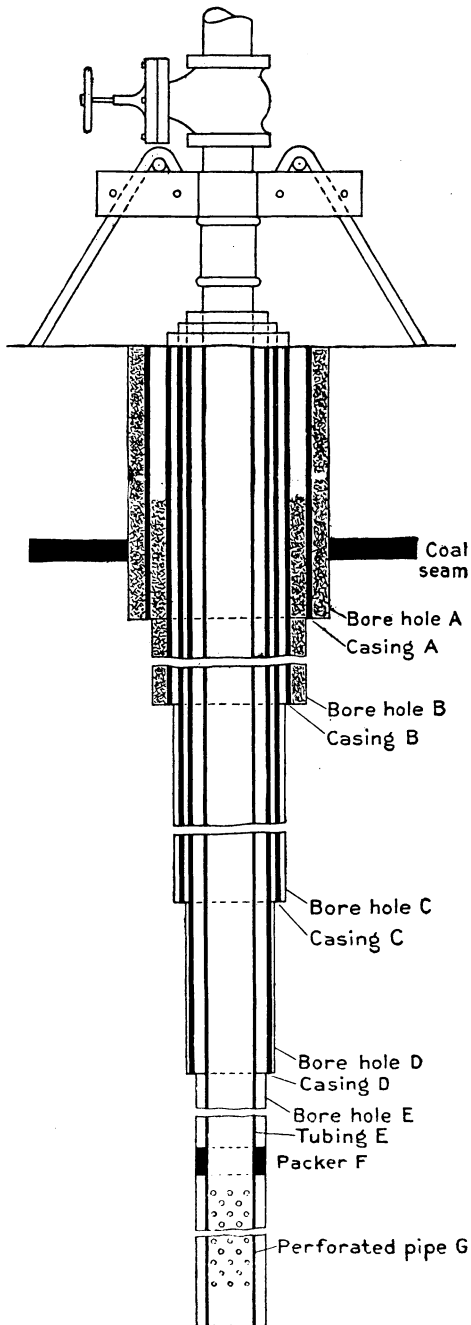


FIGURE 9.—Proposed method of protecting exposed casing.

extend downward to any depth beyond that prescribed, but in the

event that it is stopped 10 feet below the first casing, requirement is made that in cementing it the cement shall not extend up to the first or outer casing. The drawing of the outer casing when the well is abandoned is thus facilitated.

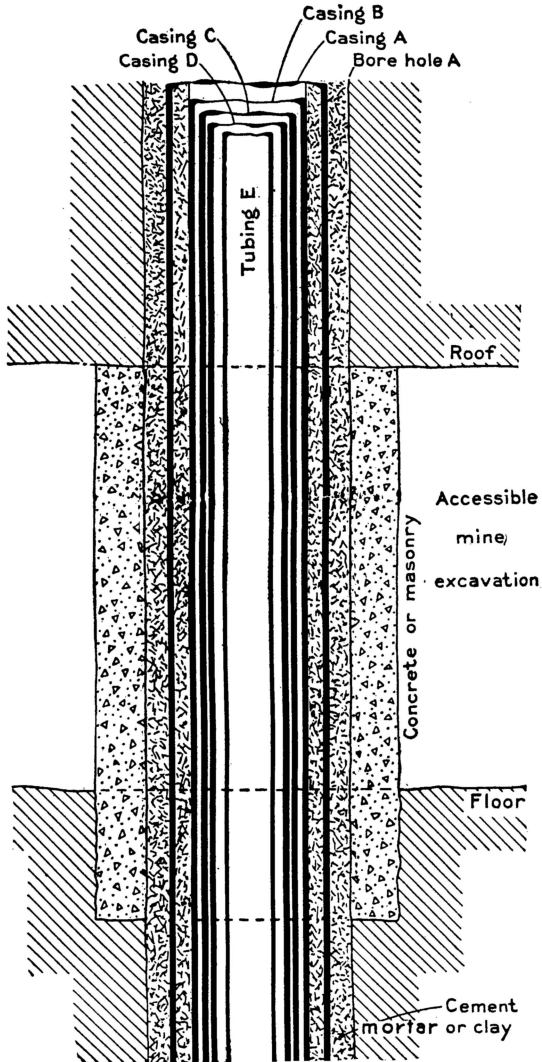


FIGURE 10.—Method of protecting exposed casing with concrete or masonry.

Where the casings pass through a mine excavation, a further mechanical protection, embracing a suitable wall and a clay pack surrounding the outer casing, is prescribed with the intent of preserving it from injury and corrosion. (See fig. 10.) Where such casing passes through an inaccessible mine excavation, attempt has been

made to provide a similar protection by prescribing a cement covering held within an outer metal tube acting as a form. (See fig. 7.)

In prescribing the arrangement of casings and casing head, endeavor has been made to insure a free vent to the atmosphere from a point in the well below any of the casing used and to insure that this vent shall be maintained by openings that can not be readily closed.

Where oil is allowed to rise within a casing above the floor of a mine, as may happen during disuse of the well, it may find its way past the several casing seats and into the mine, so that the requirement that the level of any such oil be kept below the mine floor seems necessary.

The abandoning of a well has been made a formal matter, so that a proper record shall be made and there shall be assurance that the work is properly done.

In prescribing a plugging method, attempt has been made to keep the method as simple and as general as possible. The method is based on the theory that although clay alone may make a good stopping, it may flow and not be maintained in its proper place. Although the cement mortar or concrete is apt to be porous, to deteriorate in oil, and to form a plug of doubtful tightness, it has the quality of staying where it is put. To combine the desired qualities the proposed regulations prescribe that there be a 25-foot cement plug with 5 feet of clay at each end, so that if there is any movement of fluids through the cement the clay will be carried into small openings and eventually close them. It also seems desirable that there be a hard, solid filling through any coal seam, so that if the well hole be struck by mining tools it will be immediately recognized.

The draft of the proposed regulations follows.

DRAFT OF PROPOSED REGULATIONS IN THE MATTER OF BORE HOLES PASSING THROUGH WORKABLE BEDS OF COAL.

OFFICERS.

(1) METHOD OF APPOINTMENT.

A chief inspector of gas and oil wells shall be appointed by the governor from an eligible list of men who have passed a satisfactory examination showing their technical fitness for the position.

(2) SALARY.

The yearly salary of the chief inspector of gas and oil wells shall be _____ dollars. Necessary travel expenses to the amount of _____ dollars shall be borne by the State, and an office equipped with suitable filing arrangements shall be provided.

(3) ASSISTANTS.

Assistant inspectors of gas and oil wells, subject to the authority of the chief inspector, may be appointed by the governor.

(4) DEPUTIES.

Competent men may in an emergency be deputized by the chief inspector to perform the duties of his position in the field, but an appeal from the decisions of such deputies may be had to the chief inspector. Deputies may receive not over — dollars per day and actual expenses not exceeding — dollars per day.

DUTIES.

(5) LOCATION OF BORE HOLES.

It shall be the duty of the inspector to receive applications for permission to drill bore holes and to issue a license to drill to persons who comply with the law.

The inspector shall receive and file maps giving the location of bore holes, shall determine the sufficiency of such maps for the purpose of accurately locating such bore holes, and shall cause a new survey of such location in case the available maps are unsatisfactory.

It shall be the duty of the inspector or his assistant to examine the maps accompanying applications for permission to drill a bore hole, and if the proposed location is in the vicinity of a mine he shall immediately proceed to the site and request the district mine inspector and the coal operator to state whether the proposed location as indicated on the map accompanying the application to drill is such as will interfere with the safe and economical operation of the mine.

The inspector shall issue a license when the proposed location of a bore hole shall have been determined to be such as will not interfere with the safe and economical operation of any mine or mines that might be affected, as determined by the mine owner, the State mine inspector, and himself. To this end he shall have the power to move the proposed location of a bore hole, as hereafter specified.

After hearing and duly weighing the evidence he shall permit the bore hole to be drilled at such point as will, in his judgment, permit the safe and economical operation of the mine or mines affected.

(6) RECORDS.

It shall be the duty of the inspector to keep a complete record and to prepare for publication a yearly report of the wells drilled in his district, including their location, date of completion, depth, production, and date of abandonment, and the names of owners.

(7) SUPERVISION.

It shall be the duty of the inspector to examine each well in his district at frequent intervals, giving special attention to all wells containing gas in such quantity as, in case of leakage, to make them a menace to a mine; the inspector shall see that all the provisions of this act are observed and strictly carried out.

(8) COMPLAINTS.

The inspector shall receive and investigate all complaints as to injury, present or impending, due to a lack of precaution on the part of any well owner or mine operator, and if he finds the complaints against the mine owner to be well founded, he shall lay the facts before the State mine inspector.

(9) PLUGGING WELLS.

Upon receiving notice of an owner's intention to abandon a well the inspector or his assistant shall proceed to such well and satisfy himself that the provisions of this act referring to plugging wells are complied with. He shall join the owner in making affidavit to the manner in which the well has been plugged.

(10) VIOLATIONS.

If the inspector discovers any well being drilled, operated, or plugged contrary to the requirements of this act he shall order the workmen engaged upon such well to cease work at once and shall not permit the work to be resumed until he is satisfied that the law is complied with.

(11) ENFORCEMENT OF LAWS.

To enable the inspector to perform the duties imposed upon him by this act, he shall have the right at all times to approach and examine any well in his district, and, with the authority of the State mine inspector, to enter any mine affected, and upon the discovery of any violation of this article or upon being informed of such violation, he shall institute proceedings against the person or persons at fault, under the provisions of the law provided for such cases.

In case of failure of the owner to properly plug an abandoned well, it shall be the duty of the inspector to have the work properly performed by contract and to assess the cost against the well owner.

(12) PENALTIES.

There shall be adequate penalties provided to aid in obtaining the safer conditions here proposed.

LOCATION OF BORE HOLES.

(13) APPLICATION.

Any person (firm or corporation) purposing to drill a bore hole through a workable seam of coal shall make application in writing to the chief inspector of gas and oil wells for permission to drill such hole, and he shall not commence drilling until such permission in writing shall have been received by him. In case of dispute the State geologist shall determine whether a seam of coal is workable within the intent of this act.

(14) SURVEY AND MAPS.

Accompanying the application for permission to drill such bore hole there shall be submitted a map, showing the location of the proposed bore hole, with reference by course and distance to the boundaries.

Said map must be made on a scale of 200 feet to 1 inch, and shall be based on surveys made by surveyors or engineers of recognized standing, and shall be certified to by the surveyor or engineer making the same.

In case the inspector finds the map insufficient to enable him accurately and completely to locate the proposed well, he shall require that another survey and map be made before permission to drill shall be granted.

If the original map is subsequently found to be adequate the cost of the second survey and map shall be borne by the State.

(15) BOND.

Any person (firm or corporation) purposing to drill a bore hole through any workable seam of coal shall be required to give bond in the amount of _____ dollars, to insure that the drilling and abandoning of such bore hole shall be in accordance with the provisions of this act.

(16) DISTANCE FROM BUILDINGS, ETC.

No bore hole penetrating a gas-bearing or oil-bearing formation shall be located within 300 feet of a shaft or entrance to a coal mine not definitely abandoned or sealed; nor shall such bore hole be located within 100 feet of any mine shaft house, boiler house or engine house, or mine fan. The proposed location of any bore hole must insure that when drilled it will be at least 15 feet from any mine haulage way or airway.

(17) LICENSE.

If a proposed bore hole be so located as not to interfere with the safe and economical operation of any mine, and if the previous requirements of this act be complied with, a license shall be granted, and said person (firm or corporation) may proceed to drill such bore hole in accordance with the further provisions of this act.

PROTECTION OF COAL BEDS.

(18) CASING OFF SURFACE WATER.

Any bore hole penetrating any workable seam of coal shall be cased by the owner of the bore hole with a suitable casing (conductor or drive pipe), so as to shut off all surface water from entering the coal seam.

(19) CASING THROUGH ANY COAL SEAM.

Any bore hole drilled for gas, oil, or other mineral shall be drilled to a point at least 20 feet below any workable seam of coal that may be penetrated, and receive a metal casing not less than one-fourth of an inch in thickness and of an inside diameter 4 inches less than the diameter of the bore hole. This casing shall be concentrically seated on the bottom of the hole, shall extend to the surface, and shall be known as the first casing.

A second inner casing, 4 inches less in diameter, shall extend at least 10 feet below the first casing and shall be seated in 9 feet of cement mortar composed of 1 part Portland cement and 2 parts sand. The inside of the second casing shall be open to the atmosphere its full length.

The intervening spaces between the second and the first casings and between the first casing and the bore hole or outer wall shall be filled with puddled clay to a height of 30 feet above the coal seam.

(20) CASING THROUGH ACCESSIBLE MINE EXCAVATION.

Any casing that passes through a mine excavation shall be protected by a wall of concrete or of masonry or brick laid in cement mortar, extending from 2 feet below the mine floor to the mine roof. Between the first casing and the wall thus constructed there shall be left an annular space of not less than 2 inches, which must be filled with puddled clay. This work shall be done by the well owner.

Casings that are exposed by mining operations shall be covered by the mine operator in the manner prescribed above.

(21) CASING THROUGH INACCESSIBLE MINE EXCAVATION.

Where a bore hole passes through an inaccessible mine excavation the outer casing shall be protected by cement mortar held within a metal tube with a diameter 4 inches greater than the diameter of

the casing and extending from 4 feet below the mine floor to 4 feet above the mine roof or cave.

(22) CASING TO EXCLUDE WATER.

Before a bore hole is drilled into a gas-burning or oil-bearing formation a string of casing shall be so set as to exclude all water from the lower bore hole.

(23) TUBING A GAS WELL.

To conduct gas from a gas well, tubing shall be inserted with a suitable packer placed below the inner casing and so constructed as to prevent the escape of gas except through the tubing.

The inner casing shall be left open to the atmosphere throughout its full length.

(24) TUBING AN OIL WELL.

To conduct oil from an oil well, tubing shall be inserted and extend from the oil-bearing formation to the top of the well.

The inner casing shall be left open to the atmosphere throughout its full length.

Should gas be liberated in the well in sufficient volume to have commercial value it may be shut in by means of a packer placed below the inner casing and may be conducted from the well through tubing inserted into the well parallel to the oil tubing. (See fig. 11.)

(25) CASING HEADS.

Casing heads must have at least one opening to the atmosphere to which a valve or plug is not attached, so as to insure ample vent in case of leakage into casing spaces.

(26) COMPLETION OF WELL.

When a bore hole has been drilled and put into operation the owner shall file with the inspector a statement of the total depth of the hole, the sizes and lengths of casing used and remaining in the hole, the depth and thickness of all coal seams penetrated, and whether oil, gas, or water is obtained.

(27) SUSPENDED OPERATION.

When for any cause a bore hole that passes through a workable seam of coal shall cease temporarily to be operated, the inner string of casing shall be maintained open to the atmosphere. Should oil tend to rise in the well above the bottom of the first or outermost casing passing through the workable coal seam, such oil shall be

pumped out by the owner, and its level maintained below the bottom of such outermost casing.

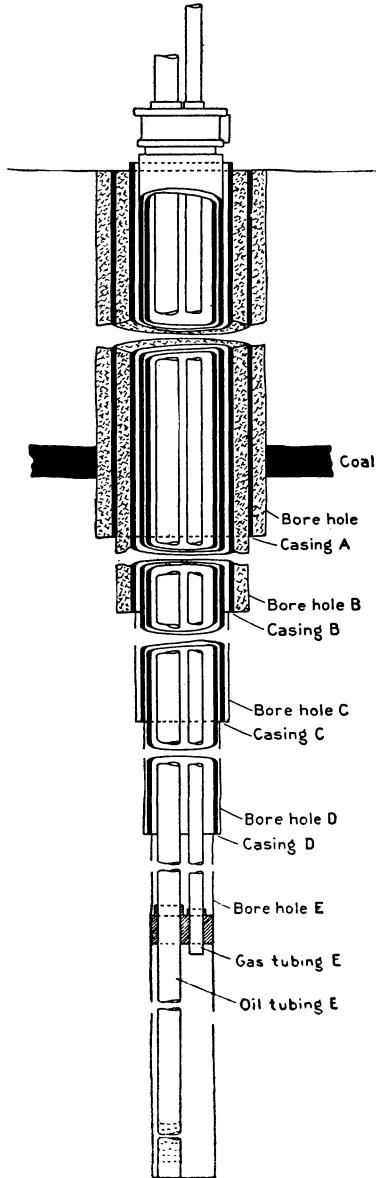


FIGURE 11.—Section of oil well showing tubing for gas.

ABANDONMENT OF WELL.

(28) NOTICE OF INTENTION.

When any oil or gas well is to be abandoned the owner shall notify the chief inspector in writing of such intent to abandon, and shall

proceed with plugging methods only after complete arrangements for inspection shall have been made and permission granted.

(29) METHOD OF PLUGGING.^a

When a well is to be abandoned it must be entirely filled from the bottom to the surface. The lower hole must first be filled with sand, clay, or rock sediment to a point 5 feet above the lowest gas bearing or oil bearing formation. Above each formation supplying gas, oil, or water, and immediately below any workable seam of coal, there shall be a plug as hereafter described, and each well shall have not less than three such plugs whatever the formation.

The plug above mentioned shall consist of 25 feet of cement mortar made of one part Portland cement and two parts sand properly mixed, and placed with a bottom-dump bailer upon 5 feet of clay resting on a seasoned wood plug 2 feet long and of the same diameter as the hole. Five feet of clay shall also be placed on top of the cement section. The space between the plugs here called for must be filled solidly with puddled clay, sand, or rock sediment, or with cement, mortar, or concrete. The filling shall be complete up to the bottom of a casing before such casing can be drawn; the filling shall continue length by length as the casing is withdrawn, cement, mortar, or concrete being used in those sections of the well hole that pass through coal seams.

(30) LOG OF METHOD OF PLUGGING.

When a bore hole has been plugged, an affidavit in reference thereto shall be made by the well owner, who shall state the method followed, the materials used, and the length of the sections occupied by each material. The affidavit shall be certified by and filed with the gas and oil well inspector. A duplicate of the affidavit shall be filed with the county recorder by the gas and oil well inspector.

(31) RELEASE OF BOND.

After and not until these several requirements have been met, any bond that may have been given by the owner shall be returned.

(32) FEES.

(The question of whether fees shall be charged for license and inspection is left for further consideration.)

DISCUSSION.

Chairman FOHL. Gentlemen, the subject is now before you in its entirety. We have had a general statement of the problem, coupled

^a See Fig. 7.

with suggestions from Mr. Rice, an account of some of the troubles that have been encountered in mining coal in the vicinity of oil and gas wells by Mr. Jones, and finally the suggestions for laws and regulations by Mr. Hood and Mr. Heggem. In a way the papers form a comprehensive treatise on this subject by the Bureau of Mines, but I think they have made it very clear to us that they claim no finality for the views expressed here nor for the suggestions as to legislation. The subject is now before you for discussion, and I hope that you will all assist in every possible way, whether with criticism or with suggestion bearing on the various points brought out. The meeting is now open to you.

Mr. DE WOLF. I would suggest that we turn these pages slowly, perhaps numbering the paragraphs as we go along, and call for criticisms of the particular pages as we turn them.

Chairman FOHL. I think possibly we might advance matters a little by asking Mr. Hood to read slowly the suggestions, and then stop for suggestions, criticisms, or questions.

Mr. Hood thereupon began rereading the suggestions for laws and regulations in the matter of bore holes passing through workable seams of coal included in his paper.

OFFICERS.

1. METHOD OF APPOINTMENT.

A chief inspector of gas and oil wells shall be appointed by the governor from an eligible list of men who have passed a satisfactory examination showing their technical fitness for the position.

2. SALARY.

The yearly salary of the chief inspector of gas and oil wells shall be —— dollars. Necessary travel expenses to the amount of —— shall be borne by the State, and an office equipped with suitable filing arrangements shall be provided.

Chairman FOHL. The first thing we have for consideration is the method of appointing gas and oil inspectors. Are there any remarks on this?

Mr. HICE. It seems to me this is a matter that would vary in the different States very materially. The disposition, in some States at least, is to reduce the number of departments. This suggestion here would practically be making a new department similar to our present mine-inspection department, and in some of the States possibly there would be no necessity for that; in other States there might be. In a State like this, where we have, for instance in 1911, a record of over 3,000 wells being drilled and over 2,000 being abandoned—and how many were drilled and abandoned of which we have no

record is mere guesswork—it would require the appointment of a number of men, and would perhaps justify a separate department, as is suggested here; but probably in most of the States this would go under some of the present organizations.

Chairman FOHL. I think we might ask Mr. Hood to give his ideas on this point.

Mr. HOOD. Under the wording I believe it would be entirely possible for anyone who had satisfactory qualifications, such as the geologists or the State mine inspectors, to be appointed by the governor in whatever way thought desirable.

Mr. DE WOLF. It strikes me that this is a perfectly logical scheme for getting at it. As Mr. Hice has said, the conditions will vary markedly in all the States. In some States, like our own, there will be a civil-service board, which will probably have the responsibility for examining and preparing an eligible list. This is a broad-gage group of men at present in my State (Illinois), and it would doubtless ask for expert advice in holding examinations and seeing that the men were qualified. With reference to the need for a separate group of men, or a separate inspector in my own State, I think that would be desirable, because the coal-mine inspectors there are concerned only with the counties that produce coal at present. We have a number of counties that do not produce coal yet, but will in the near future, and in which at present oil and gas development is at its maximum. So I think it ought to be some one's function to attend to the matter in such counties. He might well be a subordinate under the present State mining board, he might be a subordinate under the State geological survey, or he might be an independent official; however, he should have an acquaintance with both mining and oil and gas well operations, and with the geologic aspect of his work. In other words, I think this is a good scheme on which any State might build up a satisfactory law.

Mr. Hood thereupon read the sections relating to assistants and deputies:

3. ASSISTANTS.

Assistant inspectors of gas and oil wells, subject to the authority of the chief inspector, may be appointed by the governor.

4. DEPUTIES.

Competent men may in an emergency be deputized by the chief inspector to perform the duties of his position in the field, but an appeal from the decisions of such deputies may be had to the chief inspector. Deputies may receive not over _____ dollars per day and actual expenses not exceeding _____ dollars per day.

Mr. CUMMINGS. I would like to inquire who will examine these gentlemen and decide whether they have passed a satisfactory examination.

Mr. HOOD. Each and every State will have its own way for that. As Mr. De Wolf has said, Illinois has machinery for that at present. Pennsylvania, I think, has some sort of machinery for mine inspectors, and might have similar machinery for this. It is not intended to make any detailed suggestion along that line.

Chairman FOHL. It may be entirely possible that some suggestion of that sort would not be out of place. With that in mind, I think I shall ask Mr. Schluederberg to tell us what the machinery of Pennsylvania is for the examination of inspectors.

Mr. SCHLUEDERBERG. I do not know but that the department of mines would be well enough organized and thoroughly competent to take care of gas and oil inspection in Pennsylvania. There is no special attention given to it now by the inspection department. All inspectors of the different districts, of course, to some extent look after wells sunk through mines and see to the safety of miners, but they do not now have any authority to supervise the drilling or abandonment of wells. But as far as I can see, I think that such matters could be handled by the department of mines of the State of Pennsylvania.

Mr. TAYLOR. It appears to me that in my own State (Pennsylvania) it would be better if it were under the geological survey department.

Chairman FOHL. Do you mean the Federal bureau?

Mr. TAYLOR. No; the Pennsylvania geological survey. It appears to me that a part of the survey's duties ought to be the exact location of these wells, with reference to property corners or to monuments, and such work requires a different class of men, and I think probably a different class of examiners to examine the men; and it would be better to have this done under the State geological survey. I am not sure whether the survey now has any way of examining applicants for positions or not, but they could easily be provided for.

Chairman FOHL. We have representatives from other States here, and we would like to hear from them.

Mr. CROCKER. At the present time in West Virginia we are using the United States Geological Survey monuments as a basis to work from. We must have something permanent, and we are using them and making all our locations from them.

In regard to the inspectors, in that State at the end of the year there were 700 wells drilling and probably at the same time 100 or 200 more in operation and abandonment, so the matter of inspectors and deputies is going to be a pretty large problem, because—unless

several wells happen to be pretty close together—they can not visit any large number of wells and do their work properly.

Mr. TAYLOR. I might state that in Pennsylvania we do the same thing. We locate wells on our property from the Government survey monuments, and all the locations are coordinated with reference to the values that we have fixed for the Government monuments.

Mr. HALL. I think the objection to the United States Government monuments is that they are too far away. The surveying done by the oil companies is not, I think, as accurate as that done by the coal companies. In the coal business at one time we had some very poor surveying. To-day our surveys are reasonably accurate. The coal companies are putting in their own monuments for their corners, and by using such monuments as these which are only a short distance from the points of surveying, or by using some other monuments, possibly of a specific kind, we would work out the inaccuracies of extensive surveys. To take the United States Geological Survey points would be a mistake, because it would involve extended surveys that might be extremely inaccurate. The average local surveyor, such as works at oil and gas well locations, is a man who has marvelous ideas both of surveying and of geology. Altogether he is possibly as little competent as any man we could imagine to do that character of work, and the shorter the distance away from the point he is surveying that he has to go for his monuments the more likely we are to get accurate results.

Mr. LAYTON. Then, if there is a company operating in any county, the State geologist could immediately go to that district, and we might be able to get some monuments that would be permanent. As to the question of accuracy, I would take exception to the gentlemen, for the simple reason that in the last few years the location of an oil or gas well is accurately made from actual surveys. There was a time when no attention was paid to that, but all the larger companies to-day have accurate locations of all wells.

Mr. CORRIN. I believe Mr. Moore, of the Consolidation Coal Co. (West Virginia), could tell us how its work is done and the accuracy of the locations.

Chairman FOHL. Would it not be better to confine ourselves to the question first raised here, as we come to the matter of locations later? We are now considering the methods of appointment and the character of the people who are to be the inspectors. Are there any further suggestions in that connection?

Mr. HICE. The question that is brought up here reaches possibly a little further than that. It is altogether probable that any act relating to plugging oil and gas wells under inspection will have to be broad enough to cover all wells drilled, regardless of whether they

are in coal-bearing sections of a State or not. Therefore the matter of the qualification of the inspector is important; he will have to have considerable knowledge of the oil and gas fields, of the different sands, and, in addition, the relations which they have to the coal seams and to the structure. Notwithstanding the title simply refers to oil and gas sands and coal-bearing portions of the State, it is very questionable if an act of that kind will be passed. In getting in our report of production, I have been surprised in the last month or six weeks to receive as many complaints as I have from oil producers, who say that their neighbors will not plug their wells. It is not the first time I have noticed it, but during this week we have had a number of complaints of that kind.

Mr. WATTERS. I think the matter of the location and the parties who do the locating and the matter of inspection might well be taken together, for the reason that as a matter of economy to the State it might be possible that the same individual can perform the same work, but it occurred to me while we were discussing this that we may be conflicting with the already existing 1911 bituminous mining laws, inasmuch as there is a provision in them for the locating of oil and gas wells by the producing companies. It is information I am after, that is all.

Mr. HALL. The main object of these remarks by Mr. Hood, as he has definitely stated, is that there should be some arrangement by which inspectors may be examined. He has omitted to say anything about how the assistants should be examined, and how the deputies should be examined. Of course that could be provided out of the machinery which is already provided by the State, in a general way, for examination, but in making that distinction it more or less seems to help the overlooking of that part, and if that paragraph could be reworded so that the statement might be made that the State government should choose, or at least that those departments should be chosen, from an eligible list of men who have passed satisfactory examinations and shown technical fitness not only for the position of chief inspector but of all inspectors, it might meet my objections. I think that this is simply an oversight in making up the paper.

Chairman FOHL. I notice it is well understood that the various State legislatures will have the last word on this, and I think we scarcely have arrived at the point yet at rewording this paragraph. If that seems necessary a little later, it would be a matter for a committee, but I should think we should go just as far as possible in the matter of suggestions, to give such a committee such suggestions as Mr. Hall has just made, and if there are any further suggestions along this line we will be glad to hear from them.

Mr. RICE. That is really the object of presenting merely a skeleton set of rules and regulations. We found that there was such a com-

plexity of matters that we could not hope to make more than a general outline. It was thought that a committee which might be organized by this body could gather together such suggestions as have been made and might then be able to put them into shape. One could go into almost endless detail in the attempt to provide just how the several service bureaus, for example, should examine deputies and others. The outline was merely intended to be suggestive. It was not intended in any sense to be a final draft. We thought the committee would be much better qualified to make such a draft.

Chairman FOHL. At the same time, there is no intention to make you feel that you are hurried. Any further suggestion will be welcome. If it gets to the committee stage such work as this will be very helpful to that committee. If there are no further suggestions in connection with the personnel of the inspectors we may proceed to the matter of the duties of the inspectors.

DUTIES OF OFFICERS.

Mr. Hood thereupon read the next section, as follows:

5. LOCATION OF BORE HOLES.

It shall be the duty of the inspector to receive applications for permission to drill bore holes and to issue a license to drill to persons who comply with the law.

The inspector shall receive and file maps giving the location of bore holes; shall determine the sufficiency of such maps for the purpose of accurately locating such bore holes; and shall cause a new survey of such location in case the available maps are unsatisfactory.

It shall be the duty of the inspector or his assistant to examine the maps accompanying applications for permission to drill bore holes, and if the proposed location is in the vicinity of a mine he shall immediately proceed to the site and request the district mine inspector and the coal operator to state whether the location on the map accompanying the application to drill is such as will interfere with the safe and economical operation of the mine.

The inspector shall issue a license when the proposed location of a bore hole shall be such as not to interfere with the safe and economical operation of any mine or mines that might be determined by the mine owner, the State mine inspector, and himself.^a To this end he shall have the power to move the location of a proposed hole, as hereafter specified.

After hearing and duly weighing the evidence he shall permit the bore hole to be drilled at such point as will in his judgment permit the safe and economical operation of the mine or mines affected.

Mr. DE WOLF. It is doubtless true that some oil and gas operators at certain times want to proceed with all possible speed in starting their operation. I am wondering whether the requirement that the chief inspector shall proceed to the spot and notify the district mine

^a The authors of this paragraph agreed that this should have read "as determined by the gas and oil well inspector after due hearing of evidence offered by the mine operator and the mine inspector, as well as by the drilling applicant. (See discussion following.)"

inspector, the coal inspector, etc., does not need attention in that regard. Now, in most States, if conditions are anything like those in Illinois, it will take some time to get the district mine inspector on the ground. He has other duties, and unless these duties are considerably reduced from what they now are, it will be a matter of some days before he can be present at the spot where it is proposed to drill the well. I am wondering whether the gentleman would think it altogether necessary for that district mine inspector to be present, or whether the oil inspector, together with the representative of the coal operator and of the oil company at the place, could pass on this question as to whether the location was a safe one.

Mr. RICE. We thought that the parties interested should be notified. If the case is an important one, then they would be present, but if they are not present, then the gas and oil well inspector could at once proceed and either approve the location of the hole or disapprove of it, as the case might be. The thought was that there are three parties in interest—the operator of the well, the coal-mine operator, and the miner as represented, with respect to safety, by the mine inspector. If it is a case which appears at all dangerous, it will certainly be the duty of the inspector to be present. If he is not present, it will be understood that it is a case in which he feels there is no particular danger. The same will be true as far as the coal operator is concerned, perhaps. If he does not choose to be present, it will be presumed that the location of the hole of which he has received notice is satisfactory to him.

Mr. LELAND. That is the idea, and that should be stated very clearly in the statement of the duties. The next paragraph states that the State mine inspector and the State oil inspector must agree. It makes it mandatory in this case. Is it the idea that if one does not come the others can go ahead? If so, we should say so plainly.

Mr. RICE. It is true that there is an apparent conflict; this came about because after assembling our ideas we did not have time to harmonize them fully. It was the intent to give the gas and oil well operator the power to decide after he had given proper hearing to the several interests.

Mr. CROCKER. It seems to me that there is a party left out—the landowner. He gets a royalty, if it is oil or gas. I think he should be recognized.

Mr. TAYLOR. I think the oil man is hardly interested until he has permission from the surface owner.

Mr. CROCKER. I think he is decidedly interested.

Mr. MOLYNEAUX. I think the intention of the entire discussion is particularly to protect the miner and the mine owner largely. The oil man and the gas man, of course, will have to bear largely the brunt of what is going on, as far as protection goes, and I think that

in some cases it has been suggested that, for instance, a gas man would get a lease which limits him to a certain time in which to drill a well. Now, he may get a good well if he can do the work within that time; but if he has to wait until all these people are seen and get their permission, the lease may expire and he will lose out. Those are instances within my knowledge. And while fair to the mine owner, the regulations should also be fair to the driller. After the driller has duly notified the mine owner and talked to the inspector of that district, if within a certain fixed time, a few days, they do not pay attention to it, he should be permitted to go ahead with his work. I think there is no provision of that kind intended in the article, but there should be something of the kind in order that the man who drills the well, or has his money invested in that business, and is looking forward to possible success with a certain well and with other wells in the immediate vicinity, may be able to go ahead within a reasonable limited time and drill his well after he has notified this inspector and also the mine owner.

Mr. HOOD. Let me say that on reading this section over the second time I am quite ready to admit that it is not as clear as it should be. It does not bring out the intent as sharply as it should. It is believed that if there were some such law as this then even to a greater degree than is true at the present time these parties would get together beforehand, and it would only be in a rare case that all of this machinery would be brought into play, for the parties would agree in short order, and the inspector would have no formal meeting of this sort. That is the intent, and it can be brought out better and much more clearly with different language.

Mr. LAYTON. I suggest that it be amended to read something like this: File the paper; and if within 5 or 10 days they fail to appear, then let the party drill his oil or gas well and proceed immediately.

Mr. MOORE. A coal operator might not know about that as well as the gas-well operator. The coal operator, unless some other provision is made, ought to have some way to know that this location is made. On the other hand, the gas-well operator would have no way of knowing whether the well would interfere with the mine or the mine workings unless he has access to a mine map. He has got to communicate with the coal operator before he knows whether the location is objectionable or not.

Mr. DE WOLF. This is just a matter of routine, after all. If there is a State gas-well inspector, or somebody acting for him in his absence, a request or application which comes in would then be duly forwarded and a time limit put on it. Forwarded by registered mail, if you wish, notifying the coal operator, the mine inspector, and anybody else who is in interest in the matter; and after the lapse

of a certain length of time let it be understood that the oil and gas man, if there has been no objection, can go ahead.

Mr. TAYLOR. This matter of notice, it appears to me, could be confined to well locations over an active mine, a "live" mine, and where that is the case there ought not to be any boring until the location has been actually passed upon. It is not simply the driller then. It becomes a question of life and death. This clause here, it seems to me, is definite in that.

Mr. CORRIN. The company that I am interested with has a system of locating that has proved quite satisfactory. When we make a location we make an additional map, giving the measurements of that location, that is, where that well is to be drilled. When we send a record of the location out to the field man we send a duplicate to the people who own the coal under that land. Of course, we have an abstract made of the title to the land before we make a location, and we know how that land is platted, and before any injury is done by drilling the coal owner comes back with his suggestions. I do not see why an addition of that kind could not be made to include the coal operator. If the coal operator has any suggestions he can take it up to the inspector.

Mr. HOOD. What would be a reasonable time, in your judgment, for the approval of the location for a well?

Mr. CORRIN. I should say a week. A week would be the outside limit, in my judgment.

Mr. RICE. As Mr. Hood has indicated, in giving this outline we have merely suggested the machinery for handling a case. We expect that in the greater number of times the matters will all have been arranged beforehand between the well operator and the mine operator, before it even goes to the chief oil and gas inspector, if there is such, and it is only in the exceptional case that there will be any difficulty, but when such arises the machinery is provided for handling it.

Mr. RICE. Immediately upon an application, then, the requirement would be for a plot with sufficient references to actually locate the well, and that would be a part of the application. And undoubtedly that should also contain a statement as to whether the well is located over a mine or near a working mine, and the inspector would at once have that information, and if the blanks were properly prepared he would know exactly to whom the notice was to go, and if the location was over a working mine, part of the requirements would be to show the position of the mine workings.

Mr. CORRIN. The larger coal companies furnish maps of their mine workings, and in making our locations we try to keep away from very bad spots.

Chairman FOHL. I take it that the consensus of opinion is that all three parties in interest must have notice, but that a certain time must be set, so that after they have had notice it is possible to proceed. Are there any further suggestions along this same line? The chair would like to ask who is to furnish the maps that the inspector is to receive and file? What is the purpose of that paragraph?

Mr. HOOD. This is only defining the duties of the inspector. Where the duties of the oil well and gas well people are taken up, is made clear.

Chairman FOHL. Suppose you take the next three subjects together.

Mr. Hood thereupon read the next three subjects.

6. RECORDS.

It shall be the duty of the inspector to keep a complete record and to prepare for publication a yearly report of the wells drilled in his district, together with their location, date of completion, depth, production, date of abandonment, and name of owner.

7. SUPERVISION.

It shall be the duty of the inspector to examine each well in his district at frequent intervals, giving special attention to all wells containing gas in such quantity as, in case of leakage, to make them a menace to a mine; the inspector shall see that all the provisions of this act are observed and strictly carried out.

8. COMPLAINTS.

The inspector shall receive and investigate all complaints as to injury, present or impending, due to a lack of precaution on the part of any well owner or mine operator, and if he finds the complaints against the mine owner to be well founded he shall lay the facts before the State mine inspector.

Mr. DE WOLF. In the sixth paragraph you mean each active well, do you not?

Mr. HOOD. Each active well.

Mr. HALL. The name of the owner—not only the owner of the land, but the owner of the coal—the operating company that may own the coal, and the name of the person on whose farm the well is to be drilled, so there may be some way to trace records and look up the incumbrances that may be on any farm where there are gas wells or oil wells.

Chairman FOHL. Are there any further suggestions in reference to this matter?

Mr. HOOD. The general subject of penalties has not been entered into here at all, but when this goes into a lawyer's hands he would doubtless add the penalties to make this workable.

Mr. Hood then read the provision relating to plugging wells.

9. PLUGGING WELLS.

Upon receiving notice of an owner's intention to abandon a well the inspector or his assistant shall proceed to such well and satisfy himself that the provisions of this act referring to plugging wells are complied with. He shall join the owner in making affidavit to the manner in which the well has been plugged.

Chairman FOHL. Are there any remarks on this subject?

Mr. HALL. When an undertaker buries a man he has got to have permission to do so, and it seems to me that when a man plugs a well not only the owner ought to receive permission, but the man who does the plugging ought to be made responsible, and he ought to be required, or at least to be held liable if he has not received that permission before he does the work, just as the undertaker law is in our State—a man who buries is responsible if he has not received permission from the board of health. In this case the man is responsible who does the plugging if he has not received the certificate that the well may be plugged and that notification has been duly given.

Mr. RICE. Paragraph 11 makes provision for this.

Mr. MOORE. I should like to ask one question. Suppose this oil-well owner makes his application to the gas-well inspector to plug a well. Suppose the inspector is present and signs this certificate, but suppose, nevertheless, that something happens from that well—that a miner is killed in the mine. The miner's family will bring suit against somebody. Who is to be held responsible? Does the State assume the responsibility on account of its representative approving the method, or are the gas people or the other people to be held responsible, or both?

Mr. LAYTON. If the accident was caused by delay on the part of the coal operator or the mine inspector, I suppose they would be liable.

Mr. MOORE. The part I wish to bring out is that the present responsible oil and gas companies feel that they have a moral responsibility for taking care of the wells that they plug, and because of that moral responsibility they plug them as best they know how. Would this be a loophole for somebody that doesn't want to spend quite so much money in plugging wells to release him from the present laws?

Mr. HOOD. It doesn't seem to me that such release would follow from a law of this sort. This is simply a supervision—a police duty—to see that they do the best they can, and yet it would not release one from responsibility. I think we have similar cases with other laws.

Mr. CAMERON. Going back to the paragraph before that, under "Complaints," is the State mine inspector the referee or the final

arbitrator in this case? It says he shall lay the facts before the State mine inspector.

Mr. RICE. That was intended to meet a complaint against the coal operator. The intent of it is this: That the gas and oil well inspector, if there be such, would have supervision, as far as the gas and oil well operation is concerned, but if through mishandling within a mine damage is done or anticipated and complaint has been brought to the attention of the oil and gas well inspector, he would not have the power to enforce within the mine, that would be the State mine inspector's duty, and oil and gas inspectors should simply lay the facts of the complaint before the State mine inspector. He will then have fulfilled his duty, and it will be up to the mine inspector to investigate and remedy—

Mr. CAMERON. Then, as the State mine inspector is subject to the department of mines, you will have a conflict of law.

Mr. LAYTON. Where would the oil or gas well operator be? You make no provisions for him.

Mr. CAMERON. He would be subject at all times to the law that might be adopted. There is no law at this time governing oil and gas, but the coal operator is already provided for by the mining laws.

Chairman FOHL. Are there any further remarks? If not, we will take up the matter of the enforcement of the law.

Mr. Hood read the provision relative to violation and the enforcement of the law.

10. VIOLATIONS.

If the inspector discovers any well being drilled, operated, or plugged contrary to the requirements of this act, he shall order the workmen engaged upon such well to cease work at once and shall not permit the work to be resumed until he is satisfied that the law is complied with.

11. ENFORCEMENT OF LAWS.

To enable the inspector to perform the duties imposed upon him by this act, he shall have the right at all times to approach and examine any well in his district, and with the authority of the State mine inspector, to enter any mine affected, and upon discovery of any violation of this article or upon being informed of such violation, he shall institute proceedings against the person or persons at fault, under the provisions of the law provided for such cases.

In case of failure of the owner to properly plug an abandoned well, it shall be the duty of the inspector to have the work properly performed by contract and to assess the cost against the well owner.

12. PENALTIES.

There shall be adequate penalties provided to aid in obtaining the safer conditions here proposed.

Mr. WATTERS. A good many people are considered in formulating laws of this kind, but how about the man who goes to his neighbor

or by himself employs a neighbor to drill a well? He has enough means to finish that well, but, because of the plugging on account of not getting gas or oil, he does not have enough money. It seems to me there ought to be something put in as to a bond by individuals, for there is more trouble with them than with the corporations. We have no trouble with the largest corporation; it is with the individual who drills a well to make something out of it or "bust". There ought to be something to cover that individual.

Mr. HOOD. That is covered a little later by a paragraph that requires a bond to be put up. If a man hasn't got enough money to drill a well and to pay for the bond, he doesn't drill.

Mr. PAUL. In connection with the section just read I should like to ask if it would apply to all wells being drilled in new territory, where the operators of the well are desirous of keeping secret whether or not the territory is productive; or is there anything in here against giving out advance information in connection with the authority given the inspector to examine any well at any time?

Chairman FOHL. I suppose we might say that it is to be taken as a matter of course that information of that kind is confidential and must stay with the operator and not be spread abroad, but I presume when we come to make a final act it ought to be mentioned there.

Mr. HALL. It seems to me the depths at which oil is to be found are so great that as far as drilling is concerned his (the inspector's) interest might cease after the well is through the coal measure. But when it comes to plugging, that is a different proposition.

Chairman FOHL. I think the coal operators are interested in the well until it is finally abandoned.

Mr. RICE. We should like to hear from gas and oil well people on this. On the matter of plugging I think that the provisions of a legislative act should be comprehensive. The oil and gas well operators, I understand, would like to insure that the plugging of every hole is properly done to prevent salt water leaking from one horizon to another. In order that this be efficiently done, it would seem necessary that the inspector have full records of the hole from top to bottom.

Mr. MOLYNEAUX. The actual value of a well should not be disclosed by the permission to drill, or by any inspector. The records asked for should not say anything about the value of the well. It is simply a matter of safeguarding, and I do not think the matter of value should be disclosed. Assuming that the inspector would know enough to be discreet in such matters, I do not think the matters of secrecy should or would be disclosed by inspection, unless the inspector was a grafter, and we assume that men in such positions should be above graft.

Chairman FOHL. Mr. Corrin, would you care to say anything in reply to what Mr. Rice has just suggested?

Mr. CORRIN. No, sir; I do not think there is a great deal of danger of disclosures. There might be a case once in a long while where there might be trouble. I do not believe all the information you would learn would do anybody any good or harm.

Chairman FOHL (to Mr. Rice). Don't you have in mind the matter of plugging between various sands?

Mr. RICE. That is what we intend to be a matter of public record, so that it might afterwards be accessible, and if the oil and gas inspector did not have access at the time of drilling it would be a difficult matter to get the information later. As far as giving out information is concerned, it is entirely conceivable that an inspector might not do his duty, but as far as I know, and I have considerable acquaintance with coal-mining inspection, it has rarely happened that information has been disclosed which was injurious to the operating company. I think the inspectors are generally reliable, and I do not think we ought to anticipate the contrary. It is manifest that if any inspector failed to do his duty he would promptly render himself liable to removal.

LOCATION OF BORE HOLES.

Chairman FOHL. Suppose we take up the entire next five sections, 13 to 17, inclusive, from the matter of locating to the protection of coal measures, as they all seem to be interwoven.

Mr. Hood thereupon read the section suggested by the chairman.

13. APPLICATION.

Any person (firm or corporation) purposing to drill a bore hole through a workable seam of coal shall make application in writing to the chief inspector of gas and oil wells for permission so to do, and he shall not commence drilling until such permission in writing shall have been received by him. In case of dispute the State geologist shall determine whether a seam of coal is workable within the intent of this act.

14. SURVEY AND MAPS.

Accompanying the application for permission to drill such bore hole there shall be submitted a map showing the location of the proposed bore hole with reference by course and distance to the boundaries.

Said map must be made on a scale of 200 feet to 1 inch, and shall be based on surveys made by surveyors or engineers of recognized standing, and shall be certified to by the surveyor or engineer making the same.

In case the inspector finds the map insufficient to enable him accurately and completely to locate the proposed well he shall require that another survey and map be made before permission to drill shall be granted.

If the original map is subsequently found to be adequate the cost of the second survey and map shall be borne by the State.

15. BOND.

Any person (firm or corporation) purposing to drill a bore hole through any workable seam of coal shall be required to give bond in the amount of —— dollars to insure that the drilling and abandoning of such bore hole shall be in accordance with the provisions of this act.

16. DISTANCE FROM BUILDINGS, ETC.

No bore hole penetrating a gas-bearing or oil-bearing formation shall be located within 300 feet of a shaft or entrance to a coal mine not definitely abandoned or sealed; nor shall such bore hole be located within 100 feet of any mine shafthouse, boiler house or engine house, or mine fan. No bore hole shall be located to drill within 15 feet of any mine haulage way or airway.

17. LICENSE.

Should the proposed bore hole be so located as not to interfere with the safe and economical operation of any mine, and if the previous requirements of this act be complied with, a license shall be granted and said person (firm or corporation) may proceed to drill such bore hole in accordance with the further provisions of this act.

Mr. HALL. In section 16, I wish that word "abandoned" was followed by the words "and sealed."

I was interested in the Consolidation Coal Co.'s mine, and the interest the company showed in a particular mine that was opened near a gas well. The company was anxious to know whether any of that gas would be drawn into the mine. I think in many cases that care is not taken. There may be a mine opening not far from a gas well. The well may not be properly sealed or it may not be sealed at all, or it may be sealed at the opening, and there may be a break in the surface above and the air drawn may be at any time contaminated by the leakage from that gas well. Two responsible gas operators have made careful surveys and their work, which I have noted myself, agrees very closely with the coal-mine surveys which have been made. But I wish to say these two companies are not completely representative of the field. There are some people, "wild catters," whose surveys are not at all reliable and whose locations are possibly made with a flexed stick. It is people like that against whom we have to be on guard. The arrangements in certain parts of West Virginia are creditable both to the oil producer and to the coal corporation, but there are sections where the surveys are creditable to neither, and it seems to me that one of the requirements which we should make is that if the State is not going to make these surveys the connection shall be made to two monuments and those monuments connected. Then we shall have a survey that can be traversed and the State or anybody else who is interested could ascertain at any time whether it was correct or not. * * *

Of course, the United States monuments would be desirable, but if the distance is very considerable to where that survey has to be extended it would be undesirable. It might work very well with large corporations doing a great deal of drilling, and naturally, therefore, in portions of the fields not far from some monument of the United States Geological Survey. But with a small "wild catter" it might not only put a considerable burden on him, but the survey when made would be inaccurate and of no value.

Mr. RICE. I might explain what our intent was in saying that "no bore holes penetrating gas and oil formation shall be located within 300 feet of a shaft or entrance to a coal mine not definitely abandoned or sealed." In the preliminary conferences we had quite a discussion as to drilling through old, abandoned mines, and some of the gas-well people said it was very difficult at times to determine whether a mine is definitely abandoned. It might have been an old country bank and might not have been sealed. It might not ever have been definitely abandoned; that is, no notice of abandonment was ever given. We thought, therefore, that we should leave the wording in rather general terms, putting it up to the gas and oil well inspector to determine what steps should be taken.

Mr. HOOD. In regard to the survey, it was intended to tie this up pretty tight, a good survey being recognized as absolutely necessary, and it was thought that if the courses and the distances to the boundary were given you could not locate two boundaries without having three monuments—three points from which to locate the boundaries—and that such a provision would still be flexible enough to cover a larger number of cases than a provision that surveys should be carried to the section corners or the Geological Survey monuments, or something of that sort.

Mr. LAYTON. Assuming that we are about to locate a well in what is known as "wild-cat" territory. On the filing of that application then the mine inspector or the oil and gas inspector could immediately place two or three monuments, which should govern all future developments in that neighborhood. That would eliminate all further trouble.

Mr. CAMERON. In section 16 it states, "No bore hole shall be located to drill within 15 feet of a mine haulage way or airway." What is the intent of the provision? Does that mean solid coal or in a cut-through or in an abandoned working or gob, or what?

Mr. RICE. The intent is to cover the situation where the gas and oil people have rights prior to the coal operators, and therefore demand that they be enabled to locate a hole anywhere. We have to recognize that in most cases the two interests will get together and

make mutually satisfactory arrangements; but there may be cases where you have to provide legal machinery, matters in regard to which there is a disagreement; that is, it may be that the coal operator will say it is dangerous to locate anywhere in or near a mine or a gas well, which would prevent the drilling of a well on the property. I think we have got to recognize the rights on both sides. The thought was that where the gas and oil well company had those prior rights they should then give the oil and gas inspector authority under the police power of the State, on account of safety, to prevent the hole being drilled through a haulage way or airway, which would include either an intake or a return airway. It would require that it be drilled to one side. The distance 15 feet was chosen merely because we thought that would take care of the errors of a survey or in drilling, in locating a hole enough to one side to permit mechanical protection.

Mr. CAMERON. That had reference entirely to the errors in the survey, and not to the location of the hole?

Mr. RICE. To provide that there should be no hole actually drilled through a haulage road or an airway, or so close that it could not be protected by a covering without interfering with the haulage road or airway, we agreed, as a sort of compromise, on not allowing the hole to be started at the surface nearer than 15 feet from one side or the other, as indicated by the survey. There might be errors in the survey or the hole might not go down truly vertical. We considered that between errors of survey or lack of verticality the hole might be off the true position in striking the coal bed 5 or even 10 feet. It would allow you to put a hole down in the middle of a chain pillar or on the other side of the entry in a barrier pillar or even in a room.

Mr. CAMERON. Your gob or fallen strata might be only 15 feet, or it might be a good many more feet away from that.

Mr. RICE. Yes; we did not attempt to frame a clause preventing drilling through broken ground or abandoned areas, because the courts, at least, have already decided that gas and oil operators who have the property rights have the right to drill through such areas where protection that in the eye of the court is adequate is given.

Mr. HALL. I would suggest the addition of the words "made or provided" at the end of the statement "haulage way or airway."

Mr. RICE. This matter of 15 feet, or any other distance that a location may be moved by an inspector, should be very carefully considered by the coal operators present. We realize that it is a vital point and a very important one in any determination of the powers given to gas and oil well inspectors. It would be applied only where there has been a nonagreement between the two sides.

Chairman FOHL. I think we might come back to this matter of distance after a thorough discussion of the protection of coal measures, which is the next general topic.

Mr. DE WOLF. May I raise a question here for the guidance of any committee which attempts to work out the details? This section with reference to the location, where it speaks of any person proposing to drill a bore hole through a workable seam of coal, etc., "In case of dispute the State geologist shall determine whether a seam of coal is workable within the intent of this act." I want to point out that you are putting a very difficult problem up to the State geologist. What is a workable coal seam? Is it a coal seam workable 5 years hence, or a coal seam workable to-day? We have in Illinois a law requiring that when wells are to be drilled through a workable coal seam, certain records shall be filed with the State mining board and a certain procedure shall be followed. It does not say who shall decide whether a certain seam is workable; if it did, it would be very difficult for any one to say how thick a seam actually is from the record obtained with a churn drill. If one knows or thinks he knows, it is a question whether his judgment is to be trusted as to whether it is workable now or will be workable in the future. There have been drilled in Illinois over 20,000 wells in a region where there is no active mining, and most all of the gas well drillers will say to you, "Oh, no; we didn't go through any workable coal; there is no coal at all," and yet the diamond drill going down in that precise territory has shown that there are two workable coal beds which some day will doubtless be worth mining. So it seems to me that it would be essential in our State that this permission should be obtained and these regulations observed, for all wells drilled, certainly all within areas underlain with coal. Moreover, proper plugging of a well is certainly important to the oil and gas people in protecting their sands from the water of a wildcatter who is irresponsible and it would be to their advantage to have this section include all borings for oil and gas.

Chairman FOHL. Within the coal measures?

Mr. DE WOLF. I should say that anywhere within the State it would be to their advantage to have these regulations followed.

Mr. RICE. We realized that we are putting a difficult problem to the geologists. We didn't know any persons better able to judge than the geologists. We did consider the use of the words "coal measures," but that is more indefinite for our purpose; for instance, the lower coal measures may not contain workable coal. We thought that by including only the workable coal we could confine it within the boundaries of those coals which could be perhaps in the most remote terms considered as workable; that is, if you have

the lower measures carrying a coal which in no place has been found to be over a foot in thickness, it is a negligible chance that it will be worked, so for practical purposes could be disregarded. Our aim has been to minimize the expense to the gas and oil well operators, where safety or conservation was not at stake; that is to say, where it is clearly without workable coal areas, there need not be delays in getting permission to drill.

Mr. Hood. I think there is one other thought there, too; that is, it might be entirely proper to lessen the requirements when there is a lower coal bed which in some other districts is workable, yet is so deep that within 10 or 15 years, or within the probable life of a well in that district, it is quite unlikely that the coal in that locality will be mined. It seems very difficult to pick words that will allow drilling without restriction in one part of the county and not in another part, when permission depends on the judgment of some qualified person, and it seemed best to put that responsibility in the hands of the State geologist. The idea was to make it easier for the gas and oil well man, who would not have to case down to a deep-lying coal bed, where it probably would not be mined within the life of that well.

Mr. DE WOLF. Would it not be well to require that the application for a permit shall be filed in all cases, so that the man in charge or the State geologist might inform the parties as to what the likelihood of going through coal strata is? In other words, the first opening sentence says, "any person purposing to drill a bore hole through a workable seam of coal shall make application." He may not know; he may be quite ignorant as to whether he is going to go through a coal seam. He first ought to make inquiry or file an application, and give some one a chance to tell him whether he is going to go through a workable coal seam.

Mr. HALL. You lay too much emphasis on coal. I have had some experience in clay. I know of a 30-foot bed of clay being removed, and a cave in that 30-foot bed came so close to an oil derrick that the sills were hanging over the edge of the hole. We do not want to lay too much emphasis on coal. The idea is to protect all mines; iron mines perhaps need not be considered, but at the same time there are large deposits of clay in Pennsylvania which are close to the gas deposits and the oil deposits.

Mr. RICE. I should like to hear from Mr. Hice as to how near the gas and oil areas are to the underground limestone quarries in this State, with which I am not familiar.

Mr. HICE. As I recall, in the State at least two companies with underground limestone workings are working where oil and gas are produced. There is no question about the fact that the regulation ought to apply in all cases, and there ought to be a broader statement

than one covering simply coal mining. We do not think much about any mining other than coal mining in this part of the State, but other kinds of mines, as any person looking up the production of minerals in the State of Pennsylvania will find, are numerous. There are clay mines in almost every county where coal is produced, and likewise in some of the counties that are not producing coal in commercial quantities. We have very valuable clay products.

Mr. HOON. I should like to ask whether, if this were made to apply to all bore holes, it would act as a hardship on the oil and gas industry, or would it not? What is the opinion on that?

Mr. HICE. Probably half of the oil wells in Pennsylvania are in coal-producing counties. The other half are in what we class as noncoal-producing counties. I do not know, but personally I think we should require applications to drill in all counties in the State of Pennsylvania. There are other interests to be conserved and looked after in this matter of drilling. The matter of application or location is simply a part of the whole scheme, and the preservation of the oil and gas is to be looked after in the noncoal county as well as in the coal counties; and there is the matter of the pollution of surface water, which is important in every county, and is of very great importance in some counties. I know, for example, that the water in a certain river several times has been so badly polluted from the oil wells in Potter County that the water could not be used for boiler purposes. But water for domestic use is a matter that should be kept in consideration all the time in considering this matter of regulating the location, operation, and abandonment of each oil and gas well and each small water well also.

Mr. CROCKER. As to the pollution of water by oil and gas wells, I think that is pretty far-fetched when we see what has been done by the coal mines. Nearly all the larger oil and gas companies are trying to do all they can to make everything safe, but I think the general tendency is to make us the scapegoat. The whole weight is thrown on us. The landholder has got to be taken into consideration. He has an interest in this matter, and perhaps the man getting a royalty from the coal has a right to say something. I think the whole question of the danger from wells is exaggerated greatly. Of the two cases cited here this morning, the one of the Consolidation Coal Co. concerns something that can be easily overcome. It was simply an oversight that should never have happened. With care it never would have happened. In both cases it was through an oversight, and, unfortunately, those two cases have made the question of danger to appear much worse than it is.

Now, answering for the company I am connected with, we are willing to do everything we can to make it safe, and I think our

relation with the coal companies lets them know that we are carrying out everything we can to do it.

Mr. TAYLOR. I can speak with reference to the mines of the Pittsburgh Coal Co., and of the men who drill for gas and oil through its territory. There are a great many of them doing everything they can, everything within reason. There are others that will not do anything. As to the danger, I will say that at the Dunbar mine, where miners cut into a bore hole, there were 29 men killed. That is not cited in the records. It is really dangerous. Every mining man knows that it is dangerous, and he is afraid of the situation.

Mr. CORRIN. To my mind, it is the future and not what has been done for the coal; the future is more important than something about wells already sealed. Miners are likely to run into an old hole at any time. It would be of more benefit to know where existing wells are located, than the future wells.

Mr. LAYTON. I think the idea is that we should do everything possible to conserve the oil and gas and at the same time to save the men. The object of this meeting is largely that we can do everything possible and reasonable to be done. Speaking about Butler County, the slope mines are all gone. There is no danger of running through them, and I think we all feel that way.

Mr. LELAND. The language of this application refers to bore holes, and it might mean simply bore holes for a shallow water well. If it is to be for all bore holes, it is a hardship on the people drilling small water wells, all over this State.

Chairman FOHL. Are those water bores not a menace to the mines as well as others? Isn't the case Mr. Hall cited one of that sort? It is the column of water standing in the well that is liable to cause an accident, so that these shallow holes might have their own dangers as well as the deep ones.

Mr. LELAND. Is it the thought that any well driller drilling a well must make an application before he is to drill a hole?

Chairman FOHL. If he drills through a coal mine.

Mr. HOOD. If it is to go into a coal seam, or the likelihood is that it would go into a coal seam, he ought to specify not only what the hole is for but where it is and what it is likely to strike, no matter whether it is a water well or an elevator hole, or whatever it may be.

Chairman FOHL. Or whether it is for testing for coal?

Mr. HOOD. Yes. Then it ought to be under supervision in some way. There may be limitations, but it is the intent to cover any hole which might endanger a mine.

Mr. LELAND. That is just what I want to bring out. I put a water well down 125 feet and went through two small seams of coal. If that is the case everywhere, the same thing would apply everywhere.

Mr. HOOD. Were they workable seams?

Mr. LELAND. That is a matter of judgment.

Mr. RICE. I am not altogether in accord with my colleague in the matter of trying to cover either shallow wells or prospecting holes drilled only to the horizon of a workable coal bed, with the intent of prospecting the coal bed, or possibly in certain cases of furnishing a vent for gas from that coal bed. I think that we had better not attempt to regulate the very large class of holes that have a very different purpose. It seems to me we had better confine the suggested regulations to the deep wells that pass below the workable coal beds. That is my personal view.

Mr. HOOD. I know there was some limitation in the discussion. When we were told that producing wells of good quality had been struck within 100 feet of surface, and some water wells would have to go considerably more than 100 feet, and that either of them might go to or through a coal seam which is now being mined, it seemed difficult to pick words that would differentiate one from the other and protect the situation. So it was put in this form. I think that was the last idea.

Mr. RICE. While I appreciate there are some dangers from shallow wells and also that there are some productive gas and oil wells in the upper Carboniferous series, yet I think the chief dangers to mining come from gas and oil in the sands below the workable coals, and when you pass a measurable distance, say 30 or 40 feet or more below the lowest workable coal seam, a bore hole then becomes one which ought to be covered. I feel it is very doubtful whether we should attempt to cover all kinds of drill holes by the proposed regulations; it would be a complicated subject. The matter of record of all holes would be desirable from the public standpoint, but, on the other hand, it might cause serious trouble in the case of prospecting for mineral to make the records public.

Chairman FOHL. It seems a little difficult to make fish of one and fowl of another.

Mr. CAMERON. Regarding the protection of the wells, we have had some experience with wells such as Mr. Taylor mentioned. The drillers did not always do what they agreed to do. When we deal with good people you get everything done you could want, but we have had some dealings with people that wouldn't do even what they agreed to do. In 1906 our mine No. 3 cut into an abandoned gas well containing 400 feet of water. The well didn't do any damage, but it frightened the men who did not know it was there. We then made an agreement with the gas company that any wells drilled in the future would be covered by an agreement. The company drilled a well in 1908, and complied with the contract. It wanted to drill a well in 1910 and selected a location, and we told the company that

location would not do, as it went down in our gob. The company said it didn't care; it would look out for that all right. It went through the gob, and when it attempted to carry out the contract, that is, to cement between the casing and the wall of the well, it could not. All the cement went out in the old gob, and the company applied to the court for a release from the contract. In some inconceivable manner the well was filled up and at once the company went into court and withdrew its bill. Then we went into court and filed a bill and asked that the company comply with its contract, which we considered it had not done. We did not get the release we expected in court. We had the testimony of five mine inspectors that that well was a menace to our mine. It was near an intake airway and connected with a room from a butt entry, and the intake airway will certainly draw the gas from that oil well into our mine. We applied to the State department, and threw the burden on it to stand between us and the gas company.

Mr. LAYTON. My idea is this: The oil and gas people all need protection; everybody needs it; the farmer needs it; he must be taken into consideration as well as the oil and gas operator and the coal operator. All we want to do is to be able to get the oil or gas and at the same time be able to put that farm owner to the least inconvenience possible and still safeguard the life of the man who is mining the coal. That is the problem we have, and the only one, and the one that we must take care of. How we can do that and still put no great burden on the oil and gas man and let the coal man get his product is the question.

Mr. CAMERON. We never denied the right of the gas company to get the gas. We want them to get it, under a certain restriction. I understand that to be the intent of this proposed set of regulations.

Chairman FOHL. We understand that is the purpose. Are there any further remarks?

Mr. SMITH. Regarding the suggestion of bringing diamond drill holes under the provisions of that act, who is to reimburse the operator who spends his good money for putting down those diamond drill holes? He spends his money, and if it is a question of public record it is something he wishes to keep to himself, for he is spending a great deal of money to drill and to get that information.

Mr. TAYLOR. It appears to me that records may be well left in the hands of whomsoever the State appoints to take care of those records, just as much as the affairs of our banks are published, yet the details are kept secret. I do not think there would be any serious danger arising from the records becoming public property.

Chairman FOHL. It occurs to the chair that the next subject for discussion, if there is no further discussion on this subject, is one of considerable importance and may take up quite a bit of time. It

ought to be discussed with the slides on the screen before us, and possibly its discussion might be postponed until the evening session. What is the will of the meeting?

Mr. RICE. I would suggest that it would be very desirable when you have finished with the general discussion that a committee be appointed, which I suggest might be formed from representatives of the different interests here represented; that is to say, to have two or more members from each body, the coal operators, the State inspectors, the gas-well operators, the oil-well operators, the State geologists, and from the Bureau of Mines. My further suggestion is that these different interests select their own representatives on the committee and that this committee go into session, take up and consider the different points which have been suggested at this conference, and to-morrow morning bring back a report to this conference. Then the conference could consider what should be done with the report of that committee.

Chairman FOHL. Are there any further suggestions in this connection?

Mr. WILSON. If the committee were as large as indicated in Mr. Rice's suggestion, it might include a considerable part of the people present. I would suggest a smaller committee, say, one member from each body. The suggestion of having a committee, I believe, is an admirable one.

Chairman FOHL. The chair had in mind that possibly this discussion might be concluded to-night and that such a committee might be selected to-morrow, as then there would be a fuller representation of the parties in interest. However, the matter is in your hands, and I will entertain a motion in any direction you choose to move.

A MEMBER. It seems to me that a better way to accomplish it would be to go through this proposed bill, discussing it now and finishing it, and then turn it over to a committee for report to-morrow morning. That, it seems to me, will be the better course to follow.

Mr. SCHLUEDERBERG. I think the point of appointing a committee and putting the work in the hands of this committee is all right. I think it is perfectly proper that it should be discussed fully, to give the committee points to work on. This is a great question. The subject is growing as we get into it, and it is going to keep growing. It is a matter that can not be cut off very short; therefore, it is utterly impossible to turn the matter over to a committee to-night and have the committee report to-morrow. You have got to give the committee more time, and I think the matter should be thoroughly discussed here; but it is impossible to come to any conclusion in a meeting such as this, so after discussion it ought to be delegated to a smaller committee for that work, but give that committee time.

Mr. LELAND. I agree with that, and I think the minutes of this discussion ought to be available for that committee.

Mr. SCHLUEDERBERG. I move that we proceed with the discussion. The motion was put to vote and duly carried.

PROTECTION OF COAL BEDS.

Chairman FOHL. We will now take up the next section.

Mr. Hood thereupon read the next section relating to casing off surface water, as follows:

18. CASING OFF SURFACE WATER.

Any bore hole penetrating any workable seam of coal shall be cased by the owner of the bore hole with a suitable casing (conductor or drive pipe) so as to shut off all surface water from entering the coal seam.

Mr. Hood. It is to be drilled to a point 20 feet below the lowest workable seam of coal that is being worked in the district, the idea being to get far enough down so that in case of any movement of the strata through mining there would be no tilting of the casing but the ground should have a good grip on it and a true seat should be furnished. The several State laws vary from 10 to 50 feet as to the distance of the seat below the seam. There seems to be no particular reason for these differences, the idea in each being that of seating the casing some distance below the coal. The idea of specifying a metal casing not less than one-quarter of an inch in thickness is to have a reasonably thick casing and yet not so thick as standard iron pipe, the thickness retarding corrosion. The space between the casing and the wall of the bore hole is made as small as we thought it possible to be to get a tight filling of clay between the casing and the surrounding bore hole. That explains the 4 inches difference in diameter. Some scheme should be adopted to keep the pipe centered in the hole so that the packing shall be on all sides of it and we can be certain that the packing extends to the surface, so that there is a complete seal between the casing and the wall of the bore hole. The second inner casing, 4 inches in diameter, shall extend 10 feet below the first casing, the difference in diameter being enough to get a good pack between the two. The extension of 10 feet below the outer casing is sufficient to make it more difficult for a leak to extend under the seat of the inner casing into the space between the two casings. The filling was specified to be of clay rather than of cement mortar because it was believed that the clay would pack tighter and in any movement of the ground would not crack but would flow and pack tightly; that if the ground moved, the stresses would not be localized and would not tend to

cause local shear or break, but a gradual bend in the pipes. These are the ideas intended to be brought out by this wording.

Chairman FOHL. Are there any remarks on this section?

Mr. CROCKER. In regard to the diameter of the casing being 4 inches less than that of the bore hole, we are drilling places where the Pittsburgh bed is 1,000 feet deep. We put in our 10-inch casing there. Suppose there were a lower bed 200, 300, or 400 feet under that. The proposed wording calls for another casing 4 inches less in diameter. In order to complete a well taking 1,000 feet of 10-inch casing, we would have to start with 16 or 18 inch casing. If the well is properly plugged, such precaution is useless. The expense would be such that we could not stand it.

Mr. HOOD. Is that lower coal being worked in that neighborhood?

Mr. CROCKER. No; but it might be 10 or 15 or 50 years hence. Probably we shall be away from there long before it is worked; but if the proposed law is placed on the statutes, we are expected to obey it. Where a well is properly plugged I do not believe there is any danger.

Mr. HOOD. The only way you can avoid that is to leave the determination of what is a workable seam of coal in the hands of some person who would be reasonable about it. For the specific case which was mentioned I do not know whether any State geologist would say that that was a workable seam of coal within the intent of this act. If not, the driller would not have to put down a 16-inch hole to that great depth. If, however, there is a workable bed of coal, some protection ought to be given. When they work that bed 1,000 feet or more in depth, then these unfortunate beings many years hence who may have to drill holes while the seam is being worked may be required to make some such arrangement as is called for.

Mr. CROCKER. If the requirement is going to be put in the form of legislation, ought not the term "workable bed of coal" to be defined, so as to make the law definite?

Mr. HOOD. We thought we would make the State geologist the definer of a workable seam of coal in any case.

Mr. CUMMINGS. Isn't that putting it into the power of the State geologist to make or destroy millions of dollars worth of property in this State?

Mr. MOLYNEAUX. If the coal seam is what we call a workable seam to-day, the Pittsburgh coal, which ranges from 5 to 8 feet in thickness, is the only bed that is worked in this vicinity; but on the other side of the Allegheny River and a little farther north the Freeport seam, which is not nearly so thick, is being worked. We know that the Freeport seam underlies the Pittsburgh, and there are other workable seams underneath; that is, they are of workable thickness, which is largely the intent of the wording here. Whether these

lower beds will be worked within the life of the gas or oil field, within this district, might be another proposition. I think it would not be well to have the act cover those lower deposits, which will probably not be worked for 50 or 75 years, when the oil and gas in the vicinity will be completely exhausted. If those measures are worked at that time, the records will show where these wells are, and proper precaution can be taken. I think it would be a serious burden on the driller to have to case down to those lower depths at this time, where the probability is largely against the coal being in the market in the lifetime of the oil or gas.

Mr. RICE. I think any committee appointed will be glad to have a discussion of this point, which was one of the most difficult things we had to consider, because we realized that what is commercially workable to-morrow might not be commercially workable to-day. Southwest of Pittsburgh, where the Pittsburgh coal is deeper and may be underlain by the Freeport and other seams, it is not probable that within this generation, or perhaps the next one, the Freeport coal will be worked, even if it is of workable thickness. Yet we can not tell when deep mines may be started, I admit.

Mr. LAYTON. I should like to know how you can puddle that clay down the outside and between the casings.

Mr. HOOD. I would rather have Mr. Heggem answer that question.

Mr. HEGGEM. Clay can be mixed with water so that the water will carry about 40 per cent of solids, and this fluid mixture will flow into small crevices. It can be put in as fluid, either through another pipe lowered to the bottom, or by means of a bailer, or by being poured. As regards pouring from the top, there is some doubt as to whether the clay will bridge, but it can be poured down through a smaller tube. A provision is made in these suggestions that the first string of casing need not be set in the cement, whereas the second string of casing is set in the cement. The cement does not come up to the shoe of the first string of casing. That permits the second or inner string of casing to be put in first, and gives a larger space, not less than 4 inches, on each side of the second casing in which to introduce a 2-inch tube and force the clay down. After the clay is put in it will settle. It may be allowed to settle immediately, or it may be kept in suspension for a longer or shorter period. While it is still soft the first or outer casing can be put in.

Mr. HICE. What will you do in case of striking a flow of water? The water will probably rise to the top, or the clay will not settle through the water.

Mr. HEGGEM. You can make the clay settle.

Mr. HOOD. That question was asked of a clay expert. We had a little doubt as to how that clay would act, and we asked him this question: "If a clay is puddled and introduced into a pipe or

a space like this, how long will it take to settle? Is it a matter of minutes, or days, or months, or years?" He replied: "You can make the time anything you want; if the solution is acidulated precipitation is rapid, if the solution is alkaline the clay can be held in suspension for a considerable time." It is a matter of manipulation. The amount of acid required, the degree of acidulation, is very mild indeed. It takes only a little acid to settle the clay. Dr. Bleininger, of the Bureau of Standards, is my authority.

Mr. HICE. I agree with him, but under the peculiar conditions, with quite a number of years' experience in the clay business, I do not think that clay so settled would have sufficient density to accomplish the desired result, but think it would largely adhere to the sides or the walls of the pipes, in the way clay does in casting ware.

Mr. HOOD. Would that be true with any considerable hydraulic pressure?

Mr. HICE. Undoubtedly so. Clay wares are cast under pressure.

Mr. HALL. What you get would be flocculence. Of course, the probability is that the water down there is acid with hydrochloric acid from the well, but I do not think you would get much more than flocculence.

Mr. HICE. Clay so settled would be very different from puddled clay. It would be more like soft slime.

Mr. HOOD. I would like to ask Mr. Heggem whether this method is being followed in any case that he can think of; that is, the use of clay for filling holes such as this?

Mr. HEGGEM. Clay is being used in drilling oil wells chiefly in Louisiana, Texas, and California. It is used in various degrees of fluidity. Perhaps I might cite Louisiana, where oil is found below the gas. A driller may strike gas at 750 or 800 pounds pressure. He has safety appliances to control that gas, and on top of the inner casing he mounts a gate valve and puts about 40 feet of pipe above that valve, and another gate valve on top of that. Then he closes the lower valve, fills between the valves with thick mud or clay, closes the upper valve and opens the lower valve, and the clay slides down into the well. This operation is repeated until the pressure of gas is entirely removed. Muddy water is pumped down then to finish the job; the driller then proceeds with his drilling, and is not bothered with gas coming in. As to clay being used in the way we have suggested, I do not know of a case. We are simply making the suggestion.

Mr. DE WOLF. Would sand pumpings fill the bill just as well?

Mr. CAMERON. I think it would, rather better. I believe it is the same with cement. In cementing our casing through the coal, we are drilling our holes to the proper depth, filling the hole until we get

above the coal at the proper depth, and then are forcing the casing down to the bottom of the well, bailing the cement out of the casing and pouring it down the outside. In this way you know that the cement is in the proper place, whereas if you pour it in first, you do not know where it stops.

Mr. HOOD. Your preference then would be to put in cement; that is, 1 to 2 mortar?

Mr. CAMERON. Yes; and then fill in between the casing and the side of the hole; for the latter purpose sand pumpings would probably be just as good. Sand pumpings get as hard as slate.

Mr. CORBIN. In several localities you get gas at four or five different levels, and we may be using three or four different pipes. If you have two casings to start with, you might have five or six sands to reach, carrying different pressures of gas. Start a hole with 18-inch, and you never in the world could get down to the lower sand. We are cementing wells now about 990 feet deep, and put 10-inch pipe in, and I know we could not put in larger sized pipe at all.

Mr. HOOD. It may be that the gentlemen have other suggestions; if so, suggestions are exactly what we want. If any one who does not care to discuss it now will send a sketch or written memorandum later, we shall certainly be glad to have it.

Mr. RICE. We might invite Dr. Bleininger to be here. He has had very wide experience with clays and is regarded, I think, as an authority on clay working.

Mr. HICE. There is no question as regards settling by acidulation.

Mr. TAYLOR. It may be a matter of interest here to read to you part of an agreement that we had with a number of gas companies in the way of plugging and cementing wells, which they have agreed to do. When a well is abandoned the 2-inch pipe from below the coal bed to the surface is for a vent, so that there will be no pressure upon the coal. We have found trouble in complying with the requirements in casing a hole, or at least in getting what we considered good work. Frequently the space between the casing and the walls of the well is filled with water, and if the cement is poured in at the top the cement and sand separate, and there is only a sand filling at the bottom. If a pipe about 1-inch or 1½-inch were inserted outside of the casing, the cement can be forced with compressed air clear to the bottom, and the pipe can be lifted and the hole filled in a perfectly satisfactory manner. We would be entirely safe if the cementing were done in that way, since the space between the rock and the casing would be thoroughly cemented. This takes care of only the Pittsburgh coal. To carry such cementing to a greater depth would be a hardship on the oil-well people, one that I do not see how you could overcome. To carry out the method to 1,000 feet or 1,200 feet, I think, would be impracticable.

Mr. LAYTON. There is no great objection to this part of his agreement, but there is another section immediately following that that might be of interest. I wish you would read that.

(Mr. Taylor read further in the contract.)

Mr. LAYTON. The only objection we had to this agreement was just a little rider, as I call it, that we were to save them harmless from all water and everything else forever, in addition to the features mentioned. There is one thing we want, speaking for myself individually, and that is a reasonable method. We want a method for plugging abandoned wells under a just and fair inspection. Now, is it possible to eliminate some of the details mentioned and put the matter in the hands of a disinterested department that would give us proper results?

Mr. DE WOLF. In connection with committee work I wonder whether we have proceeded far enough in the reading of this proposition so that such a committee might find it convenient to begin its work this evening.

Mr. RICE. I think we should have a committee which should report to-morrow, although I believe there is much to be discussed.

Mr. HICE. If anything is to be done it ought to be whipped into shape so that it could be presented to the legislatures promptly. Some of the legislatures in session now will adjourn early in March.

Mr. HOOD. It will be better to have it right than to hurry it.

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Mr. RICE. We should try to get everybody out to-morrow morning, and to then appoint a committee which might proceed to-morrow afternoon to lay the framework or at least arrange an organization, so that those who could not attend might present a written discussion. The committee might then assemble at a later date and report back to the adjourned body.

Mr. SCHLUEDERBERG. I would like, as Mr. Rice suggests, to hurry this along, but it is too big a question to rush. We have got entirely too much to do. There are too many interests to consider. We have to consider not only the coal interests but the oil and gas interests and numbers of others. We have been working on this thing with our own gas wells in connection with coal mines for the last 20 or 25 years. Things are going on that are not exactly right, and we can not make them right in a week. This is not a matter of days; it is a matter perhaps of weeks.

On motion of Mr. Schluederberg, adjournment was had until 10 o'clock Saturday morning.

The Saturday morning session was called to order by Chairman Fohl, who stated that one of the gas companies had handed in a plan, showing a method of protecting a well, and asked Mr. Corrin to make what explanation was necessary in connection with slides

thrown on the screen. [The plan showed a bore hole through a coal bed to a series of gas sands.]

Mr. CORRIN. There is not very much explanation. It gives the plan of sinking a 16-inch hole 15 feet below the bottom of the Pittsburgh seam of coal, and then putting a shoe at the bottom of the 10-inch casing and inserting the 10-inch casing. The shoe is to keep the 10-inch casing in the center of the hole, so that the cement will be equally distributed around the casing. Before the cement is put in, the hole is drilled 100 feet below the bottom of the Pittsburgh coal. The idea is that if you put the cement in first and drill through, you will break the shoulder off. If you drill the 10-inch hole through before cementing, and put in thin concrete, there will be no danger of breaking it at the bottom. Then cement is poured in to about 50 feet above the top of the Pittsburgh coal, and allowed to stand, and afterward sand pumpings are put on top of the cement to the surface. This explanation is practically shown on the next slide.

Mr. RICE. May I ask if the space between the inner and outer casings has a vent to the outside?

Mr. CORRIN. That is where we generally take out the gas coming from the upper sand. We sometimes get a little gas between the 10-inch casing and the hole, but generally there is a vent into the low-pressure line.

Mr. RICE. The shoe may be under some small pressure?

Mr. CORRIN. Yes.

Mr. RICE. Do you have an automatic relief valve, that is, one that will lift at a certain pressure? Suppose there is a sudden outburst of any sort, how would you keep that gas from forcing its way up under the shoe?

Mr. CORRIN. The low-pressure line would take care of that, but there is not a complete vent straight through; that never could be. The low-pressure line is one that has little or no pressure on it.

Mr. FOHL. Is there not a vent between the 10-inch and the next pipe always?

Mr. CORRIN. Yes, sir; practically.

Mr. HOOD. There is a low pressure in there?

Mr. CORRIN. There would be only 1 or 2 pounds.

Mr. RICE. Doesn't it give the opportunity, though, for some man, not intentionally, to close the vent, so that there will not be a vent to the outside?

Mr. CORRIN. That did happen once.

Mr. RICE. That would be an objection to that particular system.

Mr. MOORE. Don't you usually take the gas up in another pipe inside of that 10-inch?

Mr. CORRIN. Yes; there is a 10-inch casing put in and inside of that an 8½-inch and inside of that a 6½-inch and the high-pressure gas comes then in a 5-inch pipe inside of that.

Mr. MOORE. Do you take gas up in the 10-inch casing?

Mr. CORRIN. Yes; that would be merely surface gas.

Mr. DE WOLF. What is the extreme depth you carried this method?

Mr. CORRIN. The deepest I know is 990 feet.

Mr. DE WOLF. Is that handled by a 16-inch hole all the way?

Mr. CORRIN. A 16-inch hole clear down to 50 feet below the coal. The high-pressure gas always comes between the 5-inch and the tubing. The only gas that would come up in the 10-inch would be the shallow gas with a very low pressure.

The second slide contains the following written explanation:

“Drill a 16-inch hole 50 feet below the coal. Then stop and insert a 10-inch casing with a shoe, or a swedge nipple, at the bottom, in order that the casing may be certain to fit in the center of the hole. Before doing anything more, or doing any cementing, drill a smaller hole 100 feet below the point where the 10-inch casing rests. Then insert cement on the outside of the 10-inch casing so that it will come to 50 feet above the top of the Pittsburgh coal; then after the cement has set fill to the surface of the ground with sand pumpings; after the 10-inch casing has been inserted, and before starting to drill the hundred feet above mentioned, provide some protection for the space between the 10-inch casing and the wall of the 16-inch hole, so that no sand pumpings or other foreign matter will get into it before the cement has been inserted. The idea of drilling a smaller hole 100 feet deeper, after the 10-inch casing has been inserted, is to prevent any breaking of the cement by the hammer of tools on the casing in drilling.”

Mr. HOOD. Why is it 50 feet above instead of any other amount?

Mr. CORRIN. It is merely a matter of judgment.

Mr. HOOD. I should like to know whether any casing thus protected has ever been uncovered in coal mining, so that anyone knows in what shape that 3-inch coating of cement is, whether it is really intact.

Mr. CORRIN. We insert the cement through a 2-inch pipe put down to the bottom of the hole and worked around the casing. As it fills the casing the pipe is gradually raised. The idea is to try to distribute that cement evenly around the casing.

Mr. HOOD. Those who have worked with considerable quantities of cement know that it sometimes swells and sometimes shrinks, and you are not always sure just what does happen, and it is rather difficult to get a job of cement that has a perfectly clean face. In this case it seems to me it is questionable as to whether the cement

really gets in and whether the cement is water-tight. Personally I am inclined to be doubtful.

Mr. WATTERS. In regard to that shoe, how much larger in diameter would it be than the collar of the 10-inch casing, or what space would there be between the casing and the shoe, and might the cement get away from you at that place?

Mr. CORRIN. The shoe is intended to be just large enough to go down in the hole; to have the same diameter as the hole.

Mr. WATTERS. How about the collar passing the casing? The collar would have to pass through this shoe.

Mr. CORRIN. The shoe is on the outside of the casing.

Chairman FOHL. Are there any further questions? If not, we will proceed with the discussion of the paper.

Mr. DE WOLF. May I ask a question of the last speaker? I suppose, of course, there would be some economy if, on abandonment of the well, it would be practicable to cut that 10-inch casing 50 or 60 feet above the coal vein and pull it out, or is it necessary to leave it all in? In Illinois we have always left it in.

Mr. CORRIN. I do not see why it could not be cut with a right and left hand thread and screwed off above the coal.

Mr. Hood then read the paragraph entitled "Casing Through any Coal Seam," as follows:

(19) CASING THROUGH ANY COAL SEAM.

Any bore hole drilled for gas, oil, or other mineral shall be drilled to a point at least 20 feet below any workable seam of coal that may be penetrated and receive a metal casing not less than $\frac{1}{4}$ inch in thickness and of an inside diameter 4 inches less than the diameter of the bore hole. This casing shall be concentrically seated on the bottom of the hole, shall extend to the surface, and shall be known as the first casing.

A second inner casing 4 inches less in diameter shall extend at least 10 feet below the first casing and shall be seated in 9 feet of cement mortar composed of one part Portland cement and two parts sand. The inside of the second casing shall be open to the atmosphere its full length.

The intervening spaces between the second and the first casings and between the first casing and the bore hole or outer wall shall be filled with puddled clay to a height of 30 feet above the coal seam.

The idea of this is that a central casing going through and accessible from the excavation might be rapidly corroded at the floor, where water would flow. It might get through into the 2-inch space inside left for the clay; so to protect the outside casing from corrosion a wall is put up, with a 2-inch space between that wall and the casing, to be filled with puddled clay. In order that this may not act as a mine pillar in any place where it is not wanted, the inclosing wall is made small.

Chairman FOHL. Are there any remarks or discussion?

Mr. HALL. I do not believe that the discussion of the previous subject was really finished. The main feature of the suggestion of the Bureau of Mines, outside of that of having a vent inside the outer or first casing, is that the use of clay between the casing and the sides of the bore hole provides a certain elasticity or flexibility. I think the point is well taken. I think that what the coal operator has demanded in the past has been a perfectly rigid hole, which is the very thing he does not want. When we are dealing with masses of rock, the weight of which may run anywhere from 4,000,000 to 9,000,000 tons, such rigidity as the operator has been demanding and getting by a few paltry inches of concrete and a small iron pipe is wholly inadequate. And whether that proposition of the Bureau of Mines does really give sufficient flexibility is open, I think, to question, in view of the fact that it proposes that there shall be a difference between the diameters of the two pipes of only 4 inches. That means, you see, that there will be a difference of only 2 inches on either side, but as the couplings will take up three-fourths of an inch on each side, the size of the couplings varies a great deal with the kind of casing, thus reducing the thickness of clay to $1\frac{1}{4}$ inches. That seems to me to be wholly inadequate, and it seems to me that it is really necessary to consider what does happen when any movement of the strata takes place. When a body of rock rotates about the edge of the coal pillar, say 15 feet long, * * * there must be some considerable sheering at certain specific points. The question is whether it would be possible to give a certain degree of flexibility. My suggestion is to drill a hole somewhat larger than was suggested, and to lower into it a spiral riveted pipe of a diameter possibly 2 inches less than that of the hole. That spiral riveted pipe would not cost much and would not last long, but it is not intended for anything more than a form. This should be filled up with concrete or cement mortar in such shape that it would be possible afterwards to put in clay grouting; then put in, say, an 8-inch tube, at least less than the diameter of this outer pipe; the clay not to be put in puddled, but in an intermediate size. The size would be a matter of determination, but we will say up to No. 3 buckwheat, without large pieces and no excessively fine stuff that would not settle. Then there would be a chance for the whole pipe to move somewhat. Otherwise, with only an inch and a quarter, as now provided by the bureau's suggestion, there might not be sufficient flexibility.

Several other things connected with the breaking of measures are interesting. If, for instance, you put a beam across two piers and hang a pipe from it, as soon as the beam begins to bend it lowers the pipe down into the opening, and there may be considerable strain on the pipe if it is not properly centered in the hole, but if it is hung in the center there will be hardly any strain. I think the important

suggestion made by the Bureau of Mines is that we should have a clay face so that the pipe can slide. Anything that is rigid is the worst thing that the coal operator could ask for, because the barrier he is trying to put up is totally inadequate for the purpose for which it is designed.

Mr. MOORE. I think there is one feature that Mr. Hall has overlooked—that is, the possibility of a lateral movement in the strata over the coal which, as any mining man knows, is of frequent occurrence; not necessarily a general squeeze of a section of a mine, but you haven't any assurance that an entire piece of roof 150 feet long will fall down vertically. It may not be 150 feet, it may be 80 feet long, and when it drops it is just as liable to slide a little to one side as to fall straight down. I do not subscribe to the theory of taking coal out around that hole. I may be a standpatter, but I am in favor of a rigid support around the casing for the simple reason that a squeeze is one of the meanest things you have to contend with in a coal mine, and no matter how good your mining practice if you get any lateral motion whatever, as you may have with all the coal out around that well, it will cut any number of strings of casings or any amount of cement or clay that you might put in there, as a pair of shears clips a string.

Mr. CROCKER. Why is the clay put in? If you want movement why not leave it out entirely? The clay stuffs the hole to a certain extent.

Mr. HOOD. Relative to these questions of horizontal shear that may be applied to such pipe as that mentioned, it is very easy to get all sorts of stresses sufficient to cut a pipe right in two. We have been looking for some evidence that that has ever happened and we have not been able to find it. Those who make a practice of testing materials know that it is very difficult to get a true shear of any material. Two planes, sliding one on the other, must come close together. What we actually get is a bending with a short lever, because that is what occurs in most shears. In the case of a rock shear, such as we are considering, it is just a question of how long that lever is. Maybe that lever will be increased by a clay pack. It means that the stress will be distributed around the tube that is to be sheared, when if there is nothing in there at all the two planes might come closer together and make a shorter bearing. That is one of the objects of the clay pack—to distribute the stresses.

Mr. LAYTON. Your fulcrum would be pretty small wouldn't it if there was a split 6 feet long and 2 or 3 feet at the back?

Mr. HOOD. Very small indeed, too small. I think if we ever had a case such as Mr. Hall mentions nothing a man could put in there would stop it.

Chairman FOHL. Is there any further suggestion along this line? If not we will take up the subject of casing through accessible mine excavation.^a Are there any remarks on that, as to the method of protecting these pipes coming down through the workings? If not, the next matter is casing through inaccessible mine excavations. Will you read that?

Mr. Hood read the section indicated, as follows:

(21) CASING THROUGH INACCESSIBLE MINE EXCAVATION.

Where a bore hole passes through an inaccessible mine excavation the outer casing shall be protected by cement mortar held within a metal tube with a diameter 4 inches greater than the diameter of casing and extending from 4 feet below the mine floor to 4 feet above the mine roof or cave.

Mr. Hood. There is perhaps a little inconsistency here, in that we have asked for cement in this place, and clay in the other, and we recognize the inconsistency, and perhaps can not put up a very good argument for the cement in this place, except a seeming necessity of keeping this distance as small as possible. We recognize that to make the hole larger there would require the use of some sort of a form put down through this hole, and we have not even asked for a casing; we have asked for a metal tube. It might be a spiral pipe or it might be anything that would hold the cement while it is setting. We will get it in as best we can. It was thought that cement would protect the outer casing that we provide, or the first casing, from acid mine water. If clay were put in, just as soon as the outer metal tube had rusted away, the clay would slump and go away, and there would be no protection at all, and that is the reason for putting in cement rather than clay in this place. Yet it is recognized that the cement will crack, it will not be thoroughly waterproof, and acid will in time go through it.

I may say that this matter of corrosion is a function of the rapidity with which the water is changed. If water could be held absolutely quiet and still, there being no replacement at all, or very, very slow replacement; the corrosion would be correspondingly slow. It is not believed that this cement will be an absolute protection, but it will simply be a retarder to the flow of fluids, and it

^a(20) CASING THROUGH ACCESSIBLE MINE EXCAVATION.

Any casing that passes through a mine excavation shall be protected by a wall of concrete or of masonry or brick laid in cement mortar, extending from 2 feet below the mine floor to the mine roof. Between the first casing and the wall thus constructed there shall be left an annular space of not less than 2 inches which must be filled with puddled clay. This work shall be done by the well owner.

Casings that are exposed by mining operations shall be covered by the mine operator in the manner prescribed above.

will, therefore, retard the possible corrosion of the outer casing, which is provided for.

Mr. JOHNSTON. I have been interested in bringing forth a system of cementing that is used in shaft working for shutting off water. In a shaft that we sunk last spring for the Pittsburgh Coal Co. we ran into a seam of gas that forced the water out of the drill holes that we were drilling. We applied this system and shut off that gas and water completely. In speaking with two or three mining men the subject of oil-well holes and gas-well holes was brought up, and I suggested this system of grouting. I have listened to the previous speakers, who mentioned forcing the cement into the bore hole. It is perfectly possible to force this cement under pressure into the crevices of the rock until the rock is absolutely impervious. It is possible to make a cement lining for the well that is absolutely waterproof, and this must be done by pressure by the use of a plug on top. I am not familiar with oil wells and gas wells or coal mines except as regards the shafts going into mines, but this system is so successful that it ought to work. It was used in the Catskill Aqueduct. I believe that men who are familiar with the actual details of drilling holes and plugging them could find some application of this process.

Chairman FOHL. Could you give us a brief description of your method of application?

Mr. JOHNSTON. Putting in cement between a spiral riveted pipe and casing was mentioned previously. That would be put in to make the lining waterproof, but the cement grouting would have air bubbles in it, and, of course, air bubbles would make it pervious after the casing corroded. If the grouting were put in under pressure the bubbles would come out.

Chairman FOHL. The cement, if put in as they describe, would carry air bubbles?

Mr. JOHNSTON. Yes, sir; be full of air bubbles.

Chairman FOHL. I think your explanation of how this is done would be very interesting.

Mr. JOHNSTON. The scheme as we use it is for plugging holes in drilling rocks at any depth. Suppose we are sinking a shaft. The ordinary method would be first to drill a hole in advance, to make a sump, and then to put in side holes. If we get water in the first hole, we then drill three or four more holes. We then plug all the holes we have drilled, using tight swedge nipples with valves on top. Each nipple is packed in with bagging, or a gunny sack, or a rim of cement, or anything to make the hole tight. The swedge nipple, when driven, will be absolutely tight. We connect with this a grouting machine which was patented two or three years ago and has been very successful.

It is nothing more nor less than a tank in which the cement grouting has been put very thin, and then the top of the tank closed and connected with air pipes worked with compressed air. The cement is mixed by this air. It is run back and forth, so that it is fairly mixed. The air pipe is attached to the tank, and the compressed air drives this cement out through the pipe into the hole and completely closes it. We have got as high as 335 pounds pressure on some of those holes and have absolutely plugged the rock. After all the holes have been plugged we drill another hole to see if the strata still leak. We have seen crevices that were completely filled when we got through. This process, to my notion, could be used in as deep a hole as you want. Suppose you had a hole 300 or 400 feet deep, and you wanted to fill it so completely full that gas would be kept from getting up into the mine. Put in a plug, put the pipe in the plug, and force in cement until the hole is absolutely plugged and the crevices all around the plug are full. It would be perfectly possible to drill through a body of rock without having the water or the gas leak out after you had drilled through. We have taken shafts—I mention shafts because I am more familiar with them—and have made them absolutely waterproof by this process. I certainly believe that there is some application that can be made with reference to oil and gas wells.

Mr. LAYTON. Anyone liking to see a machine of this kind can do so by visiting the Mount Washington Tunnel, where the same thing is being used now. They had trouble, and they have been working for a year and a half trying to fill in back of the cribbing of the bridge of the arch. It is the very same thing the gentleman speaks of here now.

Mr. RICE. This system of filling porous ground with cement grouting is certainly a most excellent one in shaft sinking, and it may have some application here. In 1908, in the Pas-de-Calais coal field of France, I found they had been using for several years a system of cementing the fissured chalk measures which must be passed through in shaft sinking. The chalk measures are so filled with water that it was formerly necessary to employ the freezing process. In 1911 I found the cementation process, as it is there called, had come in almost to the exclusion of the freezing process in that district. The hole is drilled in a circle around the projected shaft in much the same manner as for the freezing process; then cement grouting under high pressure is pumped into the hole, successively filling the fissures and joints at different horizons. As a result what is practically a concrete pillar is built. The shaft is sunk through this as in dry rock.

Chairman FOHL. Are there any further remarks on the immediate subject of casing through inaccessible mining excavations?

Mr. HICE. I should like to ask how you arrive at the designation of 4 feet above the mine roof—whether that would be sufficient?

Mr. HOOD. Just the same way that other persons have arrived at the 10 or the 50 feet.

Mr. HICE. It would not be above immediate falls.

Mr. HOOD. I believe a suggestion was made that in the ordinary coal mine it should not be enough to be more than one length of pipe. With an 8-foot seam, 4 feet above and 4 feet below, would make 16 feet. If we call for 10 feet above, as has been suggested by Mr. Rice in a preliminary conference, you would have more than a pipe length, which would require a joint; but we haven't any real good reason for a specific distance.

Mr. HICE. If it were 4 feet below the coal, and you have an 8-foot seam, with 12 feet, you will have most of this down, so that with a 4-foot fall your pipe would be open.

Mr. HOOD. And if we tried to make it long enough to take care of that situation there is no telling how long it would have to be. Is that a situation that can be met? To go a little further on Mr. Hice's line of thought regarding this cement protective layer, the useful portion I consider to be the bottom 2 or 3 feet, or as high as the water level is likely to rise; above that it is of little use.

Mr. HICE. Another question would be the matter of getting in the cement properly.

Mr. HOOD. Yes. And while I am on my feet I want to call attention to one point. I do not think the gentleman in referring to his method of putting in grout under pressure means to imply that the air is taken out of that cement. It is there somewhere.

Mr. JOHNSTON. There is usually a vent pipe.

Mr. HOOD. But I can't see how the air would get out with the arrangement described.

Mr. JOHNSTON. Through the vent pipe.

Mr. HOOD. What actually happens is, I think, that under your high pressure your little bubble of air is compressed to a smaller diameter. The cement is still porous to the extent of having those openings in it, but they are so much smaller that the surface tension of the liquid is enough to keep it in instead of allowing it to flow through. If we could get that pressure in any other way—for instance, if we had a hole 600 feet deep filled with water—we would get exactly the same condition as with mechanically produced hydraulic pressure, and the same little air bubbles would be just as much smaller.

Mr. LELAND. If it is not feasible to make this arrangement water-proof, it would still be of some use, if we had a large movement of the roof, as large as was suggested by Mr. Hall.

Chairman FOHL. The point is well taken. Are there any further remarks on this subject? If not, we will proceed to the subject of casing to exclude water.

Mr. Hood read the paragraph referred to, as follows:

22. CASING TO EXCLUDE WATER.

Before a bore hole is drilled into a gas-bearing or oil-bearing formation a string of casing shall be so set as to exclude all water from the lower bore hole.

Mr. CORRIN. I know a section in West Virginia where there are 11 different levels from which you get gas. How would you take care of it?

Mr. HOOD. I do not see how it would be possible to maintain a vent to the surface so as to keep gas from escaping through under the casing seats, if the well is not cased for each one of those levels. Perhaps we are trying to ask one well to do too many things.

Chairman FOHL. I should like to ask whether this coincides with present practice in the matter of taking gas from wells.

Mr. McCLOY. It does not. We take gas on the inside of the tubing, and also on the outside of the tubing. We have 6 $\frac{5}{8}$ -inch, 8 $\frac{1}{4}$ -inch, and 10-inch. We take gas out on the inside of the tubing, and also between the tubing and the casing. That is absolutely necessary in most fields in West Virginia.

Chairman FOHL. Are there any further remarks? If not, we will proceed to tubing gas and oil wells.

Mr. Hood read the paragraphs referred to, as follows:

(23) TUBING A GAS WELL.

To conduct gas from a gas well, tubing shall be inserted with a suitable packer placed below the inner casing and so constructed as to prevent the escape of gas except through the tubing.

The inner casing shall be left open to the atmosphere throughout its full length.

(24) TUBING AN OIL WELL.

To conduct oil from an oil well, tubing shall be inserted and extend from the oil-bearing formation to the top of the well.

The inner casing shall be left open to the atmosphere throughout its full length.

Should gas be liberated in the well in sufficient volume to have commercial value, it may be shut in by means of a packer placed below the inner casing and may be conducted from the well through tubing inserted into the well parallel to the oil tubing.^a

Mr. CROCKER. I consider it not at all practicable to have two strings of pipe in the well within the casing. In the present practice

^a See figure 11.

there is always the outside casing to protect from leakage into the mine, and we have wells from which we would not dare let the gas all out. It would hurt our production at once. It is very seldom that we have over 40 or 50 pounds pressure on the outer casings. If we open these to the air, we lose the gas immediately. We use it for fuel. I do not think it would be possible with a $5\frac{3}{8}$ -inch hole to get two strings in unless you used very small pipe, let alone injuring the well by running it entirely open. Ordinarily we have to keep a little pressure on to keep the gas line full.

Chairman FOHL. Is it your idea to increase the diameter of the hole to accommodate your other two pipes?

Mr. HOOD. It seems to me it comes back to the question of whether we are not asking too much from one hole. It seems that in order that there shall be no leakage under the seat of the casing there must be no pressure, and as the packing with cement or clay may be not perfect, the only absolutely safe course is to keep the pressure from off those seats. As long as that pressure is on the seat and the work may not be well done, it might be that that pressure will work up under the seat, outside of the packing, and then through the ground into the mine, as it has done in some cases. It is recognized that the problem is extremely difficult.

Mr. CROCKER. But there is another string of casing outside if there is any leakage.

Mr. HOOD. That furnishes sufficient protection only as long as there is no possibility of a leak getting up under the seat that is just below the mine floor.

Mr. CROCKER. There are generally two or three strings for protection; oftentimes three.

Mr. HOOD. So that, as a matter of principle, you say the plan proposed is all right, but, as to the specific working, it is wrong?

Mr. CROCKER. Yes.

Chairman FOHL. Is it your idea that the principle he suggests coincides with the methods you suggested for passing through a coal bed?

Mr. HOOD. I think not; I am not so sure about that. I would have to study the question.

Chairman FOHL. That would be a matter for the committee to study—the details. Are there any further remarks? If not, we will proceed to the next subject, "Casing Heads."

Mr. Hood read the paragraph mentioned, as follows:

(25) CASING HEADS.

Casing heads must have at least one opening to the atmosphere to which a valve or plug is not attached, so as to insure ample vent in case of leakage into casing spaces.

Chairman FOHL. That is to give a vent or to be sure in some cases that the vent is so maintained that it is not an easy thing to deprive the well of a vent. Now, just how that should be arranged is the question.

Mr. CROCKER. The criticism that applies to the other would apply to this. The inside casing—if you left that open, you could not utilize the gas entering it. As long as the other strings of casing are in, protection would be afforded the mine.

Mr. HOOD. If the outer casing was connected with an open vent to release the pressure on that seat, it would fulfill the requirements.

Mr. CROCKER. That clause is taken care of by the other one.

Chairman FOHL. Is there any further discussion? If not, we will proceed to the paragraph "Completion of Well."

Mr. Hood read the paragraph referred to, as follows:

(26) COMPLETION OF WELL.

When a bore hole has been drilled and put into operation the owner shall file with the inspector a statement of the total depth of the hole, the sizes and lengths of casing used and remaining in the hole, the depth and thickness of all coal seams penetrated, and whether oil, gas, or water is obtained.

Chairman FOHL. Are there any remarks? If not, we will proceed to the paragraph "Suspended Operation."

Mr. Hood read the paragraph mentioned, as follows:

(27) SUSPENDED OPERATION.

When for any cause a bore hole that passes through a workable seam of coal shall cease temporarily to be operated, the inner string of casing shall be maintained open to the atmosphere. Should oil tend to rise in the well above the bottom of the first or outermost casing passing through the workable coal seam, such oil shall be pumped out by the owner and its level maintained below the bottom of such outermost casing.

Chairman FOHL. The whole intent of this is to take care of a well that an operator is letting stand and does not know whether to abandon or not, or a well that is simply being neglected. If oil accumulates and rises above the seat of the casing immediately below the floor of the mine, it might force its way through. There would be a hydraulic pressure forcing the oil into the mine, and in some way that should be prevented. It was thought also that if this requirement was prescribed it would lead to a formal abandonment of the well and a formal plugging, rather than to simple neglect.

ABANDONMENT OF WELL.

Chairman FOHL. Is there any further discussion? If not, we will take up the subject, "The abandonment of the well."

Mr. Hood read the first two sections under that head, as follows:

(28) NOTICE OF INTENTION.

When any oil or gas well is to be abandoned the owner shall notify the chief inspector in writing of such intent to abandon, and shall proceed with plugging methods only after complete arrangements for inspection shall have been made and permission granted.

(29) METHOD OF PLUGGING.

Any well that is to be abandoned must be entirely filled from the bottom to the surface. The lower part of the wellhole must first be filled with sand, clay, or rock sediment to a point 5 feet above the lowest gas-bearing or oil-bearing formation. Above each formation supplying gas, oil, or water, and immediately below any workable seam of coal, there shall be a plug as hereafter described, and each well shall have not less than three such plugs whatever the formation.

The plug above mentioned shall consist of 25 feet of cement mortar made of one part Portland cement and two parts sand properly mixed and placed with a bottom-dump bailer upon 5 feet of clay resting on a seasoned wood plug 2 feet long and of the same diameter as the hole. Five feet of clay shall also be placed on top of the cement section. The space between the plugs here called for must be filled solidly with puddled clay, sand, or rock sediment, or with cement mortar or concrete. The filling shall be complete up to the bottom of a casing before such casing can be drawn; the filling shall continue length by length as the casing is withdrawn, cement, mortar, or concrete being used in those sections of the wellhole that pass through coal seams.

Mr. RICE. The thought was to minimize, as far as possible, the expense of maintaining casing. As has been suggested, there are a vast number of wells that will not be approached by mining for years to come. Therefore, if we can restore the ground to approximately its original condition and make it equally impervious, that would be the best way for the mine. Moreover, we thought that by allowing the withdrawal of the casing the oil and gas companies would be put to a minimum expense.

Mr. CROCKER. Complete plugging is a pretty expensive point with us. There are places where it is almost impossible to get anything to fill in with, even ordinary dirt. Personally, I do not think it is necessary to fill completely if you put in a plug at the proper place. We are using now a lead plug with an iron mandrel. We find it far superior to anything we have yet had. I have in mind a gas well where a wooden plug could not be used on account of the pressure; it came right up after the tools. We then used a lead plug in the well. The plug was heavy, and we could get it down and keep it there. We got it down and got something to set it with and put the mandrel on the top of it, and in a dozen revolutions there was no

leakage of any gas. It has been down now three or four years and has never shown leakage. There is no chance in the world for it to break or go to pieces, and we consider it far superior to a wooden plug.

Mr. HOOD. May I ask whether, if it were anticipated that such a hole would have to be filled, it would be burdensome to save the stuff that came out of that hole, or a good share of it, in order to put it back; that is, is it available?

Mr. CROCKER. The pumpings come out pretty thin and run off a good distance, and it is pretty hard to keep them where you can get them, and I do not believe they would fill the hole either. A good deal disappears somewhere.

Mr. McCLOY. What is the objection to an anchored plug; that is, a plug anchored to your last string of casing? That is the manner in which it is used at the present time.

Mr. DE WOLF. I do not know to what extent the geologists were responsible for this suggestion of plugging from bottom to top. The present point of view is one we had in mind. There are doubtless in some localities a number of coal seams, aside from the major seams, that you all recognize and look for, which sometime may be available. It is impracticable for your driller to run a steel tapeline to all of those, and we recognize that however careful he is he can not absolutely locate such a seam of coal. Therefore, it is impracticable to put in a sufficient number of plugs in their proper places to protect those seams of coal. So, from our point of view, the easiest way out was to suggest that the entire hole be filled with rock material, so as to avoid that trouble.

Mr. WATTERS. In regard to plugging wells, I am interested in the coal-mining end of it, but I do not believe in putting a burdensome load on the gas and oil operator. For my part, I am opposed to plugging a well from top to bottom. I rather believe, from the experience we have had this last summer in plugging abandoned gas wells, that it would be better to fill it with sand to the top of the upper gas-bearing sand, and leave the hole open from there up to a point 100 or 150 feet below some particular coal seam. Then place a packer, say a disk packer, with a tube not less than 2 inches in diameter leading from the packer to the surface and extending above the surface, to keep people from dropping things down it. Next cement around this tube to a point above the coal or all the way to the surface. If the cement should not protect the tube, it seems to me that the cement lining would still leave a vent large enough so that there never would be any accumulated pressure of gas. This summer we struck a well that, had it been open at the surface, I am positive never would have caught fire when we cut into it. We don't

know yet who drilled the well, and the location was not previously known to us. We dug around on the surface to find that well. We had a small drilling machine, and on opening up that well we found that it was not plugged, but simply filled to a point about 110 feet from the surface. From there down it was open for about 715 feet from the surface to a point, as we presume, above the upper gas sand where some kind of a plug had been put in. But it was a plug in name only, because it did not hold the gas. It was more likely intended to keep the water out of the gas sand. We placed a packer 150 feet below the coal and ran the tube to the surface, but as there was question as to whether there was gas coming from above the seam we placed a sleeve packer over the 2-inch tube, with a 4-inch tube leading to the surface, and those two pipes stand 8 or 10 feet in the air. There isn't a sign of gas in the mine—not enough at a time to keep an ordinary jet burning—but it was accumulated pressure in that abandoned well that caused the trouble. We are particularly in favor of an arrangement of that kind, and I believe the gentleman representing the gas and oil companies will agree with me when I say that that method is far cheaper to them and I believe more satisfactory than any other method—that is, plugging the well to the surface.

Mr. RICE. I think undoubtedly this particular case was very well taken care of, but that was looking for the present. We have to bear in mind the coal operators of the distant future, in the areas now remote or in deeper coal beds, the positions of which are not precisely determined by the driller.

Mr. DE WOLF. As pointed out, the difficulty is that we do not know precisely where these beds are located. I would not have supposed from what has been said previously in the conference that there has been this objection on the part of the gas and oil well operators, because I understood that it was a matter of agreement, with certain of the large gas companies and certain large coal operators, that they should fill the holes with concrete or cement mortar. The expense involved would seem to be much heavier than is here contemplated, because with the use of these so-called official concrete plugs there would be perhaps four or five needed. These, if used in a 10-inch bore, would represent only several cubic yards of concrete—I haven't figured the amount of filling, disregarding the amount of the hole excavated under ground, but I believe that a 10-inch hole about 3,000 feet deep would average, if filled, about 60 cubic yards. I would suppose that in the country concrete material would be expensive, so it would appear to me to be much cheaper to use only concrete plugs and fill the rest with dirt or clay.

Mr. Hood. The total cost of material with cement at \$2 a barrel and sand at \$1.25 or \$1.50 a yard—and I know that where you have

to haul it 15 or 20 miles \$1.25 or even \$1.50 is entirely too low—the total cost for material for plugging will be, say, \$30 to \$50.

Mr. HICE. There is another matter in putting a pug at the bottom of the well. I think we have cases where plugs have been known to move in a well, and therefore not perform their real duty for 100 feet or so. That is one of the necessities for plugging a well from the bottom up.

Mr. WATTERS. Mr. Rice's remarks bring another thing to my mind. When we had the trouble I spoke of, the gas companies showed the greatest willingness to help us out, and we have never had any trouble with them in that respect. However, we were going to plug it ourselves, and the expert drillers we had from all the surrounding country advised against it, for the reason that in that particular locality the strata between the coal measures that we were working and the upper gas sand seemed to contain underground water currents. They told me that in drilling some of those wells in that locality the water came out of the well entirely clear all the time; that is, there was such a current of underground water that the water was not discolored by the pumping. Whether that is true or not, some of the gas people and geologists might tell us. In that case, I do not see how we could get enough of the liquid cement down to plug it.

Mr. HOOD. Speaking of the 2-inch vent, what is your judgment as to what would be its condition after some years, when that part of the mine in its vicinity has been worked out and abandoned, and the roof has begun to come down, and you are working in some distant part connected with these workings? Would you still feel safe with that small 2-inch pipe sticking up through this part of the mine, which you could not get at, and knowing that the roof was coming down? Do you still think it would be a safe vent?

Mr. WATTERS. I do not believe it is possible in any way to guard against the breaking of the tubing in that case, particularly where there is a heavy covering. But in ordinary cases, to my mind the 2-inch tubing would be enough.

Mr. HOOD. I think you are right, perhaps, in ninety-nine cases out of a hundred.

Mr. RICE. I would think that to plug a hole in the way now done in some coal properties would be more expensive than the plan suggested of simply filling it, except for short concrete plugs, with any material that might be available.

Mr. HALL. I believe any arrangement ought to take into consideration the distance between the coal and the gas sand. If the two are close together, of course the plugging is not sufficient, because complete plugging would raise the pressure so much that the crevices would very easily bring the gas to the coal seam. That whole matter

could be adjusted by specifying a certain distance that must exist between the coal bed and the gas sand if simple plugging is to be used.

Mr. WILSON. My thought is that there is possibly an excellent field over here for some actual experimentation, and as the conference, or the committee that we may appoint, may take some time to come to any conclusion, there may be an opportunity, perhaps, for the Bureau of Mines to cooperate with oil and gas men in actually plugging wells with various materials and ascertaining the facts by tests.

Mr. CORRIN. Answering something that was said a few minutes ago, we had a well in which the gas had a very high rock pressure, and we were for more than three months trying to plug that well. It finally cost about \$5,000 to plug it. We tried the lead plug and it failed.

Mr. HICE. The diagram shown calls for two lead plugs. I simply want to ask where those lead plugs were placed, whether they were placed in shale or in sandstone. I can readily conceive of sandstone such that they could be put in and seemingly shut off the gas entirely, and yet there would be sufficient passage of the gas through the pores of the sandstone up around that plug to allow a dangerous accumulation at a higher level in time, although you would not get the effect immediately, in all probability.

Mr. CORRIN. I think it would depend a great deal on the pressure of that well.

Mr. CROCKER. I would like to ask Mr. Neill to explain about this well I had in mind.

Mr. NEILL. We had quite a lot of trouble about two wells, one of which had not been properly plugged. The cost to plug it, if I am not mistaken, was \$5,000 or \$6,000. We built a new rig over the well and cleaned the well out. There was very little gas, maybe 100,000 feet, but not enough to use. However, the pressure was very high. With a wooden plug we could not stop it. The wooden plugs came out with the tools when we brought them out.

We put in some tubing with a flange on top and set a lead plug on the flange. At about the third revolution the gas was shut off. We drove on the plug for 10 or 15 minutes after that and then filled in above and put in our wooden plug and filled on top of that. We put in three plugs and then got out what casing we had.

We plugged each hole, 5, 6, and 8 inch, separately, and the well has never shown a particle of gas since. I do not think it ever will. It surely can not get through that lead.

The lead plug was made with a steel mandrel on the inside. The mandrel extended down about 10 inches into the top of the plug, and it was cast in that position, about 6 inches projecting from the top of the lead.

It has been about five years, I think, since we did that job, but we did not fill it clear up. We plugged below the coal, and we put in a wooden plug above in order to keep the water from going down onto the coal, and that is the condition the well is in to-day.

Chairman FOHL. Your objection, Mr. Hice, would obtain either with the lead or the wooden plug, wouldn't it?

Mr. HICE. Certainly. It would depend altogether on the character of the sand. I can conceive of a sand where the plug would shut off the gas perfectly. On the other hand, there are plenty of sands that would allow the gas to accumulate and pass around.

Mr. LELAND. If we will provide legislation for an oil and gas inspector who is competent, we should depend on his judgment to some extent, and if we find it is necessary to use a variety of stoppings, depending on the character of the rock, wouldn't it be better, instead of formulating absolute, definite legislation, to leave the details to the inspector's judgment?

Chairman FOHL. That is a problem that should be settled by each State legislature.

Mr. HICE. There ought to be a method prescribed, some discretion, however, being allowed the inspector.

Chairman FOHL. A tentative method, at least?

Mr. HICE. A tentative method, at least.

Chairman FOHL. Is there any further discussion on this subject?

Mr. HICE. As we provide for recording the location of new wells, I think the notice of abandonment should provide for a map and record of old wells of which there is now no record. That is, we would have a record of them, the same as of the wells.

Mr. DE WOLF. I would like to ask some of the gentlemen who have raised the question of expense of filling the hole whether that applies only to those inaccessible regions where materials are scarce; and may we assume that where materials are readily available the proposed method of filling from bottom to top with clay or sand or other like debris would not be excessively expensive or perhaps be even cheaper than the customary method? Is there any mechanical difficulty in getting stuff down into the hole as the casing is pulled?

Mr. CROCKER. Sometimes a piece drops in that is a little bit large. It lodges at some place in the hole. It is solid as long as fluid does not strike it, but if any water or oil strikes it, away it goes. We are plugging very successfully without entire filling.

Mr. DE WOLF. Let me call your attention again to the condition we have in Illinois, and get your cooperation in arriving at a solution of our difficulty. We have a field where there is undoubtedly an important seam of coal, but there is no mining in the vicinity now, and the drillers are prone to say there is no coal in the hole. Perhaps they are perfectly sincere. Be that as it may, it would be in-

adequate to prescribe a method of plugging a workable coal seam when no record is kept of where or what that seam is. There would be no plug in our State under such a law. If you could require the hole to be filled up with rock material, any carelessness on the part of the driller or any intentional attempt to deceive would be offset.

Mr. CROCKER. It may be possible that there is no coal in that particular place.

Mr. DE WOLF. Diamond-drill holes show that the coal is there.

Mr. CROCKER. Assuming that such is the case, wouldn't it be safer to plug under and above the coal?

Mr. DE WOLF. The geologist doesn't know, within perhaps 50 feet, just exactly where that coal is.

Mr. CROCKER. If one knows it is within 50 feet, one can put a plug down.

Mr. DE WOLF. I say they do not know within 50 feet.

Mr. CROCKER. But if they could put a plug down, it would be much safer than filling it up.

Chairman FOHL. The next business before this conference relates to the provision concerning plugging.

Mr. RICE. I think before we adjourn we should like to have an expression of opinion from the gas and oil men about the last one or two clauses of the suggested laws and regulations.

Mr. Hood thereupon read the provision relating to the log of method of plugging:

(30) LOG OF METHOD OF PLUGGING.

When a bore hole has been plugged, an affidavit in reference thereto shall be made by the well owner, who shall state the method followed, the materials used, and the length of the sections occupied by each material. The affidavit shall be certified by and filed with the gas and oil well inspector. A duplicate of the affidavit shall be filed with the county recorder by the gas and oil well inspector.

Mr. DE WOLF. Isn't that intended to be the coal-mine inspector the second time it comes in the provision?

Mr. HOOD. The intention was to file with the chief inspector, and then have a copy go to the recorder, and a variation has been suggested that the filing with the county recorder should be by the State inspector to make it more accessible.

Capt. BARGER. It is the exception, undoubtedly, but it is nevertheless what we may and do need to do at times.

Mr. Hood thereupon read the last two paragraphs relating to the release of bond and to fees.

(31) RELEASE OF BOND.

After, and not until these several requirements have been met, any bond that may have been given by the owner shall be returned.

(32) FEES.

The question of whether fees shall be charged for license and inspection is left for further consideration.

This matter of bond and the next item are perhaps inseparable. This method is going to cost money, and the question is who should pay it, the State or the gas industry or the coal industry, the people who are protected, or who? It is not intended here to suggest who. Some larger body should suggest that. Instead of the method proposed, it is suggested that a system of fees be charged, these fees to go to the State and as they accumulate they will be sufficient to do things with—for instance, to plug wells abandoned by people who are unable to plug them or are insolvent. Then the question of whether it should be a fee system or depend on a bond given by the driller is a question that should be discussed.

Mr. CROCKER. Leave that to the committee.

Chairman FOHL. If there are no further suggestions, we will proceed to the conclusion of the discussion.

Capt. BARGER. In this matter of plugging abandoned gas wells, I have followed with marked success this method that Mr. _____ has outlined. I have used a rubber plug and a wooden mandrel, and in other cases a lead plug. Out in the district where we operate there are possibly five different producing coal seams encountered, and the cost of this plugging, if it were borne by the large corporations, possibly would not work grave harm; but if borne by the individual operator it would work serious harm. A large number of wells are drilled by people who have perhaps just about money enough to drill a well. When you come to saddling them with an added sum of \$5,000 (for plugging), from which they receive no benefit whatever, it is going to do them harm, and it will possibly check the corporations in a great many cases. If you are going to fill up these wells, plug the different oil and gas sands, and keep your tools going at the prices that you have to pay for day's work to-day, the individual operator would very likely go to the almshouse. It strikes me that some simpler method might be evolved by this committee which would require much less expense. The committee should bear in mind that it is not big corporations that are doing all this development, but it is the individual oil or gas operator, who can not stand the enormous expense of this proposed method when he is obliged to abandon his well.

Mr. LAYTON. I think that the method illustrated, using plugs and filling with concrete solidly, is the exception, as mentioned by our friend over here.

ORGANIZATION OF COMMITTEE.

Mr. RICE. I understand Mr. Schluederberg, of the Pittsburgh Coal Co., now has to leave and I think perhaps others and it might be well before they leave if we could take up the matter of the organization of this committee which has been talked about and as to which we all seem to be in accord.

Chairman FOHL. We are open to suggestions as to the personnel of that committee and the proposition of what action should be taken by this conference is now before you. The drift of sentiment before you has seemed to be that we should have a committee appointed to go fully into the matter. The make-up of that committee is for you to propose. We are now open for suggestions as to the manner in which this shall be handled.

Mr. SCHLUEDERBERG. This matter has been pretty thoroughly discussed. It is a matter not only for the State of Pennsylvania, but it seems to me it is a matter for other States, and it is a question that can not be settled in a day or a week and it is going to take considerable discussion and perhaps some experimenting, and therefore I think there ought to be a good committee and a representative one. I think the coal operators, the oil men, the gas men, the geologists, the Bureau of Mines, and the mine inspectors should be represented on that committee and the officers of this meeting ex officio, and I would make a motion that there be a committee appointed, of, say three of each—that is, three coal operators, three oil men, three gas men, three State geologists, three State mine inspectors, and three representatives of the Bureau of Mines—to whom this question shall be referred, to take it up thoroughly in such manner as they may see fit and proper and report at a future meeting such as this.

The motion was seconded by Mr. Rice.

Mr. DEWOLF. What would be the total membership of the proposed committee?

Mr. SCHLUEDERBERG. I have made this committee rather large, because on such committees are many who are not always able to attend, and by making it large enough we shall always have somebody present. I think there will be three from each of the departments I have suggested, and the two officers of this meeting ex officio, which will make 20 members.

Chairman FOHL. Are there any other remarks?

Mr. RICE. It may seem at first that this committee is rather large, and I had in mind two men of each, but at the same time even two from each body would make a large committee, and it may be that the brunt of the work will fall on a subcommittee whom this

general committee may appoint. The subject under discussion is a national matter, and not simply a local matter, and therefore the representation should be as wide as possible, and it seems to me, as Mr. Schluederberg suggests, that each party should, perhaps, appoint its own committee, so as to have it tolerably representative of each body. Some of the work of the committee will have to be carried on by correspondence, of course, but the appointments should as far as possible be made representative in a national, rather than local sense.

Chairman FOHL. The resolution is silent as to the manner of appointment, and that will have to be taken up immediately after we dispose of the resolution. Are there any further remarks on the resolution?

There being no further remarks the resolution was put to vote; it was carried unanimously.

Mr. WILSON. About the method of appointment it must be in order to offer a motion, and in order to give opportunity for the discussion I move that each of the interests represented in this motion that has just been passed select its own committee, bearing in mind that the distribution should be, as far as practicable, geographical, and bearing in mind also that that geographical relation concerns the places where oil and gas and coal come together.

Mr. Wilson's motion was unanimously carried.

Chairman FOHL. I should think there should be some time limit set or some arrangement made as to when these appointments are to be made, and that that should be decided right at this meeting.

Mr. RICE. I think it should be borne in mind that it will be desirable to have the work expedited as much as possible, but we want due consideration given to the subject. As to just how that would be worked out I should like to hear from the other members.

Chairman FOHL. The chairman would suggest that there be a date set now, at which time nominations should be made, and that would practically call the committee together.

Mr. HOOD. I would move that a meeting of this general committee be called for February 18. That allows 10 days for correspondence and getting these committees together. That seems to be ample.

Mr. LAYTON. I know of a meeting of gas and oil well interests to be held on the 17th and 18th in Columbus, Ohio, and some of us might be at that meeting and get on that committee.

A MEMBER. Before the date is set I would state that there will be a meeting of the oil men of Oklahoma, Louisiana, and Texas at the end of this month at Austin, Tex. It might not be desirable to set the date to interfere with that.

Mr. HOOD. I will change my date to the 19th.

Mr. WILSON. Why not make that the 1st of March? I think that the 19th is too soon. The State legislatures that are now in session will not have a chance to act on this, and they could have something formulated that is worth while before the next legislative session, so I should think we should have time enough. Therefore, I move that February 26 be substituted for February 19.

Mr. LELAND. I will second the motion, and I would like to offer a further amendment that the chairman of this meeting have authority to complete these committees if at that date the membership of any of them is lacking.

Mr. RICE. I second Mr. Leland's amendment.

Chairman FOHL. It is moved as an amendment to the amendment that the chairman fill out vacancies on committees, if such vacancies exist at the date of meeting.

The amendment was carried by unanimous vote.

Chairman FOHL. The next question is on the amendment changing the date of meeting from the 19th to the 26th of February.

This amendment was carried by unanimous vote.

Chairman FOHL. We come now to the original motion as amended, that a meeting of this committee be called for the 26th of February, and that the chairman be authorized to fill any vacancies that may then exist.

The motion was carried by unanimous vote.

Mr. LELAND. Will you kindly explain where this committee is going to meet? There was nothing said about that, and it is rather indefinite.

Chairman FOHL. I think that is for the conference itself to appoint.

Mr. RICE. It seems to me eminently proper that, as the chairman of this conference, who would be chairman ex officio of the committee, and the secretary reside here in Pittsburgh, and as the oil and gas well problem is most acute in the vicinity of Pittsburgh, this city would be a proper place of meeting, and I therefore make this motion, that Pittsburgh be the headquarters of this committee.

Chairman FOHL. Presumably this room will be the place of meeting, so that will be attended to later.

Mr. MOORE. I would like to ask how the members of this committee are to be appointed by the respective interests.

Mr. HOOD. They will have to get together. It is up to you.

Chairman FOHL. It seems to the chair that that is comprised in the resolution, that these committee members be appointed by these various interests. As to the modus operandi, that has not been specified, but there are 10 days in which to do this, and in any way that

these various interests choose they may select the representatives who shall come at the time of the meeting on February 26 and appear as members of the committee.

Mr. HOOD. I should like the names of the committee members when they are appointed by the several interests. I should like that those names be sent to me at the Bureau of Mines, Pittsburgh, in order that I may communicate with each of you.

Mr. RICE. I think it would be very desirable if there would be some notification given by the different interests to the chairman in advance of the day of this meeting, so that he may know whether it is necessary to take up the question of the appointment of any person to a possible vacancy that might have to be filled.

Mr. DE WOLF. There has been, of course, some correspondence on the part of the Bureau of Mines officials in an effort to get a representative group at this meeting.

I would move that the chairman appoint now in a temporary capacity one representative from the men here present to represent each of these groups, and that the member so appointed be requested to obtain this list that has already been in use for his guidance, and that he take the responsibility for seeing that the men of his particular interest get organized.

The motion was carried.

Chairman FOHL. The committee will be announced later. Is there any further business of the same nature? If not, the chair would like to suggest that possibly a general invitation should be extended to all people interested to be present at these committee meetings. What would be the sentiment of the conference on that subject?

Mr. RICE. I should think there might be some objection from the standpoint of a working body. It seems to me that the representatives of each interest should try to gather all the information they can from their respective bodies; but if they all attend the meetings, might not some major matters be sidetracked by some of the minor features? I think it might be objectionable to have open meetings.

Mr. LELAND. I suppose when the committee has completed its labors it will report to a larger meeting, which will be open, and there will then be opportunity to discuss this, and that will be the time to invite every one to be present.

Chairman FOHL. Are there any further remarks?

Mr. RICE. If there is no further discussion, I would suggest that before these gentlemen go it would be desirable to take up the question of the appointment of this temporary committee. This is merely a suggestion to help the chairman.

Chairman FOHL. As the chair understands it, there are six groups of interests—the coal miners, the Bureau of Mines, the gas and oil

interests, the State inspectors, and the geologists. For the subcommittee the chair appoints the following: Mr. Schluederberg, Mr. Rice, Mr. Corrin, Mr. Crocker, Mr. Young, and Mr. DeWolf. Is there any further business before the conference?

Mr. RICE. Before the meeting closes, I wish to express on behalf of my colleagues of the Bureau of Mines their appreciation of the way in which this meeting has been conducted, and their appreciation of the response of the different interests in sending representatives to this meeting. I will add what I have several times repeated during the conference, that the bureau has no wish in any way to dominate or control the result. Its purpose was to start the ball moving and let it go of its own impetus. I think the thanks of the meeting are due to our chairman for his able handling of this meeting. I therefore propose a rising vote of thanks to the chairman and to the secretary of this meeting.

The motion, having been duly seconded and put to vote by Mr. Wilson, was carried unanimously.

Chairman FOHL. The chairman and secretary in turn will rise and acknowledge it. Is there any further business to come before the conference? If not, we are ready for a motion to adjourn.

Mr. Rice moves that we adjourn to meet at the possible future call of the chairman for the committee.

At 12.25 p. m. adjourned.

PUBLICATIONS ON PETROLEUM TECHNOLOGY.

The following Bureau of Mines publications may be obtained free by applying to the Director, Bureau of Mines, Washington, D. C.:

BULLETIN 19. Physical and chemical properties of the petroleums of the San Joaquin Valley, Cal., by I. C. Allen and W. A. Jacobs, with a chapter on analyses of natural gas from the southern California oil fields, by G. A. Burrell. 1911. 60 pp., 2 pls., 10 figs.

TECHNICAL PAPER 3. Specifications for the purchase of fuel oil for the Government, with directions for sampling oil and natural gas, by I. C. Allen. 1911. 13 pp.

TECHNICAL PAPER 10. Liquefied products from natural gas; their properties and uses, by I. C. Allen and G. A. Burrell. 1912. 23 pp.

TECHNICAL PAPER 25. Methods for the determination of water in petroleum and its products, by I. C. Allen and W. A. Jacobs. 1912. 13 pp., 2 figs.

TECHNICAL PAPER 26. Methods of determining the sulphur content of fuels, especially petroleum products, by I. C. Allen and I. W. Robertson. 1912. 13 pp., 1 fig.

TECHNICAL PAPER 32. The cementing process of excluding water from oil wells, as practiced in California, by Ralph Arnold and V. R. Garfias. 1913. 12 pp., 1 fig.

TECHNICAL PAPER 36. The preparation of specifications for petroleum products, by I. C. Allen. 1913. 12 pp.

IMPORTANCE OF OIL AND NATURAL-GAS INDUSTRIES.

In order to bring out the importance of the subject discussed at the conference and in this report, the following figures giving the value of the natural gas, petroleum, and coal produced in the United States in 1911 are presented:

Value of the natural gas, petroleum, and coal produced in 1911, by States.^a

	Value of natural gas.	Value of crude petroleum.	Value of coal.
West Virginia.....	\$28,451,907	\$12,767,293	\$53,670,515
Pennsylvania.....	18,010,796	10,894,074	321,537,250
Ohio.....	9,367,347	9,479,542	31,810,123
Oklahoma.....	6,731,770	26,451,767	6,291,494
Kansas.....	4,854,534	608,756	9,645,572
New York.....	1,418,767	1,248,950	.....
Indiana.....	1,192,418	1,228,835	15,326,808
Texas.....	1,014,945	6,554,552	3,273,288
Louisiana.....	858,145	5,668,814	19,079,949
Alabama.....	.....	.....	.....
California.....	800,714	38,719,080	b 23,297
Illinois.....	687,726	19,734,339	59,519,478
Kentucky.....	407,689	328,614	13,617,217
Arkansas.....	.....	.....	3,396,849
Colorado.....	295,858	228,104	14,747,764
Wyoming.....	.....	c 124,037	10,508,863
South Dakota.....	16,984	.....	.....
Missouri.....	10,496	d 7,995	6,431,066
North Dakota.....	5,738	.....	720,489
Michigan.....	1,330	e 7,995	2,791,461
Tennessee.....	300	.....	7,209,734
Iowa.....	70	.....	12,663,507
Utah.....	.....	f 124,037	4,248,666
Washington.....	.....	.....	8,174,170
Virginia.....	.....	.....	6,254,804
Montana.....	.....	.....	5,342,168
Maryland.....	.....	.....	5,197,066
New Mexico.....	.....	.....	4,525,925
Georgia and North Carolina.....	.....	.....	246,448
Oregon.....	.....	.....	108,033
Idaho and Nevada.....	.....	.....	4,872
Total.....	74,127,534	g 134,044,752	626,366,876

^a Mineral resources of the United States for 1911.
^b Includes Alaska.
^c Includes Utah.
^d Includes Michigan.
^e Includes Missouri.
^f Includes Wyoming.
^g Figures representing combined output of Utah and Wyoming and combined output of Missouri and Michigan counted only once.



