Members and Guests in Attendance at the Lake Superior Mining Institute meeting, held on the Missabe Range, Minnesota, August 26 to 30, 1913.

PROCEEDINGS OF THE Lake Superior Mining Institute EIGHTEENTH ANNUAL MEETING

MISSABE RANGE, MINN.

AUGUST 26, 27, 28, 29, 30, 1913

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1913

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ISHPEMING, MICH.

INDEX TO VOLUME XVIII.

OFFICERS.

For the Year Ending With the Close of the Annual Meeting, August 30th, 1913.

PRESIDENT.

PENTECOST MITCHELL .....Duluth, Minn.
(Term one year).

VICE PRESIDENTS.

GEO. H. ABEEL .....Ironwood, Mich.
†W. P. CHINN .....McKinley, Minn.
W. H. JOBE .....Palatka, Mich.
(Term expires 1913).

FRANCIS J. WEBB .....Duluth, Minn.
A. D. EDWARDS .....Atlantic Mine, Mich.
(Term expires 1914).

MANAGERS.

M. H. GODFREY ..... Coleraine, Minn.
JAMES E. JOPLING ..... Ishpeming, Mich.
(Term expires 1913).

G. S. BARBER ..... Bessemer, Mich.
WM. H. JOHNSTON ..... Ishpeming, Mich.
C. H. BAXTER ..... Loretto, Mich.
(Term expires 1914).

TREASURER.

E. W. HOPKINS ..... Commonwealth, Wis.
(Term expires 1913).

SECRETARY.

A. J. YUNGBLUTH ..... Ishpeming, Mich.
(Term expires 1913).

(The above officers constitute the council).

†To fill vacancy of Graham Pope, deceased.

OFFICERS.

The following is list of officers elected at the annual meeting, August 30th, 1913, also the officers holding over from the previous year which are indicated by *.

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WM. H. JOHNSTON ..... Ishpeming, Mich.
(Term one year).

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(Term expires 1914).

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CHARLES E. LAWRENCE ..... Palatka, Mich.
LUTHER C. BREWER ..... Ironwood, Mich.
(Term expires 1915).

MANAGERS.

*G. S. BARBER ..... Bessemer, Mich.
*CHARLES H. BAXTER ..... Loretto, Mich.
†STUART R. ELLIOTT ..... Negaunee, Mich.
(Term expires 1914).

W. A. SIEBENTHAL ..... Republic, Mich.
J. S. LUTES ..... Biwabik, Minn.
(Term expires 1915).

TREASURER.

E. W. HOPKINS ..... Commonwealth, Wis.
(Term one year).

SECRETARY.

A. J. YUNGBLUTH ..... Ishpeming, Mich.
(Term one year).

(The above officers constitute the council).

†To fill vacancy of Wm. H. Johnston, elected to presidency.

LIST OF STANDING COMMITTEES FOR YEAR ENDING 1914.

PRACTICE FOR THE PREVENTION OF ACCIDENTS.

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PAPERS AND PUBLICATIONS.

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P. S. WILLIAMS ..... Ramsay, Mich.

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J. B. COOPER ..... Hubbell, Mich.
A. J. YUNGBLUTH, Secretary ..... Ishpeming, Mich.

BIOGRAPHY.

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J. B. COOPER ..... Hubbell, Mich.
R. A. DOUGLAS ..... Ironwood, Mich.
M. B. M'GEE ..... Crystal Falls, Mich.
W. H. NEWETT ..... Ishpeming, Mich.

MINING METHODS ON THE MARQUETTE RANGE.

Committee to consist of three members to be appointed later.

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M'CORMICK, EDWARD .....Negaunee, Mich.
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M'INDOE, JAMES A.....Norway, Mich.
M'INTYRE, JOHN E.....Nogales, Arizona
M'LAUGHLIN, W. J.....Loretto, Mich.
M'LEAN, JOHN H.....Duluth, Minn.
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NEWETT, W. H.....Ishpeming, Mich.
NEWTON, L. L.....1324 La Salle Ave., Chicago, Ills.
NICHOLAS, THOMAS J.....Palmer, Mich.
NICHOLS, F. W.....Houghton, Mich.
NICKERSON, H. F.....Houghton, Mich.
NIXON, JOHN A.....Ishpeming, Mich.
NOBLE, THOMAS H.....Marquette, Mich.
NOETZEL, BENJAMIN D.....Trimountain, Mich.

OBERG, ANTON C.....Hibbing, Minn.
OLCOTT, WILLIAM J..... ..Duluth, Minn.

ORBISON, THOMAS W.....Appleton, Wis.
ORR, FRANK D.....Lyceum, Bldg., Duluth, Minn.
OSBORN, CHASE S.....Sault Ste. Marie, Mich.
OVERPECK, HOLLIS W.....Box 617, Virginia, Minn.

PAINE, W. A.. .....82 Devonshire St., Boston, Mass.
PAINE, FRANCIS W.....Houghton, Mich.
PARKER, RICHARD A.....929 Foster Bldg., Denver, Colo.
PASCOE, PETER W.....Republic, Mich.
PATRICK, RICHARD S.....314-15 Sellwood Block, Duluth, Minn.
PELLING, WILLIAM F. J., ...Carson Lake, Minn.
PENGILLY, EDWARD .....Crystal Falls, Mich.
PENNIMAN, DWIGHT C.....Clinton Hotel, Minneapolis Minn.
PENTON, JOHN A.....Iron Trade Review, Cleveland, Ohio
PERKINS, SAMUEL J.....Ironwood, Mich.
PETERSON, A. Y.....Chisholm, Minn.
PHILBIN, DONALD M.....408 Sellwood Bldg., Duluth, Minn.
PHILLIPS, W. G.....Calumet, Mich.
PITKIN, S. H.....682 W. Market St., Akron, Ohio
POTTER, OCHA .....Houghton, Mich.
POWELL, D. W.....Marquette, Mich.
PRESCOTT, FRED M.....Oregon St., Milwaukee, Wis.
PRESCOTT, L. L.....Menominee, Mich.
PRYOR, R. C.....Houghton, Mich.
PURSELL, H. E.....Kewanee, Illinois

QUIGLEY, G. J.....Antigo, Wis.
QUINE, JOHN THOMAS.....413 Vine St., Ishpeming, Mich.
QUINN, CLEMENT KRUSE.....Virginia, Minn.

RAHT, CHARLES .....29 Broadway, New York City
RAISKY, F. H.....Ishpeming, Mich.
RALEY, ROBERT J.....Spalding Hotel, Duluth, Minn.
RANKIN, WILLIAM A.....Painesdale, Mich.
RASHLEIGH, WILLIAM J.....Aurora, Minn.
RAYMOND, HENRY A.....Rockefeller Bldg., Cleveland, Ohio
REDFERN, JOHN A.....Hibbing, Minn.
REDNER, A. E.....216 Aurora location, Ironwood, Mich.
REEDER, J. T.....Houghton, Mich.
REEDER, EDWIN C.....1917 Fisher Bldg., Chicago, Ills.
REEDER, J. H.....Houghton, Mich.
REIFUSS, LOUIS I.....LaCrosse, Wis.
REIGART, JOHN R.....Princeton, Mich.
REIFEL, H. T.....Nashwauk, Minn.
REYNOLDS, M. K.....430 E. Arch St., Marquette, Mich.
RICE, CLAUDE T. .....1420 Monadnock Bldg., Chicago, Ills.
RICE, JOHN H.....Houghton, Mich.
RICHARDS, WILLIAM J.....Crystal Falls, Mich.

RICHARDS, MORRIS EARL.....Virginia, Minn.
RICHARDS, WILLIAM J.....Painesdale, Mich.
RICHEY, E. W.....211 Railway Exchange Bldg., Chicago, Ills.
RIDLEY, FREDERICK WILLIAM.....Calumet, Mich.
ROBERTS, HARRY .....Duluth, Minn.
ROBERTS, ALTON T.....Marquette, Mich.
ROBERTSON, HUGH J.....Escanaba, Mich.
ROHN, OSCAR .....Butte, Mont.
ROSE, R. S.....Marquette, Mich.
ROSKILLY, JOSEPH .....Virginia, Minn.
ROUCHLEAU, LOUIS .....Minneapolis, Minn.
ROUGH, JAMES H.....Negaunee, Mich.
ROWE, HENRY .....Ironwood, Mich.
ROWE, WM. C.....Bessemer, Mich.
RUEZ, GEORGE F.....Ishpeming, Mich.
RUMSEY, SPENCER S.....610 Wolvin Bldg., Duluth, Minn.
RUNDLE, A. J.....Iron Mountain, Mich.
RYAN, JOHN A.....Iron Mountain, Mich.

SALSICH, L. R.....Coleraine, Minn.
SCADDEN, FRANK .....Crystal Falls, Mich.
SCHACHT, WILLIAM H.....Painesdale, Mich.
SCHLESINGER H. J.....Milwaukee, Wis.
SCHUBERT, GEORGE P.....Hancock, Mich.
SEAMAN, A. E.....Houghton, Mich.
SEBENIUS, JOHN UNO.....Wolvin Bldg., Duluth, Minn.
SEEBER, R. R.....Winona, Mich.
SEELYE, R. W.....Sault Ste. Marie, Ont.
SELLS, MAX .....Florence, Wis.
SELLWOOD, R. M.....Duluth, Minn.
SENTER, A. W.....Hubbell, Mich.
SHELDEN, R. SKIFF.....Houghton, Mich.
SHELDON, ALBERT F.....112 N. Arch St., Marquette, Mich.
SHERLOCK, THOMAS .....Escanaba, Mich.
SHERRERD, JOHN M.....340 Spring Garden St., Easton, Pa.
SHIELDS, IRVIN J.....Houghton, Mich.
SHOVE, BRIGHAM W.....Ironwood, Mich.
SIEBENTHAL, W. A.....Republic, Mich.
SILL, GEO. A.....504 Marquette Bldg., Chicago, Ills.
SILLIMAN, THOMAS B.....Coleraine, Minn.
SILVER, C. R.....29 W. Lake St., Chicago, Ills.
SIMMONS, CHARLES .....Beacon, Mich.
SKINNER, MORTIMER B.558 560 W. Washington Blvd., Chicago, Ills.
SLINEY, DAVID J.....Ishpeming, Mich.
SMITH, FRED .....Kearsarge, Mich.
SMITH, WILLARD J.....Mohawk, Mich.
SMITH, CARL G.....Kearsarge, Mich.

SMITH, ALFRED L.....Wakefield, Mich.
SMYTH, H. L.....Rotch Bldg., Cambridge, Mass.
SOADY, HARRY .....Duluth, Minn.
SPARKS, BENJAMIN F.....205 Ruby St., Houghton, Mich.
SPERR, F. W.....Houghton, Mich.
STAKEL, CHARLES J.....Ishpeming, Mich.
STANTON, F. McM.....208 5th Ave., New York City
STANTON, J. R.....11 William St., New York City
STEPHENS, JAMES .....Ishpeming, Mich.
STEVENS, THOMAS J.....Ironwood, Mich.
STOEK, H. H.....University of Illinois, Urbana, Ills.
STRONG, CLARENCE G.....Cincinnati, Ohio
SUESS, JOSEPH E.....Negaunee, Mich.
SULLIVAN, A. J.....Chisholm, Minn.
SUTHERLAND, D. E.....Ironwood, Mich.
SWIFT, GEORGE D.....Duluth, Minn.
SWIFT, PAUL D.....Houghton, Mich.

TALBOYS, HENRY H.....717 Providence Bldg., Duluth, Minn.
TANCIG, A.....Hibbing, Minn.
TAPPAN, WILLIAM M.....Hibbing, Minn.
TARR, S. W.....610 Wolvin Bldg., Duluth, Minn.
TAYLOR, JAMES HALL.....Box 485, Chicago, Ills.
THIEMAN EDWARD .....Florence, Wis.
THOMAS, KIRBY .....505 Pearl St., New York City
THOMS, REUBEN KNIGHT.....Ely, Minn.
THOMPSON, CARMI A.....Room 222, G. N. Bldg., St. Paul, Minn.
THOMPSON, G H.....Hibbing, Minn.
THOMPSON, HENRY S.....Beacon, Mich.
THOMPSON, JAMES R.....Ishpeming, Mich.
TOWNSEND, C. V. R.....Negaunee, Mich.
TRAVER, WILBER H.....Fisher Bldg., Chicago, Ills.
TREBILCOCK, JOHN .....Ishpeming, Mich.
TREBILCOCK, WILLIAM .....North Freedom, Wis.
TREPANIER, HENRY .....Iron Mountain, Mich.
TREZONA, CHARLES .....Ely, Minn.
TREVARROW, HENRY .....Negaunee, Mich.
TREVARTHAN, W. J.....Bessemer, Mich.
TRIPP, CHESTER D.....1515 Corn Exchange Bldg., Chicago, Ills.
TRUDGEON, JOHN .....Wakefield, Mich.
TUBBY, CHARLES W.....705 Commerce Bldg., St. Paul, Minn.
TUFTS, JOHN W.....900 Hackett Ave., Milwaukee, Wis.
TURNER, CHAS. N.....Colby-Abbott Bldg., Milwaukee, Wis.

UHLER, FRED WALTER.....Buhl, Minn.
ULRICH, WILLIAM F.....Chisholm, Minn.
UREN, WILLIAM J.....124 College Ave., Houghton, Mich.

VALLAT, BENJAMIN W.....Ironwood, Mich.
VAN DYKE, W. D.....Milwaukee, Wis.
VANDEVENTER, VIVIAN H.....Ishpeming, Mich.
VAN EVERA, JOHN R.....Marquette, Mich.
VAN EVERA, WILBUR .....Virginia, Minn.
VAN MATER, J. A.....55 Wall St., New York City
VAN ORDEN, F. L.....Houghton, Mich.
VILAS, P. M.....425 New York Life Bldg., Minneapolis, Minn.
VILAS, ROYAL L.....Ishpeming, Mich.
VIVIAN, JAMES G.....909 Alworth Bldg., Duluth, Minn.
VOGEL, F. A.....25 Broad St., New York City

WADE, JEPTHA H.....Wade Bldg., Cleveland, Ohio
WAGNER, JOHN M.....Houghton, Mich.
WALKER, ROBERT S.....Fidelity Bldg., Duluth, Minn.
WALKER, ELTON WILLARD .....Mass, Mich.
WALL, JAMES S.....Iron River, Mich.
WALLACE, W. R.....Houghton, Mich.
WALLACE GEORGE .....Marquette, Mich.
WARE, JOHN FRANKLIN.....Forest and Five Oaks Ave., Dayton, O.
WARE, FRED .....Negaunee, Mich.
WARREN, O. B.....Hibbing, Minn.
WARRINER, S. D.....Wilkesbarre, Pa.
WATSON, CHARLES H.....Crystal Falls, Mich.
WEARNE, WILLIAM .....Hibbing, Minn.
WEBB, FRANCIS J. .....812 Fidelity Bldg., Duluth, Minn.
WEBB, WALTER M.....Gilbert, Minn.
WELLS, PEARSON .....Ironwood, Mich.
WENGLER, MATT P.....1055 Cambridge Ave., Milwaukee, Wis.
WESSINGER, W. E.....610 Wolvin Bldg., Duluth, Minn.
WEST, WILLIAM J.....Hibbing, Minn.
WHEELWRIGHT, O. W.....Florence, Wis.
WHITE, WILLIAM .....Virginia, Minn.
WHITE, EDWIN E.....Ishpeming, Mich.
WHITE, J. W.....1905 E. Superior St., Duluth, Minn.
WHITEHEAD, R. G.....Amasa, Mich.
WHITESIDE, DR. JOHN W.....Ironwood, Mich.
WILCOX, LEE L.....Gilbert, Minn.
WILLARD, PAUL D.....Hibbing, Minn.
WILLEY, NORMAN W. .....Hibbing, Minn.
WILKINS, WILLIAM .....Detroit, Mich.
WILLIAMS, THOMAS H.....Ely, Minn.
WILLIAMS, PERCIVAL S.....Ramsay, Mich.
WILLIAMS, DEAN R.....1213 Majestic Bldg, Milwaukee, Wis.
WILSON, EUGENE B.....Scranton, Pa.
WILSON, ARTHUR O.....Hibbing, Minn.
WINCHELL, HORACE V.....505 Palace Bldg., Minneapolis, Minn.

WINTER, JOSEPH H.....Negaunee, Mich.
WITHERBEE, F. S.....Port Henry, New York
WOODBRIDGE, DWIGHT E.....Sellwood Bldg., Duluth, Minn.
WOODWORTH, G. L.....Iron River, Mich.
WOODWORTH, R. B.....427 Carnegie Bldg., Pittsburg, Pa.
WOOLF, PERCIVAL J.....Minneapolis, Minn.
WORDEN, EUCLID P.....571 Summit Ave., Milwaukee, Wis.

YATES, WILLIAM H.....Negaunee, Mich.
YOUNG, H. OLIN .....Ishpeming, Mich.
YOUNGS, FRANK W.....Iron River, Mich.
YOUNGS, G. W.....Iron River, Mich.
YUNGBLUTH, A. J.....Ishpeming, Mich.

ZAPFFE, CARL .....213 Citizens State Bank Bldg., Brainerd, Minn.
ZIMMERMAN, WALTER G.....Duluth, Minn.

DECEASED MEMBERS.

ARMSTRONG, J. F.....1898
BAWDEN, JOHN T.....1899
BENNETT, JAMES H.....
BIRKHEAD, LENNOX 1911
BROOKS, T. B.....1902
BULLOCK, M. C.....1899
COWLING, NICHOLAS ...1910
CONRO, ALBERT 1901
CLEAVES, WILL S.....1910
CHADBOURNE, T. L.....1911
CUMMINGS, GEO. P.....1911
DANIELS, JOHN 1898
DICKENSON, W. E.....1899
DOWNING, W. H.....1906
DUNCAN, JOHN 1904
DUNSTON, THOMAS B.....
GARBERSON, W. R.....1908
HALL, CHAS. H.....1910
HARPER, GEORGE V.....1905
HASELTON, H. S.....1911
HAYDEN, GEORGE 1902
HINTON, FRANCIS 1896
HOLLAND, JAMES 1900
HOLLEY, S. H.....1899
HOUGHTON, JACOB 1903
HYDE, WELCOME .....
JEFFREY, WALTER M..1906
JOCHIM, JOHN W.....1905
KRUSE, JOHN C.....1907
LUSTFIELD, A.....1904
LYON, JOHN B.....1900
MAAS, WM. J.....1911
MARR, GEORGE A.....1905
MILLER, A. M.....1912
MITCHELL, SAMUEL 1908
M'VICHIE, D.....1906
NINESE, EDMUND 1909
OLIVER, HENRY W.....1904
PEARCE, H. A.....1905
PERSONS, GEORGE R....1908
POPE, GRAHAM 1912
ROBERTS, E. S.....
ROWE, JAMES 1911
RYAN, EDWARD 1901
SHEPHARD, AMOS 1905
STANLAKE, JAMES 1910
STANTON, JOHN 1906
STEVENS, HORACE J....1912
STURTEVANT, H. B.....1910
THOMAS, HENRY 1905
TOBIN, JAMES 1912
TREVARTHEN, G. C.....1898
TRUSCOTT, HENRY 1910
VAN DYKE, JOHN H.....1906
WALLACE, JOHN 1898
WHITE, PETER 1908
WHITNEY, J. D.....1894
WILLIAMS, W. H.....1897

LIST OF DECEASED MEMBERS REPORTED SINCE THE ANNUAL MEETING OF 1912.

CLARK, H. S. .....
KOENIG, GEORGE A.....January 14th, 1913.
THOMAS, WILLIAM .....
M'NAMARA, T. .....October 26th, 1912
MINER, A. B.....January 12th, 1913
DEACON, JOHN .....May 15, 1913

LIST OF PAPERS PUBLISHED IN PRECEDING VOLUMES.

1893—Vol. I.

1894—Vol. II.

LIST OF MEETINGS OF THE INSTITUTE AND THEIR LOCALITIES FROM ITS ORGANIZATION TO AUGUST, 1913.

No.	Place.	Date.	Proceedings.
1	Iron Mountain, Mich.	March 22-23, 1893.	Vol. I
2	Houghton, Mich.	March 7-9, 1894.	Vol. II
3	Mesabi and Vermilion Ranges.	March 6-8, 1895.	Vol. III
4	Ishpeming, Mich.	August 18-20, 1896.	Vol. IV
5	Ironwood, Mich.	August 16-18, 1898.	Vol. V
6	Iron Mountain, Mich.	February 6-8, 1900.	Vol. VI
7	Houghton, Mich.	March 5-9, 1901.	Vol. VII
8	Mesabi and Vermilion Ranges.	August 19-21, 1902.	Vol. VIII
9	Ishpeming, Mich.	August 18-20, 1903.	Vol. IX
10	Ironwood, Mich.	August 16-18, 1904.	Vol. X
11	Iron Mountain, Mich.	October 17-19, 1905.	Vol. XI
12	Houghton, Mich.	August 8-10, 1906.	Vol. XII
13	Mesabi and Vermilion Ranges.	June 24-27, 1908.	Vol. XIII
14	Ishpeming, Mich.	August 25-27, 1909.	Vol. XIV
15	Ironwood, Mich.	August 24-26, 1910.	Vol. XV
16	Crystal Falls, Mich.	August 22-24, 1911.	Vol. XVI
17	Houghton, Mich.	August 28-30, 1912.	Vol. XVII
18	Mesabi Range	August 26-30, 1913.	Vol. XVIII

Note—No meetings were held in 1897, 1899 and 1907.

RULES OF THE INSTITUTE.

I.
OBJECTS.

The objects of the Lake Superior Mining Institute are to promote the arts and sciences connected with the economical production of the useful minerals and metals in the Lake Superior region, and the welfare of those employed in these industries, by means of meetings of social intercourse, by excursions, and by the reading and discussion of practical and professional papers, and to circulate, by means of publications among its members the information thus obtained.

II.
MEMBERSHIP.

Any person interested in the objects of the Institute is eligible for membership.

Honorary members not exceeding ten in number, may be .admitted to all the privileges of regular members except to vote. They must be persons eminent in mining or sciences relating thereto.

III.
ELECTION OF MEMBERS.

Each person desirous of becoming a member shall be proposed by at least three members approved by the Council, and elected by ballot at a regular meeting (or by ballot at any time conducted through the mail, as the Council may prescribe), upon receiving three-fourths of the votes cast. Application must be accompanied by fee and dues as provided by Section V.

Each person proposed as an honorary member shall be recommended by at least ten members, approved by the Council, and elected by ballot at a regular meeting, (or by ballot at any time conducted through the mail, as the Council may prescribe), on receiving nine-tenths of the votes cast.

IV.
WITHDRAWAL FROM MEMBERSHIP.

Upon the recommendation of the Council, any member may be stricken from the list and denied the privilege of membership, by the vote of three-fourths of the members present at any regular meeting, due notice having been mailed in writing by the Secretary to him.

V.
DUES.

The membership fee shall be five dollars and the annual dues five dollars, and applications for membership must be accompanied by a remittance of ten dollars; five dollars for such membership fee and five dollars for dues for the first year. Honorary members shall not be liable to dues. Any member not in arrears may become a life member by the payment of fifty dollars at one time, and shall not be liable thereafter to annual dues. Any member in arrears may, at the discretion of the Council, be deprived of the receipt of publications or be stricken from the list of members when in arrears six months; Provided, That he may be restored to membership by the Council on the payment of all arrears, or by re-election after an interval of three years.

VI.
OFFICERS.

There shall be a President, five Vice Presidents, five Managers, a Secretary and a Treasurer, and these Officers shall constitute the Council.

VII.
TERM OF OFFICE.

The President, Secretary and Treasurer shall be elected for one year, and the Vice Presidents and Managers for two years, except that at the first election two Vice Presidents and three Managers shall be elected for only one year. No President, Vice President, or Manager shall be eligible for immediate re-election to the same office at the expiration of the term for which he was elected. The term of office shall continue until the adjournment of the meeting at which their successors are elected.

Vacancies in the Council, whether by death, resignation, or the failure for one year to attend the Council meetings, or to perform the duties of the office, shall be filled by the appointment of the Council, and any person so appointed shall hold office for the remainder of the term for which his predecessor was elected or appointed; Provided, That such appointment shall not render him ineligible at the next election.

VIII.
DUTIES OF OFFICERS.

All the affairs of the Institute shall be managed by the Council except the selection of the place of holding regular meetings.

The dunes of all Officers shall be such as usually pertain to their offices, or may be delegated to them by the Council.

The Council may, in its discretion, require bonds to be given by the Treasurer, and may allow the Secretary such compensation for his services as they deem proper.

At each annual meeting the Council shall make a report of proceedings to the Institute, together with a financial statement.

Five members of the Council shall constitute a quorum; but the Council may appoint an executive committee, business may be transacted at a regularly called meeting of the Council, at which less than a quorum is present, subject to the approval of a majority of the Council, subsequently given in writing to the Secretary and recorded by him with the minutes.

There shall be a meeting of the Council at every regular meeting of the institute and at such other times as they determine.

IX.
ELECTION OF OFFICERS.

Any live members not in arrears, may nominate and present to the Secretary over their signatures, at least thirty days before the annual meeting, the names of such candidates as they may select for offices falling under the rules. The Council, or a committee thereof duly authorized for the purpose, may also make similar nominations. The assent of the nominees shall have been secured in all cases.

No less than two weeks prior to the annual meeting, the Secretary shall mail to all members not in arrears a list of all nomination s made and the number of officers to be voted for in the form of a letter ballot. Each member may vote either by striking from or adding to the names upon the list, leaving names not exceeding in number the officers to be elected, or by preparing a new list, signing the ballot with his name, and either mailing it to the Secretary, or presenting it in person at the annual meeting.

In case nominations are not made thirty days prior to the date of the annual meeting for all the offices becoming vacant under the rules, nominations for such offices may be made at the said meeting by live members, not in arrears, and an election held by a written or printed ballot.

The ballots in either case shall be received and examined by three tellers appointed at the annual meeting by the presiding officer; and the persons who shall have received the greatest number of votes for the several offices shall be declared elected. The ballot shall be destroyed, and a list of the elected officers, certified by the tellers, shall be preserved by the Secretary.

X.
MEETINGS.

The annual meeting of the Institute shall be held at such time as may be designated by the Council. The Institute may at a regular meeting select the place for holding the next regular meeting. If no place is selected by the Institute it shall be done by the Council.

Special meetings may be called whenever the Council may see fit; and the Secretary shall call a special meeting at the written request of twenty or more members. No other business shall be transacted at a special meeting than that for which it was called.

Notices of all meetings shall be mailed to all members at least thirty days in advance, with a statement of the business to be transacted, papers to be read, topics for discussion and excursions proposed.

No vote shall be taken at any meeting on any question not pertaining to the business of conducting the Institute.

Every question that shall properly come before any meeting of the Institute, shall be decided, unless otherwise provided for in these rules, by the votes of a majority of the members then present.

Any member may introduce a stranger to any regular meeting; but the latter shall not take part in the proceedings without the consent of the meeting.

XI.
PAPERS AND PUBLICATIONS.

Any member may read a paper at any regular meeting of the Institute, provided the same shall have been submitted to and approved by the Council, or a committee duly authorized by it for that purpose prior to such meeting. All papers shall become the property of the Institute on their acceptance, and with the discussion thereon, shall subsequently be published for distribution. The number, form and distribution of all publications shall be under the control of the Council.

The Institute is not, as a body, responsible for the statements of facts or opinion advanced in papers or discussion at its meetings, and it is understood, that papers and discussions should not include personalities, or matters relating to politics, or purely to trade.

XII.
SPECIAL COMMITTEES.

The Council is authorized to appoint from time to time special committees to consider and report upon, to the Institute through the Council, such subjects as changes in mining laws, safety devices, the securing and editing of papers on mining methods, definition of mining terms, affiliations with other societies, and such other subjects as the Council shall deem it desirable to inquire into, such reports not to be binding on. the Institute except action is taken by the Institute in accordance with the rules, and the Council is authorized to expend not exceeding six hundred dollars in any one year to carry out the purpose of this section.

XIII.
AMENDMENTS.

These rules may be amended by a two-thirds vote taken by letter ballot in the same manner as is provided for the election of officers by letter ballot; Provided, That written notice of the proposed amendment shall have been given at a previous meeting.

EXCURSIONS.

TUESDAY, AUGUST 26TH, 1913.

The Lake Superior Mining Institute held its Eighteenth Annual Meeting on the Missabe Range, the members assembling at Duluth, most of them arriving there on the morning trains. Headquarters were established at the Spalding Hotel where members and their guests secured tickets and reservations for the trip over the range. The morning was very pleasantly spent in renewing old acquaintances, meeting new ones, and expressions of good fellowship.

The party left Duluth at 2 o'clock on the Steamer "Columbia" to inspect the plant of the Minnesota Steel Company, a subsidiary of the United States Steel Corporation. They found the plant still in the process of construction upon a tract of 1,500 acres with a water frontage of more than two miles along the St. Louis river. It is about nine miles from the center of Duluth. The plant when completed and equipped will, it is said, be the best plant among the many operated by the Steel Corporation. The buildings are of steel frames, enclosed with two-piece concrete blocks, making them absolutely fire-proof. There will be two blast furnaces of 500 tons capacity each, and ten open-hearth furnaces, also ninety Koppers type by-product coke ovens; one 40-inch reversing blooming mill; one 28-inch finishing mill; one 16-inch continuous roughing train. The power is of 10,000 k. w. capacity; five blowing engines, driven by gas, and of 20,000 cubic feet capacity each, and a pumping station of 40,000 gallons daily capacity. There will be also machine and structural shops sufficient to supply the needs of the company. The company is also erecting 175 houses containing 350 apartments for the accommodation of their men and their families. They contemplate building a cement plant, of 4,000 barrels per day capacity, in the near future.

After securing much valuable information from the inspection of this plant the party returned to Duluth, arriving there shortly before 6 o'clock. The evening was very enjoyably spent as guests of the various clubs. The party left in three special trains over the Duluth & Iron Range Railroad at midnight. One of these luxurious trains was composed of ten sleeping and dining cars, the other two of fifteen private cars.

WEDNESDAY, AUGUST 27TH,. 1913.

The first stop was made at Biwabik, which is located on the eastern end of the range. A very interesting inspection of the Biwabik mine was made. This property was the second on the range to mine iron ore. It was opened in 1891, one year after the discovery at Mountain Iron. A part of the ore mined there is of a very hard grade and has to be crushed. The crusher is of the gyratory type. Its capacity is 1,000 tons per hour. It is said to be the largest crusher of this type, having an opening of 48 inches.

The party left Biwabik, in seventy automobiles, for Virginia, where the afternoon and night were spent sight-seeing and visiting. On the road a visit was paid to the Genoa mine, near Eveleth, one of the deep pits of the range. It is so deep that it is no longer profitable to work with steam shovels. Most of the ore is now taken to the surface through two shafts. A stop was also made at the Leonidas. Here many went underground for the purpose of inspecting the concrete pumping station and new pumps. This is the deepest property on the range. They are now mining at a depth of 480 feet.

A very enjoyable dinner of the New England style was served by the people of Eveleth at the new Glode Hotel. After dinner the Norman, Union, and Commodore mines of Virginia were inspected. It is interesting to note that the Norman is the deepest pit on the range, so deep that the steam shovel work has been abandoned. The pit is over 300 feet deep and, owing to the narrowness of the vein and the perpendicular walls of rock, mining operations have been carried on with much difficulty.

The party was next taken to the modern equipped sawmill plant of the Virginia & Rainy Lake Company. This plant consists of three large mills, all within the city limits of Virginia. They have a combined capacity of one million feet of lumber per day. It requires a force of about 1,400 men to operate these mills. The company also has a large force of men employed in the woods getting out logs to supply the mills.

Some of the company who were especially interested in this feature of Missabe mine operations visited the drying plant at the Brunt mine. The ore is brought from the open pit a mile distant and run through the dryers. This process reduces the moisture from 18 to 8 per cent. The plant consists of four dryers and the estimated output for 1913 is 200,000 tons. This plant is operated by the M. A. Hanna Company. A short visit to the concentrating plant at the Madrid mine, of the A. B. Coates group, was made. This plant is described by Benedict Crowell in a paper which is printed in this volume. A map and description of the Commodore mine of the Corrigan, McKinney Company, is published in connection with the paper on “Mining Methods on the Missabe Range.”

Some other properties were visited during the afternoon, and at 4 o'clock a game of base ball between the Virginia and Range teams was greatly enjoyed. A splendid dinner was served by the mining men of Virginia at the new home of the Elks Lodge of that city. The dinner was followed by an excellent musical program. A business session was held in the evening in the high school building.

THURSDAY, AUGUST 28TH, 1913.

The party left Virginia, at 9 o'clock, for Chisholm, where luncheon was served by the citizens at Bergeron Hall. Stops were made en route at the Mountain Iron, Shenango, and Monroe properties. As mentioned above Mountain Iron is the place where the first iron ore on the Missabe Range was discovered. This big pit has shipped over seventeen million tons of iron ore. The Shenango is one of the big open pit mines of the Missabe. It has been worked to considerable depth. The Monroe is not operating. The mine is completely stripped, but no ore has been mined since 1909. The property adjoining the Monroe is now being stripped by the Great Northern Railroad interests, who contemplate operating the mines on the Hill Lands, now under lease to the Oliver Iron Mining company.

The party moved from Chisholm to Hibbing, which is only a few miles, stopping on the way at the Leonard mine. Here the entertainment provided a visit to the Fair grounds where the St. Louis County Fair was being held. Everybody greatly enjoyed the horse races in spite of the fact that recent rains had made the track exceedingly heavy. The exhibit of agricultural produce was exceptionally creditable for such a new country. The Fair was well patronized by people from the adjoining towns and everybody seemed to' be having a good time.

The evening entertainment at Hibbing was given at the Armory. The several city clubs held open-house and the evening was very enjoyably spent.

FRIDAY, AUGUST 29TH, 1913.

About 9 o'clock in the morning the party embarked in flat cars provided with seats, and were taken into the open pits of the Mahoning, Hull-Rust, Burt-Pool, and Sellers. These mines are located in the city of Hibbing. Mining is being done very close to the city streets in several places, and before many years a part of the city will have to be moved to make way for mining. The Hull-Rust is the largest iron property in the world. It has shipped over 20,000,000 tons of ore up to the present time. The mine was first opened in 1896, and there are many million tons now in sight so that mining will be carried on there for many years to come. The extent of the ore body at this point is given as 5 miles in length by 3 or 4 thousand feet in width. A visit was also made to the Buffalo & Susquehanna property. More than 140 feet of over-burden had to be removed before the ore could be mined and shipping commenced. The work was done in record time because of the character of the ground. They found the ore to a depth of 700 feet.

Special trains departed from Hibbing at 10:30 o’clock for Coleraine, on the western end of the Range, where the night was spent and a business meeting held. Stops were made at the Stephenson, Hawkins, Crosby, Hill, Holman, and Canisteo mines. All of these mines do open pit mining although some are also operating with shafts. The Holman and Canisteo mines are very near to Coleraine. Coleraine is one of the best laid-out and finest mining locations in the country. Its location is almost ideal, being on the hills on the shore of Trout Lake.

SATURDAY, AUGUST, 30TH, 1913.

After breakfast Saturday morning the Oliver Iron Mining Company's concentrating plant was visited. Here we saw how the ores from the pits are freed of sand. A large portion of the ore on the Western Missabe range contains a great quantity of sand. This worthless material is washed out in the concentrating plant, thereby bringing the ore to a merchantable grade. The Coleraine plant has a capacity of 20,000 tons daily. This is composed of five units of 4,000 tons each. A paper by John Uno Sebenius, chief engineer for the Oliver Iron Mining Company, describing this plant, appears in another part of this publication.

The inspection of the concentrating plant ended the pleasurable and instructive inspection of the wonderful Missabe Range, so the special trains were again hoarded and the party began the return to Duluth, where they arrived shortly after the noon hour. Most of those who had enjoyed the trip left on evening trains for their homes, all loud in their praises of the entertainment accorded to them by the good people of the Missabe Range. How could they feel otherwise? Brass bands were in atendance in all towns visited and every host seemed to endeavor to outdo every other in the cordial sincerity of their greetings. It is always pleasant to meet old acquaintances and fellow workers of days that are gone. Many of the residents of the newer towns of the Missabe Range were formerly residents and workers in the older fields. There was evidence of progress and improvement on every hand which was remarked by all who had visited the Range on former trips of the Institute. The attendance numbered more than 300.

A booklet, published by the General Committee, contains many views and. much interesting information, compiled and arranged by W. W. J. Croze, mining engineer, Duluth, and is published as an appendix to this volume.

BUSINESS SESSIONS.

The first business meeting was held on Wednesday evening at 8:30 at the Roosevelt High school, in the City of Virginia, President Pentecost Mitchell presiding. Mr. Mitchell, on behalf of the membership from the Minnesota ranges, extended a cordial welcome to the members and guests present.

Papers were presented in the following order:

*Report of Committee on the Practice for the Prevention of Accidents, was, in the absence of the members, read by title. It presented the report of the two« meetings held by the Committee, on March 26th and July 22nd, 1913. The Committee especially advises the adoption of the classification of accidents as used by the United States Bureau of Mines in order that all reports may be uniform. Discussion of this paper should he presented at the next meeting.

The following papers, in the absence of the authors, were read by title:

*Sanitation for Mine Locations, by W. H. Moulton, Ishpeming, Mich.

*Winona Stamp Mill, by R. R. Seeber, Winona, Mich.

*Mining Methods on the Missabe Range, by Willard Bayliss J. S. Lutes and E. D. McNeil, Committee was presented in oral abstract by Messrs. Bayliss and McNeil.

*What Our Neighbors Can Do In Mining Iron Ore, by Dwight E. Woodbridge, Duluth, Minn., was read by the author.

*Safety in the Mines of the Lake Superior Iron Ranges, by Edwin Higgins, Ironwood., Mich., was presented in oral abstract. Discussion is published following paper.

This concluded the reading of papers for the evening.

*Papers distributed in printed form.

The President here introduced Charles E. VanBarneveld, chief of the department of Mines and Metallurgy of the Panama-Pacific International Exposition, 1915, who addressed the meeting as follows:

Someone has aptly called the Panama Canal "the Greatest Liberty I ever taken with nature." The successful completion of this project is due to American enterprise and American engineering skill. The nation is justly proud of this achievement and proposes to celebrate it by holding an International Exposition in San Francisco in 19.15. I wish to lay special emphasis on the word International. Because of its location, the Exposition is often spoken of and more often thought of as California's Exposition. While the majority wish it success and hope to take it in, a great many people do not seem to realize that practically everyone who occupies a position of any responsibility in American professional and industrial life owes some direct thought and attention to this Exposition now.

In a sense California is the host. In a larger sense, however, the Nation is the host. The Nation has issued the call and has invited world-wide participation. Canadian, Australian, Asiatic and South American participation are assured on a large scale. The same may be said of Europe. While two important European Nations have officially declined to participate for the present, there is every reason to feel assured that they will ultimately be well represented.

The citizens of California in preparing for this Exposition have raised 17½ million dollars. This sum is being wisely expended in preparation of the site, in the erection and equipment of the Exposition Palaces and in the maintenance of the Division of Exhibits. The Director of Exhibits and his staff will be in readiness to advise with you, to receive and intelligently display the Nation's contributions towards this celebration. Beyond that, it must be clear to you that the responsibility for a successful Exposition lies with professional and industrial America.

This Exposition will be a record of the history of the world's progress in all the arts and industries. Its exhibits, gathered from all over the world, will tell the casual observer, the student, the thinker by object-lessons instead of by words, what mankind is, does, and seeks to do. It will be a living picture illustrating and interpreting the cold and bare statistics which, without such interpretation, are incomprehensible and meaningless to the average mind. It is therefore the privilege

and duty of each industry to properly represent its activities. Each industry being in turn the host to all others.

The Division of Exhibits is organized into eleven departments, one of which is Mines & Metallurgy. The Palace of Mines is a beautiful building, well located and has about 200,000 square feet of floor space. In addition to exhibiting the World's Natural Mineral Resources, including the Metallics and Non-Metallics, we hope to fully illustrate the technique and the industrial side of Mining and Metallurgy. This can only be done through the hearty co-operation of the profession and the industry.

It has been said that mining operations do not lead themselves readily to exhibition and that the legitimate mine-operator has little commercial incentive to exhibit because he has nothing to advertise, nothing to sell! Fortunately, the mining industry is, in the main, in the hands of public-spirited men, accustomed to taking a large view of things, men who will not allow the lack of commercial incentive, the lack of apparent direct individual benefit, to outweigh the decided indirect, collective benefits to be derived from the right sort of publicity. We hear much of the decadence of prospecting and mining, of the lack of security and stability of mining investments. The miner has suffered greatly from misunderstanding, from public ignorance, and above all from persistent misrepresentation. We all recognize in a general way, the importance of education; it is the greatest remedy for prejudice, superstition, and ignorance; it makes for greater all-around efficiency. A well planned exposition is of incalculable value as an educator of the public mind and no industry is in greater need of this service today than mining. Many important questions in which the miner is vitally interested are pressing for settlement. The public is taking an increasingly active part in forcing these settlements. When not blinded by prejudice and ignorance, the public is essentially fair-minded; it only needs to be educated. You have before you now an opportunity which probably will not recur for a decade to give the public an insight into the importance, the stability, and solidarity of your industry, its legitimate speculative and investment features, your need of capital, of fair treatment, of wise legislation, of public support and co-operation.

Every mining man should see in this Exposition an opportunity for some broadcast sowing. The higher he has risen in his profession, the more important the enterprise he owns, directs or is associated with, the greater will his opportunity be. To approve the sentiment that the industry should be properly represented is only the first step. While the result will be collective, the responsibility is individual. If each man will ask himself, What can I do individually—What can I do to interest my company, my clients—What can I do to interest my superiors, my subordinates, to interest machinery men and those interested in special processes; and having asked and thought, will then set about doing it, we will have a mining and metallurgical exhibit worthy of the industry.

The Lake Superior Districts are justly famed for their copper and iron ore production. From the standpoint of tonnage, scale of operation and engineering practice, this is the iron mining center of the world. The Lake Superior miner of the past generation was the originator and you of the present generation are the perfectors of mining methods which are copied all over the country. The Exposition therefore makes a direct appeal to your individual pride, to your pride of industry, to your state and national pride—in a word, to the best that is in you; your patriotism.

Get together on this proposition, gentlemen, and give us an Exhibit worthy of your branch of the industry which more than any has advanced the settlement, the upbuilding and civilization of this country.

The next order of business was appointing the various special committees. On motions duly made, seconded and carried, the President appointed the following committees, to report at the business session on Friday evening.

COMMITTEE ON NOMINATIONS—Mark Elliott, Virginia, Minn.; Wm. J, Richards, Crystal Falls, Mich.; Peter W. Pascoe, Republic, Mich.; Andre Formis, Ojibway, Mich.; L. M. Hardenburgh, Hurley, Wis.

AUDITING COMMITTEE—Frank B. Goodman, Hurley, Wis.; Max H. Barber, Nashwauk, Minn.; Charles Grabowsky, Virginia, Minn.

COMMITTEE ON RESOLUTIONS—John H. Hearding, Duluth, Minn.; George H. Abeel, Ironwood, Mich.; Wm. H. Johnston, Ishpeming, Mich.

An adjournment was then taken to Friday evening at 8:30 o'clock, at the Village Hall, Coleraine.

BUSINESS SESSION FRIDAY EVENING.

At 8:30 the final business meeting was held. Owing to the inability of President Mitchell to be present, Vice President George H. Abeel presided. The presentation of papers was continued, and were taken up in the following order:

The following papers were read by title:

*Relining No. 2 Hamilton Shaft with Reinforced Dividers, End Plates and Poured Concrete Walls, by S. W. Tarr, Duluth, Minn.

*Suggest ions on the Application of Efficiency Methods to Mining, by C. M. Leonard, Gwinn, Mich.

*The Application of Mining Machines to Underground Mining on the Missabe Range, by H. E. Martin and W. J. Kaiser, Hibbing, Minn.

*Mine Laws, Special Rules and the Prevention of Accidents, by E. B. Wilson, Scranton, Pa. Discussion is published with the paper.

^Concentrating at the Madrid Mine, by Benedict Crowell, Cleveland, Ohio.

Wash Ores in Western Missabe and the Coleraine Washing Plant, by John Uno Sebenius, Duluth, Minn.

Electricity, by William Kelly, Vulcan, Mich. (Title not final.)

Hoist Efficiency, by Frank H. Armstrong, Vulcan, Mich. (Title not final.)

Dry House at East Vulcan Mine, Penn Iron Mining Co., by Floyd L. Burr, Vulcan, Mich.

This completed the reading of Papers and the report of the Council was then presented.

*Papers distributed in printed form

REPORT OF THE COUNCIL.

Secretary's report of Receipts and Disbursements from August 22nd, 1912 to August 18, 1913.

RECEIPTS.

Cash on hand August 22nd, 1912			$5,994 58
Entrance fees for 1912	$ 330 00		
Dues for 1912	2,210 00		
Back dues, 1909	$ 25 00		
Back dues, 1910	70 00		
Back dues, 1911	210 00	305 00	
Advance dues for 1913		55 00	
Sale of Proceedings		31 25	
Proposals for membership		30 00	
Institute pin		4 00	
Houghton meeting proportion of program		127 22	
Total		$3,092 47	
Interest on deposit		205 53	
Total receipts			3,298 00
Grand total			$9,292 00

DISBURSEMENTS.

Stationery and printing	$ 95 00		
Postage	139 06		
Freight and express	23 90		
Exchange	2 15		
Telephone and telegraphing	4 74		
Secretary's salary	750 00		
Stenographic work	60 00		
Total		$1,075 59	
Publishing Proceedings Vol. XVI	1,007 98		
Photographs, maps, etc.	131 31		
Advance papers 1912	191 75		
Programs, etc., 1912	170 72		
Advance papers, 1913, (cuts)	52 37		
Expense Houghton meetings, rent and stenographer	33 50		
Badges for meeting, 1912	81 25		
Committee meetings, traveling expenses	51 96		
Total		$1,720 84	
Total disbursements			2,796 43
Cash on hand August 18th, 1913			6,496 15
Grand total			$9,292 58

MEMBERSHIP.

	1913	1912	1911
Total	518	486	517
Members in good standing	483	437	467
Honorary members	4	4	4
Life members	2	2	2
Members in arrears (2 years)	29	43	44
New members admitted, 1912	71	31	46
New members not qualified	5	4	3
New members added	66	27	43

TREASURER'S REPORT.

Treasurer's Report from August 26th, 1912, to August 18th, 1913:

Cash on hand August 26th, 1912	$5,994.58	
Received from secretary	3,062.47	
Received interest on deposits	205.53	
Paid drafts issued by secretary		$2,796.43
Cash on hand August 18th, 1913		6,466.15
Totals	$9,262.58	$9,262.58

Summary of cash on hand:

As per treasurer's report	$6,466.15
In hands of secretary	30.00
Total as per secretary's report	$6,496.15

The following standing committees were appointed by the Council for the ensuing year:

"PRACTICE FOR THE PREVENTION OF ACCIDENTS."
(Committee to consist of five members.)

C. E. Lawrence, Palatka, Mich., Chairman; D. E. Sutherland, Iron Mountain, Mich.; Wm. Conibear, Ishpeming, Mich.; W. H. Schacht, Painesdale, Mich.; M. H. Godfrey, Virginia, Minn.

"CARE AND HANDLING OF HOISTING ROPES."
(Committee to consist of five members.)

W. A. Cole, Ironwood, Mich., Chairman; O. D. McClure, Ishpeming, Mich.; J. S. Jacka, Crystal Falls, Mich.; W. J. Richards, Painesdale, Mich.; A. Tancig, Hibbing, Minn.

"PAPERS AND PUBLICATIONS."
(Committee to consist of five members.)

Wm. Kelly, Vulcan, Mich., Chairman; J. H. Hearding, Duluth, Minn.; F. W. McNair, Houghton, Mich.; J. E. Jopling, Ishpeming, Mich.; P. S. Williams, Ramsay, Mich.

"BUREAU OF MINES."
(Committee to consist of three members.)

M. M. Duncan, Ishpeming, Mich., Chairman; J. B. Cooper, Hubbell, Mich.; A. J. Yungbluth, Secretary, Ishpeming, Mich.

"BIOGRAPHY."
(Committee to consist of five members.)

J. H. Hearding, Duluth, Minn., Chairman; J. B. Cooper, Hubbell, Mich.; R. A. Douglas, Ironwood, Mich.; M. B. McGee, Crystal Falls Mich.; W. H. Newett, Ishpeming, Mich.

"MINING METHODS ON THE MARQUETTE RANGE."
(Committee to consist of three members to be appointed later.)

Committees to serve until their successors are appointed; each committee to have power to appoint sub-committees as may be deemed necessary.

The following letter and invitation was received from the Committee of Management of the International Engineering Congress, to be held in San Francisco, Sept. 20th to 25th, 1915:

INTERNATIONAL ENGINEERING CONGRESS, 1915,
New York City, N. Y.

To the Secretary of
Lake Superior Mining Institute,
Ishpeming, Mich.

Dear Sir:

On behalf of the Committee of Management of the International Engineering Congress to be held in San Francisco in 1915, we have the honor to enclose herewith a most cordial invitation to the officers and members of your Society to attend and to participate in the proceedings of this Congress.

We would respectfully request that you transmit to your members the information contained in the prelim nary announcement, which is also enclosed and which gives such outline of the Congress as can be furnished at the present time.

Further details relative to the Congress will be sent to you in the near future by the Secretary of the Committee of Management in San Francisco, and we would request that your reply to the invitation and to this, as well as to all future communications relative to the Congress, be addressed to the Executive Officers of the Committee of Management in San Francisco.

Very respectfully yours,

GEO. F. SWAIN, President.
CHAS. WARREN HUNT, Secretary.
American Society of Civil Engineers.

CHAS. F. RAND, President.
BRADLEY STOUGHTON, Secretary.
American Institute of Mining Engineers.

W. F. M. GOSS, President.
CALVIN W. RICE, Secretary.
The American Society of Mechanical Engineers.

RALPH DAVENPORT MERSHON, President.
F. L. HUTCHINSON, Secretary.
American Institute of Electrical Engineers.

ROBERT M. THOMPSON, President.
DANIEL H. COX, Secretary.
The Society of Naval Architects and Marine Engineers.

The American Society of Civil Engineers
The American Institute of Mining Engineers
The American Society of Mechanical Engineers
The American Institute of Electrical Engineers
and
The Society of Naval Architects and Marine Engineers
extend to the officers and members of
THE LAKE SUPERIOR MINING INSTITUTE
a most cordial invitation
to attend and to participate in the proceedings of
The International Engineering Congress
to be held in connection with
The Panama Pacific International Exposition
September twentieth to twenty-fifth
in the year one thousand nine hundred and fifteen
in San Francisco
California

The letter ballot on the resolution presented at the last annual meeting was referred to William Kelly and L. C. Brewer as tellers, who canvassed the vote and presented the following results

Whole number votes cast, 200.

In favor of resolution, 200.

The resolution was accordingly adopted and added to the rules as Rule XII.

On motion, the report of the Council was adopted.

The following proposals for membership have been approved by the Council:

Barr, J. Carroll, General Manager, Pittsburg Steel Ore Co., Crosby, Minn.

Batchelder, B. W., Superintendent Hawkins Mine, Nashwauk, Minn.

Bolles, Fred R., Assistant General Manager, Copper Range R. R., Houghton, Mich.

Burdorf, Harry A., Representative The Lunkenheimer Co., 2316 Garfield Ave., S. Minneapolis, Mann.

Bush, E. G., Diamond Drill Contractor, 909 Alworth Bldg., Duluth, Minn.

Caine, D. T., Local Superintendent, Republic Iron & Steel Co., Duluth, Minn.

Cash, F. H., Local Superintendent, Republic Iron & Steel Co., Kinney, Minn.

Christianson, Peter, Professor of Metallurgy, School of Mines, University of Minnesota, Minneapolis, Minn.

Comstock, Henry, General Superintendent, Witherbee Sherman & Co., Mineville, New York.

Comstock, Ehling H., Professor Mechanics & Mathematics, School of Mines, University of Minnesota, Minneapolis, Minn.

Cook, Charles W., Instructor in Economic Geology, University of Michigan, Economics Bldg., Ann Arbor, Mich.

DeHaas, Nathan G., Wholesale Lumber, Marquette, Mich.

Diehl, Alfred S., Chief Engineer, Oliver Iron Mining Company, Coleraine, Minn.

Donahue. E. J. W., Secretary, Cuyuna-Duluth Iron Company, 416-17 Lonsdale Bldg., Duluth, Minn.

Dow, Herbert W., Sales Manager, Nordberg Mfg. Co., Milwaukee, Wis.

Drake, John M., Superintendent, Meridan Mine, Hibbing, Minn.

Eckstrom, Alexander, J., Mining Engineer, Keewatin, Minn.

Emmons, William H., Director, Minnesota Geological Survey, University of Minnesota, Minneapolis, Minn.

Flannigan, Thomas A., General Superintendent, Republic Iron & Steel Co., Gilbert, Minn.

Foote, George C, Resident Director, Witherbee Sherman & Co., Port Henry, New York.

Forbes, Guy R., Mining Engineer, 329 Hemlock St., Virginia, Minn.

Gaynor, William E., Manager Great Lakes Dredge & Dock Co., Duluth, Minn.

Halloday, Fred H., Superintendent Winston & Dear, Hibbing, Minn.

Hayden, J. Elzey, Mining Engineer, C. C. I. Co., Ishpeming, Mich.

Heim, Harry R., Salesman Westinghouse Elec. Co., 936 Metropolitan Life Bldg., Minneapolis, Minn.

Higgins, Edwin, Mining Engineer, care Bureau of Mines, Iron wood, Mich.

House, Allen C, care M. A. Hanna & Co., Cleveland, Ohio.

Jenks, C. O., General Superintendent, G. N. Ry., Superior, Wis.

Johnson, Harry O., Osterberg & Johnson, Diamond Drill Contractors, Virginia, Minn.

Johnson, Nels, Local Superintendent Republic Iron & Steel Co., Keewatin, Minn.

Johnstone, Orland W., Special Agent Soo Line, Duluth, Minn.

Kieren. Rseph, Master Mechanic, Republic Iron & Steel Co., Gilbert. Minn.

Kurtzman, P. L., Local Superintendent Republic Iron & Steel Co., McKinley, Minn.

Locker, W. H., Treasurer, Cuyuna-Duluth Iron Company, 416 Lonsdale Bldg., Duluth, Minn.

Middlemise Bruce A., Mine Superintendent, Hibbing, Minn.

Mitchell, Harold E., Leonidas, Oliver Iron Mining Company, Eveleth, Minn.

MacKillican, James A., Mining Engineer, Meridan Iron Co.. Hibbing, Minn.

McRandle, William E. R., Superintendent Gale Mine, Bessemer, Mich.

Oberg, Anton C, Chief Engineer, Arthur Iron Mining Co., Hibbing, Minn.

Overpeck, Hollis W., Safety Inspector, Oliver Iron Mining Co., Virginia District, Virginia, Minn.

Pellenz, William F., Jr., Mining Superintendent, Carson Lake, Minn.

Penniman, Dwight C, Representative Central Electric Company, Clinton Hotel, Minneapolis, Minn.

Peterson, A. Y., Assistant General Superintendent, Oliver Iron Mining Co., Chisholm, Minn.

Philbin, Donald M., Charge Great Northern Iron Ore Properties, 408 Sellwood Bldg., Duluth, Minn.

Pursell, H. E., Sales Manager, Kewanee Boiler Co., Kewanee, Illinois.

Redner, A. E., Mining Captain, 216 Aurora Location, Ironwood, Mich.

Reifel, H. T., Superintendent La Rue Mine, Nashwauk, Minn.

Rouchleau, Louis, Mine Owner, West Hotel, Minneapolis, Minn.

Sellwood, R. M., Mining & Banking, Duluth, Minn.

Sheldon, Albert F., Garlock Packing Co., 112 N. Arch St., Marquette, Mich.

Shove, Brigham W., Agent C. N. W., Ry., Ironwood, Mich.

Silliman, Thomas, B., Mining Engineer, Coleraine, Minn.

Stephens, James, Mining Captain, North Lake, R. F. D., Ishpeming, Mich.

Sullivan, A. J., General Superintendent, Oliver Iron Mining Co., Chisholm, Minn.

Talboys, Henry H., Salesman, Ingersoll-Rand Drill Co., 717 Providence Bldg., Duluth, Minn.

Tappan, William M., Mining Superintendent, Hibbing, Minn.

Thomson, Carmi A., General Manager, Great Northern Iron Ore Properties, Room 222, G. N. Bldg., St. Paul, Minn.

Tubby, Charles, W., District Manager, International Steam Pump Co., 703 Commerce Bldg., St. Paul Minn.

Ulrich, William F., Chief Chemist Oliver Iron Mining Company, Chisholm, Minn.

Webb, Walter M., Safety Inspector, Republic Iron & Steel Co., Gilbert, Minn.

White, J. W., Sales Representative, The Jeffrey Mfg. Company, 1905 E. Superior St., Duluth, Minn.

Wilcox, Lee L., Chief Engineer, Republic Iron & Steel Co., Gilbert, Minn.

Willard, Paul D., Mining Engineer, Hibbing, Minn.

Williams, Dean R., Sales Agent, Williams & Wolff, 1213 Majestic Bldg., Milwaukee, Wis.

Wilson, Arthur O., Engineer Susquehanna Mine, Hibbing, Minn.

Woodbridge, Dwight E., Mining Engineer, Sellwood Bldg., Duluth, Minn.

Zimmerman, Walter G., Contracting Manager, American Bridge Co, Duluth, Minn.

On motion the Secretary was instructed to cast the ballot for the election of the applicants to membership.

The Auditing Committee then presented the following report:

Your Committee appointed to examine the books of the Secretary and Treasurer, beg leave to report that we have carefully examined same and find the receipts and expenditures shown therein to be in accordance with the statements of the Secretary and Treasurer for the fiscal year ending August 26th, 1913.

FRANK B. GOODMAN,
MAX H. BARBER,
CHAS. GRABOWSKY.

On motion the report of the Committee was adopted.

REPORT ON COMMITTEE ON NOMINATIONS.

Your Committee on nominations beg leave to submit the following names for officers of the Institute for terms specified

For President (one year):
W. H. Johnston, Ishpeming, Mich.

For Vice Presidents (two years):
C. T. Kruse, Ishpeming, Mich.
Charles K. Lawrence, Palatka, Mich.
Luther C. Brewer, Ironwood, Mich.

For Managers (two years):
W. A. Siebenthal, Republic, Mich.
J. S. Lutes, Biwabik, Minn.

For Manager (one year, to fill vacancy):
S. R. Elliott, Negaunee, Mich.

For Treasurer (one year):
E. W. Hopkins, Commonwealth, Wis.

For Secretary (one year):
A. J. Yungbluth, Ishpeming, Mich.

MARK ELLIOTT,
W. J. RICHARDS,
PETER W. PASCOE,
ANDRE FORMIS,
L. M. HARDENBURGH,
Committee.

On motion the Secretary was instructed to cast the ballot for the election of the officers as submitted by the Committee.

On motion by Robert A. Douglass, the chair appointed the following Committee to escort the newly elected President to the platform: Robert A. Douglass and Pearson Wells. Mr. Johnston, upon being introduced, addressed the meeting as follows:

MR. JOHNSTON:

Mr. President and Members of the Institute: I appreciate what a very great honor you have conferred upon me, for I realize that it is a great honor to be President of the Institute. With this honor also goes a very great responsibility. I am more impressed with this responsibility after the fine program they have given us on this range. This meeting has been one of the most enjoyable I have ever attended. I think we have never had a greater number present than we have at this meeting. I should hesitate somewhat about accepting the responsibility, or the honor, if it were not for the fact that I know the members of the Institute stand so loyally by the President, and that they do everything in their power to make their meetings successful. I also know that I have some friends on the Marquette Range, members of the Institute, who will do everything in their power to make the meeting successful. I thank you for the honor.

The Committee on Resolutions presented the following report which was on motion adopted:

WHEREAS, The Virginia Club, Elks Club of Virginia, Algonquin Club of Hibbing, the Commercial Clubs of Duluth, and the entire Missabe Range have extended to this organization the facilities, conveniences, and what is much more, the greatest possible hospitality;

AND WHEREAS, Many of our friends and associates have contributed most kindly the use of their automobiles for our comfort and pleasure;

AND WHEREAS, Many of the church societies, other organizations and hotels, have given to us most plenteously of their food and good cheer;

AND WHEREAS, The Duluth Commercial Club contributed greatly to our enjoyment in the visit to the Minnesota Steel Plant by boat;

AND WHEREAS, The Duluth, Missabe and Northern Railway, the Duluth and Iron Range Railway, and the Great Northern Railway, and the Mining Companies, have made this trip possible through the use of their tracks and locomotives;

NOW THEREFOR, Be it resolved by the Lake Superior Mining Institute, and particularly by those members attending the 1913 meeting, they being well-fed, well-cared for, and widely traveled, that they extend to each and all of the above mentioned persons, individually and collectively, their sincere and hearty thanks.

J. H. HEARDING,
G H. ABEEL,
W. H. JOHNSTON.
Committee.

This concluded the business sessions of the Eighteenth Annual meeting. The splendid list of papers prepared by the members will make this volume one of the most interesting yet published. The authors are fully entitled to the appreciation so freely expressed by the members for their efforts in contributing to the interest of the meeting.

Before the adjournment was taken the acting President announced that Mr. Sebenius would present some moving pictures of the various features connected with mining on the Missabe range. These consisted in views of the first steps in breaking roads and establishing diamond drilling, mining operations, loading and hauling ore to the docks and loading same into boats. Also the complete operation of getting out the timber used by mines, running logs and delivering same to the mines. This feature of the meeting was novel and most interesting.

The following is a partial list of those in attendance:

Abeel, G. H.....Ironwood, Mich.
Abeel, G. H. Jr..Ironwood, Mich.
Abell, O. J.....Chicago, Ills.
Allen, R. C. .....Lansing, Mich.
Armstrong, F. H. ..Vulcan, Mich.
Atkins, S. E.....Duluth, Minn.

Baldwin, C. K.....Chicago, Ill.
Barber, M. H...Nashwauk, Minn.
Barber, G. S....Bessemer, Mich.
Barney, Joseph .McKinley, Minn.
Barr, J. C.....Riverton, Minn.
Batchelder, B. W. .....
..... Nashwauk, Minn.
Bayliss, Willard..Chisholm, Minn.
Benjamin, F. S....Duluth, Minn.
Bergeat, Prof. A..... .....
..... Koenigsberg, Germany
Bernhardt, F. J....Duluth, Minn.
Binney, Joseph..McKinley, Minn.
Blackburn, R. D..Hancock, Mich.
Bolles, F. R....Houghton, Mich.
Bond, Wm. ....Ironwood, Mich.
Bond, Thomas ..Ironwood, Mich.
Boss, C. M.....Duluth, Minn.
Boyd, A. H.....Denver, Colo.
Brewer, L. C....Ironwood, Mich.
Brewer, Carl.Crystal Falls, Mich.
Brigham, E. D.....Chicago, Ill.
Burdorf, H. A.Minneapolis, Minn.
Bush, E. C.....Duluth, Minn.

Caddy, Thomas...Hibbing, Minn.
Caine, D. S.....Gilbert, Minn.
Campbell, D. H.Iron River, Mich.
Carbis, F..Iron Mountain, Mich.
Carbis,W. J.Iron Mountain, Mich.
Carmichael, Wm..Biwabik, Minn.
Carroll, J. R....Houghton, Mich.
Carroll, Philip..Houghton, Mich.
Cash, F. H.....Kinney, Minn.
Carlton, D. E....Biwabik, Minn.
Chinn, W. P....McKinley, Minn.
Christianson, Peter, ...
..... Minneapolis, Minn.
Clifford, J. M....Escanaba, Mich.
Cole, C. D.....Ishpeming, Mich.
Cole, W. T. ....Ishpeming, Mich.
Cole, T. F.....Duluth, Minn.
Conibear, Wm..Ishpeming, Mich.

Comstock, E. H.....
..... Minneapolis, Minn.
Cook, C. W...Ann Arbor, Mich.
Congdon, W. B....Duluth, Minn.
Congdon, E. C....Duluth, Minn.
Cory, E. N.....Negaunee, Mich.
Coventry, Frank..Hibbing, Minn.
Crosby, Geo. H....Duluth, Minn.

Desrochers, G. E.Houghton, Mich.
Diehl, A. S.....Coleraine, Minn.
Donahue, E. J. W..Duluth, Minn.
Donovan, M. J.....
.....Iron Mountain, Mich.
Dormer, Geo. H...Eveleth, Minn.
Douglas, R A....Ironwood, Mich.
Dow, H. W.....Milwaukee, Wis.
Dudley, H. C.....Duluth, Minn.
Drake, J. M....Keewatin, Minn.

Eaton, Lucien..Ishpeming, Mich.
Eichenberger, R. W..Chicago, Ill.
Elliott, Mark.....Virginia, Minn.
Emmons, W. H.....
..... Minneapolis, Minn.
Erickson, Carl E.Ironwood, Mich.
Estep, H. Cole.....Chicago, Ill.

Fairchild, D. L....Duluth, Minn.
Fay, Joseph ....Marquette, Mich.
Fay, A. H.....Washington, D. C.
Federstrom, J. A.Ironwood, Mich.
Felver, H. C....Houghton, Mich.
Fishwick, E. T..Milwaukee, Wis.
Flannigan, T. A...Gilbert, Minn.
Fodin, N. P....Marquette, Mich.
Forbes, G. R....Virginia, Minn.
Formis, A.....Ojibway, Mich.

Gardner, O. D....Calumet, Mich.
Gaynor, W. E.....Duluth, Minn.
Gish, J. R.....Beaver Dam, Wis.
Godfrey, M. H....Virginia, Minn.
Goodman, F. B....Hurley, Wis.
Goodsell, B. W.....Chicago, Ill.
Goudie, James ..Ironwood, Mich.
Grabowsky, Chas.Virginia, Minn.

Halloday, F. H....Hibbing, Minn.
Harris, S. T....Houghton, Mich.

Harrison, G. E...Hibbing, Minn.
Hart, Wm. C....Hibbing, Minn.
Harvey, W. H....Eveleth, Minn.
Hardenburgh, L. M.....
..... Ironwood, Mich.
Hastings, E. X..Green Bay, Wis.
Hayden, J. E..Ishpeming, Mich.
Hearding, J. H....Duluth, Minn.
Hearn, A. L.....Virginia, Minn.
Heggaton, W. S.Negaunee, Mich.
Heim, H. R...Minneapolis, Minn.
Helps, S. E.....Eveleth, Minn.
Hendrick, C. E..Virginia, Minn.
Heyn, Howard ..Ishpeming, Mich.
Higgins, Edwin..Ironwood, Mich.
Hill, Stacy H.....Duluth, Minn.
Hingston, C. E....Duluth, Minn.
Hoatson, Thomas.Calumet, Mich.
Hocking, R. O....Hibbing, Minn.
Hodge, Richard ..Hibbing, Minn.
Holley, A. B....Virginia, Minn.
House, A. C....Cleveland, Ohio.
Huhtala, John....Palmer, Mich.
Hunner, Earl E....Duluth, Minn.
Huyck, Charles.....Clio, Mich.

Lindberg, J. F....Hibbing, Minn.
Locker, W. H....Duluth, Minn.
Loudenback, C. I...Chicago, Ill.
Lutes, J. S.....Biwabik, Minn.

Mace, R. E.....Duluth, Minn.
Markell, John....Duluth, Minn.
Mars, W. P.....Duluth, Minn.
Martin, E. C.....Chicago, Ill.
Middlemise, B. A.Hibbing, Minn.
Mitchell, H. E....Eveleth, Minn.
Mitchell, R. J....Eveleth, Minn.
Mitchell, Pentecost.Duluth, Minn.
Mitchell, W. A....Chicago, Ill.
Mowatt N. P.....Duluth, Minn.
Murray, Robert ..Hibbing, Minn.
McCord, R. D.....Duluth, Minn.
McDonald, D. B....Duluth, Minn.
McDowell, John..Hibbing, Minn.
McGee, M. B.Crystal Falls, Mich.
McGonagle, W. A...Duluth, Minn.
McLane, John H..Duluth, Minn.
McNamara, T. B.Ironwood, Mich.
McNeil, E. D....Virginia, Minn.
McRandall, W. E.Bessemer, Mich.

Ireland, J. D.....Duluth, Minn.

Jenks, C. O.....Superior, Wis.
Johnson, E. F....Virginia, Minn.
Johnson, H. O..Virginia, Minn.
Johnston, W. H..Ishpeming, Mich.
Johnstone, O. W..Duluth, Minn.
Jory, Wm.....Gwinn, Mich.
Johnson, Nels.. Keewatin, Minn.

Kelly, Wiliam ....Vulcan, Mich.
Kennedy, C. S....Duluth, Minn.
Kieren, Jos. .....Gilbert, Minn.
Kitts, Thos.....Hancock, Mich.
Kleffman, John....Hibbing, Minn.
Knight, R. C....Eveleth, Minn.
Kreiter, J. W.....Duluth, Minn.
Kurtzman, P. L..McKinley, Minn.

LaCroix, M. F..Ishpeming, Mich.
Lane, J. S.....New York, N. Y.
Larochelle, L...Houghton, Mich.
LaRue, W. G.....Duluth, Minn.
Latham, A. M....Virginia, Minn.
Letz, J. F.....Milwaukee, Wis.
Lien, Nels .....Eveleth, Minn.

Quigley, G. J.....Antigo, Wis.
Quine, John T..Ishpeming, Mich.
Quine, Wm.....Ishpeming, Mich.
Quinn, C. K.....Virginia, Minn.

Raisky, F. ....Ishpeming, Mich.
Raley, R. J.....Duluth, Minn.
Redfern, John A..Hibbing, Minn.
Redner, A. E....Ironwood, Mich.
Reifel, H. T....Nashwauk, Minn.
Richards, W. J.....
..... Crystal Falls, Mich.
Richards, M. E..Virginia, Minn.
Richards, John C..Virginia, Minn.
Roberts, Harry ....Duluth, Minn.
Rowe, W. C....Bessemer, Mich.
Rowe, Nathaniel.Ishpeming, Mich.
Rouchleau, L..Minneapolis, Minn.
Rough, J. H....Negaunee, Mich.
Rough, J. H., Jr.Negaunee, Mich.
Rumsey, S. S.....Duluth, Minn.

Salsich, L. R.....Duluth, Minn.
Sampson, John....Ashland, Wis.
Schubert, Geo. P.Hancock, Mich.
Scott, A. J.....Iron River, Mich.
Scott, Harry, M....Chicago, Ill.
Searle, C. E....Milwaukee, Wis.
Sebenius, J. Uno..Duluth, Minn.
Sellwood, R. M....Duluth, Minn.
Sheldon, A. F..Marquette, Mich.
Shove, B. W....Ironwood, Mich.
Silliman, A. P....Hibbing, Minn.
Silliman, T. B....Hibbing, Minn.
Silver, C. R.....Chicago, Ill.
Smith, Bert ....Ironwood, Mich.
Sparks, B. F....Houghton, Mich.
Stakel, C. J....Ishpeming, Mich.
Sutherland, D. E.Ironwood, Mich.
Sullivan, A. J....Chisholm, Minn.
Swain, R. A..Minneapolis, Minn.
Swift, G. D.....Duluth, Minn.

Talboys, H. H....Duluth, Minn.
Taley, D.....Duluth, Minn.
Tancog, A.....Hibbing, Minn.
Tappan, W. M....Hibbing, Minn.
Thompson, G. H..Hibbing, Minn.
Thomson, C. A..St. Paul, Minn.
Traver, W. H.....Chicago, Ill.
Trebilcock, Wm. .....
.....North Freedom, Wis.

Nelson, S. T.....Chicago, Ill.
Newett, Wm. H.Ishpeming, Mich.

Oberg, Anton C..Hibbing, Minn.
Olcott, W. J.....Duluth, Minn.
Orr, F. D.....Duluth, Minn.
Overpeck, H. W..Virginia, Minn.

Parker, E. W..Washington, D. C.
Pascoe, Peter W..Republic, Mich.
Pascoe, P. W., Jr.Republic, Mich.
Pelling, W. T. Jr.Hibbing, Minn.
Pendry, Wm. ....Duluth, Minn.
Penniman, D. C.....
..... Minneapolis, Minn.
Perkins, F. J..Ironwood, Mich.
Peterson, A. Y.....
.....Carson Lake, Minn.
Phillips, W. G....Duluth, Minn.
Philbin, D. M.....Duluth, Minn.
Powell, D. W..Marquette, Mich.
Power, R.....Duluth, Minn.
Prescott, Fred M.Milwaukee, Wis.
Prescott, L. L..Menominee, Mich.
Prince, W. J.....Duluth, Minn.
Pursell, H. E.....Kewanee, Ills.

Trebilcock, J...Ishpeming, Mich.
Trevarrow, H...Negaunee, Mich.
Trevarthan, W. J.....
..... Bessemer, Mich.
Trezona, Charles ...Ely, Minn.
Tubby, C. W....St. Paul, Minn.
Turner, C. N....Milwaukee, Wis.
Tyler, W. E.....Mendota, Ill.

Ulizen, B. A.....Crosby, Minn.
Ulrich, W. F....Chisholm, Minn.

VanBarneveld, Charles E.....
..... San Francisco, Calif.
Vilas, R. L....Ishpeming, Mich.
Vivian, J. G.....Duluth, Minn.
Vogel, F. A....New York, N. Y.

Wall, J. S.....Iron River, Mich.
Ware, W. F....Negaunee, Mich.
Watson, C. H.Crystal Falls, Mich.
Wearne, Wm.....Hibbing, Minn.
Webb, F. J.....Duluth, Minn.
Webb, W. M.....Gilbert, Minn.
Welker, W. F.....Ashland, Wis.
Wells, Pearson..Ironwood, Mich.
West, W. J.....Hibbing, Minn.
Westcott, J. W..Riverton, Minn.
White, J. W.....Duluth, Minn.
White, Wm.....Virginia, Minn.
Whitehead, R. G..Amasa, Mich.
Whitney, J. H....Oshkosh, Wis.
Whitney, A. E....Oshkosh, Wis.
Whiteside, Robert..Duluth, Minn.
Wilcox, L. L.....Gilbert, Minn.
Willard, P. D.....Gilbert, Minn.
Wilson, A. O....Hibbing, Minn.
Williams, T. H.....Ely, Minn.
Williams, P. S....Ramsay, Mich.
Winchell, H. V.Minneapolis, Minn.
Wivell, Wm....Nashwauk, Minn.
Woodbridge, R. M..Duluth, Minn.
Woodbridge, D. E..Duluth, Minn.
Woodworth, G. L.....
..... Iron River, Mich.
Woolf, P. J..Minneapolis, Minn.

Yates, W. H.....Duluth, Minn.
Yungbluth, A. J.Ishpeming, Mich.
Yungbluth, R. O.Ishpeming, Mich.

Ziesing, August.....Chicago, Ill.
Zimmerman, W. G..Duluth, Minn.

PAPERS

REPORT OF COMMITTEE ON THE PRACTICE FOR THE PREVENTION OF ACCIDENTS.

The Committee on the Practice for the Prevention of Accidents met in Ishpeming on March 26th, 1913, and the following members were present: J. E. Jopling, Ishpeming, Chairman; C. E. Lawrence, Iron Mountain; D. E. Sutherland, Ironwood, A. M. Gow, Duluth.

After duly considering the subject and discussing the various suggestions which were made by members of the Committee the following resolutions were adopted:

Uniform Mining Rules—It is thought advisable to collect information of mining rules used in the Lake Superior mining district and to compare the same with those published in the report to the American Mining Congress, American Institute of Mining Engineers and the Mining & Metallurgical Society of America by the Committee on Uniform Mining Laws for Prevention of Mine Accidents, October, 1910, and the proposed form now being prepared by the Bureau of Mines; also that a competent person or persons should be employed under the direction of the Committee to draft a set of rules to be presented to the Lake Superior Mining Institute as a proposed standard, for mines in the Lake Superior district.

Uniform Reports of County Mine Inspectors—It is suggested that the reports of the County Mine Inspectors of Michigan, Wisconsin and Minnesota be standardized; that the reports should cover the calendar year, and that they should include fatal and serious accidents of all mine employes whether surface or underground. In the judgment of the Committee these accidents should be classified according to a uniform system and recorded upon a uniform blank.

Classification of Accidents—It is recommended that investigations be made leading to a uniform classification of accidents for mines in the Lake Superior district.

Reports as to Carrying Out Safety Rules—The Committee recommends the collection of blank forms used for reports to show the carrying out of safety rules adopted, these blank forms to be only such as are used by employes in various departments of the mining companies for their information.

Contagious Diseases—It is the sense of this Committee that more definite action should be taken in the matter of contagious diseases in the different localities, in the form of a rigid quarantine to be established by the health officer.

Physical Examination of Employes—Investigations should be made to find out what is being clone in the matter of physical examination of employes by employers of labor.

Publicity of Mining Rules—It is recommended that suggestions be made as to the dissemination of the Rules for the Prevention of Accidents among employes,

Mine Rescue Car—It is recommended that the Bureau of Mines be requested to send mine rescue car No. 8 to the Mesabi Range at the time of the meeting of the Institute.

It is requested that the Council comment oil the above resolutions, stating whether an appropriation will be made to carry out any of the investigations enumerated above.

The resignation of Mr. Edward Koepel of Beacon Hill, Michigan, was submitted to the Committee. The Committee offers this resignation and suggests that Mr. W. H. Schacht of Painesdale, Michigan, be appointed in his place.

The Committee met for the second time in Ishpeming on July 22nd, 1913, and the following members were present: J. E. Jopling, Ishpeming, Chairman; C. E. Lawrence, Palatka; A. M. Gow, Duluth; W. H. Schacht, Painesdale.

In response to a request to Mr. H. M. Wilson of the Bureau of Mines, Pittsburg, for consultation at this meeting, he sent Mr. Edwin Higgins, District Engineer, United States Bureau of Mines, who was present and gave much valuable assistance and information.

The resolutions adopted at the former meeting were further discussed. Mr. Gow had prepared a series of fifteen charts showing in parallel columns the mining rules adopted by the Cleveland-Cliffs Iron Company, The Inland Steel Company, Pickands, Mather & Company, and the Oliver Iron Mining Co. These fifteen classifications are as follows:

1. Locomotives, Steam Shovels and Cars.
2. Boilers and Boiler Houses.
3. Engine Rooms, Engine Hoists and Signals.
4. Shops, Tools and Machines.
5. Buildings, Headframes and Structures.
6. Open Pits, Tracks, Roads and Test Pits.
7. Standard Signs and Danger Signals.
8. Cages, Skips, Buckets, Ropes, Cables, Hooks, Chains and Sheaves.
9. Shafts, Ladderways, Ladders and Pump Stations.
10. Underground Mining, Timbering and Tramming.
11. Explosives.
12. General Safety Rules and Admonitions.
13. Electrical Rules and Regulations.

14. Medical and Sanitary.

15. Fire Protection and Precautions.

In the printed rules of the different mining companies referred to there is the widest divergence in classification, in number of rules bearing upon a particular subject and in the emphasis placed upon them. Your Committee has therefore found it impossible to frame a code of safety rules to present at the meeting of the Institute for adoption. A committee of mining engineers consisting of Messrs. Ingalls, Channing, Douglas, Finlay and Hammond, framed a proposed code. We would recommend that the Lake Superior Mining Institute appoint a similar committee of operating officials from the copper and iron ranges who shall make a report at the next meeting of the Institute as to the desirability of a uniform code, and shall present such a code for discussion at that time.

We deem it desirable that the safety rules to be adopted should be based upon some classification. We consider it advisable that such a classification should conform to that adopted by the United States Bureau of Mines in collecting statistics of metal mining accidents. This classification appears to us to be thoroughly practical and inasmuch as the mining companies are required to report to this department all accidents in accordance with this classification, we see every reason why we should adopt it for our own reports.

Presented herewith is a copy of the Bureau of Mines classification. Such an arrangement will simplify to a great extent the making of reports to the government by the mining companies.

Owing to the desirability of having uniform reports made by mining companies and by county mine inspectors, it is recommended that the above form of report, except in relation to minor accidents, be adopted by county mine inspectors, thus making their reports uniform with that called for by the Bureau of Mines.

In view of the fact that some county mine inspectors report only on underground accidents while others report on both surface and underground accidents, complications have arisen in the past in comparing the accident reports of the various districts. To improve this condition we recommend that all county mine inspectors make their reports covering both surface and underground. The word “surface” is here meant to include all operations having to do with the actual operation of the mine, excluding all those which are at present covered by factory or mill inspection.

From such information as we are able to obtain we are satisfied that the installation of safety devices and appliances, such as guards, toe-boards, hand rails, etc., is the smaller part of the safety movement. We believe that efficiency in safety can only be attained by education and constant agitation of the subject and the hearty co-operation of the employes with the management. The management, in every case, should show its willingness to do its part in the installation of guards and appliances, but the most efficient work in the cause of safety must be done by methods which will constantly keep before the mind of every employe the fact that upon him rests an individual and personal responsibility. To put it another way, the problem is a psychological and not a mechanical one. We therefore urge that in addition to the installation of guards and appliances that consideration be given to those means and methods, other than mechanical, which will secure the co-operation of the employes in and about the mines.

Your Committee gave consideration to the question of the physical examination of employes and while we believe that good result might be obtained from such procedure, we are not, at this time, prepared to make any definite recommendations whatsoever.

CLASSIFICATION OF ACCIDENTS IN METAL MINES ACCORDING TO THE UNITED STATES BUREAU OF MINES.

Sub Divided Under Following Caption—

KILLED.
SERIOUSLY INJURED. (Broken arm, leg, ribs, or other injury involving loss of 20 or more days' work.)
SLIGHTLY INJURED. (Injury involving loss of more than 1 day's work, but less than 20.)

Underground

1. By fall of rock or ore from roof or wall.
2. By rock or ore while loading at working face.
3. By timber or hand tools.
4. By explosives (includes premature blasts, explosion of misfires, flying pieces from blasts, suffocation by gases from blasts, etc.)
5. By haulage accidents (by mine cars, mine locomotives, breakage of rope, etc.)
6. By falling down chute, winze, raise, or stope.
7. By run of ore from chute or pocket.
8. By drilling accidents (by machine or hand drills.)
9. By electricity (shock or burn.)†
10. By machinery (pumps, hoisting and haulage machinery, etc., not including locomotives or drills.)
11. By mine fires.
12. By suffocation from natural gases.
13. By inrush of water.
14. By stepping on nail.
15. By other causes. (Please list, showing causes.)

Total number killed or injured underground.

Shaft Accidents

16. By falling down shafts.
17. By objects falling down shafts.
18. By breaking of cables.
19. By overwinding.
20. By skip or cage.
21. By other causes. (Please list, showing causes.)

Total number killed or injured by shaft accidents.

Surface Accidents*

(Where surface mining is not performed.)

22. By mine cars or mine locomotives.
23. By railway cars and locomotives.
24. By run or fall of ore in or from ore bins.
25. By falls of persons.

26. By stepping on nail.
27. By hand tools, axes, bars, etc.
28. By electricity.†
29. By machinery.
30. By other causes. (Please list, showing causes.)

Total number killed or injured by surface accidents.

Surface Accidents*

(Where surface mining is performed.)

31. By falls or slides of rock or ore.
32. By explosives (including premature blasts, explosion of misfires, flying pieces from blasts, etc.)
33. By haulage accidents (by cars, locomotives, etc.)
34. By steam shovels.
35. By falls of persons.
36. By falls of derricks, booms, etc.
37. By run or fall of ore in or from ore bins.
38. By machinery (other than locomotives or steam shovels.)
39. By electricity.†
40. By hand tools.
41. By other causes. (Please list, showing causes.)

Total number killed or injured by surface accidents.

Grand total.

*Does not include accidents in ore dressing.

†Please state the voltage of current.

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SANITATION FOR MINE LOCATIONS.

BY W. H. MOULTON, ISHPEMING, MICH.*

Sanitation is the practical application of knowledge and science to the preservation of health. There is no one tiling that more directly affects the successful operation of our mines than the health and well being of the men, and we are now coming to realize that it is a practical as well as a scientific matter. The value of sanitation is being recognized to-day in all brandies of industry as well as in its effect upon a community as a whole. Our higher educational institutions have regular courses in this subject and men are graduated in this branch of engineering.

It is undoubtedly true, that the better living conditions and better physical health make for more satisfactory service. The health of the men may be conserved in many ways which are of practical application around our mines. Much has already been accomplished and due credit should be given to the many companies who have given special consideration to the health of its men.

The old wooden dry, of a comparatively few years ago, is now being replaced by the modern one with ample hot and cold water, individual basins or buckets, lockers for the street and mine clothes, and drying and ventilating systems which effectually take care of the wet clothing of the miner. The plan of suspending the wet clothes by means of a rope or chain, with individual lock, has much to commend it. The shower bath, which is a part of all the modern drys, has made it possible for the men to bathe who have not the proper facilities at home. Their constant use has demonstrated their value.

*Secretary Pension Department, The Cleveland-Cliffs Iron Co.

The introduction of water closets in the drys has not always met with complete success, but in the majority of cases it is working very advantageously and improving the underground conditions.

Dry closets should be placed in every main level and they should be provided in proportion of one to every twenty-five men. These closets should be made of wood or iron of a size to be conveniently handled by two men. They should be taken to the surface and washed out with the hose when emptied. Lime should be kept convenient to the boxes and used regularly. There is no more fruitful source of disease than the human excreta left in the mine workings.

The water that the men drink should have the most careful attention and under no circumstances should the men be permitted to drink water that is not known to be pure. This can only be made possible by furnishing good water so that the men can readily obtain it. The plan of the Oliver Iron Mining Company in providing bubbling fountains, thus doing away with the old dirty drinking cup, is also to be highly commended.

Anything that will lessen those diseases frequent among our miners such as tuberculosis, typhoid, and other contagious or communicable diseases, should be carefully considered. There should be a more rigid quarantine in cases of contagious diseases, and it is desirable that the mining companies cooperate more fully with the health officers and that such regulations be made and enforced that our unenviable record in contagious diseases, especially in diphtheria and scarlet fever may be greatly improved upon.

Owing to the relation that the physicians bear to the mining companies, they may hesitate to suggest things which might appear as criticism of existing conditions or methods of mine management, and should therefore be given full authority to correct undesirable conditions. I believe we would get better results in this matter of sanitation by employing the physicians at a stated added remuneration, to make periodical inspection of the entire properties.

Proper ventilation should be provided in all of our mines which would add to the efficiency of the men and incidentally prolong their lives. Tuberculosis and similar diseases would be less prevalent.

The sanitary condition of the home has a great influence on the lives of the men. What can reasonably be expected of a man living in unhealthful surroundings?

I believe that there is a duty that the mining companies owe to men employed by them and the community in which they live. One of the most efficient ways of fulfilling this obligation is in providing satisfactory homes, with healthful surroundings for the men and their families. Any work of this kind must be wisely done and in such a way that the men will be led to cooperate in it so that there will be no suggestion of paternatism in its methods or manner of inforcement. The importance of providing houses for rental is generally recognized but after the house is provided it is just as essential that its condition not be neglected. We have seen houses with no provision for waste water, which must be thrown out upon the ground. The only good things that may be said of this is that it usually provides a good place for the propagation of fish worms, but it also assists in the propagation of other less desirable things.

The old boxed-in cupboard sink may yet be found which is a place for refuse and vermin, and is so frequently a rotten, dirty, slimy hole. If there are such, let them be torn out.

The drainage around our houses and other properties requires careful attention. Ditches should be dug and kept open even if the boys fill them up, and no stagnant water left to breed mosquitoes and infection.

Garbage and refuse should be deposited in covered receptacles, preferably galvanized iron cans, and where such services are not rendered by the city or village, the companies should provide for its regular collection and disposal not less frequent than once each week. It has been found feasible in some places to have the occupants of the premises purchase the cans, which are supplied at wholesale rates, or through the company at cost, with the understanding that proper collection is assured. Rubbish should not be dumped around promiscuously but deposited in a designated place, collected, and disposed of. Few of the men have time or facilities for economically doing this and if not looked after by the city or the company, it will not be taken care of at all satisfactorily. A refuse burner, costing very little, can be so located as to make the disposal of rubbish a simple matter and comparatively an inexpensive one.

It is desirable in many cases to permit the keeping of a cow of horse but provision should be made for the care of the manure. It should not be allowed to accumulate from month to month but should be removed promptly. It also should be treated with chloride of lime, or with a kerosene carbolic acid mixture.

The companies should encourage the beautifying of home surroundings but it is even more important to see that the sanitary conditions are what they should be. In those localities haying no sewer connections, the question of out-houses is a serious matter. Too often the out-house is set on the ground with no proper receptacle for the human excreta which often spreads over the ground, even if a pit is dug. This is frequently allowed to collect throughout the season thus becoming a menace to the family. Often the houses are more or less open; vermin enters without hindrance; the ever-present disease-carrying fly freely finds access, goes from there to the house, feeds on the baby, and has even been known to be on the household food. We have just begun to appreciate the danger from these pests. The companies which have already set us an example in their campaign against the fly should he congratulated, and it should also stimulate the rest of us to make an equal effort. These out-houses should be provided with a proper receptacle which should be emptied at regular and not too separate intervals, and properly cleaned. Either earth, slaked lime or chloride of lime should be constantly used.

Much good can be accomplished by the teaching of sanitation in the public and parochial schools. Some of us may be too old to take kindly to the need of sanitary precautions but it is not too much to expect that the young may be taught to look on these matters as important and to a considerable degree help to improve conditions.

The value of the physical inspection of school children is only just beginning to be appreciated. It should be in effect in all of our communities. It is a health precaution of great merit.

The most efficient agency in extending the benefit of this work of sanitation is the Visiting or Public Health Nurse. A number of mining companies in the Lake Superior region have already introduced this service with much success. No other person can have the same opportunity of reaching the homes and the members of the families and assisting in the understanding of the

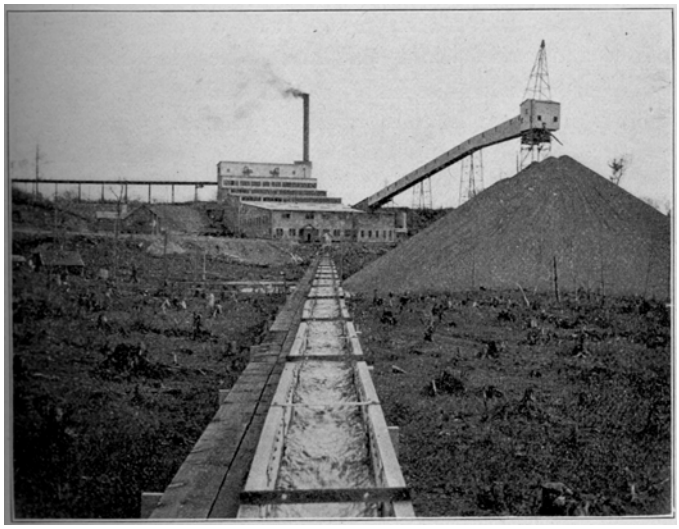
benefits to be derived from fresh air, cleanliness and other sanitary precautions. The importance of fresh air cannot be emphasized too strongly.

The advantage of all this is a better home life, the prevention of serious contagion, and the men in better condition for work. Anything that tends to the more regular work of the men is well worth consideration.

The mining companies of the Lake Superior region are to be commended for the work that has been done for the men, their families, and the communities in which their operations are conducted, but with this commendation must come the realization that there is still much to be accomplished. This can best be done by makng some one person directly responsible for the execution of the plans and methods of sanitation authorized by the mine manager.

WINONA STAMP-MILL.*

BY R. R. SEEBER, WINONA, MICH.



Winona Stamp Mill

From October, 1906, to November, 1907, the Winona mine shipped rock from one shaft to the Adventure stamp-mill. This rock showed a total copper content of about twenty pounds per ton stamped. A large part of the contained copper was fine or flaky, making extraction very difficult. Only a trifle over thirteen pounds per ton stamped was discovered during this period. With such a low grade ore, it was obviously necessary to practice every economy if a profit was to be obtained. The transportation cost per ton stamped was 17.5 cents during this period, or considerably over one cent per pound on the copper obtained. If a stamp-mill were to be built on the mine location without otherwise increasing operating expenses evidently a large proportion of this expense might be eliminated.

*Winona Copper Company, Winona, Michigan.

There are two principal reasons for the location of stamp, mills away from the mine, namely: To provide ample water for washing and to provide room for disposal of tailings. To meet the water requirement, with the mill on the mine at Winona, a dam across the Sleeping river was necessary. For a two-head mill it would also be necessary icy use at least 50 per cent of the water over and over as the stream flow is only about 3,000,000 gals, per 24 hours.

To meet the sand room requirements, some de-watering device and sand-stacking equipment would be necessary.

After considerable study it was decided that these requirements could be met without prohibitive first cost or undue operating expense and work on a two-head mill was begun May 22d, 1909.

The location chosen was a hillside between No. 4 shaft, Winona, and No. 1 shaft, King Philip. On the line of the stamp heads pipes were driven which, when stopped, indicated a layer of hard material at a depth of 40 feet below the intended plane of the stamp base. On this material the concrete foundation of each stamp head was expected to rest. This foundation is cylindrical. A steel caisson, 15 ft. in diameter, was weighted with a concrete ring 3 ft. thick and sunk as a drop shaft. When the expected layer of hard material was reached it was found to be thin and to be underlain by at least 80 ft. of sand, some of which was wet. Sinking was therefore continued until a sufficiently hard layer of material was encountered at about 55 ft. below the intended plane of the stamp base. The concrete ring was blocked up and a mushroom foot of concrete built in, as shown in the drawing, Fig. 3. The top 7 ft. of the caisson and concrete foundation was made 22 ft. in diameter in order to accommodate the 16-ft. square base for the head casting. The castings below the rock (from mortar down) weigh about 80 tons. The total weight of the stamp is about 115 tons. When sinking the 15-ft. caisson it was found that 43 ft. of concrete ring would be held up by the friction of the sand against the outer surface of the steel shell. Including the 7 feet of 22-ft. ring, this skin friction would care for at least 400 tons of total weight of about 1,050 tons to be supported, (935 tons foundation; 115 tons stamp), leaving 650 tons to be supported on the sand under the 20-ft. ring, 203 square ft. and the 20-ft. diameter base (314 square ft.) or a load of a little over 1.25 tons per square ft. on the total area of 517 square it.

Velocity cards of the stamps show a blow of from 24 to 33-ft. tons. This is partly absorbed in crushing rock. As a foundation to assist in absorbing the balance there are supplied 80 tons of cast iron and 930 tons of concrete. After two years of use, no settling of foundations is in evidence and I am inclined to the belief that the foundations are much larger than is necessary. The concrete for all purposes was supplied from a central mixing station using a Smith mixer of one-half yd. capacity. Sand and crushed rock were dumped from a temporary track and trestle into temporary bins above the mixer. Rock was first run into the hopper up to a mark, then sand. Cement from sacks was emptied on

top and the charge dumped into the mixer. The mixed charge was emptied into two-wheeled, steel-concrete buggies, wheeled over runways and dumped into the forms. Two of the steel rock bins were used for storing sand and rock for floors and other concrete work, placed after the erection of most of the steel.

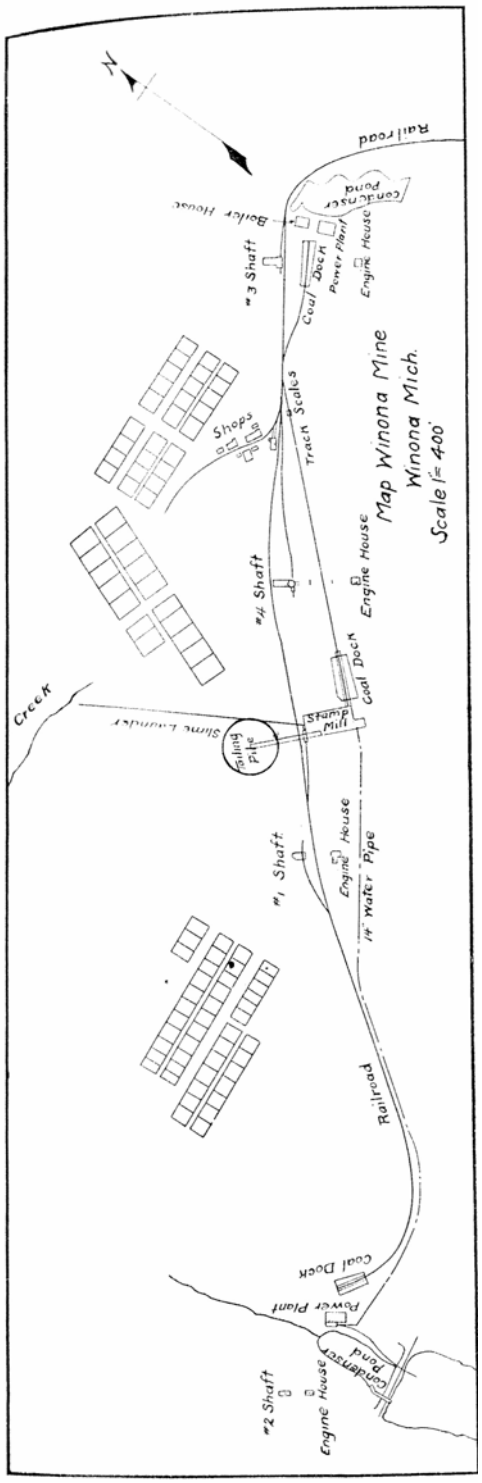


Fig. 1

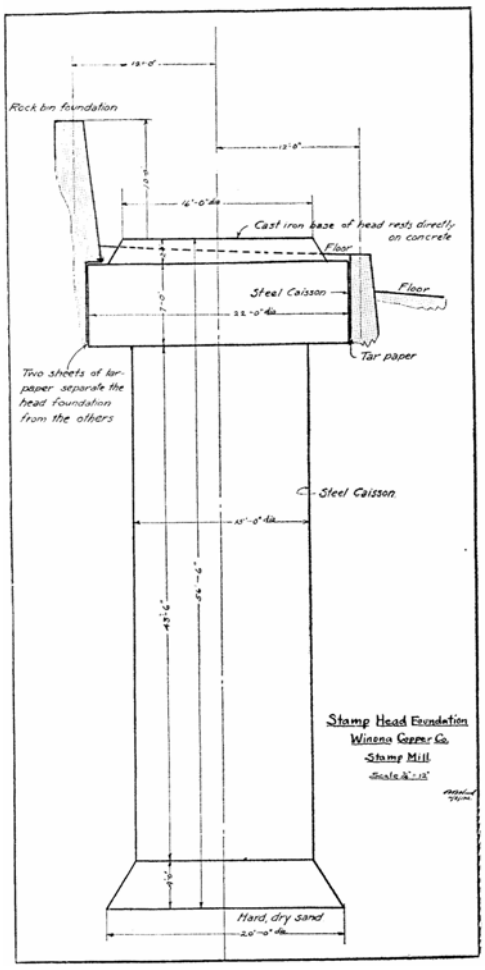


Fig. 3

Foundation walls were all of concrete, of a 1:3:5 mixture; all walls stand on dry, hard sand. The bin foundation walls were separated from the stamp foundations by tarred paper in order that any settling of the latter need not disturb the building foundations. The octagonal foundations for the rock bins were tied together, to a certain extent, by old wire cable.

The detailed construction of the concrete settling tanks is best shown in Photo “B,” and drawings, Figs. 4 and 5. Under the slime department floors eight tanks were built for settling the slimes and decanting the dirty water, to be re-used in the mill. These tanks are 46 ft. long by 24 ft. wide, and 14 ft deep. The walls are 14 to 24 in. thick and are reinforced by vertical iron rods three-quarter in. in diameter, bent at the bottoms to make the joint into the floor.

It was very difficult to place and tamp the concrete about these rods, but the walls when completed showed but a few small leaks which were easily stopped and give no trouble in operation.

The steel structure was made and erected by the Wisconsin Bridge & Iron Company. In general arrangement, it is the same as the usual copper country mill. Circular steel rock bins are used, two supplying each head, the openings being run together high up the sides thus allowing a large proportion of the contents to

run out freely. The storage capacity of four bins is about 525 tons, or sufficient to last over night.

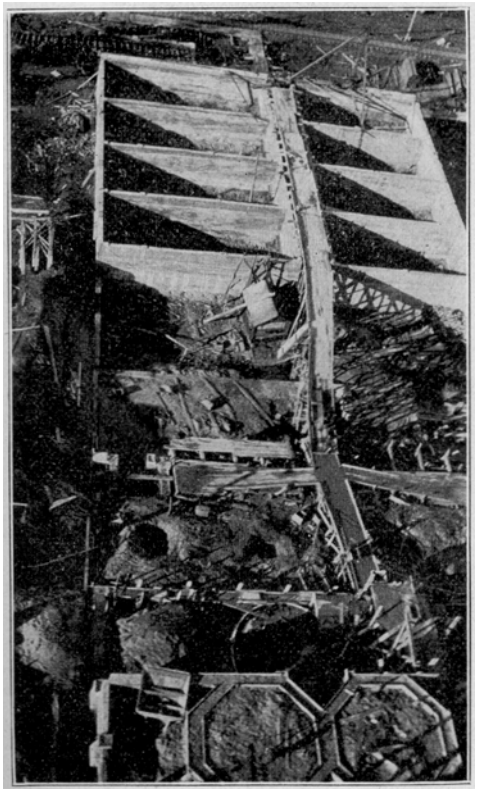


Photo B

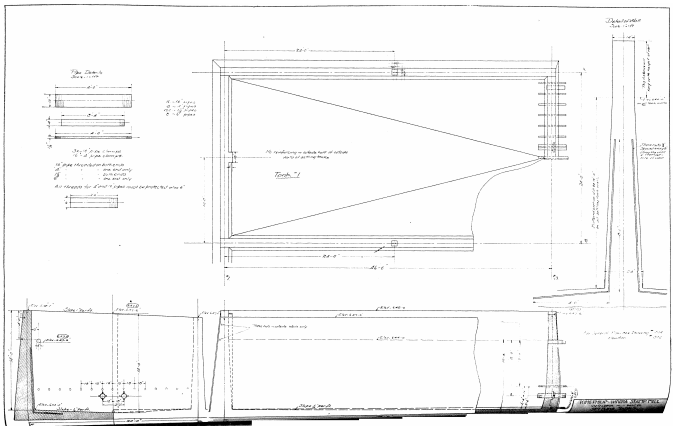


Fig. 4

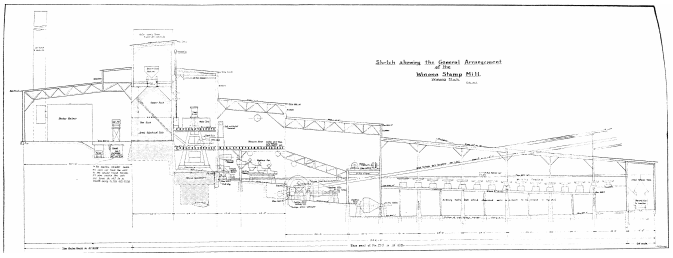
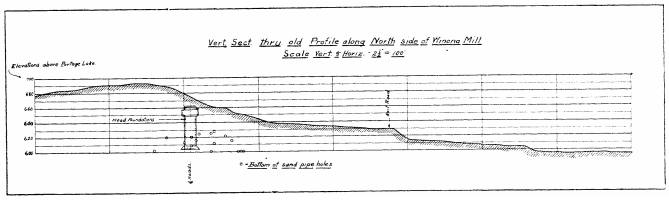


Fig. 5



Vertical Section Through Profile Along the North Side of Winona Stamp Mill.

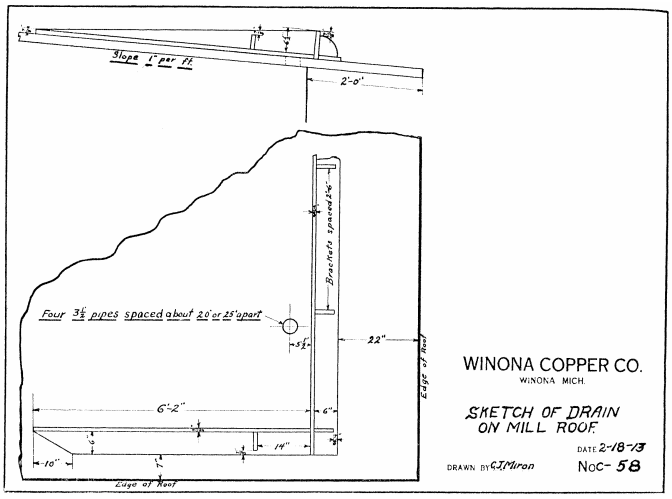


Fig. 10

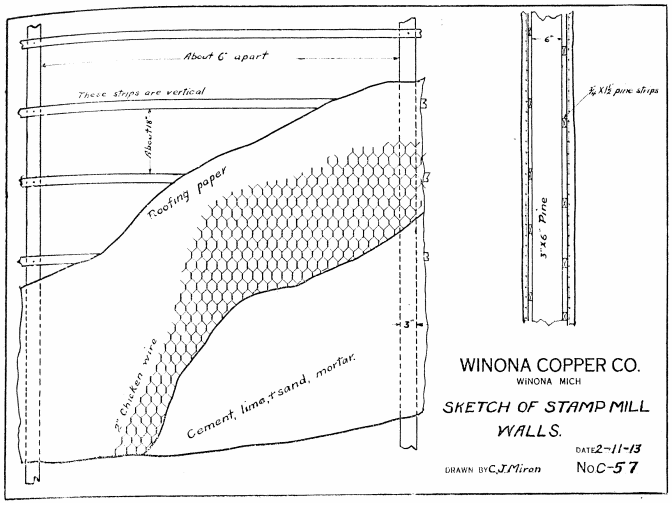


Fig. 8

Instead of a trolley beam over the stamps a light crane beam was installed. This has proved very convenient in operating as well as during erection. This crane also handles all roll parts, etc.

Over the slime department, at right angles to the line of the stamps, it was impossible to get in the usual step form of roof in a manner to allow sufficient light. Skylights of wire-glass were therefore tried and have proved satisfactory although snow sometimes accumulates over them. The roof is the usual form of matched flooring but is covered with Brooks' 4-ply asbestos roofing, in sheets about 3 ft. by 7 ft. During the first winter much trouble was experienced with ice on the eaves. As snow melts over the main body of the warm

roofs the water runs down until it strikes the eaves, which are cold. It there freezes and makes a dam of ice which backs the water up until it runs through some opening or freezes and adds to the ice already formed. Immense icicles were sometimes formed down the sides of the building to the ground. This trouble has been entirely overcome by building wooden dams just back of the line of the eaves on each step of roof. These dams slope to holes in the roof leading to a piping system inside the mill which carries off the water. The warm air from the interior keeps these pipes free from ice, and as fast as snow melts it runs off the roof. This scheme was copied from a similar one at the Calumet & Hecla mills but I have seen no description of it in print.

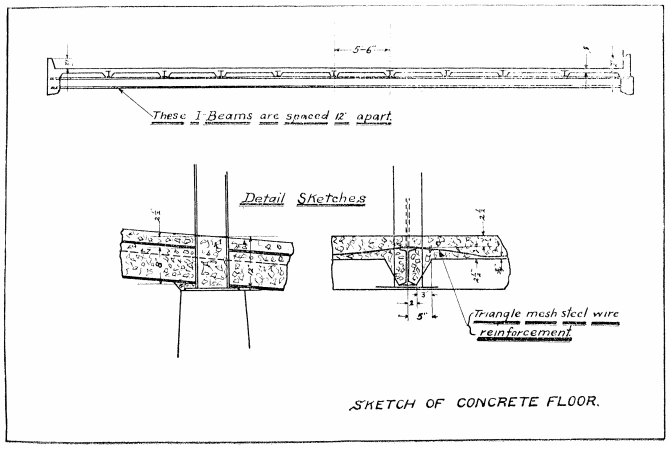
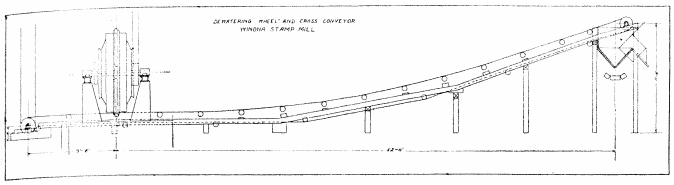


Fig. 9

The main slime department floor over the top of the settling tanks is made of concrete reinforced with triangle-mesh wire. The outside walls of the building are formed by a thick coat of cement plaster on a chicken-wire reinforcement. The inside face of the wall is made in the same manner, which leaves a good air space in the wall. The mortar is made of cement, sand, and a little lime. A detailed sketch is shown in Figs. 8 and 9.

The bins for storing mineral are in the bottom of the mill, over a spur from the railroad. They are made of steel and have 10 compartments, each of 200 cu. ft. capacity. A narrow-gauge track runs along one side of the mill and across it, back of the jigs. Headings and No. 1 mineral from the jigs are emptied directly into cars running on this track. Settling bins for finer grades of mineral are situated above this track, on the head foundation level. All the finer grades of mineral are pumped back to these bins from the various settling boxes of tables and jigs and excess water is allowed to drain off. When comparatively dry, this mineral is dumped into the mineral car, and trammed over a track scale at the lower end of the mill and dumped into the bins over the railroad track. All mineral is shipped in steel mineral cars belonging to the Copper Range Railroad Company.

Rough tailings from the tails of the jigs are de-watered by a large wheel and fed to a cross conveyor which discharges over the main conveyor running the long way of the mill. This main conveyor operates within a steel bridge supported on three steel towers and, when dumping, reaches a maximum heighth of 84 ft. above the track level at the bottom of the mill and 123 ft. above the ground. The conveyor is of the usual Robins type with troughing idlers on a 30 degree angle. The belt is balata, 20 in. wide. It has been in operation since March, 1911, and apparently has a long time yet to run before needing replacement. The conveyor is inclined 1¾ in. per ft., or 8 deg. 18 min.



De-watering Wheel and Cross Conveyor, Winona Stamp Mill.

A slime launder of steel extends 1,200 ft. below the mill. This has a semi-circular bottom, with straight sides. We are now, (March, 1913) putting in the first steel liners. The wear is only around the rivet heads where eddy-currents are set up. This launder slopes ¼ of an in. to the ft. and carries all the slime material. It empties into a ravine which joins the main river at a distance of about a mile and a half from die mill but on land belonging to the Winona Copper Company. If necessary, at any time in the future, a dam could lie built across the river at this point and water pumped back to the mill.

A circular steel bin that can hold about four cars of coarse sand is situated over the track to the mineral bin. This can be filled from a separate belt conveyor parallel to the main conveyor and, during the summer months, much of the coarse sand is sold for concrete work and for railroad ballast.

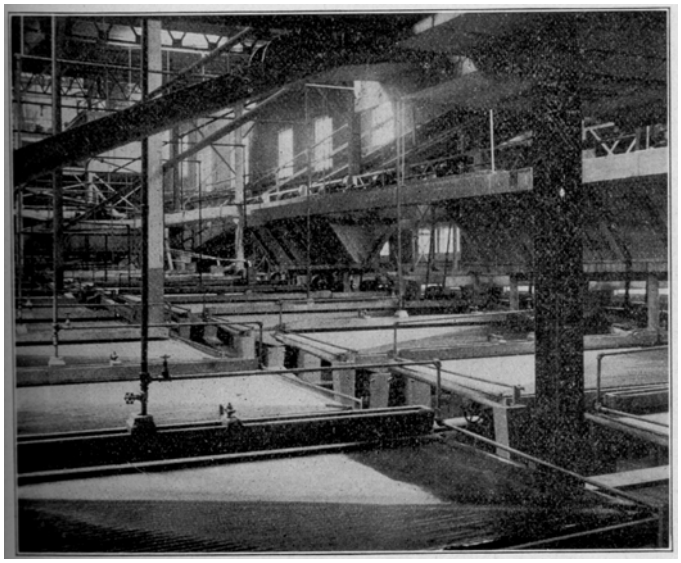
The main trestle to the rock bins is used as a coal trestle. The coal plat is 30 ft. below the base of the rail. The floor is of concrete, about 4 in. thick. The usual coal adit under the main trestle is also made from concrete. The storage capacity of the plat is about 6,000 tons. The trestle is of steel. The coal adit enters the boiler house at the same elevation as the ash adit in front of the boilers. An electric elevator elevates the car with ashes to an ash trestle and the car with coal to a trestle 8 ft. above the floor and running parallel to the boiler front. The coal supply is clumped on the floor and the boilers are fired by hand. The stack is of steel, brick lined. It is 150 ft. high and 6 ft. in diameter. The boilers were made by Parker, of Philadelphia. They are three in number, each 268 horsepower and are set in brick. They are equipped with Andrews' shaking grates, draft regulators and feedwater regulators.

The assay office is near the railroad at the bottom of the mill. It is supplied with the usual equipment for both lire and electrolytic assaying. A motor generator supplies the storage batteries for electrolytic work. A Tirrill gasolene gas plant supplies the gas.

A dam for the main water supply of the mill is situated on the Sleeping river, about 3,900 ft. from the mill. It is 440 ft. long and 27 ft. high. The width, of the bank on top is

.15 ft. The slope on the water side is 2 to 1 and on the down stream side is 2½ to 1. The spillway is 7 ft. wide and 8 ft. deep from the top of the concrete core wall. With all flash boards out of the spillway, the storage capacity of the dam is about 77,000,000 gals. Its volume is just about doubled by 5 ft. of flash boards. The core wall of the dam is concrete, 12 in. thick at the top and as much as 6 ft. at the very bottom. The sand fill was made mostly by the hydraulic process, a pump on the stream supplying water for washing sand from the banks. Both slopes are riprapped with coarse rock from the mine. A sheet steel intake 4 ft. square with a screen underneath, was first used but quickly became clogged with leaves, etc. A straight pipe 18 in. in diameter, the periphery filled with 1½ in. holes and rising above the highwater level, was then tried. This has given no trouble beyond catching in the ice once as the water level dropped.

The main pump is situated in a compressor house on the river bank. The pump was made by the Laidlaw-Dunn-Gordon Company. It has water cylinders 11¼ by 24 in. and steam cylinders 12 and 25 by 24 in. stroke. The cooling water for condensation is furnished by the main suction of the pump. Water enters the suction under a head of 5 pounds. Steam pressure is 200 pounds. The pumping capacity, at 67½ revolutions per minute, is 4,000,000 gals. per 24 hours.

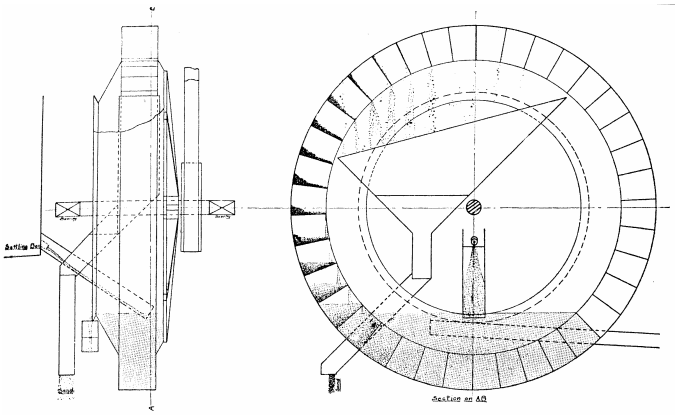


Interior of Winona Mill

The pipe line connecting the pump to the surge tank on top of the stamp-mill is spiral-riveted double galvanized pipe, with bolted points and rubber gaskets. The pressure at the pump is 80 pounds per square in. with the pump running. We have ruptured several lengths of this pipe, the rupture cutting clear across the steel. This was probably due to flaws in the steel. The joints have not given trouble. The pipe is 14 in. in diameter and 3,900 ft. long. The surge tank on top of the mill supplies pressure for fire lines. All piping for the mill is direct from this tank.

The steam stamps were made by the Allis-Chalmers Company. One is a simple stamp with a cylinder 24 in. dia. by 25 in. stroke and the other a compound with cylinders 16 and 32 in. dia. by 25 in. stroke. Both stamps have piston valves and only two eccentrics. The high-pressure cylinder of the compound stamp is on top and is removed bodily by the crane, if necessary to inspect the low-pressure cylinder or the piston. The rolls are of the rigid type and were made by the Allis-Chalmers Company. Four trammels are used instead of two.

The jigs are of the Woodbury system. One bull jig is used for the oversize and four four-compartment sets per head for the material through the trommels. Owing to the small percentage of No. 1 copper (medium-sized pieces) contained in the Winona rock, these jigs do not seem well adapted to the purpose. They do make an excellent separation of slimes for table treatment and provide a middling feed for regrinding mills. The jigs are supported on iron brackets instead of the usual timber supports. This makes it easier to get under the machines for adjustment and repairs and for washing floors.



Dewatering Wheel.

Fig. 11.

The principal machine developed for the operation of this mill is the de-watering wheel. As it is necessary to re-use the water, the tailings had to be separated from it. The water carrying the tails of the jigs is comparatively free from slime so that it is kept separate as “clear water” and re-used as wash water. The first de-watering device tried consisted of a screen tacked on a cylindrical frame which revolved slowly. The tails were drawn through spigots onto the outside of this screen the water falling through and the coarse material going over with the screen on to the cross conveyor belt. This scheme was not satisfactory as the spigots required a great-deal of attention, having a tendency to either clog or to run water as the feed varied. An 8-ft. wheel along the lines of the present wheel was then developed. This worked well but the 12-ft. diameter wheel now used gives more room for launders, etc., and takes care of two heads. As shown by the drawing, Fig. 11, the de-watering wheel consists of a sheet steel water-tight wheel with radial partitions along the periphery forming pockets in which

the sand is caught and lifted out of the water and discharged at the top of the wheel over an apron on to the belt conveyor. The sand is run from settling tanks through spigots into the bottom of the wheel. The water overflowing from the wheel is carried to the settling tanks and re-used.

The sand conveyor problem gave some little trouble before it was satisfactorily solved. The first cross conveyor used delivered sand to a bucket elevator which persisted in clogging and otherwise causing trouble. This was removed and the cross conveyor curved up to deliver directly to the main conveyor. Some trouble was experienced with the belts getting out of line but this was gradually eliminated until the sand conveyor equipment now has no special attendant. As a large pile of sand was piled up around the last tower of the sand conveyor the ground began to bulge up around the edge of the pile. Settlement of the outside tower came with this movement and finally caused shearing of rivets on the upper side of the conveyor bridge over the middle tower. These rivets were then cut out and bolts in slots substituted. A pin joint was placed in the bottom of the truss. This allowed for about 2 ft. of settlement in the outer tower. The settling continued until it became necessary to cut the conveyor house free from the outside tower. The conveyor bridge is now supported at the far end on blocking and jacks from the steel of the tower embedded in the sandpile. If settlement continues, the conveyor bridge will be jacked up to keep pace. As the sand accumulates the conveyor will be extended and supported on the sand. As regrinding increases the amount of coarse sand to be stacked will decrease.

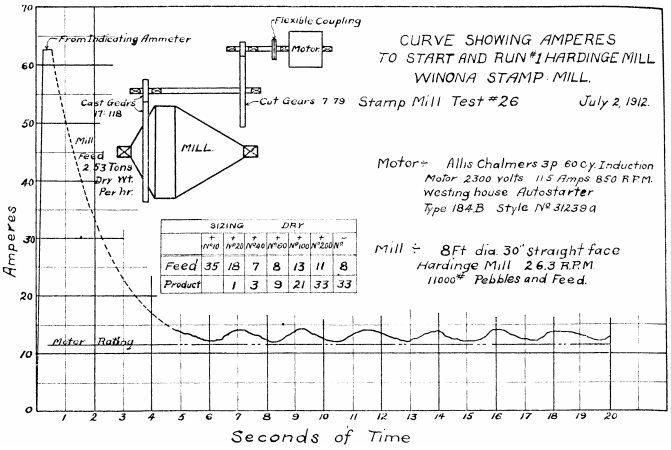


Fig. 12

Milling was started with one 8 by 30 in. Hardinge conical mill. During 1912 two more were installed, one a 6-ft. by 60-in. straight face and the other an 8-ft. by 18-in. straight face. For one period of January, 1912, no mill was at work. For most of the first six months two mills were in operation and for the last six months three mills were in operation. During the year about 36,000 tons of material was reground.

This figure is of course not exact but from several tests and records of time, etc., I feel sure that it is very nearly right. From the reground material 215,248 pounds of refined copper was produced. The grade of this mineral will average better than 50 per cent. The total cost of regrinding during the year was $9,697.09 or 26.93 cents per ton reground, and 4.5 cents per pound of copper recovered. With electricity costing 1.2 cents per k. w. hour, the power cost was $7,501.97 of the above total amount. Labor was $402.85 and supplies cost $1,792.27. Of the supplies, $1,235.80 was for 172,030 pounds of French pebbles and $280.68 for 19,342 pounds of silex lining. The balance was for oil and supplies incidental to repairs. The pebble loss figures nearly five pounds per ton reground as it includes the initial charge for two new mills. The pebble loss is now running a trifle under four pounds per ton reground, which is higher than usual in this district on account of the hardness of the rock.

COSTS OF GRINDING 36,000 TONS.

	Total.	Per ton Reground.	Per cent.	Units per ton Ground.
Power 1.2c per k. w. hr.	$7,501.97	20.84c	77.36	17.415 k. w. hrs.
Labor	402.85	1.12	4.15	
Supplies—				
.7184c per lb. pebbles	1,235.80	3.43	12.74	4.78 lb. pebbles
1.4512c per lb. lining	280.69	.77	2.90	.537 lb. lining
Incidentals	275.78	.77	2.85	
	$9,697.09	26.93c	100.00	

The 8-ft. diameter by 30-in. straight face mill has proved the most economical in power cost per ton ground and also has the largest capacity of any we have tried. We are now installing three more 8-ft. mills which have a 36 in. straight face and we expect still greater capacity. These mills have Falk's cut herringbone gears and there is only one speed reduction, which will materially reduce the power cost. The first mill installed has a silex lining but the subsequent mills are lined on the straight face with pebbles set in grooves in steel plates. The conical faces are lined with silex blocks. Steel pebble linings have proved very satisfactory. A mill is out of service at last four days to replace silex lining as the cement must be allowed to set. With a steel pebble lining the mill can go into service again as soon as new plates are placed, a matter of hours only. So far, our experience shows that the steel pebble linings are cheapest. All our new mills will be equipped with the steel pebble linings on the cones as well as the straight faces. The mill is lighted at night, principally, by 100 candle power series Tungsten incandescent lamps on a 6.6 ampere constant current. These have been found satisfactory, the life of the lamps running above 2,000 hours.

A small lathe, drill press and power shear for cutting plate are the only power tools in the stamp mill as the mine shop is equipped for handling all other work. The detailed flowsheet of water and material give, I believe, full information as to the manner of handling and method of operation.

The water re-used in the mill is pumped back by two separate pumps, one for the dirty water and one for the clear water. These are both centrifugal pumps, direct connected to electric motors, the "clear" water pump having a capacity of 4,000.000 gallons and the "dirty" water pump a capacity of 3,000,000 gallons. Both are

regulated to suit conditions by throttling of discharge. Sand from both the "clear" and "dirty" water is simply spigoted out of the bottom of the settling tanks while the pumps are drawing from the upper part of these tanks. Following is a list of motors:

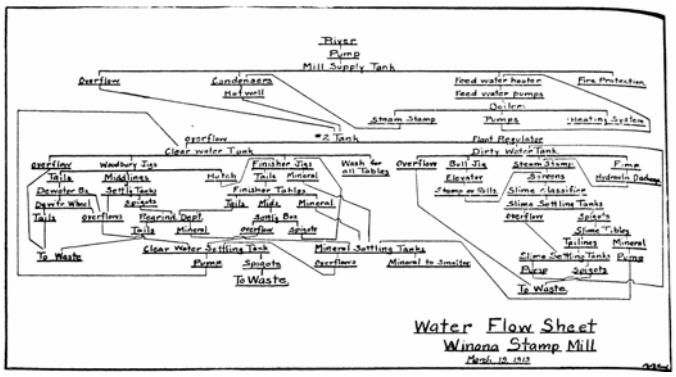


Fig. 6

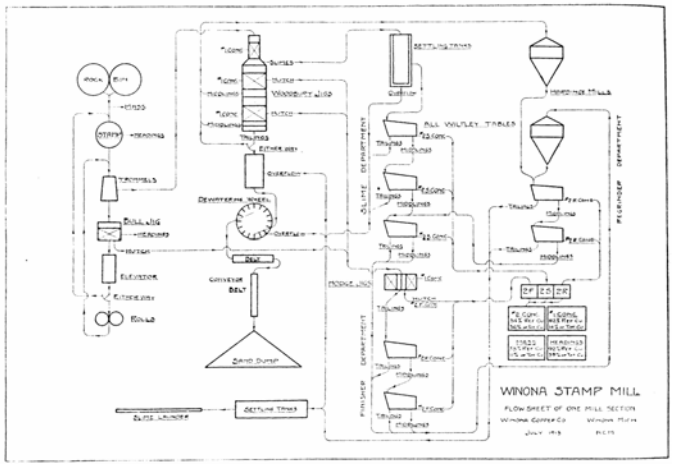


Fig. 7. Flow Sheet of One Mill Section, Winona Stamp Mill.

Make.	H.P.	Voltage.	Speed.	Driving.
A-C	75	2200	850	No. 1 Head Jigs, Shops & Gen.
A-C	75	2200	850	No. 2 Head Jigs, Shops & Gen.
A-C	50	2200	850	8′x30″ Hardinge Mill.
A-C	45	2200	835	8′x18″ Hardinge Mill.
G-E	35	2200	850	6′x60″ Hardinge Mill.
Westinghouse	50	2200	500	8′x36″ Hardinge Mill.
Westinghouse	50	2200	500	8′x36″ Hardinge Mill.
Westinghouse	50	2200	500	8′x36″ Hardinge Mill.
G-E	35	2200	600	10″ Centrifugal Pump.
G-E	25	2200	600	8″ Centrifugal Pump.
A-C	30	2200	850	Two Sets of Rolls.
A-C	30	2200	850	Sand Conveyor.
A-C	20	2200	1130	Tables and Pumps.
A-C	20	2200	1130	Tables and Pumps.
A-C	20	2200	1130	Tables and Pumps.
A-C	5	220	1200	Ash and Coal Elevator.
G-E	3	220	1200	No. 1 Head Valve Gear.
G-E	3	220	1200	No. 2 Head Valve Gear.
Westinghouse	5	220	1120	Tables.

The Winona stamp-mill was built on the mine to reduce operating expenses per ton by reducing transportation charges. Seventeen and one-half cents per ton was cut out of the transportation charge and the following items were added:

Stacking sand	1.2c per ton stamped
Transportation on the mine	3.6c per ton stamped

This still leaves an important net saving due to location of mill on the mine. The unit costs given are necessarily high due to the small tonnage handled, namely, 181,184 tons for the year 1912. The detail of these costs follows:

Cost of belt and conveyor idlers, about $4,000 erected; life 40 months; cost per month	$100.00
Power at the rate of 8 k. w. at 1.2c per k. w. hour	60.00
Attendance	10.00
Oils, etc..	10.00
	$180.00

Or 1.2 cents per ton on 15,000 tons stamped. These will of course he reduced materially with increased tonnage handled. Of the power used, at least two-thirds is in friction.

In addition, the following interest and depreciation charges might he listed against this operation:

Cost of conveyor bridge and towers, fully equipped with belt and machinery	$12,000.00
Interest at 6 per cent	720.00
5 per cent depreciation on $8,000 of this amount	400.00

The depreciation of the other $4,000 is already accounted for in the working cost.

Pumping costs should not be increased over similar costs with a stamp-mill on Lake Superior as while the water re-handled is pumped with less efficient machinery the head against which it is pumped is very materially reduced. The pumping cost taken from our cost sheet for the year 1912 is 2.3 cents per ton stamped. This is materially higher than the usual figure on Lake Superior, owing, principally, to the smaller tonnage stamped.

There is undoubtedly considerable gained by the concentration of all operations at the mine. Some of this gain cannot be expressed in cents per ton. During part of the month of March, 1913, railroad service in Houghton county was very much hindered by heavy storms. Several of the mines were shut clown temporarily and freight train service, at least, was cancelled for days at a time. Neither the Winona mine nor the mill was delayed on this account as our tracks are comparatively short and easily kept clear of snow.

SAFETY IN THE MINES OF THE LAKE SUPERIOR IRON RANGES.

BY EDWIN HIGGINS, IRONWOOD, MICH.*

It is not the purpose of this paper to go into a detailed discussion of safety in mines, or to submit a set of rules that will eliminate accidents. No living man, whatever his occupation, is immune from accidental bodily injury. Accidents cannot he eliminated; they may, however, by the exercise of care and vigilance, be kept within certain reasonable limits.

As a result of visits to many of the iron mines of the Lake Superior region, for the purpose of studying conditions and possibly learning something as to the causes of accidents, some impressions have been gathered that might be of interest. In this paper, certain existing conditions will be discussed, and some suggestions offered, not in a spirit of criticism, but with a view to emphasizing some of the features of safety work.

In general, interest in the work is high. A great deal of money is being spent in safety devices and other means

looking to a reduction in the number of accidents. Except in a few cases, the mine officials are doing all in their power to accomplish this end. The seed of "safety first," sowed some years ago on the iron ranges, has become firmly rooted.

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It seems natural in a discussion of safety to turn first to the causes of accidents, for the remedy of any evil lies in removing the cause. Few accidents may be charged to any one direct cause; most of them are due to a combination of circumstances or conditions. For example, a man is hurt from a fall of ground. The direct cause of the injury here was the falling of a section of ground. However, the falling of the ground might have been due to the failure of the miner to pick down the back; the timbering might have been insufficient or improperly placed; possibly the miner was trying for "easy dirt" and was taking a chance; or the working place might not have been carefully inspected. In turn, any or all of these conditions might have been due, indirectly, to a demand for more ore production, either by the management or by an over-ambitious captain or shift boss.

A man is crushed between a post and a motor or car. This accident might have been due to the fact that in laying the track insufficient clearance was allowed for between the cars and the post; or to the lack of a bell on the motor; or to the carelessness or inexperience of either the motorman or miner who was hurt.

In a broad sense it seems reasonable to assume that safety in and about the mines is closely related to and dependent upon the following conditions and elements:

Rapidity of production of ore.

Labor conditions.

Accident preventive measures and devices.

The Human element.

Rapidity of Production of Ore.

Forcing the production of more ore than can be supplied under normal working conditions doubtless tends to increase the number of accidents per man employed in the mine. A comparison of accident and production records will show this to be true in many cases. When the working places are overcrowded with men and machinery and the mine equipment is being worked beyond its capacity, there is a tendency for the work to go with a slam and a bang that allows little chance for anyone who happens to get in the way.

The demand for over-production might come from the management or officials; or, as is often the case, it might result from the spirit of rivalry that exists between some captains or shift bosses. To a certain extent, the belief is still prevalent that a man's worth is gaged by the amount of ore he produces. There are doubtless other causes that tend to spur the miner on in his work; the result in most cases is to make him less careful of his safety. The elimination of undue haste in all departments of mine work will tend to reduce accidents.

Labor Conditions.

A scarcity of labor means that there are a correspondingly smaller number of experienced men available. It follows that green men must be employed in the mines and that incompetent men must be kept at work when they should be discharged. Such conditions are productive of accidents. The green hand, being unfamiliar with his working place, machinery and tools, does not know what to do in an emergency. Usually he does the wrong thing and receives an injury.

Where an entire district is effected by a shortage of labor it is practically impossible for any one operator to remedy permanently conditions at his property. He may secure men from outside of his district but this is expensive and is not a lasting or satisfactory remedy.

Accident Preventive Measures and Devices.

No attempt will be made to describe the many safety devices and methods in use. The subject of accident prevention will be discussed in a general way under the following heads:

Machinery, Tools and Appliances.

Timbering.

General Conditions in and About the Mines.

Handling of Explosives.

Fire Prevention and Protection.

Rules and Regulations.

Inspection.

Machinery, Tools and Appliances.

Usually the master mechanic is held accountable for the condition of all machinery. He must be certain at all times that his machinery is in safe condition for use, and that all exposed parts, such as fly wheels, belts, pulleys, etc., are so covered that men cannot be caught and injured by them. This applies to underground as well as surface machinery, although the care of the underground machinery usually comes under a different man. Some companies make it a rule, where there is a choice, to avoid the use of machinery, devices or appliances that offer a chance of pinching or mangling the limbs of employes. In general, it was found that much has been done towards protecting men from exposed parts of machinery.

Hoists, especially those used for handling men, should be provided with an automatic cut-off to prevent overwinding. Cables should be carefully inspected at frequent intervals and the ends cut at stated periods.

Cages for handling men should be provided with safety dogs and doors. Safety dogs should be tested at least once a month by dropping the cage; there are various well known methods of doing this. Although nearly every cage inspected on the iron ranges was equipped with safety dogs, it was found that less than 40 per cent of them were tested at regular intervals; many never had been tested. A safety dog is not safe unless it is known to be in perfect working order.

Where electrical haulage is used underground, the assistant, or "swamper," on the motor is often injured by having his legs crushed or mangled. Accidents of this nature are due to the fact that no place is provided on the rear of the motor for the "swamper" to ride in safety. At one mine this class of accident became so common that motors were provided with a place for the "swamper" to sit, so that his legs are protected the same as are those of the motorman on the front end.

All electric feed wires should be well insulated and carefully laid to prevent short circuiting. Trolley wires should have protection, especially at ore chutes. The common mode of protection is to provide, where the trolley passes in front of ore chutes, inverted, troughs or launders of square or V-shaped section; or to secure, on each side of the trolley, round timbers from 5 to 8 in. in diameter.

Telephones underground often play the part of a safety device. They should be installed in every mine.

TIMBERING.

From a safely standpoint, the proper timbering of working places is of great importance. In most of the accidents happening from insecure or improperly-placed timbering, it has been found that the work has been done, or left undone, by an inexperienced man. The green man is most likely to overlook one of the first principles of proper timbering, viz: that of using sufficient blocking between the timber and the back. This has been the cause of a great many accidents. Under the head of improper timbering many conditions could be referred to that may result in injury to the miner, but it seems unnecessary to go further into this subject. The remedy for such conditions, especially where green men must be employed, is a closer inspection of all timbering. This remedy has brought forth good results in several instances known to the writer.

Another plan that has been adopted with good results is to timber every place where there appears to be the slightest chance of a fall. In one large mine a close study of accident reports brought out the fact that falls of ground, resulting in injury, were occurring in rock drifts where it was thought that timber was entirely unnecessary.

It is the rule in many of the mines for the captain or someone else to either climb, or make a slow trip by cage, through the shaft at frequent intervals, closely inspecting guides and timbering. Such trips do not consume much time and should be made every day.

GENERAL CONDITIONS

Handling Men—In order to avoid accidents that might result from the sudden disability of the hoisting engineer, two men should be on the hoist when lowering men into or hoisting them out of the mine.

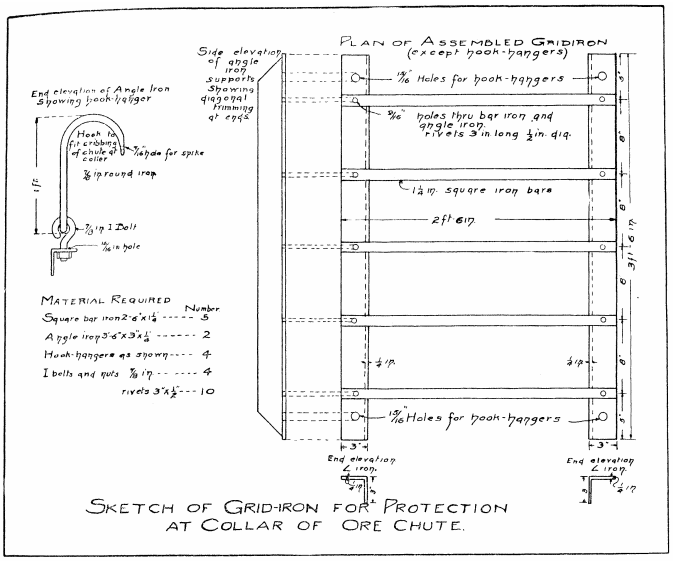
Miners are often hurt by crowding too close to the shaft when coming on or going off shift. The usual effective method of preventing accidents of this kind is to provide some kind of enclosure around the shaft collar and underground stations, into which men may he admitted in limited numbers.

Traveling Ways—Every mine should be provided with at least two outlets with ladderways in good repair. If the distance is not too great the men should be made to pass through the second outlet from time to time in order to familiarize them with the way.

All traveling ways underground should be kept as clear of rubbish and old timber as possible. Timber with jagged edges or with nails protruding, powder and candle boxes, in short, trash of any kind, are sources of danger when allowed to collect in traveling ways. A small piece of wood has been known to derail a motor or tramcar; men often are caught between a derailed car and the timber. A man may trip over a slight obstruction, fall and receive a serious injury.

In repair work in haulage drifts, neither old or new timber should be left laying or standing any longer than is absolutely necessary. Men have been crushed by motors and cars because the way was so full of obstructions that they could not escape.

Protection of Open Places—Every place into which it is possible for a miner to fall should be protected in some manner. This refers to gates or fences for shaft collars and stations, doors for manways, bars or fences for ore chutes, and fences for dangerous abandoned places.



Where cribbed ore chutes are used, as in the soft ore mines, there seems to be a tendency, due to the weight of the ore in the chute and the working of the surrounding ground, for the cribbing to settle and become distorted. Under such conditions it is important to keep the collar of the chute in repair. In the course of time the iron bars used to prevent men from falling into the chute will settle with the cribbing. While bars four or five feet below the collar of the chute may prevent serious falls, they are as much a source of danger as they are a protection; a man falling upon them is liable to very serious injury. To remedy this condition, a special grating is used at one mine. It consists of 1-in. square iron pieces riveted loose to angle-iron end pieces. The square iron pieces are placed 8 in. apart and the grill so formed is supported to the chute collar by means of four round iron hooks, 1 ft. long, bolted to the angle-iron end pieces and passing over the top set of cribbing. In the end of the hook is a hole through which a spike is driven to secure the hook to the cribbing. The device always hangs 1 ft. below the top of the chute; it will adjust itself to any distortion of the cribbing. This device is shown in an accompanying sketch.

Open and dangerous places should be further protected by the use of ample lighting. This is simple on main levels where electric lamps are used. Great care should be used, however, where it is necessary to employ some type of torch or other open light, especially if there is much timber in the immediate vicinity.

Ladderways and Ladders—For shafts, ladders placed in an inclined (forward) position, with platforms, or sollars, not more than 24 ft. apart, are recognized as safer than the continuous ladderway without platforms. Ladders should project at least 3 ft. above platforms, or there should be a hand hold of some description provided just above the platform.

Ladders, wherever used, should be placed about 3 in. out from the opening in which they are hung, and should be securely fastened. The spacing between rungs should he uniform throughout and not more than 12 in. from center to center. Broken or badly bent rungs should be immediately replaced. Three types of rungs are in general use—round iron bars, wood, and iron pipe. Wood rungs present a better hold for both hand and foot. They are subject to rot or easy breakage from falling rock or other material, and hence are not as serviceable as iron. Solid iron rungs are good, but when they are bent, especially in a wet mine, they make it easy for the miner to slip. Rungs made from discarded, 1-in. iron pipe are cheap and effective; being larger, they present a better hand and foot hold than the solid iron rung. For the protection of rungs, as well as human life, the top of every ladderway should be kept clear of loose rock. Careful inspection and repair of ladders will tend to reduce accidents from falls.

Tracks—Some importance is attached to the proper grading of tracks, from a standpoint of economical work, and because pushing cars up too steep grades may be the cause of injuries in the nature of strains. In the haulage ways, especially in rounding curves, ample room should be provided for men to stand to avoid being crushed between the ear or motor and the timber. A great many accidents happen from this cause.

Tracks should be kept clear of all rubbish, especially pieces of wood and rock.

Signs—Various kinds of signs are in use in many of the mines. This is a subject that is worthy of serious consideration. The most useful signs appear to be the following: Something to call attention to places where explosives are stored; something to indicate dangerous places, such as abandoned open stopes, places over which work is being done, etc.; signs pointing the way to the different outlets of the mine. The latter should be more numerous where the vein is wide and the workings intricate. There is a great need of a universal danger sign, something that by constant use will eventually become familiar to men of all nationalities.

HANDLING OF EXPLOSIVES.

For underground work it is the general practice to use various grades of dynamite, such as straight dynamite, and the low-freezing, ammonia, gelatin, and granular dynamites. Explosives are fired by means of fuse and detonator, except in shaft sinking, in which it is customary to use an electrical firing device.

In nearly all cases the explosive is carried into the mine in the original box, usually with the cover on, but in some cases with the cover removed. The best practice seems to be to remove the cover after the explosive is received underground, using a wooden mallet and wedge for the purpose.

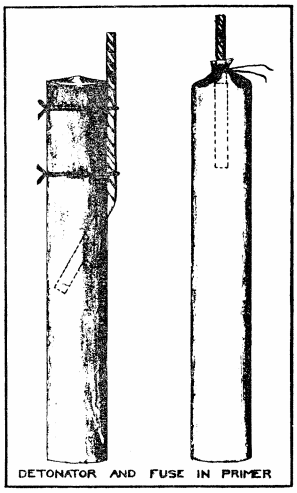
Storage Underground—Explosives are stored underground either in a central magazine or in boxes kept near the working places. The chief factor in determining the best method of storage is 'the system of mining in use. Under different conditions either method of storage may be best. In any event, no more than 48 hours' supply should be kept underground at any one time.

Powder houses should be removed from working places and traveling ways. Those cut out of the solid rock, supported where necessary by steel and concrete, are safest. They should be in charge of a powder man who shall deliver explosives to the miner on written order only. In several mines the practice is followed of requiring the shift boss to make out and sign the order for explosives. It is claimed that this method is both economical and safe, as it prevents the miner ordering too much explosive, at the same time eliminating the habit of leaving sticks of explosives lying around promiscuously. The powder magazine should be electrically lighted and no one should be allowed to enter with an open light of any kind. A good precaution is to place a fuse in the line leading to the powder magazine in order to prevent the explosion of an incandescent lamp in case the current should rise suddenly.

Fuse and Detonators—The powder man should have charge also of the detonators and fuse and these should be kept in a room at least 50 ft. from the explosives. The duties of the powder man may include the cutting of the fuse and the crimping on of the detonator, for which latter purpose a crimper should be supplied. There are still a few miners left who will crimp a detonator with their teeth.

Thawing—Thawing is variously performed. In cases where low freezing dynamite is used no means is provided for thawing. Some magazines are heated by steam coils and kept at a certain temperature. Thawing devices heated electrically or by steam pipes are used, as well as different types of hot water thawers. Electrical heaters require careful planning to prevent dangerous conditions due to short circuits or overheating. Only in a few cases was the dangerous practice of thawing in contact with a heated metal surface observed. Where steam is used for thawing it should be used under low pressure; exhaust steam from some source may be available. The practice of carrying sticks of explosives in the clothing in order to thaw them from the heat of the body should be prohibited.

Carrying Explosives—In carrying explosives from the magazine to his working place the miner has been observed to make up a bundle of a dozen or more sticks and tie it up with fuse; or he may carry the explosive loose or in a cloth sack. Obviously, the latter method is safest, because the explosive is better protected and is not likely to be lost. One objection to tying up a bundle with a length of fuse is that the fuse is very likely to develop a defect from such treatment.



Loading Detonator Into Primer—There were few mines visited in which any regulation method of attaching the detonator to the primer was followed. In practically all cases the superintendents and captains knew that certain methods were to be preferred; the difficulty seemed to be in causing the miners to adhere to rules. Any method of performing this operation that allows the detonator to protrude from the primer, or the formation of sharp angles in the fuse, should be prohibited, as they give rise to premature explosions and missfires. Either of the methods shown in the accompanying sketch is both safe and efficient. A skewer of wood or brass should be used for punching the hole in the cartridge.

Tamping—From a standpoint of both safety and economy, all explosives should be well tamped. For this purpose damp clay may be used; the tamping stick should be of wood.

Missed Holes—In handling missed holes much care is generally used, although in some mines no set rule is followed. Usually some form; of report is used whereby the captain or shift boss of the oncoming shift is notified of the missfire. The shift boss locates the hole, removes the tamping, then inserts and fires another primer. In locating the hole the shift boss may be guided by the experienced miner, who can designate, in many cases, the charge that has failed to explode from the sequence of the reports. No set rules can be laid down for handling missfires. It may be said, however, that at least one hour should elapse before anyone is allowed to return to the hole; that great care should be observed in locating the hole and removing the tamping; that the charge should never be gouged out with a metal scraper; and that no attempt should be made to pull the fuse and detonator from the hole. There should be some place for posting or delivering a printed form for the attention of the captain or shift boss of the oncoming shift. This form should be so filled out as to draw attention to the exact place where the missfire has occurred, and the number of holes missed.

Black Powder—For blasting on surface, as in open pits, various classes of black blasting powder are used. Care should be used in the storage and opening of the powder canisters. Loading should be done by careful and experienced men. The safety precautions in this class of work are well known and will not be discussed here. It seems only necessary to mention the fact that constant vigilance is essential, for even men of long experience in handling powder will in time become careless and overlook the simplest rules for safety.

Rules and Blasting Signals—Rules and regulations concerning the handling of explosives should be printed and posted in proper places. Such placards should contain a few short and concise statements regarding the chief dangers in handling explosives.

Miners should never be allowed to blast a hole, or even a plug shot of half a stick of dynamite, without giving the customary warning. The strict enforcement of this rule will prevent accidents.

INSPECTION.

Safety inspectors, or committees, are to be found at many of the mines, but a great number of them still depend upon the captains and shift bosses alone to keep the mine in a safe condition. The mines at which some form of inspection was provided showed the good results of the work. Constant contact with certain conditions may cause even the careful captain or shift boss to overlook the dangerous features.

FIRE PREVENTION AND PROTECTION.

While generously provided in few cases and moderately in most, fire protection was found entirely lacking in some of the mines. As a protection to life and property every mine should be provided with some means of preventing and fighting fires, both on the surface and underground. The aim should be to remove, as far as conditions and necessity will permit, the causes of fires; and to provide the necessary equipment for attacking quickly any fire which may originate. The following may be set down as the causes of metal mine fires:

Careless use of lights underground, in shaft, or at shaft collar.

Defective electric wiring.

Spontaneous combustion from friction in shaft rollers or underground machinery.

Spontaneous ignition of combustible rock.

Dropping lighted paper, candle or other material in ore chutes,

Building small fires underground for any purpose.

Dumping ashes into open pits connected with underground workings.

Careless use of matches.

Incendiarism.

Smoking in timbered places underground, in shaft, or at or near shaft collar.

Sparks from surface engines of any kind, or from surface fires.

Allowing combustible rubbish to collect underground.

By studying the causes of mine fires and some of well known preventive and protective measures, many of which are embraced in the following suggestions, an efficient system may be worked out for almost any conditions.

Do not place wooden structures close to the shaft collar. Have as little wood construction as possible around collar; steel headframes with steel and concrete construction to a depth of 25 ft. below the collar are safest. Sprinkle dry shafts. In all shafts use care in electric wiring; keep rollers well oiled; cover steam pipes, especially if laid close to timber do not allow candle snuffs or other open lights to be left on timber.

In shaft and pump stations use as little wooden construction as possible; provide steel and concrete where support is necessary. Do not allow combustible material of any kind to collect; do away with open lights as far as possible; use care in electric wiring; provide separate receptacles for clear and oily waste; do not place machinery close to timber; do not spill oil on timber. If conditions do not warrant steel and concrete construction, at least break timbering connecting pump station with shaft, using steel and concrete if support be necessary.

Do not allow dry wood, powder and candle boxes, paper hay, waste, manure, or other combustible material, to collect anywhere underground.

Provide a fire patrol for all timbered parts of mine. Do not store lighting or lubricating oils in great quantity underground, especially near timbered places.

Provide one or more chemical fire extinguishers at or near the shaft collar, at every station, at powder house, and in timbered drifts or crosscuts distant from the shaft.

Provide one or more water plugs or connections, with several lengths of hose, at or near shaft collar .and at stations. Water may be supplied underground from pumps, water column, or by separate line from surface. A shaft sprinkling device is useful under certain conditions. In tapping water column it may be necessary to use a special pressure reducing valve.

Make air line convertible into water line.

Have a barrel of water and buckets at shaft stations.

Provide dry fire extinguishers, such as sand, salt or powdered limestone.

Arrange for the control of ventilation through the use of doors.

Provide air tight fire doors for isolation of parts of mine.

Make rules for fire prevention and enforce them.

Have fire drills and a pre-arranged plan of action in case of fire.

Provide oxygen breathing apparatus.

Provide fire signals.

Arrange to notify miners in case of fire and be prepared to get them to surface promptly.

Before leaving this subject, it is desired to draw attention to the use of candles for lighting underground. This article has probably been the cause, directly or indirectly, of more mine fires than any other known agent. It is notable that the candle is fast being replaced by the carbide lamp on the iron ranges. No mine, especially if it be dry and timbered, is safe from fire while candles are permitted below the collar of the shaft. Carbide lamps, while they are not an ideal lamp for the purpose, seem to be the best and safest device at present known for lighting underground in metal mines. Compared with candles, they consume less oxygen, give a brighter light, are at least half as costly, and present little danger of setting fires underground, chiefly because they are not hung on dry timbers and are carried out of the mine when the miner goes off shift. It might be mentioned also that the carbide lamp, because of its greater brightness of light, affords a better chance for locating loose pieces of rock in the back, and for seeing obstructions under foot. From a standpoint of fire prevention, there is great need of some lighting device

for underground that has an enclosed flame; at the same time it must be simple, inexpensive and effective. Portable electric lamps (storage battery) are now coming on the market for use in coal mines. Lamps of this type present advantages for use in metal mines, but they must be simplified and improved before their adoption is likely to become at all general.

Oxygen Breathing Apparatus.

By the use of oxygen breathing apparatus, the wearer is enabled, without inconvenience, to perform hard labor in an atmosphere containing smoke, fumes or poisonous gases. This device is an important part of the equipment for fighting underground fires and may be instrumental in saving life where men are overcome or lost in gas-filled mines. The apparatus should be kept clean and should be tested at frequent intervals to make sure that it is ready for instant use. In storage, it should be protected from steam, hot air and dust. A sufficient supply of oxygen should be kept on hand at all times.

There should be two or more trained crews of five men each. If a crew consists of three or even four men and one of these men should meet with an accident, there is great danger that the two or three remaining men may not be able to carry him out of the danger zone. The leader of the crew should be cool and deliberate and should exact absolute obedience from every man under him. He should take every precaution for the safety of his men, thoroughly testing every apparatus before going underground in case of fire.

For a more detailed discussion of this subject the reader is referred to Miner's Circular 4, “The Use and Care of Mine Rescue Breathing Apparatus,” by James W. Paul, published by the United States Bureau of Mines, Washington, D. C.

First Aid to the Injured

From the standpoint of safety, first aid to the injured where practiced, suggests to the miner that he is liable to injury; it protects the miner who has received an injury and prevents simple injuries from developing into something more serious, thus shortening periods of disability.

In the generally accepted sense, first aid to the injured does not contemplate the production of physicians after a few lessons—or any number of lessons. Its purpose is to give temporary relief, by the simplest possible means, until the injured man can be taken to a physician or hospital. The study of first aid teaches what not to attempt, as well as what to do. As taught by the American Red Cross Association, the United States Bureau of Mines, and other institutions, a man of no schooling may become as proficient in the work as the man of highest education.

The larger companies operating on the iron ranges, and many of the smaller ones, have taken up the work of first aid to the injured. In some localities the work is well organized and is doing a wonderful amount of good. Most operators and physicians are firm believers in the efficiency of the work, both from a humane and from an economical standpoint.

It is suggested to any who have not given this subject serious consideration that they look up the records of what first, aid has accomplished in the coal fields of the United States in recent years; or better still, obtain records of what the work is doing on the iron ranges. Reports from one large hospital show that cases of infection have been reduced 50 per cent since the introduction of first aid work.

Sanitation and Ventilation.

Sanitation and ventilation in mines are closely related to safety. A miner's general health is more valuable to him than a sound leg, arm or finger; and he will do more efficient work and be less liable to long disability when injured, if his general health is good. Unsanitary conditions in the mine, coupled with an insufficient supply of fresh air, will sooner or later show their effects upon the strongest man.

Rules and Regulations.

Practically all of the mine operators believe in the use of rules and regulations. This belief is exemplified in some eases by the official who at least posts a notice against smoking in certain places, or one refusing admittance to the mine or plant; passing through many gradations up to the official who believes in the printing of rules and regulations in eight or ten different languages. There can be no question as to the necessity of rules; and there seems to be no suitable method of reaching the men of various nationalities without printing these rules in numerous languages.

The important point, often difficult to attain, is the enforcement of these rules and regulations. The only satisfactory method of enforcing rules is to discipline, and finally discharge, offenders against them. Unfortunately, labor conditions are not always such that this course can be followed.

The Human Element.

The human element enters into every angle of the safety problem. Rules may he provided, safety devices and precautions may be provided in the greatest abundance, and every preventive measure known to science may be brought into use; but they will not avail to reduce accidents to the minimum if the safety spirit is lacking in the officials, the captains, the shift bosses and the men under them.

For instance, such an experience as the following is not uncommon. An official goes underground and finds certain dangerous conditions existing, against which there are strict and clearly worded rules. These rules might not have been observed for any one of several

reasons. The captain, might not have been sufficiently impressed with the "safety first" idea; the captain might not have educated his shift boss sufficiently; or either the captain or shift boss might have been of that type who cannot adjust himself to ideas of safety as against ore production.

The remark has been heard that this or that captain or shift boss could not he brought to give serious attention to matters of this kind; that they were too valuable to discharge and would doubtless come around to the changed conditions later. In cases of this kind it seems to be a question of which man is the most valuable, the man who gets out ore without injury to his men, or the man who produces a greater tonnage at the cost of human life. This is a question that may be studied either from a humane or from an economical viewpoint.

Unless the mine official is of the firm belief that safety pays, little may be expected from the men under him. The best results seem to be forthcoming from the mines where the slogan "safety first" is strong with the officials, and by them is made to permeate every department until it finally reaches, through the captains and shift bosses, the men behind the drill, the pick and the shovel.

It is the rule on the iron ranges to find the mine officials greatly interested in safety, and the same may be said of the captains. However, the general run of shift bosses do not present a fertile field for the safety seed; either that, or the seed is improperly sowed. This does not refer to all shift bosses, for there are many safety enthusiasts among this class; nor does it mean to imply that a shift boss would willingly or knowingly put a man in a dangerous position. The idea that it is desired to bring out is that, in general, the safety spirit is high with the average official, and most of the captains; but when it reaches the shift bosses it begins to die, and by the time it conies clown, to the miner it is almost dead. The average miner resents suggestions for his safety. He will take care of his dinner pail and he will be careful to get all that is coming to him from his contract, but he will not take the necessary precautions to safeguard his life. Of course, there are some who are careful.

The above statements are made after a close study of this particular feature of safety work in many of the mines. They lead up to what the writer believes to be of the utmost importance in the prevention of accidents, namely: That far more good may be accomplished by educating and securing the co-operation of the man underground than by the use of safety devices or measures of any other kind. Safety devices are good and they are absolutely essential for protecting the miner; if they could be coupled with a mine full of men whose thoughts were for their safety, then conditions would begin to approach the ideal. The method of securing this co-operation is the problem of the management, and the problem is not the same in every mine. Schemes that will work out well in one mine might fail under widely different conditions.

ORGANIZATION AND CO-OPERATION.

In many of the mines the captains and shift bosses are looked to for the reduction of the accident list. Another class is made up of those mines which have one or more safety inspectors. Still another class embraces the mines of the larger companies that maintain safety departments and spend a great deal of time and money looking to the welfare and safety of the man in and about the mine.

Of the schemes for securing the co-operation of the captains and shift bosses there are none that seem to bring better results than the monthly or semi-monthly meetings at which accident reports are read and the accidents, with possible suggestions as to how they might have been prevented, discussed. In some cases rivalry is stirred up amongst the shift-bosses by offering small monthly prizes to the boss whose record for injuries to men is .the cleanest.

The writer is of the belief that a yearly cash bonus to shift bosses, based upon the number of men injured (or the number of days disability resulting therefrom) and killed, will be effective in reducing accidents. At first thought this proposition might not be attractive. However, let us start with the premise that in a certain mine the shift bosses are not as careful as they should be—and this applies practically to all mines. There are, say, ten shift bosses. You appeal to them from the humane standpoint; possibly three will be deeply interested, three more moderately so—the remaining four are thinking of something else. And so it will be if you talk of prizes of any kind, until you mention, say $500 as a yearly bonus; there are then exactly ten shift bosses intensely interested in your conversation. Consider the number of broken fingers it will take to cost $500 in compensation.

The cash bonus is a suggestion; the plan in detail must be worked out with careful regard to the conditions under which the men work. One objection that has been heard is that conditions in one place might be more dangerous than in another, in this way presenting difficulties that might arise under any bonus system. It would seem that in the course of a year conditions would change sufficiently to equalize risks of injuries. As a matter of fact it is often found that more accidents happen in places that are supposedly safe than in those that arc known to be dangerous. In this connection, attention is directed to the fact that certain companies have brought about great improvement by offering cash prizes to miners for gardens and clean premises.

During the past six months committees or associations have been organized in various districts on the iron ranges. Membership is made up of mine officials, captains, shift bosses, engineers and others interested in safety work from all operating properties of the district. The purposes of the organization are, through co-operation, to promote welfare, safety in and about the mines, social intercourse, first aid to the injured and rescue work, and sanitation. The co-operation is to be

effected by regular meetings, at which these various subjects will be discussed, and by visits to the different mines. Several of these organizations show signs of becoming permanent and powerful institutions.

The methods of securing the cooperation of the miner are through the posting of warnings of different kinds, the printing of rules and regulations, the posting of newspaper accounts of mine accidents with illustrations showing how men are injured, the formation of inspection committees of miners, and through personal contact of the officials, captains and shift bosses. These methods are more or less productive of results, but there still exists a woeful lack of willing cooperation among the miners. Just how this condition may be improved is a problem, the solution of which will do much for the cause of safety in mines. Suggestions along these lines may be obtained through a study of the methods in use by many of the large industrial organizations of various parts of the United States.

CONCLUSIONS.

The reader, if he has the patience to go carefully through this paper, will doubtless make the mental note that there is still much to be written on the subject of safety; that the suggestions made are mostly old and well known; or that he does not agree with the writer on some points. It is hoped that these very faults might have the good effect of suggesting the points that have been omitted; in stirring someone to adopt a suggestion that he has neglected in spite of its age; or in bringing out, through discussion, a better way to accomplish some of the objects outlined.

More than this, it is hoped that by giving publicity to the subject of safety in mines, more converts will be made for the cause. The protection of our fellowman is a duty that we owe to ourselves and to mankind. If there is no appeal in the humane side of the question, study it from a standpoint of dollars and cents, for safety in mines pays, first, last and all the time.

WHAT OUR NEIGHBORS CAN DO IN MINING IRON ORE.

BY DWIGHT E. WOODBRIDGE, DULUTH, MINN.*

Lest we forget that there are others in the United States than we of Lake Superior, who are doing things in iron mining, and other places than the Mesabi range where iron is mined, and where records are made, I want to call attention to a few items from my note books. These items were gathered recently in work for the United States Government, as consulting engineer of the Bureau of Mines.

I found that in the brown ore regions of Alabama, they are mining an average of 7 or 8 cu. yds. of material for every ton of 50 to 52 per cent ore, dried analysis, that they save. The Weems mine of brown ore, in the Rock Run district of Alabama, has mined 2,200,000 yds., and has secured 300,000 tons of ore; one ton to every 7 yds., plus. A company in that vicinity was mining, at the time of my visit, 15 yds. to get 1 ton. All this material has to be mined from the ore bank, transported to the washery, washed and loaded on cars, and the cost figure for this operation of 15 yds. to the ton was about $1. Companies like the Republic Iron & Steel Company are buying brown ore of a guarantee of 45 per cent, dry, at $1.35 a ton f. o. b. cars. The Roane Iron Company, of Chattanooga contracts for brown ore at $1 a ton when No. 2 foundry iron is selling at Birmingham at $7, and a 5 cent premium for every dollar added to the price of pig iron until it has reached a maximum cost of $1.50. That would make the Roane Company's brown ore cost it, now, about $1.20. This is for a ton of 2,268 pounds, which is a weight used, I believe, nowhere else. The Woodward Iron Company figures its brown ore costs at about $0.821 at the mine.

*Consulting Engineer.

In the Clinton ore district of New York state, where the iron content of the ore is about 40 to 45 per cent dry. they are removing an overburden that is from 10 to 20 ft. thick half of it consisting of a hard limestone which must be blasted before removal by the shovels, in order to get at a thickness of about 2 ft. of ore. This ore dips flatly into the earth, and they are now trying to figure out how they will be able to follow the ore to a depth of 500 ft. vertically, underground. This will mean a distance of 4 or 5 miles from the outcropping. This Clinton ore district of New York state, about which we hear very little, and from which but a trifling quantity of ore is now taken, is estimated to contain not less than 500,000,000 tons of merchantable ore.

An underground mine in Etowah county, Alabama, on the Clinton formation, is successfully producing a 45 per cent ore from a seam that averaged, at the time of my visit, 25.5 in. thick. Ore is successfully mined in this property to a thinness of 14 in. Miners get 55 cents a ton for ore in faces 36 in. thick, with a premium on thinner seams and a penalty on thicker. At this mine the ore is trammed underground in main galleries 48 in. high by “jennies” whose ears seem to have been cropped to fit the openings, is hoisted to the main tunnel level on platforms up an incline, is trammed out to surface by mules and run through a crusher and over a picking belt to remove slate, and the picked ore is then let down a long incline to the railroad track. The cost of all these operations was averaging, at the time I saw the mine, about $1.40 per ton of picked ore, this figure including all overhead costs as well as transportation to the furnace and amortization. Generally accepted figures on the tonnage of Clinton ores available in that part of Alabama between Birmingham and the suburb of Bessemer have been for about 800,000,000 tons of the better grade, or “self-fluxing” ore. But by virtue of a drill hole sunk last year by Cole & McDonald, of Duluth, this figure should be doubled, as to probable ore. This drill hole went vertically 1,902 ft. to the top of the “big seam” of Clinton ore, that outcrops 14,500 ft. away. At the outcrop of the

"big seam" it shows a thickness of some 12 ft., but at this point some 3 miles back from the outcrop, and 1,900 ft. deep, the ore shows a combined thickness of 15 ft. in two seams parted by 2 ft. of slate. It is probable that there is as much good ore between Birmingham and Bessemer, an extreme length of about 20 miles, as there is on the Mesabi range, and that there is about as much merchantable ore of the Clinton hematites in Alabama as of all merchantable ores in the Lake Superior region. And lest we forget the comparative value of these ores, let us bear in mind that a 40 per cent hard Clinton hematite of Alabama, is as good for furnace use as a 50 per cent Mesabi hematite, on account of its comparative freedom from moisture and its high percentage of carbonate of lime.

The distribution of brown ore banks, throughout the United States, is far wider than that of any other type of iron bearing material. These banks occur in the states of Vermont, Massachusetts, Connecticut, New York, Pennsylvania, Maryland, Georgia, Tennessee, Alabama, Kentucky, Missouri, Texas, Iowa and Wisconsin. They are mined in Pennsylvania, Virginia, Tennessee, Georgia, Alabama, Texas, Iowa and Missouri; chiefly in Alabama and Georgia. That they are some factor to be reckoned, with in the future, may be gathered when I say that there are areas of these banks in Alabama alone, covering 7,000 square miles. No estimates of tonnages that are worthy of credence have ever been made, and it is impossible to make such estimates, on account of the uncertainty of the deposits. It is a common saying in the south that no man can see into a brown ore bank, further than the end of his pick. But, it is not unlikely that the deposits of these ores in the southern states of Virginia, Tennessee, Georgia and Alabama, will be found ultimately to be of enormous quantity.

In the Clinton ore mines of Birmingham some of the mining companies pay their miners on the basis of 30 cents a ton for ore. This means the breaking of the ore, loading in train-cars, and the delivery of the cars to the main heading, where the cars are picked up by the company and pulled to the tipple at surface. In these cases the company furnishes drills air and steel, the contractor, usually a negro, supplies labor and powder. Some companies pay less than 30 cents a ton. The pig iron costs of one of the large mining and iron making companies of the district, with the elimination of all intermediate profits, and by the use of by-product coke, have been under $6.50 a ton, and can now be figured at about $7. Possibly there are others that can not do* so well.

In the case of one of the operating companies of the district, the assemblage of materials is on the following basis: It owns a strip of land 4 miles long and about a mile wide. At one end of this strip are its ore mines, as good as can he found on Red Mountain. At the other end are its coal entries. In the center are its furnaces. Connecting all is a standard gauge railway laid with 100-lb. steel, and using cars of 140,000-lb. capacity. This road connects at points less than a mile from, the furnaces, with ten trunk lines of railway. Another operating company starts the incline track carrying ore to its furnace mouths in a limestone quarry, suitable for flux. The advantage of this condition is neutralized, however, by the fact that none of these companies use any flux to speak of. Another company has five great blast furnaces in a row, some of them of 500 tons per day capacity. I think it is a fact that nowhere in the world outside of Birmingham can five great blast furnaces be found under single ownership in one, except at Gary.

There are in the state of Maryland four blast furnaces of a daily capacity of about 350 tons of pig iron each. All the iron produced in that state is made in these stacks. Sixty years ago Maryland had no less than 31 active furnaces and their combined capacity was 70,000 tons a year, or as much as the four now in blast can make in two months. All those old stacks, which averaged about six tons of iron per day, and whose ruins now dot the state, produced iron from brown ore banks that were then active, and all of which lay within a few miles of the stacks. In those days there were many stacks in the city of Baltimore and the ore to run them was mined within thirty miles of the city. Now those ore banks are deserted, and the four great furnaces of Baltimore receive their ore supplies from foreign mines situated more than 1,000 miles away on the Caribbean sea. The Lake Superior district is largely responsible for this and other similar changes in the iron trade.

In New York state there are large deposits of low grade magnetites running, say 40 per cent and better in iron, and up to 2 per cent and more in phosphorous, that are being made into a very high grade ore, both bessemer and non-bessemer, by the elimination of the gangue and of the contained apatite, which is the mineral carrying the phosphorus. They have produced so far, of magnetic ore from this Appalachian field, more than 35,000,000 tons, showing it to be a most important district. At Mineville they are now concentrating these 2 per cent phosphorus ores at the rate of a million tons a year, which is the capacity of their mines, and of their mills when working one shift per day. In these mills they are bringing their 40 per cent ore up to 63 and 65 per cent, and their 2 per cent of phosphorus they are reducing, for some grade, to .03 per cent, and they are making products that do not vary from month to month more than four or five one-thousandth of one per cent in their phosphorus content. Such close work seems almost uncanny. When one considers the vast tonnage probabilities in low grade magnetites on Lake Superior, now unused, he appreciates the opportunities for the application of such methods to the reserves of this region. At Mineville they are able to mine and concentrate on a commercial basis ores running a little better than 50 per cent that are taken out of a 12 ft. seam from 700 ft. underground.

RE-LINING NO. 2 HAMILTON SHAFT WITH REINFORCED DIVIDERS, END PLATES, AND POURED CONCRETE WALLS.

BY S. W. TARR, DULUTH, MINN.*

The No. 2 Hamilton (vertical) Shaft, Chapin Mine, at Iron Mountain, Mich., was sunk in 1891, as described in Volume XI, of the Proceedings of the Lake Superior Mining Institute, under title of "The Unwatering of the Hamilton and Ludington Mines" (page 139-147), by John T. Jones.

The original shaft consisted of six compartments, two for skips or bailers, 4 ft. 8 in. x 7 ft. 0 in., two for cages, 4 ft. 8 in. x 4 ft. 6 in., and two compartments for steam and column pipes for pumping, located in the end of the cage compartments, 4 ft. 8 in. x 2 ft. 0 in., as shown in Plate 1.

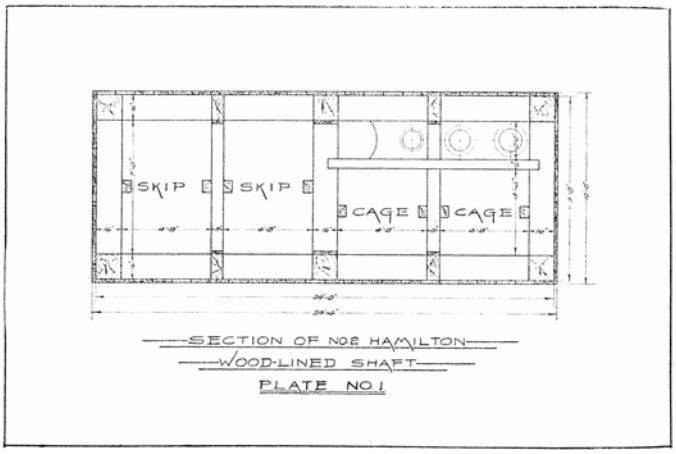


Plate 1. Original Shaft Before Enlarging and Relining

*Engineer of Construction, Oliver Iron Mining Company.

This shaft was lined with wood sets, consisting of 16 in. square timbers, spaced 6 ft. 2½ in. center to center, with wood stuttles and steel hanging bolt, the outside of which was lathed with 2 in plank, making a minimum opening to be cut in the rock of 10 ft. 0 in.x24 ft. 4 in. The timbers in this shaft, due to long service, became badly decayed, so that it was necessary to re-line the shaft or abandon it.

Early in the year 1911, it was decided to make the No. 2 Hamilton Shaft a permanent outlet to the Chapin Mine, and install in this shaft the permanent underground electrical centrifugal pumping equipment. It was, therefore, necessary to re-line this shaft from collar to bottom, a distance of 1,434 feet, and since there was a possibility of striking another vug of water in the underground workings at any time, provision had to be made in the design of re-lining so that bailers could be put in service on a very short notice. Since this shaft was to be the permanent outlet, provision has to be made for column pipes and transmission cables to transmit electric power to the underground pumps. To provide for these column pipes and transmission cables, it was necessary to increase the inside dimensions of the shaft from 7 ft. 0 in.x 21 ft. 4 in. to 9 ft. 0 in.x21 ft. 4 in., making the poured concrete wall 6 in. thick. Thus, the outside dimensions of the shaft were not increased over the original wood lined shaft. The shaft now consists of eight compartments, two for skips or bailers and two for cages, each 4 ft. 8 in.x6 ft. 4 in., three compartments for pipes and transmission cable and one for ladder, each 2 ft. 4 in.x4 ft. 8 in., with concrete slab partitions between cage and skip compartments, pipe and skip compartments, and ladder and skip compartments, as per Plate 2.

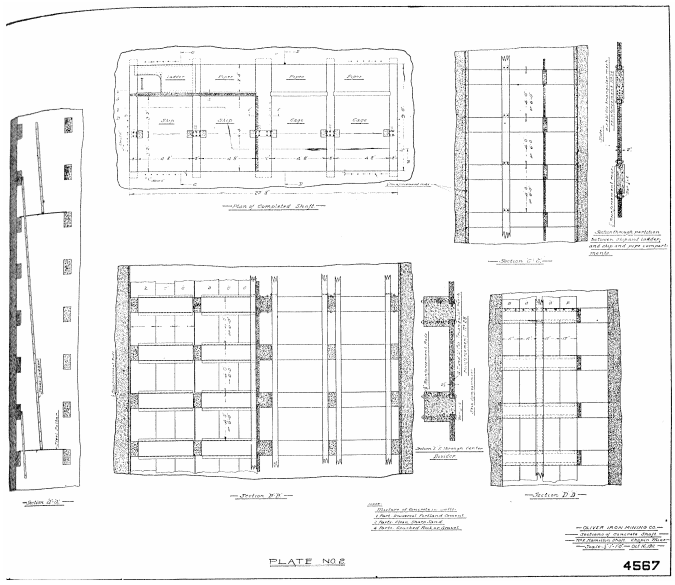


Plate 2. Sketch Showing Enlarged Shaft

Various methods of re-lining this shaft were considered, as follows:

1st. Re-lining with timber sets and wood lath, i. e. replacing the present sets.

2d. Re-lining with steel sets and wood lath.

3d. Re-lining with steel sets and reinforced concrete lath.

4th. Re-lining with steel sets, angle stuttles, and concrete poured walls.

5th. Re-lining with reinforced concrete dividers, end plates (made on surface), and poured concrete side walls.

The first and second schemes were neither fire-proof nor permanent; the third and fourth schemes were not considered practicable; the fifth scheme was adopted on account, of its permanent qualities, being strictly fire-proof and water-proof.

CONCRETE MIXING PLANT.

To economically make the reinforced concrete dividers. end plates and slabs, also the concrete for poured walls in shaft, a concrete mixing plant was built near the shaft, as shown on Plate 3. The mixing plant consists of a

crusher, bucket elevator, revolving screen, two concrete mixers, pocket divided into three divisions for sand, gravel and "over-size," and a drying room, equipped with an overhead hand traveling crane.

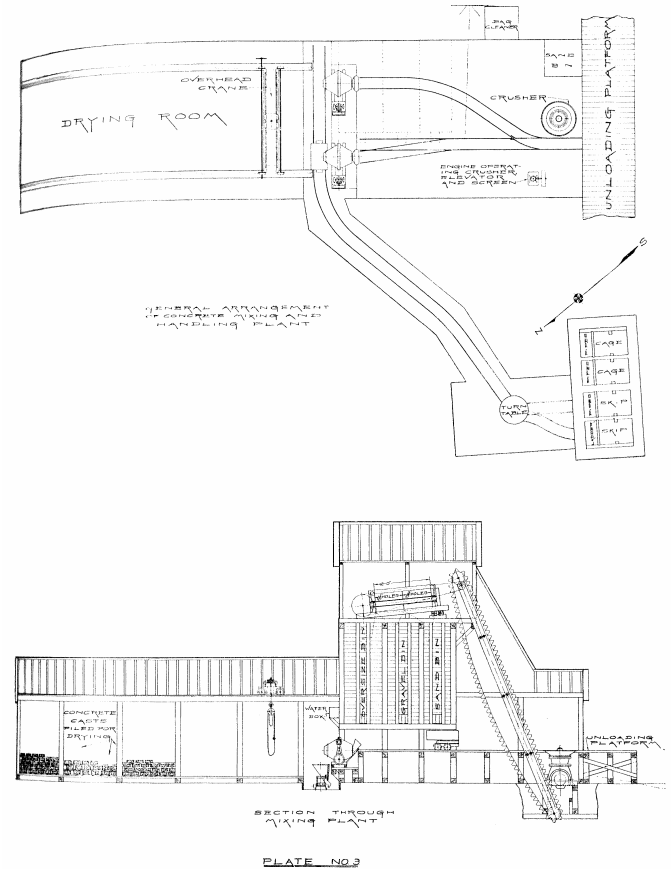


Plate 3. Concrete Mixing Plant

The material for these dividers, end plates and slabs is brought to the mixing plant from a nearby gravel pit in dump wagons. This gravel contains a large percentage of sand. The material from the wagons is dumped directly into the crusher. The product from the crusher is discharged, on to the bucket elevator which elevates it to the cylindrical revolving screen. This screen is divided into two sections. The first section is perforated with ⅜ in. diameter holes and the second section with 1⅛ in. diameter holes. All aggregate passing through the ⅜ in. diameter holes is termed as "sand" and all aggregate passing through the 1⅛ in. diameter holes is termed as "gravel." The material larger than this is termed "over-size." This "over-size" is used either for backfilling the concrete walls in the shaft or may be drawn out from the pocket into a tram car and returned to the crusher for recrushing. The concrete mixers used are Smith No. 1, of nine cubic feet capacity. The ingredients are brought to the mixer in tram cars. The body of the tram car is divided into three sections to hold the required amount of sand, gravel and cement, to give the proper mixture of one portion of cement, two portions of sand, and four of gravel, for the making of reinforced concrete dividers, end plates and slabs, and shaft wall. By moving under the sand and gravel spouts, the car is loaded with the proper portions of sand and gravel, and the required amount of cement is poured into the car from sacks. The loaded car is trammed to the mixer and contents dumped in same. A water measuring box is placed above each mixer, which discharges the proper amount of water into the batch to be mixed. The dividers, end plates and slabs are made in steel forms. These forms are placed beneath the mixer from which the concrete is poured directly into them. After the concrete has been in the forms a sufficient length of time to harden, the forms are removed and the moulds are picked up by the hand traveling crane and carried into the drying room, where they are cured. The design of reinforced concrete dividers, end plates and reinforced concrete slabs are shown in Plates 4 and 5. The steel forms for making the same are shown in Plates 6 and 7.

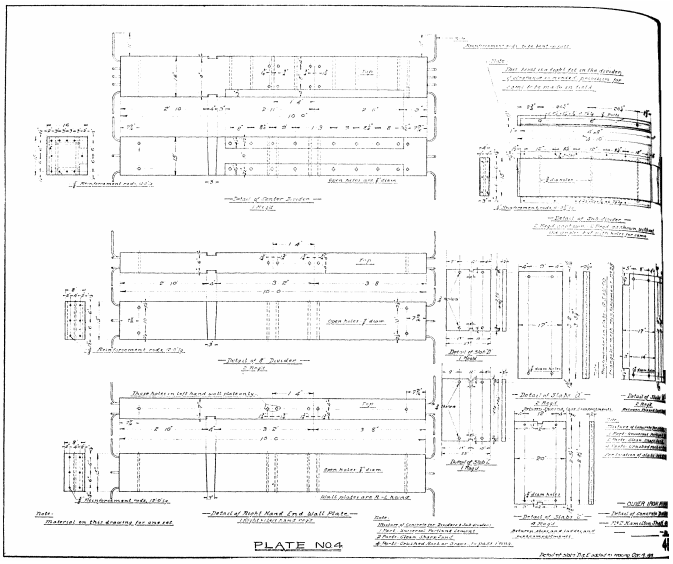


Plate 4. Detail of Concrete Dividers and Slabs

METHOD OF RE-LINING SHAFT WITH POURED CONCRETE.

The work of re-lining this shaft is done in sections. Each section is started on permanent bearers located to support the present limber shaft sets, and working upwards. A section of old timber, usually 12 ft., is removed and loaded on to the cages and hoisted to the surface, where it is unloaded on to ears and dumped into the cave nearby. The timber sets above these portions are supported by means of vertical columns with jack screws on the bottom, resting on 12x12 in. timber placed on the bearers. After the first 6-ft. section of concrete is poured, the 12x12 in; timbers are placed on the reinforced concrete dividers and end plates, which are supported on steel forms, as shown in Plate 8. The steel forms are made in sections, with recesses to support end plates and dividers spaced either 4 ft. or 6 ft. centers as shown in Plate 9. Since there are seven sets of steel forms, the footings to carry the weight of old timber sets will bear either on the permanent bearers or on at least five sets or 30 ft. of concrete, i. e., the support of the old timbers above does not depend upon green concrete. After the sections of steel forms, 6 ft. high, are lowered

in the cages and installed, the reinforced concrete dividers and end plates are lowered and placed in the recesses provided in the steel forms, and the ends bolted to the steel forms. These end plates and dividers serve as horizontal struts to hold the steel forms in position. When a section is placed, the vertical reinforcing rods are put in position in the wall, and the wall is now ready to be poured. The concrete for this shaft wall is mixed on the surface at the mixing plant and discharged into side dump steel cars, which are pushed by hand from the mixer to the shaft. A turn table is installed about 15 ft. from the shaft, tracks from which lead to both skip compartments. Cages are used in both of these compartments. The concrete car is run on to either of these cages from the turn table and lowered into the shaft. A revolving chute is attached to the spout of the car and the contents are discharged behind the forms to make the wall and properly tamped in place as shown in Plate 8. In places there are large crevices in the shaft. Where these crevices occur, they are filled to within 10 in. of the steel forms with large stones or rock from the over-size bin before the concrete is poured. The average amount of material for relining one 6-ft. vertical section of shaft is one cord of stone for backfilling 10 cu. yards of concrete, and 550 pounds of steel for reinforcing.

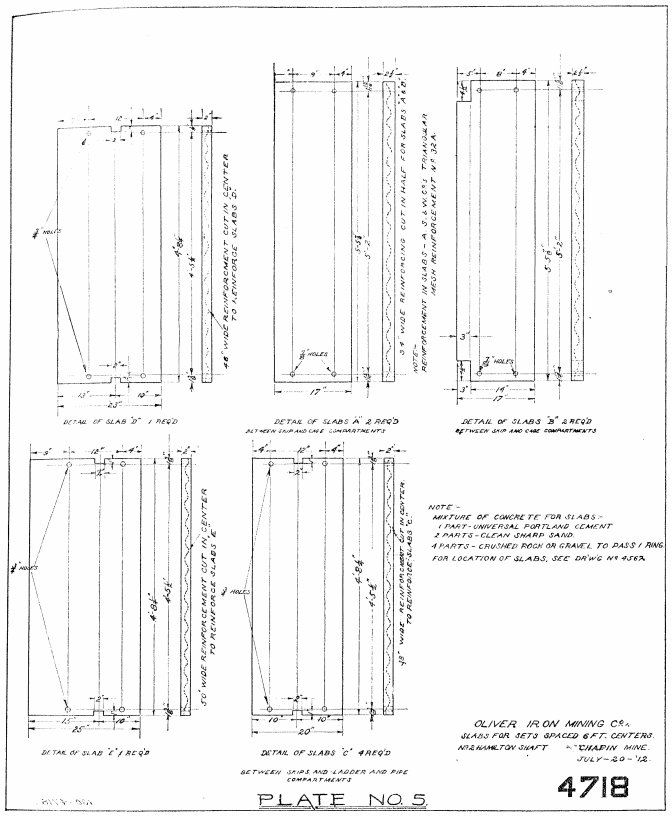


Plate 5. Detail of Concrete Slabs

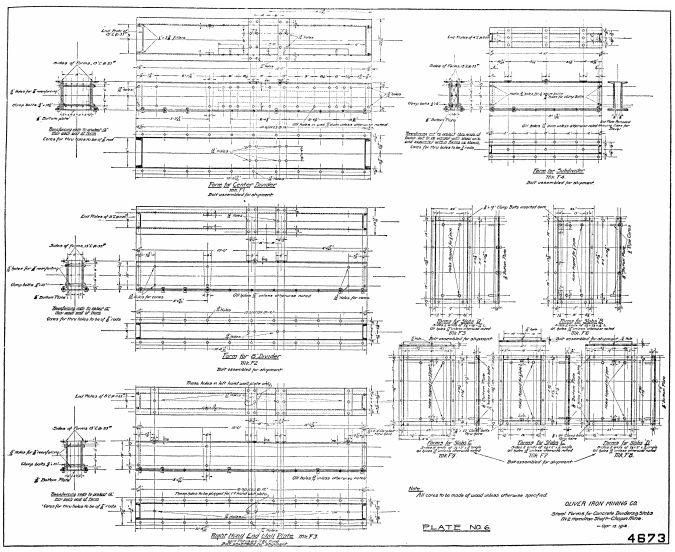


Plate 6. Steel Forms for Making Concrete Dividers and Slabs

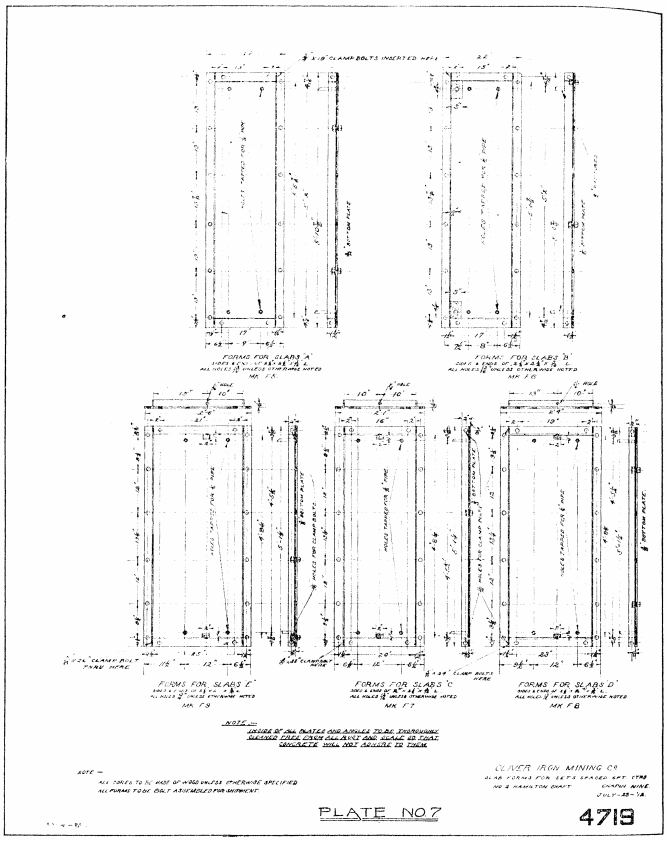


Plate 7. Steel Forms for Making Concrete Slabs

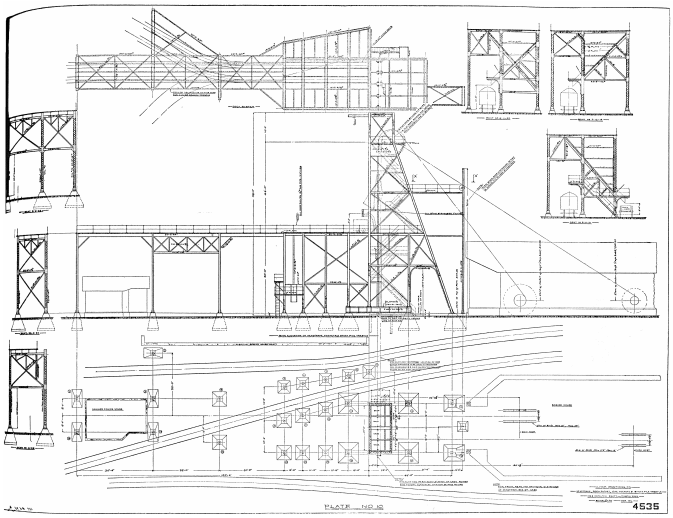


Plate 10. Detail of Hoisting and Lowering Material

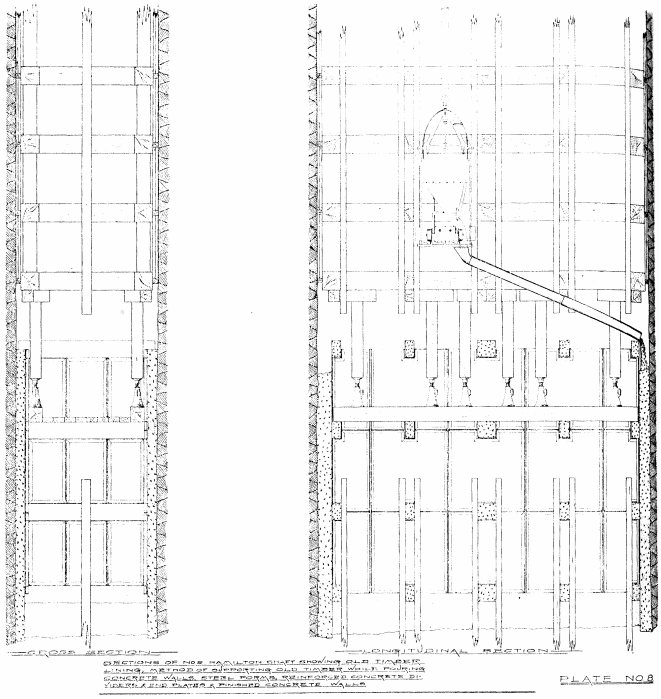


Plate 8. Showing Method of Pouring Concrete

NUMBER OF MEN EMPLOYED.

In removing old timber, five men are required to work below and one man at the collar to handle old timbers from the cage and dispose of same. The time required to remove one 6-ft. section varies according to the condition of the old material in the shaft. In placing steel forms, four men are required below and two at the collar to lower the forms on the cage. In pouring concrete, four men are required below and two men at the cellar. The above number of men does not include the shaft foreman, concrete foreman, hoisting engineer, or men working in the mixing plant, as these men do not spend all their time on this particular job. The re-lining work is carried on in three eight-hour shifts per day, and the average lime required to concrete 6 ft. of vertical shaft is 24 hours, or three shifts, which includes placing the forms, pouring concrete and removing an equal amount of forms. When the forms are removed, they are taken to the surface, thoroughly cleaned and given a coat of crude oil before they are used again.

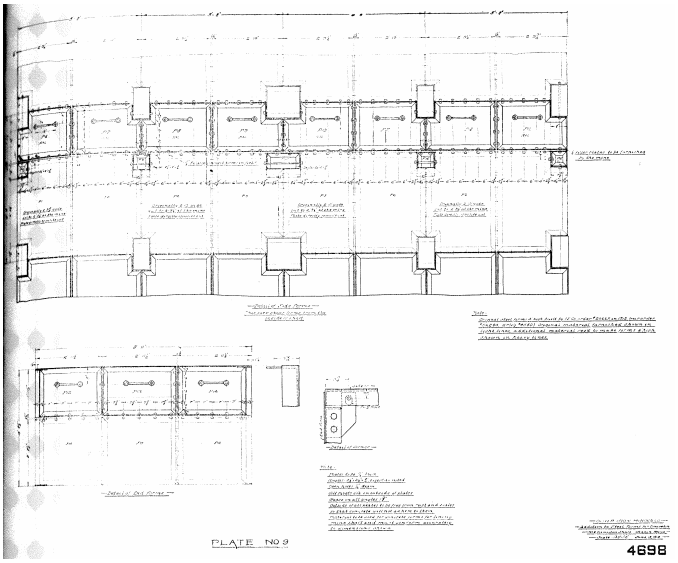


Plate 9. Steel Forms Made in Sections, With Recesses to Support End Plates and Dividers

All hoisting and lowering of material is done with the present reel hoists located in the No. 2 Hamilton engine house, as shown on Plate 10.

When it was decided to make this shaft a permanent outlet, a new steel headframe, stockpile trestle and idler stand were erected, as shown on Plate 10.

On account of the heavy flow of water in the underground working's at this shaft, it was necessary, in dismantling the old wooden head-frame and erecting the new steel head-frame, that this work he done in the smallest possible time, as bailers might have to be put in operation on very short notice. When it came time to make this change, the old wooden head-frame was dismantled and the new steel, one erected ready for hoisting in ten days. In the design of re-lining, the provision made for installing bailers on 24 hours' notice proved to be a good precaution, as a vug of water was encountered on October 22d, 1912, and the bailers were put in operation within 24 hours, thus preventing the flooding of the lower workings of the mine.

PROGRESS OF WORK.

The first portion of the work of re-lining this shaft was started 83 ft. 3 in below collar of shaft, on May 3d, 1912, and the concrete lining between this point and the collar was completed on June 29th, 1912. The second portion was started 302 ft. 7 in. below collar of shaft, on July 1st, 1912, and was connected to the first portion on October 5th, 1912. The third portion was started 551 ft. 3 in. below collar of shaft, on October 12th, 1912, and connected to the second portion March 15th, 1913. in this portion, the shaft work was discontinued from

October 22d to November 18th, 1912, on account of striking the vug of water on the 16th level. One week was also lost between January 11th and January 18th, 1913, on account of a slip of old timbers in the shaft. The fourth portion was started 695 ft. 7 in. below collar of shaft, on March 22nd, 1913, and was connected to the third portion on May 10, 1913. The fifth portion was started 917 ft. 4 in. below collar of shaft on May 17th, 1913, and to July 5th, 1913, 812 ft. 7 in. of the entire shaft have been completed. Weekly reports of the progress of this work are sent to the Chief Engineer's office, where a graphic report is kept, as shown on Plate 11.

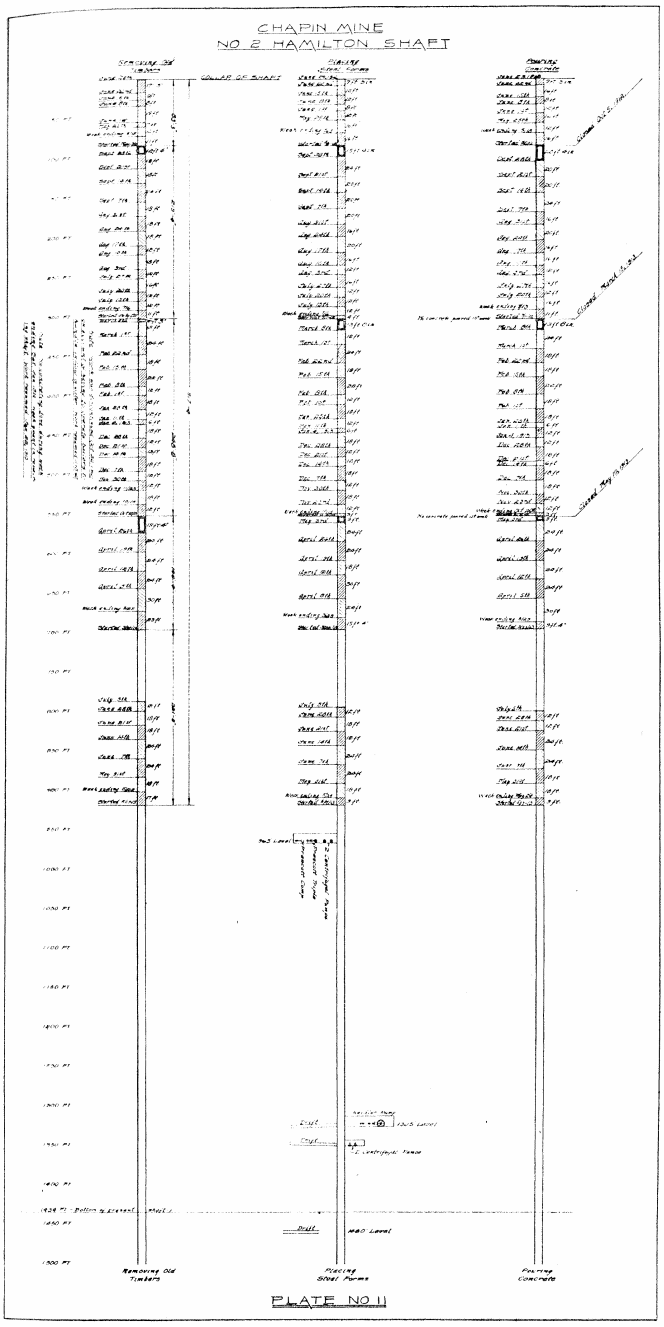


Plate 11. Showing Progress of Work

The average rate of progress since the beginning, without deducting the time due to delays, is 56.7 ft per month, or 63 ft. per month for actual working time. The progress for the past month was 72 feet. The preliminary estimate was based on re-lining 100 ft. per month. The old shaft timbers however, were in far worse condition than could possibly be anticipated, and the slower progress has been due entirely to the difficulty in removing the old timbers and the precautions required to protect the lives of the men who are employed on this work.

In the portion of shaft completed to date, all the work has proven perfectly satisfactory and entirely up to expectations. The walls are smooth and waterproof. The reinforced concrete dividers and end plates come from the steel forms perfectly true, straight and smooth, and fit perfectly in the recesses provided in the steel forms.

All cement used in the construction of this shaft lining was furnished by the Universal Portland Cement Company, and the steel forms, reinforcing rods, steel head-frame, stockpile trestle and idler stand were furnished by the American Bridge Company.

SUGGESTIONS ON THE APPLICATION OF EFFICIENCY METHODS TO MINING.

BY C. M. LEONARD, GWINN, MICHIGAN.

The original application of the term "Efficiency" was made to machinery and was represented by the work accomplished, divided by the energy expended. This result in the older type of machines was very low and men specially trained, made a study of the application of power and the results and by some small change in the organization of an engine, the use of a different type of valve, the use of the condenser, etc., have increased this factor several hundred per cent.

In 1883, Fred W. Taylor realized that the efficiency of human energy was low, began to analyze operating conditions and the result of this analysis is one of the prime factors which enables American industrial labor to earn more per day than in any other country and American manufacturers to sell their products at a profit in countries where labor receives but 40 to 50 per cent of what it receives in this country.

Until a comparatively recent date, efficiency engineering was confined to industrial plants and construction work. The results obtained in these lines has suggested its application to mining and from the very nature of the necessary working conditions in mining, it would seem that even greater results might he looked for than in other industries.

The cost of production in mining may be divided into two parts, viz: Supplies and Labor. Of these the latter is the larger.

Supplies—