In our experience the latter feature is much the more important and from results of our drilling I should not say that the great majority of drill holes deviate either North or South in all districts. If the strata are flat and uniform the holes may do so but if the strata dip steeply this is not the case. In one district where the dip is steep we are certain of the course of 14 holes which deviated from the vertical and these are shown in Figure 15. Of these holes one went approximately North, one approximately South, one Northeast, five Northwest, one Southeast and five Southwest. Putting it in another way seven deviated to the North and seven to the South, while two deviated to the East and ten to the West. If these results show anything they only show that the majority of the holes deviated to the West, but equally to the Northwest and Southwest.

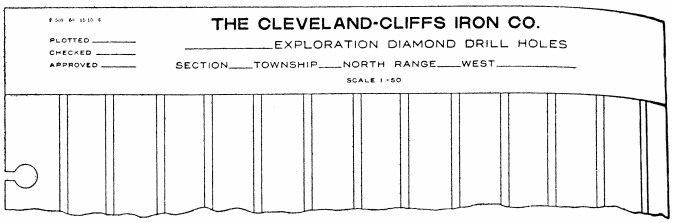


FIG. 14

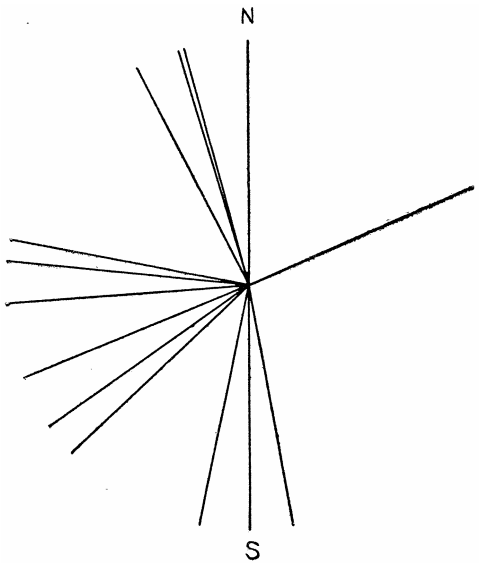


FIG. 15

It is very difficult to keep vertical diamond drill holes straight and I believe that a hole can be located with more assurance of striking a certain point in depth if it is given an inclination of 85° against a steeply dipping formation than if it is started vertical. We have only drilled two holes with this inclination, with results as follows:

Depth.	No. 1.	No. 2.
At surface	85°	85½°
At ledge	86°	86½°
200′	86°	
400′	85°	87¾°
500′	87½°	
600′	87°	
800′		88½°
1200′		85½°

These two holes are not enough to generalize upon but they certainly kept straighter than vertical holes in the same district. In addition to that we knew in which direction the holes were going, which we do not know when we start a vertical hole. In my article in the Engineering & Mining Journal of September 17th, 1910, I gave a series of curves showing the curvature to be expected in an inclined hole when dipping against a steep jasper formation. I would change the curve for a hole started at 85°, as that seems to be a critical angle under these conditions and the hole does not flatten as would be expected.

In view of the sometimes surprising curvature of drill holes I feel that all holes should be tested for both course and inclination at 100 ft. or 200 ft. intervals, whether started vertical or an an angle, otherwise there is not telling where the ore or other strata cut really occur. We recently started a vertical hole which at a depth of 800 ft. was found to have an inclination of only 51 ° from the horizontal. Another hole started at an angle N54°W was found to be running N64°E at the bottom.

SOCIAL SURROUNDINGS OF THE MINE EMPLOYE

BY CHARLES E. LAWRENCE, IRON MOUNTAIN, MICH.

In this period of time the magazines and newspapers call our attention to “Progress in Peace.” One of the historical events of the movement is the recent treaty of the Empire of Great Britain and the United States of America, including France, signed by President Taft and the ambassadors of these nations. As the United States leads in the art of peace in contrast to war, as it effects nations at large, I call your respectful attention to the advancing of the peaceful welfare of the mine employes, in comparison to former careless and indifferent treatment.

These local conditions are passing through an experimental stage, and only the future period of time can determine the correctness of this mode of action. The mining territory of the Lake Superior district is composed of a large European population, coming from all countries, who have only their labor to give, lacking in personal wealth, or educational refinement, to make their lives pleasant and peaceful, or in other words, leading a hard pioneer life. With this view the present laws of labor, society and governments begin to change these foreigner’s lives and make American citizens. The laws of personal freedom, exercised here under pioneer conditions, are misused, and misjudged, and make for abuses, largely through ignorance, and demand constant vigilance, supervision and care on the part of all good Americans, to guide these foreigners in the right channels of thought and action, toward each other.

In the proper consideration of this broad civic duty, and its many relations, we come to its bearing as to mining.

The labor cost is usually the greatest charge in products, and applied to mining, from two-thirds (2-3) to three-fourths (3-4) is a probable rate. We, therefore, should give to it the most consideration. We have, in the operation of mining: First, experts in the securing or winning of the mineral in the ground, represented by our mining captains; second, experts of machinery; third, experts in geology; and fourth, expert secretaries and auditors. But can we say truly that we have experts for the handling, care and study of labor? I think you will all agree with me that it is the one item which has been seriously neglected.

AM I MY BROTHER'S KEEPER?

Yes! When it is a serious financial question of two-thirds of the cost of mining ore in the district.

Yes! When you consider it financially, morally or from a broad civic view, as this is the object of government.

Labor, which is another name for the man, who must first lake care of himself in dangerous places of mine operation; who must handle tools and machinery properly, who must do it ten hours on the job and keep it up for three hundred days of the year, and for several years. Labor is the man from Europe, be he Finn, Swede, German, Russian, Austrian or Italian.

Labor, under this consideration, primarily answered is "That I am my brother's keeper," will assist materially to aid ns in the mining of ore, cheaper, easier, pleasanter, and help rob the vocation of mining of its danger or fear and instilling a contrasting satisfaction of safety and relief of anxious care.

HOW SHALL WE BEGIN?

First. In having every kind of safety device, as applied to mining and machinery, with a competent surgeon and a trained corp of employes to act as first aid to the injured.

Second. In not allowing men to work two or three shifts continuously and without rest, which over-taxes their physical strength, also, to have a true knowledge of mine conditions.

Third. By compulsory accident funds and pension systems.

Fourth. By providing good sanitary houses and surroundings, with a social center typified by a club house.

By going into detail classification of these four genera I divisions, we find:

First. Safety devices. The last few years a deluge of valuable ideas have been put in vogue as regards machinery and the application of the same to the working parts, to save accidents and injury. In mining it is not so easy. The safety committee, composed of from three to five employes of average intelligence, at each mine, could easily criticise all dangerous places, and have them properly fixed to save injury. Their report of criticism could be gone over by a meeting of bosses and employes, say once a month, and in this way, spread the general information of "Safety First," which makes a vital, live subject in which each and all are interested. This spirit prevailing through the whole force of employes will save many injuries, due to general neglect or oversight, and help to make an amicable relation between nationalities where friction exists. Safety signs could be put up to call, attention, and renewed from time to time by changing the colors of placard. The surgeon plays a big role in the safety program. He could organize a class of employes who could render first aid to the injured, and who are constantly on the job, and supplied with splints for broken limbs, and a galvanized box containing sanitary antiseptic bandages. The money so spent is returned in many ways, by consistent care and interest, as a humane proposition, also in keeping in good shape the .tools and equipment for use around the mine, following closely all suggestions of the safety committee.

Second. Next to railroading, statistics classify mining as producing the greatest number of fatal accidents. As we stop and ponder why, we conclude (1) that a large number of men go down in the dark drifts and stopes who are young, without judgment and knowledge, lacking a proper understanding of the English language, in orders given by the mining capitain or his assistants, (2) careless fellow workers and partners, (3) lack of sufficient light to see how to perform the necessary work, (4) poor tools or dangerous conditions in working places, left so by the employes on the previous shift, (5) lack of knowledge of explosives, (6) long hours in bad air, and numerous other causes, all of which end fatally, and give to mining a careless indifference which is not seen in time to overcome, in the judgment used by green and ignorant employes, who take the risks in order to secure the higher wages for duties which they are not fitted to perform.

To avoid this, the mining captain should have a man constantly to study the employes, in their different nationalities, to round out the many sided phases presenting, and build up an organization to overcome the dangers constantly coming up by the new and changing conditions on each level.

Third. Every mine should be compelled to have an accident fund and a pension system. The vocation of mining will always be dangerous. Employes should contribute a part of their wages to the care of an accident fund and receive in this manner back an insurance fund, to help pay for the loss of time. Likewise, as the exhausting and arduous work shortens their lives, a pension system would sweeten and make pleasant old age, all of which could be systematically handled.

Fourth. Social surroundings. Wages being approximately equal, men will leave a property where there is an old or poor dry house, and go to a mine where there is one up-to-date, being supplied with proper washing facilities, such as cold and warm water,

shower baths and tubs, including individual lockers and sanitary arrangement to keep clean.

This humane phase, considered in its broad view, applies to the company houses, which can be kept clean and neat inside by a fresh coat of white wash or calsomine, once a year, and a coat of paint outside, and should also be supplied with fresh water and a small garden, with growing trees to make it look like a home. To encourage this latter idea and start it for a few years, prizes could be given for the best vegetable or flower gardens, also a small expenditure made in free seeds, to get the movement properly started.

With up-to-date schools, a church and a social center at which to congregate, such as a club house, it rounds out a complete whole in the lives of employes, around a mine. This latter may seem a luxury, but a club house, put up by the mining company, containing shower and tub baths, bowling alley, card tables, billiard and pool tables, combined with a reading room having various magazines and newspapers, with a pianola and graphophone, will take people out of the four wall of their homes at occasional times, and change their thoughts and form a silver lining to the clouds of their daily labor, done under dark and dirty conditions. This club house, kept always clean and cheerful, and used by wives one day of the week, also permission given to growing boys and girls on Sundays, has, in at least one case, proven of such value that the mining company are putting up a second one, at another of their properties.

The officer of the company whose duty it will he in the future to look after the men, could arrange with entertainment companies, such as colored minstrels, popular lecturers and singers, combined with moving picture or stereopticon shows, these to be interspersed to suit local conditions. This officer could conduct a night school which is a great demand at all mines by the foreigner who is anxious to read and write the English language. Last, but not least, a sympathetic nurse should be kept around a mine to assist in family sickness.

This whole subject simmers down to mutual and amicable relations of mine employes and the securing of same. The suggestions offered seem warranted and demanded, first, because of financial returns and second on civic humane grounds, also to change the small distorted ideas of the foreign laborer towards his employer to one of mutual respect and confidence, all of which will give a cheaper cost in the ore produced, clue to the amount of two-thirds or three-fourths entering same.

“All work and no play makes Jack a dull boy,” unless mine operators change the rut they have been running in for the past years. This can be accomplished on a joint basis more satisfactorily than is done singly.

Labor, sandwiched with some pleasant variations, is the ideal goal for all mankind.

Following statistics have been prepared by the officers of the Baltic Mine club, showing attendance from January 1st, 1909, to August 31st, 1911:

	Total Attendance.	Average Daily Attendance.	Total Baths.	Average Daily Baths.
1909—				
January	2,725	88	281	9
February	2,135	76	361	13
March	2,175	72	281	9
April	2,175	72	281	9
May	1,863	60	340	11
June	1,639	55	353	12
July	1,639	55	353	12
August	1,758	57	388	13
September	1,645	55	292	9
October	1,635	53	241	8
November	1,882	63	185	7
December	1,745	56	192	6
Average for year	23,016	63	3,548	10
1910—				
January	1,219	68	270	9
February	2,436	87	213	8
March	2,305	74	296	11
April	2,020	67	240	8
May	1,480	48	289	9
June	1,558	52	320	11
July	1,590	51	309	10
August	1,620	52	367	12
September	1,568	52	186	6
October	1,530	50	249	8
November	1,830	61	160	5
December	1,805	59	125	4
Average for year	20,961	59	3,024	9
1911—				
January	2,680	86	180	6
February	2,355	84	226	8
March	2,131	70	172	6
April	1,940	64	275	9
May	1,880	61	300	10
June	1,235	42	224	8
July	1,130	36	174	6
August	1,220	41	160	5
Av. for 8 months	14,571	60	1,711	8

TIMEKEEPING SYSTEM AND LABOR DISTRIBUTION AT THE NEWPORT MINE.

BY G. L. OLSON, IRONWOOD, MICH.

There has been installed at the Newport Mining Company, a system of keeping time and labor distribution, which might be termed, “In and Out clock check system,” with additional check made by actual observation of men while at work by field timekeeper and underground clerks, and it is the intention in this paper to outline briefly the methods used to obtain and collate all data in connection with the labor roll and distribution of labor charges.

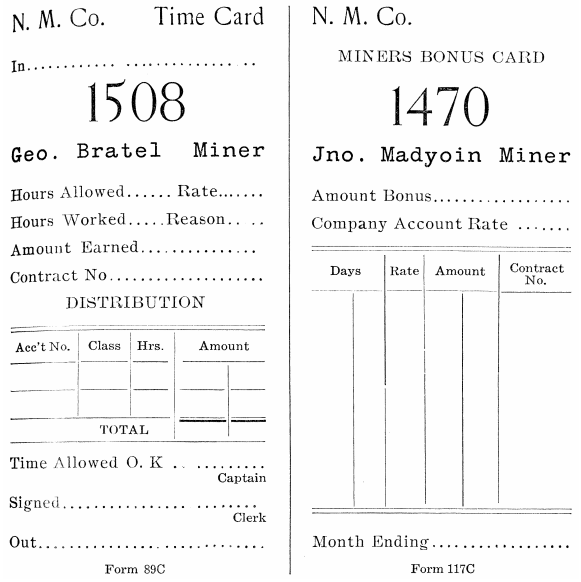
Both labor roll and distribution are assembled in what may be termed a cumulative roll, that is, on the labor roll the earnings of each man, each day, are added to his earnings for the previous day comprising the pay period, so that at any time we are able to see at a glance exactly what amount any or all employees have earned to date, and in a like manner by referring to distribution summaries, the total amounts chargeable to any particular item for the period to date may be ascertained. This feature of cumulative figures might be thought, at first, very complicated and unwieldy, but experience has

taught us that the operation is both simple and speedy. By availing ourselves of the various mechanical appliances now in use in all modern offices, such as time stamps, adding machines, addressographs, etc., all electrically operated, we have been able to reduce our expense in connection with the time department, and also remove to a very large degree the "human element" which is always an undesirable factor where actual time records are desired. In connection with speed attained by the use of these mechanical appliances and method of accumulative roll and distribution, we believe you will agree with us that the desired result is obtained when we state that at the Newport Mine the Time department is able to send to the General office the complete pay roll, checked and audited, and distribution of same (covering under normal conditions approximately 1,500 employes and 500 distribution accounts) eight hours after the completion of a month's operations. This is on account of showing the complete roll to date and balancing cumulative distribution of same each day as the month's work progresses, so that at the end of the period there is no necessity for making the extensions for the whole month on each individual, and large loss of time in endeavoring to balance a month's figures as obtained by the pay roll against the distribution charges to the various items comprised in the card of accounts. As a matter of fact, the ending of a month at the Newport has none of the usual terrors for the time and accounting departments which are so common at plants where the old systems are in vogue, the operation being almost exactly the same as any other day of the period, no extra work or overtime by the department being necessary.

We have also endeavored, to arrange all blanks used in the rime department so that the information placed on same by field timekeeper, underground clerks and foremen will be exact and give no confusion whatsoever when collected and recorded in the time office. Our pay roll and distribution sheets are ruled so that they will fit and tabulate on mechanical devices exactly.

We were fortunate at the Newport to have had this system of "In and Out checking" installed and perfected before building our new timekeeping office, and were able to arrange same so that the handling of checks and time cards to the men at the start and completion of the day's work is greatly facilitated by the arrangement of checking windows, alleyways, etc., and, if necessary, we are able to check men in or out at four different windows or bays, handling at the rate of approximately seventy-five men per minute. (See drawing of Captain's and Timekeeper's office, showing layout of checking windows, racks, alleyways, etc.) The equipment in the timekeeping department consists of the following, check and time card racks, same being interchangeable. That is, when checking the men in we have the time card racks in place, and when checking out, the brass check racks are in place. The brass check racks each hold 500 brass checks, and the time card racks each hold 250. In addition to this equipment, we have a time card filling bus which is divided into compartments and numbered, each compartment holding one month's supply of time cards. The time cards are filed daily in this bus and held there until the end of the month.

All men must come to the Timekeeper's Office before going to work (the underground men to be in their underground clothes) and present their brass checks at the window and receive, in turn, a time card (Form 89-C) on which the time that the employe checks in is stamped with electric time stamp. This card bears the man's name, occupation, and pay roll number, (number in large type), all of which information is printed by the Addressograph. As a general rule a weekly supply of these cards is printed and racked on card racks which are placed near the check window. The card provides for the insertion of the hours worked, rate, hours allowed and reasons, if change has been made, amount earned, contract number, distribution, and for the signature of the underground clerk. It also provides for the signature of foreman or captain as voucher for the extra time allowed.



N. M. Co. Time Card

In..... .....

1508

Geo. Bratel Miner

Hours Allowed..... Rate.....
Hours Worked.....Reason.. ..
Amount Earned.....
Contract No.....

DISTRIBUTION

Acc't No.	Class	Hrs.	Amount
TOTAL			

Time Allowed O. K .. ..
Captain
Signed..... .....
Clerk
Out.....

Form 89C

N. M. Co.

MINERS BONUS CARD

1470

Jno. Madyoin Miner

Amount Bonus.....
Company Account Rate .....

Days	Rate	Amount	Contract No.

Month Ending.....

Form 117C

All underground men carry these cards until seen by the underground clerk, who inserts the distribution, hours worked, rate, amount earned, contract number on the miners cards, and signs same, taking up the cards at each place of operation and giving them to the foreman in charge. The foreman in charge of each particular gang retains the cards until the end of the shift, at which time he stations himself near the shaft and returns them to the men. In this way the foreman is aware that all of his men have gone to the shaft. Owing to the inability of our underground clerks to make more than one trip per turn, on account of the large territory they cover, all underground time cards are marked with the number of hours constituting a shift. Should an underground man go to surface before the end of the shift, he must go to his foreman who re-marks the card as to actual hours worked and the employe then goes to the 15th level where a record is kept by the station man showing the man's number and the time that he goes to surface. These reports are furnished the chief timekeeper that he may verify the time appearing on the card. In this way

no employe can go to surface before quitting time and not check out immediately and still receive full time. In addition to the underground clerk's duties of marking time cards, they assist the foreman in ordering supplies and also relieve them of as much clerical work as possible in order to allow them a greater amount of time for supervision, inspection, etc.

The surface cards are marked in a like manner, except for mechanical department, teamsters, and surface laborers whose cards the distribution is not shown for the reason tint their time, being more or less divided, is taken care of by distribution tickets rendered by the foreman or clerk of the various shops. See forms 97-98-99-C. (White shop ticket for construction and red for ordinary repairs). The surface cards are marked on the second, or afternoon trip, of the surface timekeeper, the cards not being picked up and given to the foremen, but returned to the men.

At the end of the shift all men must exchange time cards at check windows for their brass checks (the underground men in underground clothes). These cards are then stamped with the out time by the electric time stamp, in the same manner as checking in. In addition to the surface time keeper and underground clerks marking the time cards, a record is kept by them in a time book showing the man's name, number, occupation, time worked, and carried under the various places of operation. This, time book serves as the mine record and whenever an employe leaves the service of the company, a notation is made in this book and the reason therefor. This time book is filed and is an easily accessible guide, in addition to the daily time card, for the settling of any questions that might arise regarding an employe. In order to be absolutely certain that all men check out, an inventory of the brass check board is taken in the morning and evening and any checks remaining after a shift is accounted for by inquiries made of the foreman by the timekeeper. The explanation for these checks remaining on. the board is inserted, on a regular form (CI-178) kept in the timekeeper's office and thus furnishes information to captains for others interested as to reason of employe not checking out at the usual time.

The next step is the method of getting and handling distribution. As explained above, all distribution for mechanical department, teamsters, and surface laborers, is reported by tickets. These tickets give a full description of the work, pay roll number of the man who did the work rate, and also on the shop tickets the shop in which the work was performed. The tickets are sent to the timekeepers' office at the end of each shift and extended and checked against the above enumerated departments.

After getting the distribution of the mechanical men, the time cards for all others are arranged according to the card of accounts and entered on a working sheet, (Form CI-48), for the puspose of assembling all charges against each account. Instead of entering the total amount under each sub-division, the days and rates are entered. This form (CI-48) is also used in compiling the daily summary of men employed (CI-17) which will be mentioned later. When these are extended, the total of the distribution should agree with the total of the time cards. From the working sheet the distribution shown thereon is posted to the regular distribution sheets which carry the accumulative total against each account.

Shop Order No._____ NEWPORT MINING CO. REPAIRS

NEWPORT MINE

_____ Shop WORK TICKET Account No. _____

Date _____ 19

Pay Roll No.	Description of Work	Dept.	Hours	Rate	Amount

Time Started _____

Time Completed _____ Foreman

Form 97C—Red—(Reduced)

Shop Order No._____ NEWPORT MINING CO. CONSTRUCTION

NEWPORT MINE

_____ Shop WORK TICKET Account No. _____

Date _____ 19

Pay Roll No.	Description of Work	Dept.	Time	Amonnt

Time Started _____

Time Completed _____ Foreman

Form 98C—White—(Reduced)

_____ NEWPORT MINING CO.

Dis. of Surface Time NEWPORT MINE Account No. _____

Date _____ 19

Pay Roll No.	Description of Work	Dept.	Hours	Amount

Form 99C—(Reduced) Foreman

NEWPORT MINING COMPANY

NEWPORT MINE

Record of Brass Checks in Check Boards

Ironwood, Mich., _____ 191

7:00 A. M.		7:00 P. M.		3:00 P. M. to 10:00 P. M.	
Check No.	Reason for Check in Board	Check No.	Reason for Check in Board	Check No.	Reason for Check in Board

Form CI-178—(Reduced)

Daily Total - -
Previous Total -
To Date Total -

Date.....

Sheet No.....

LABOR DISTRIBUTION

Account	Days.	Hrs.	Rate	Amount	Total Amount	Account	Days.	Hrs.	Rate	Amount	Total Amount	Account	Days.	Hrs.	Rate	Amount	Total Amount

Form CI-48 (Reduced) (Sheets arranged for loose leaf binder.)

THE NEWPORT MINING COMPANY

Daily Summary Men Employed ....191 .....

LOCATION		D SHAFT						K Shaft	
		Ore		Rock		Main Levels			
SURFACE	UNDERGROUND		Total		Total		Total	Total D	Total K / Grand Total
Mgr., Supt. and Mach. Eng.	Capts. and Assts.	Under this head there is space for 13 columns		Under this head is space for 5 columns		Under this head is space for 6 columns		Under this head is space for 12 columns	
Acct., Clerks and Timekrs.	Shift Foremen								
Safety Insp'ct'r and Interp.	Trammer Foremen								
Mining Engin'r and Assts.	Clerks								
Chief Chemist and Assts.	Timb. Forem'n & Assts.								
Samplers	Timber Miners								
Grinders	Timber Trammers								
Watchmen	Skiproad Inspectors								
Janitors	Shaft Repair Foreman								
Stablemen	Shaft Repair Men								
Surface Foremen & Assts.	Skip Tenders								
Lander Foremen	Chute Tenders								
Ore Landers	Motormen								
Timber Landers	Swampers								
Dry Tenders	Dumpers								
Timber Unloaders	Car Repair								
Timber Framers	Track Foremen								
Teamsters	Trackmen								
Surface Laborers	Track Cleaners								
Motormen	Door Boys								
Puffermen	Bell Boys								
Rope Inspectors	Switch Tenders								
Master Mechanics	Powdermen								
Machinists and Helpers	Car Oilers								
Pipe Foreman	Water Boys								
Pipe Fitters	Pumpmen								
Carpenter Foremen	Pipe Fitters								
Carpenters and Helpers	Fire Patrolmen								
Blacksmith Foreman	Pump Foreman								
Blacksmiths and Helpers	Puffermen								
Chief Electrician	Ventilation								
Electricians and Helpers	Skip Pit Cleaners								
Steam Shovel Crew									
Watching Engineers	New Construction								
Hoisting Engineers									
Wipers									
Oilers									
Comp'rs & Dynamo Engrs.	Total								
Boiler House Firemen									
Ash Wheelers									
Elevatormen	Trammers Day								
Coal Handlers	Trammers Night								
P'mp Sta. Eng's & Firem'n	Total								
Decker Engineer									
Deckers									
Lagging Unloaders	Miners Day								
Loco Craneman	Miners Night								
Fire Patrolmen	Total								
New Construction									
Total Surface									
Grand Total For 24 Hours									

Total Surface

Grand Total

Form CI-17—(Reduced).

The time cards are then arranged in numerical order for the purpose of entering same on the pay roll. The cards are added in series of thirties, constituting a pay roll sheet. When all the cards have been added in this manner, they are then posted to the pay roll sheet accumulative, and each sheet is balanced by adding the previous total as shown on the pay roll sheet to the total on the adding machine tape. The miners are carried on the pay roll at company account rate throughout the month, and at the end of each month the difference between the amount earned by contract and that carried on the roll is added to the earnings of each miner. This difference, or bonus as it might be termed, is posted from the contract sheets to bonus card (Form 117-C) on which name and number, (number in large type), is printed by the Addressograph. These bonus cards are filed with the other cards and after the due bills have been made out and checked against the pay roll, which is an additional check and serves as an audit of the pay roll, they are boxed and stored away for future reference. The total accumulative shown on pay roll sheets and distribution sheets must at all times balance.

From the working sheet (CI.-48) a report is made out daily (Form 103-C) which shows the charges for the day and total for month to date against each account, as per the card of accounts. This report is forwarded to the General Office and at all times is hi balance with the pay roll.

NEWPORT MINING COMPANY

NEWPORT MINE

Daily Report of Labor for ..... and to date

		D Shaft	K Shaft	Total this Date	Total to Date D	Total to Date K	Grand Total to Date
1	Mine General Expense						
20	Steam Expense						
30	Water Expense						
40	Electric Light and Power						
50	Compressed Air Expense						
60	Laboratory Expense						
70	Stable Expense						
80	Shop Expense						
140	Surface Expense						
190	Dry Expense						
210	Handling Supplies						
	Total Indirect Charges						
90	Hoisting Ore Expense						
100	Bradford Breaker						
110	Rock Pile Expense						
120	Stocking Ore Expense						
130	Loading Ore Expense						
150	Underground Expense						
160	Operating Main Levels						
170	Mining Sub Levels						
200	Pumping						
300	Opening Main Levels						
320	Sinking Shaft						
	Total Direct Charges						
S. R. No.							
S. R. No.							
S. R. No.							
S. R. No.							
S. R. No.							
S. R. No.							
S. R. No.							
S. R. No.							
S. R. No.							
S. R. No.							
	Total Special Repair						
	Total Operation Charges						
S. O. No.							
S. O. No.							
S. O. No.							
S. O. No.							
S. O. No.							
S. O. No.							
S. O. No.							
S. O. No.							
S. O. No.							
S. O. No.							
	Total Shop Order						
	Bush Stores In Account with						
	GRAND TOTAL						

Form 103-C—(Reduced)

In addition to the complete roll which is forwarded to the General Office at the end of the month, we are able to furnish the mine management each day, from data assembled by methods herein described, the total cost of each day's operation in each division of the plant, giving as complete detail as necessary, as well as the cost for month to date, in this manner it any particular account shows an. excessive cost, steps can be taken immediately to ascertain the reason therefor and remedied if possible. This daily cost is shown on Form CI-103. It will be noted that this cost is complete, including materials and other information, as we carry our supply disbursements and various other plant data on the same cumulative plan as labor. From the working labor distribution sheet, Form CI-48, as mentioned above, we are able to make up complete data showing number of men and just where employed each day on a

general force report, (CI-17), by which the management is being accurately informed as to exact location of every man employed, and any changes in the organization from day to day is noted from Form C-171 made from CI-48.

NEWPORT MINING COMPANY
NEWPORT MINE

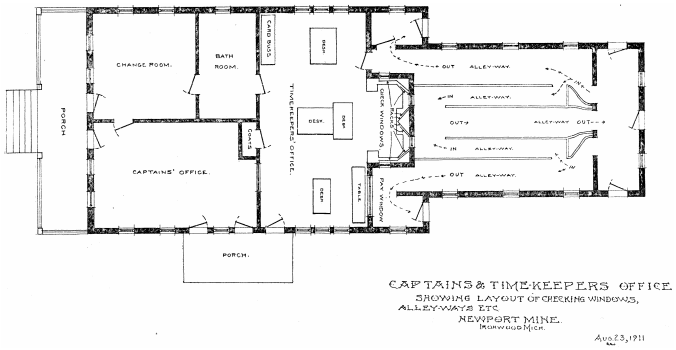
Daily Cost Statement for _____ and to date

	Labor	Cost per ton	Material	Cost per ton	Total for day	Cost per ton	Total to Date	Cost per ton
Mine General Expense								
Steam Expense								
Water Expense								
Electric Light & Power Expense								
Compressed Air Expense								
Laboratory Expense								
Stable "								
Shop "								
Surface "								
Dry								
Handling Supplies								
Total Indirect								
Hoisting Expense								
Rock Pile "								
Stocking Ore "								
Loading Ore "								
Underground "								
Pumping								
Mining Sub Levels								
Operating Main Levels								
Opening "								
Sinking Shaft								
Sinking Winze								
Locomotive Crane Expense								
Hauling Timber								
Load & Unload Cages								
Total Direct								
Spec. Rep. No.								
" "								
" "								
" "								
Total Special Repairs								
GRAND TOTAL								

MEMORANDUM

Tons Produced
Electric Power Output
" " "D" Line
" " "K" Line
Total Weight of Water Evaporated at Deg. F.
" " of Coal Consumed
Lbs. of Water Evaporated per lb. of Coal
Average Feed Water Temperature
Average Steam Pressure
Boiler Horsepower in Service
Total Horsepower Developed per cent. of Rating
Total Horsepower Developed per hour
Equivalent weight of Water evaporated from and at 212 Deg. F
Cost per ton Explosive
Lbs. of powder per ton produced
Tons of ore per lb. of powder
Nos. of sleighs Timber from Timber Operation
" " Lagging " "
No. of Candles per man

Form CI 103—(Reduced)



CAPTAINS & TIMEKEEPERS OFFICE.
SHOWING LAYOUT OF CHECKING WINDOWS, ALLEY-WAYS ETC.
NEWPORT MINE.
Ironwood Mich.
Aug 23, 1911

We pay our employes once per month using bank checks drawn on pay roll account as a medium of settlement, and, as the names on these checks as well as on our due bills or receipt time cards, and pay roll, are all printed by the Addressograph, it removes all possibility of the oft-times ludicrous and sometimes serious evolution of employes' names which is always cropping out when the names are transcribed from mouth to mouth, by long hand or even typewriter.

At the close of each pay period, a remainder roll is compiled (Form 84-C) which includes all uncalled for pay checks. A copy of this remainder roll is sent to the Chief Timekeeper for his reference.

In the event that an employe does not receive his check on the regular pay day, he must go to the Timekeeper's Office where he secures, upon request, Claim for Remainder Checks filled out (Form 81-C) and upon presentation of this claim together with his brass check to the Paymaster, he receives his check.

An employe leaving the service of the Company during the month receives from the foreman a settlement slip (Form CI-76), and presents same to the timekeeper's office. This slip is then filled out from the employe's time cards which are filed in the Card bus and checked with the pay roll. It is then returned to the employe who presents same to the Paymaster's Office, which is located in the main office building, where, in turn, a bank check is drawn on the Pay Roll Account and given to the employe on presentation of his brass check. This brass check is retained by the Paymaster and returned to the timekeeper's office for future use.

NEWPORT MINING COMPANY
NEWPORT MINE

DETAIL OF SUMMARY OF MEN EMPLOYED Ironwood, Mich.. _____ 191

PRODUCING OCCUPATIONS	Standard	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total	Amount	Rate
Gen. Mgr. Supt. and Mech. Engr																					
Acct. Clerks and Timekeepers																					
Telephone Operators																					
Janitor																					
Safety Insptr. and Intrprtr.																					
Watchmen																					
Engineers and Draftsmen																					
TOTAL MINE GEN. EXPENSE																					
Superintendence																					
Unloading Fuel																					
Coal Handlers																					
Elevator Men																					
Firemen																					
Ash Wheelers																					
Boiler Washers and Helpers																					
All Other Producing Labor																					
TOTAL STEAM EXPENSE "A"																					
Superintendence																					
Unloading Fuel																					
Coal Handlers																					
Firemen																					
Ash Wheelers																					
Boiler Washers and Helpers																					
All Other Producing Labor																					
TOTAL STEAM EXPENSE "B"																					
(Continued Per Card of Accounts)																					

These columns continued up to 31

Form CI-171—(Reduced)

NEWPORT MINING COMPANY

Uncalled for Pay Checks for Month of _____ 19

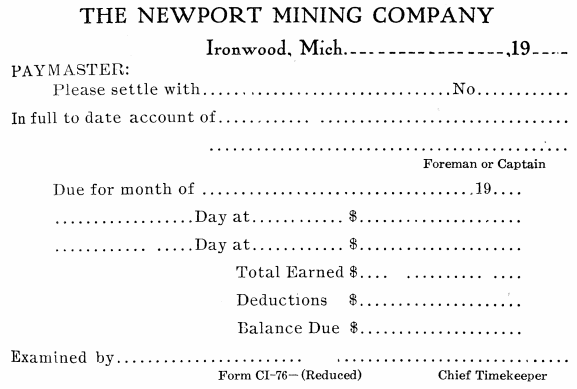
NAME	Pay Roll No.	Check No.	Amount	Paid

Form 84C—(Reduced)

NEWPORT MINING COMPANY
Claim for Remainder Checks

Date .....
Name .....
Payroll Number .....
Month .....
Identified by .....
Signed .....

Form 81 C—(Reduced) Chief Timekeeper



THE NEWPORT MINING COMPANY

Ironwood, Mich.----------,19----

PAYMASTER:

Please settle with.....No.....

In full to date account of..... .....

.....

Foreman or Captain

Due for month of .....19....

.....Day at..... $.....

....Day at..... $.....

Total Earned $.... ....

Deductions $.....

Balance Due $.....

Examined by..... .....

Form CI-76—(Reduced) Chief Timekeeper

It has not been my intention to enter largely into discussion and method of time distribution and costs, but as both are interwoven so closely with "Timekeeping," it has been almost impossible to differentiate in this paper, and I might add that we are making a distribution of both labor and supplies on a card of accounts which is so simply "keyed" that it is possible for the accounting department, with hardly any extra cost to the department or mine, to furnish a comparative cost of mining ore per ton for each sub-level, as well as complete parallel detail of each main level operation, the cost of development or both per foot and per ton of ore recovered and developed, etc.

Departmental exhibits are also furnished wherein cost of each department is shown on its own particular unit, such as Boiler House expense per Boiler horse power developed—Light and Power in kilowatt hours—Stable expense in number of Horse days worked, etc., and it is believed that the care exercised in the first operation of gathering the data in connection with each man's time is more than repaid in die results achieved by an intelligent and complete exhibit of monthly costs furnished to the management almost immediately after the completion of a month's business.

SQUARE SET MINING AT THE VULCAN MINES.

BY FLOYD L. BURR, VULCAN, MICH.

Since the invention of the square set system of timbering by Phillip Deidesheimer in 1860, at the Ophir mine of the Cornslock Lode in Nevada, it has been used under widely varying conditions in many districts and may be considered to possess in a very marked degree the qualities of safety, thoroughness and general conservatism; while it is always open to criticism on the score of expense. Being used under such varying conditions and by men with widely varying ideas, it is not surprising to find very considerable differences in the dimensions of the timber, the detail of the joints and the general application of the system.

This square set timbering was developed to take the place of simple props when the Ophir mine vein suddenly widened out with depth from 4 feet to about 70 feet. It was of course, entirely impracticable to span such a width between the hanging and foot walls with a one-piece prop or stull timber and in order to produce what would be in effect a prop made up of several pieces, the square set scheme was devised. The idea was that the compressive stress due to the weight of the hanging wall would be resisted by a series of "caps" butting against each other and held in alignment by other members acting at the joints. This conception of the function of the caps makes them the principal members, the others being more of the nature of auxiliaries. Probably this condition is most nearly true in case of steep dips. However, in the use of the system in general, there are places where the "legs" or the "dividers" may have to carry the heaviest load and indeed they must always carry certain considerable components of the main loads. It must also be borne in mind that the timber is used incidentally as staging from which to carry on the work of mining and to support temporarily considerable amounts of broken ore. These incidental functions of the timbers may indeed have a strong bearing on their manner of use and in the selection of sizes.

There are many systems of details for framing the ends of the pieces to form the joints, depending on the conditions of pressure, cost, facilities for framing, etc., as these conditions appear to the man who directs the mining operations-but it is my belief that timbering is carried out too generally by a blind following of the local time-honored method with little consideration of the actual requirements. To design a joint scientifically, one must first decide as to the magnitude and direction of the pressure and stress to be resisted and then dispose the timber in such a way as to best serve the purpose, it being of paramount importance to remember that timber is about five times as strong to resist compression along the grain as it is across the grain.

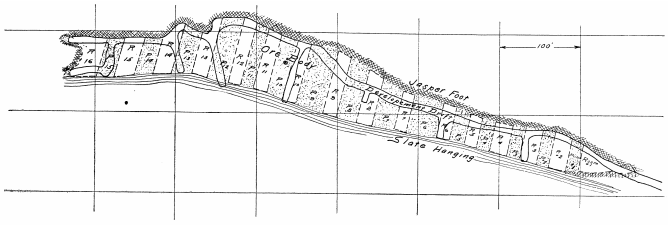
This square set system of timbering has made possible and given rise to a number of square set systems of mining. That in use by the Penn Iron Mining company at its Vulcan mines might be called the "square set room and pillar" system of mining. There are several other mining methods in use at these mines, the most notable of them being the "top slicing" system, which is sometimes used independently, but more often as an auxiliary to the square set work to mine out the ore pillars left between the square setted rooms. In the mining of soft or medium ores, the square set room and pillar method is applicable where the ore body is too wide for stull timbers; where it is so irregular in shape that in following out the limits of the ore the width is liable to vary greatly and unexpectedly; where the condition of the rock back is such that it will not cave clown successfully for the top slicing method; where caving methods in general cannot be used for fear of destroying valuable or essential surface works; where previous operations have rendered underground conditions unfit for caving methods; where it is necessary to begin mining on several levels at once instead of progressing only from the top downward; where the output must be forced in quantity or in date; where it is considered

essential to recover with certainty all the ore; and in general where conservatism is the ruling factor.

Due to the existence of some of the above conditions at Vulcan, the system has been quite generally used there. Levels usually established at 100 foot intervals and when the ore body is encountered the drift is continued throughout the length of the ore, there being no regular practice as to following the foot or hanging walls or drifting in the middle. Some Crosscutting is done at irregular intervals, thus defining the general limits of the ore body. Frequently raises are driven upward to connect with the level above for ventilation and for lowering timber.

In beginning the mining operation a line for the timbering is chosen, sometimes paralleling the timberwork on the level above and sometimes being a line parallel to the longitudinal axis of the ore body as nearly as may be approximated from the development done. When there are pillars of ore still unmined on the level above, it is of course considered essential to keep that in mind in the laying out of rooms and pillars, which comes next in sequence. At right angles to this longitudinal line which has been chosen for the timbering, rooms are laid out. These rooms are made from two to four sets, or from 14 feet 10 inches to 29 feet 8 inches wide and their length is of course the width of the ore body. The intervening pillars vary in width from two sets to five sets.

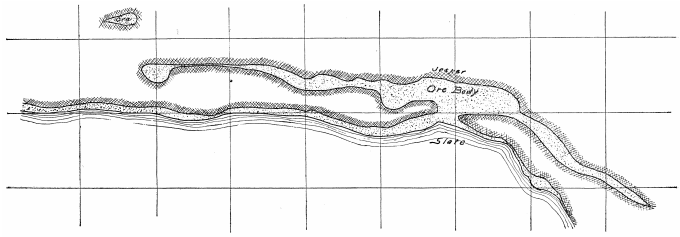
Figure 1 shows the plan of a certain level in one of our mines being worked by the square set system. This ore body is larger and more regular than many of them, but the smaller and irregular ones are worked the same way. In this figure an irregular development drift has marked out the limits of the ore in a general way and then rooms have been laid out, leaving pillars between them. The heavy dotted lines are the side lines of the rooms. The area occupied by pillars is shaded. Figure 2 shows the irregularity in size and shape commonly met with in the Vulcan ore bodies.



Square Set Mining at Vulcan Mich
Plan Showing
Developement Drift and Outline of Rooms and Pillars
Fig. 1

As the rooms are gradually cut out on the level, square sets of timber are placed in position and usually a set is placed as soon as there is space for it, thus avoiding large areas of unsupported back. The sets are blocked in place and 7-foot lagging are laid on top. Usually 9-foot legs are used for the first floor, while all other floors have 7-foot legs. These lower legs are usually stood directly on the ore beneath, it not being found necessary to use sills to distribute pressure or to tie the legs together. Years ago, sills were used regularly. The only reason for using sills would be to facilitate the "catching up" of the debris when the room has been filled with waste rock and the workings below have progressed up to the level. Instead of using sills, the present practice is to anticipate the beginning of the filling operation by laying down on the floor of ore at the level a sheeting of 10-foot round lagging, it being comparatively easy to "catch up" this lagging when working up to it in the subsequent operations from below, and to thus avoid the caving down of loose filling material. The sides of the rooms next to the pillars are lagged up outside the legs of timber to prevent the ore from the pillar caving into the room.

After a given room has been cut out and timbered the one set in height over the whole area from hanging to foot, thus completing the "first floor," the lagging are removed over one set and an opening is cut upward large enough to accommodate a set of timber, thus beginning the "second floor." This floor and the succeeding floors of ore are in clue time mined out one set at a time and the timbering left in its place until die level above is reached, or to a point some 15 feet under the level in case it is necessary to leave a floor to accommodate haulage ways or other conditions on the level above. In the most usual case when a 15-foot floor pillar is left, a raise is cut through it connecting to the level above. See Figure 3.



Plan Showing
The irregular form and size
of the Orebodies often met with at Vulcan
Fig. 2

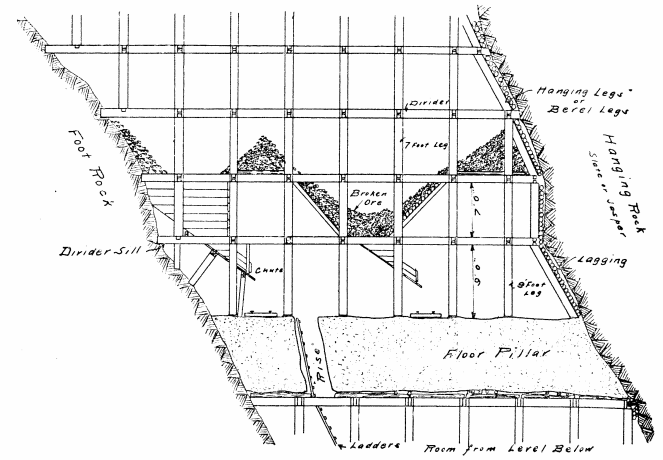
In blasting down the ore it is allowed to accumulate to some extent on the various lagging floors and occasionally the "slope is cleaned up" by shifting the lagging like the dump-boards of gravel wagons, allowing the ore to fall down into the chutes which have been provided at the level. The various rooms in the series will generally be found in different stages, some being worked nearly up to the limit, while others are barely begun.

In the usual course of action, the rooms are filled up with waste rock produced elsewhere in the mines by the driving of exploratory drifts and other openings or sent down from surface rockpiles in cars or chutes; or in case these sources do not yield the necessary material, rock is mined for the purpose from suitable places in the hanging or foot walls. This rock is trammed in cars and dumped down from the level above until the room is full. Of course the timbers are left in place and no attempt is ever made to recover them. Before starting to fill a room, a sheeting of split lagging is placed at the side of the room bearing against the legs toward the pillar to

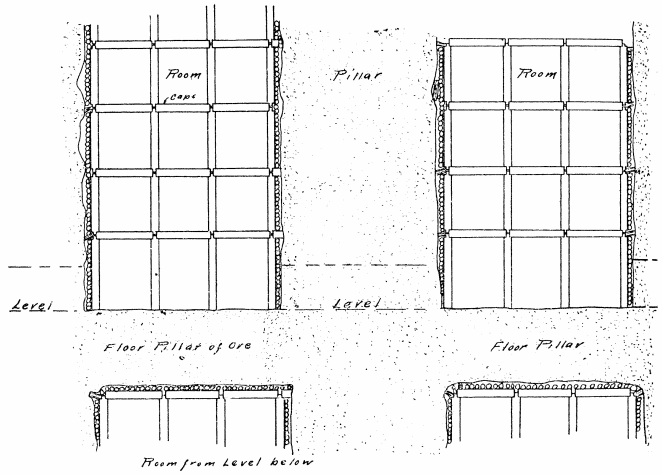
prevent the subsequent rock filling from running out when the pillar is being worked later on.

I understand that some years ago at the West Vulcan mine the filling was “puddled in” with water and the result was a material like a water-bound macadam, concrete-like in its ability to stand up as a rigid mass. This, I presume, would hardly have required the support of lagging.

Whatever passage-ways it is desired to maintain are cored out in the rock filling. These may include a ladderway between levels, tramways on the lower level and suitable mills adjacent to the pillars. These mills are to be used for access to the pillar and for chutes down which the ore is sent when mining these pillars by the top-slicing method. When all the rooms have been worked out and filled, the pillars are usually attacked by the well known “top slicing” method. By this method the ore is mined from the top of the pillar in a “slice” only some 10 feet in depth and the debris above caved down as each successive slice is removed. At the same time the floor pillar left over the adjacent rooms may be removed.



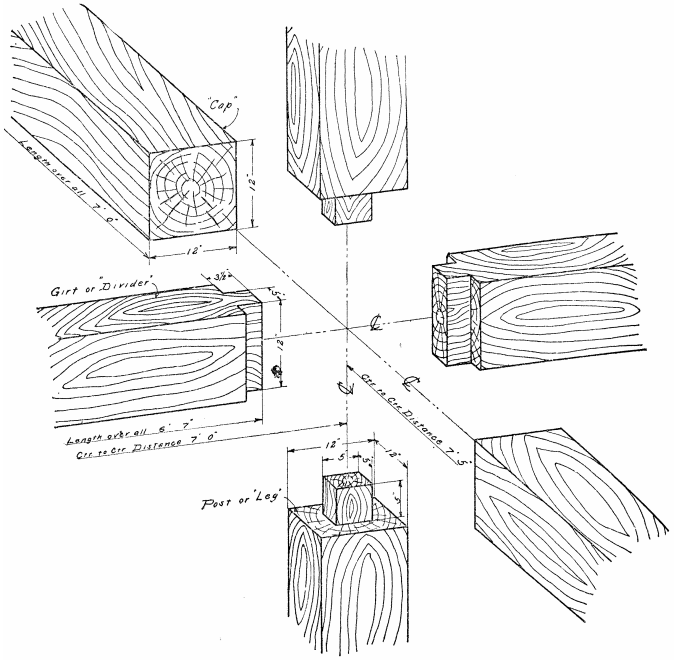
Cross Section



Longitudinal Section

SQUARE SET MINING AT VULCAN, MICH.
Vertical Section Showing Square Set Timbering and Scheme of Mining.
FIG. 3.

While the method as outlined might be called the standard method is frequently departed from in several ways. Thus sometimes the pillars are worked away as extensions of the rooms by what is known locally as “side slicing.” This side slicing has been used considerably. To explain it: Suppose we have a pillar three sets wide between two rooms each three sets wide. After the rooms have been worked out and the square set timbering occupies the space, it may be found that no severe strain has shown its effects upon the timbering and the ore pillar shows no tendency to cave. Under these circumstances it may seem wise to risk taking off a slice one set wide from one side of the pillar. This then widens the adjacent room to four sets wide and reduces the pillar to two sets wide. This space is of course timbered with square sets precisely like those in the rooms, progressing from set to set and floor to floor. After this one slice has been successfully cut off from our pillar, we may be bold enough to risk taking off a similar slice from the other side and finally removing the remaining third producing a great room 9 sets wide; or it may be considered too risky to do this and resort he made to filling the rooms and top slicing the remaining’ portion of the pillar.



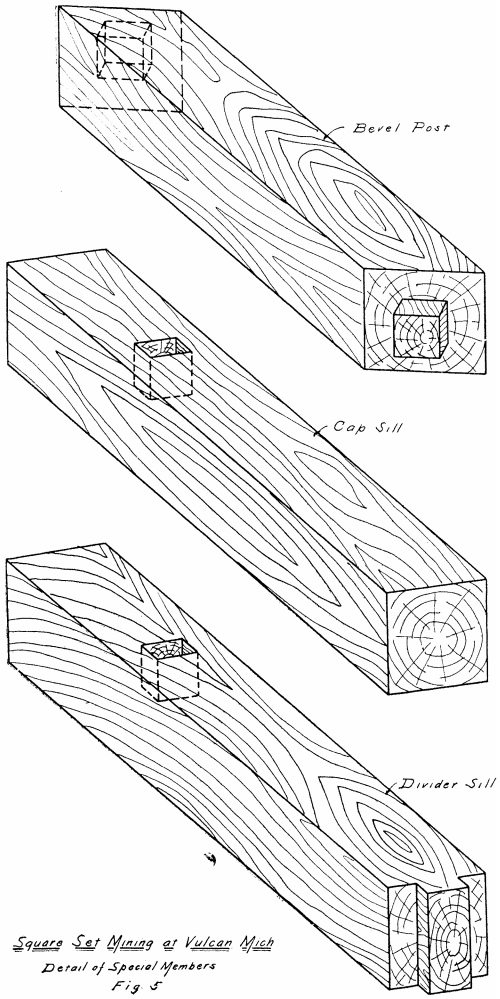
Square Set Mining at Vulcan Mich
Dimensions and Detail of Square Set Joint
Fig. 4

Sometimes the above described procedure is carried on with the variation that the rooms are filled in the usual manner with waste rock before attacking the sides of the pillars. Sometimes also’ after the rooms have been filled with waste rock, the pillars are “taken out on timber” as it is “spoken of locally. In this scheme the pillar is treated just as if it were a room and the filled room a pillar, the whole three sets width of pillar being mined up and timbered with square sets.

Taking up now the details of timbering, reference should be made to the sketches. In Figure 4 the joint is shown

in modified isometric projection. The sketch represents 12-inch timbers, but 10-inch and 16-inch timbers are also in use, the tenons on the legs being made 4 inches and 8 inches square respectively. It will be noticed that the framing is extremely simple. A great deal of the timber is framed by machinery, but there is also some hand-framing. Both round and square timbers are used.

Figure 5 shows a "divider sill" and a "cap sill" and a "bevelled post," and their use is indicated in Figure 3. The "divider sill" is used to allow the timbering to progress over the foot wall, while the "cap sill" may come into use in a similar way at the end of the ore lense at the foot of the pitch. The "beveled post" or "hanging post" is used in following up the hanging wall.



Square Set Mining at Vulcan Mich
Detail of Special Members
Fig 5

Contrary to the more usual practice, the caps are placed along the strike of the vein and the dividers at right angles. I am informed that the reason for this is that it is desired to place the overhead lagging in the direction from foot to hanging and since it must take the weight of ore blasted down on it, it must rest on the stronger members—the caps if caps being the stronger because they have the greater bearing area on the leg.

The legs are spaced 7 feet center to center from foot hanging, while in the longitudinal direction they are at 7 foot 5 inch intervals.

SOME SAFETY DEVICES OF THE OLIVER IRON MINING COMPANY.

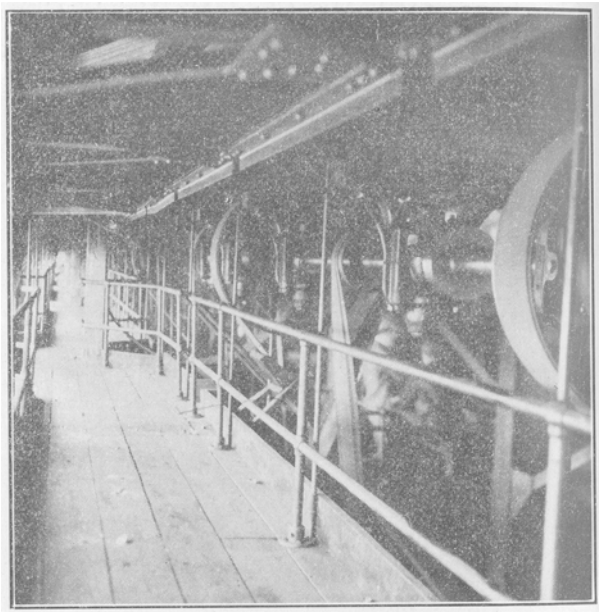
BY ALEX. M. GOW, DULUTH, MINN.

No. 1—Trout Lake Power Plant, Coleraine, Minn.

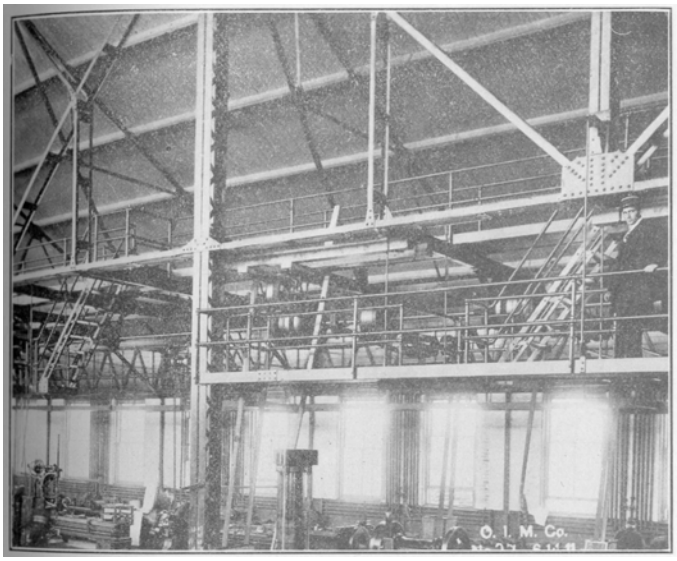
On March 23, 1908, Mr. Chas. MacVeigh, General Solicitor of the United States Steel Corporation, called a meeting of the casualty managers of the subsidiary companies to consider the results of attempts that had already been made to prevent accidents, and to consider and formulate further plans for the safeguarding of employes. Judge E. H. Gary, chairman of the board of directors, gave his hearty endorsement of the purposes of the meeting and the assurance that "we will not hesitate to make the necessary appropriations in money to carry into effect every suggestion that seems to us to be practical for the improvement of the conditions at our mills so far as the question of taking care of our employes is concerned." The result of this meeting was the appointment of a committee of safety which, wince that time, has been actively engaged in furthering the cause of safety to employes.

As it stands today, the safety committee of the United States Steel Corporation consists of seven members, with General Solicitor MacVeigh as chairman. It acts as a clearing house for all safety matters, appliances and devices. It appoints special inspection committees to visit the various plants and make reports and recommendations. It gives careful consideration to reports of serious accidents with a view of providing means to prevent their recurrence. It also assists in the voluntary accident relief plan. In addition to the general safety committee, each subsidiary company has such safety committees and safety regulations as are best adapted to secure the end that is desired. The Oliver Iron Mining Company, which is the ore-producing subsidiary of the United States Steel Corporation, has been diligently working along lines suggested by the general safety committee. A number of committees have been appointed by the management to make

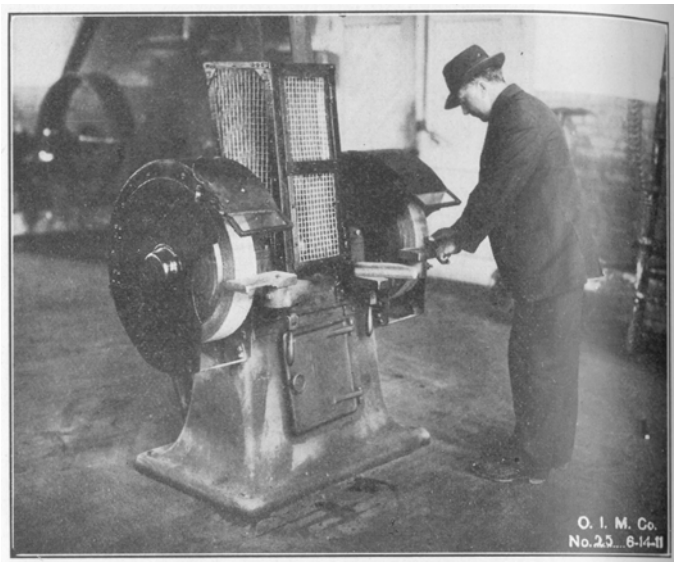
suggestions and draw up rules and regulations in various lines of operating; for instance, one committee gives its attention to safety matters underground; another to open pit work; another to standard warning signs, etc. A large number of rules and regulations have been framed pertaining to underground work, handling of explosives, open pit operations, machine shops, boilers, etc., and reports are regularly made to the management as to how these rules and regulations are carried into effect. No reasonable expense has been spared to protect the machinery in the shops, and to render mechanical operations as free from risk as possible. Owing to the limited space available in the Proceedings of the Lake Superior Mining Institute, it is not desirable to reproduce all the sixty lantern slides which were shown at the meeting. A few are selected to give a general idea of what the Oliver Iron Mining Company has done in the matter of safeguards and protection around machinery.



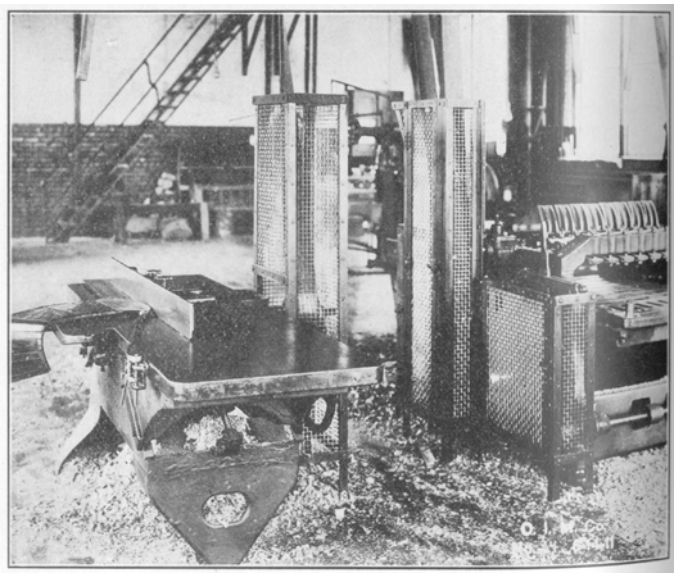
No. 2—Concentrating Plant, Coleraine, Minn.



No. 3—Canisteo Shop, Overhead Platforms, Coleraine, Minn.



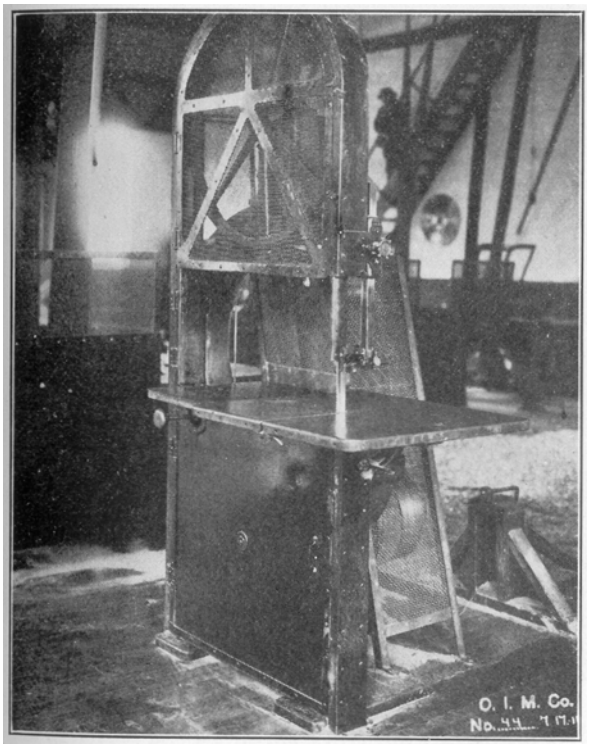
No. 4—Canisteo Shop, Tool Grinder, Coleraine, Minn.



No. 5—Hibbing Shop, Buzz Planer, Hibbing, Minn.

Illustration No. 1, reproduced from Oliver Iron Mining Co.'s photograph No. 1, shows the generator and engine at the Trout Lake Power Plant, Coleraine, Minnesota. Attention is called to the wire netting guard around the generator and fly-wheel, and to the steel stairway and steel platform giving access to all the valves on the steam header. One of the safety regulations require that all valves on steam lines, shall be accessible by means of steel stairways and platforms, thus dispensing with the use of ladders.

Illustration No. 2, from photograph No. 6, shows an overhead platform running the entire length of the concentrating plant, Coleraine, Minnesota, so all pulleys, clutches belts and couplings on the main line shaft can be reached without risk. The platform is fitted with handrails and toeboards in conformity with the rules.

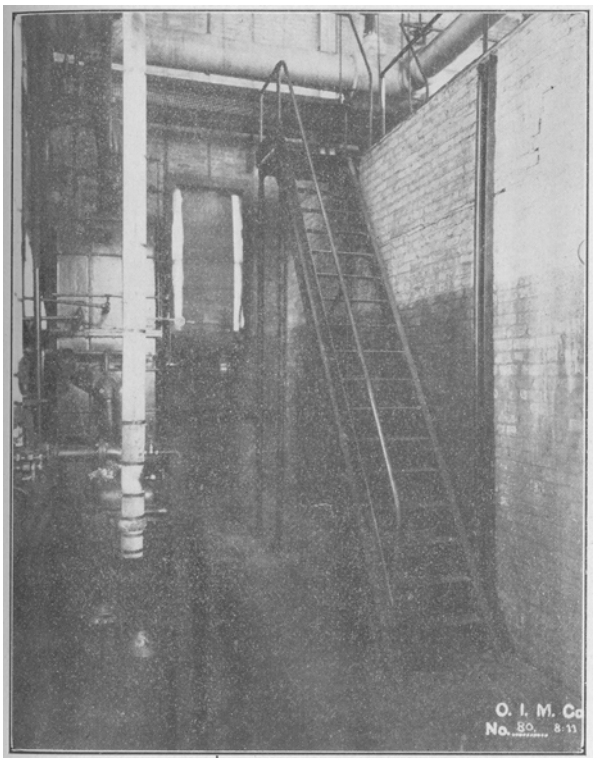


No. 6—Virginia Shop, Band Saw, Virginia, Minn.

No. 7—Spruce Mine, Top of Boiler Setting, Eveleth, Minn.

Illustration No. 3, from photograph No. 27, shows similar overhead platforms and stairways in the Canisteo' shop giving access to all line shafts and counter shafts overhead. One of the safety regulations demands that all trestles, overhead crossings, platforms or landings must be fitted with suitable toeboards to prevent anything falling off and striking some one below.

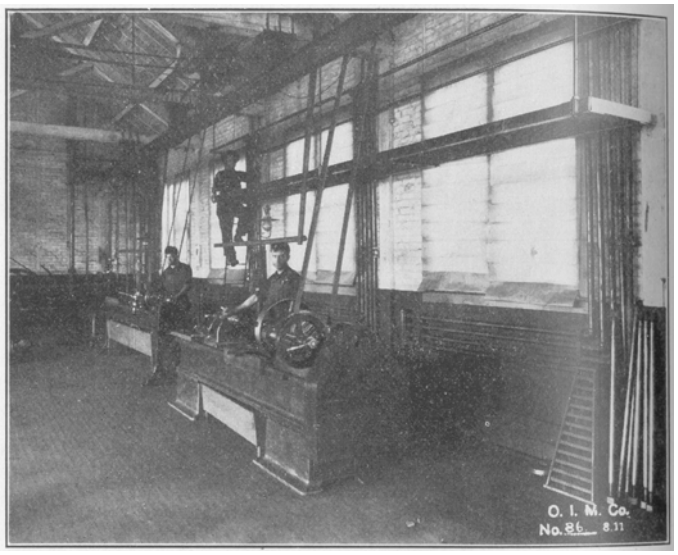
Illustration No. 4, from photograph No. 25, shows a tool grinder in the Canisteo shop. Attention is called to the safety collars, the wheels being made tapered, and the shields around the wheels and the guard over the belt. To prevent parks living in a man's eye a piece of plate glass is provided and the work is observed through this plate glass. This arrangement is very much liked by the workmen.



No. 8—Sec. 16 Boiler House, Ishpeming, Mich.

Illustration No. 5, from photograph No. 34, shows a buzz planer and a surfacer in the Hibbing shops, Hibbing, Minnesota. The safety rules demand that all belts shall be guarded up to five feet from the floor. The buzz planer or jointer is fitted with a safety cylinder head and in addition a sliding guard is provided to protect the operator's left hand. A permanent steel stairway giving access to the overhead platforms, is shown in the rear.

Illustration No. 6, from photograph No 44, shows the guard over a hand saw at Virginia headquarters shops. All hand saws are similarly guarded.

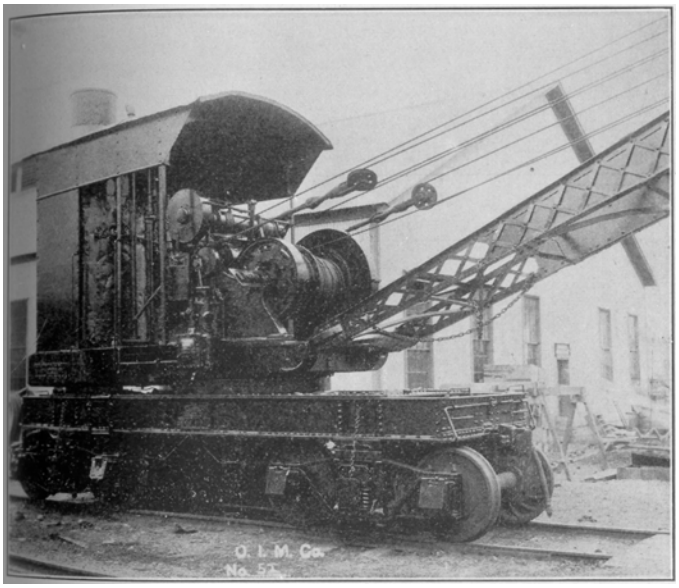


No. 9—Queen Mine Shops, Negaunee, Mich.

Illustration No. 7, from photograph No. 40, shows the top of a boiler setting at No. 4 Spruce mine. The top of the setting is finished level with brick and a coating of cement. All around the setting is a handrail with toeboard and, to get access to the valves on the header, steel stairway and platform are provided.

Access to the top of a boiler setting must be by means of a steel stairway if there is room in the boiler house to get it in; if not, a permanent steel ladder must be provided. Illustration No. 8, from photograph No. 80, shows such a stairway at Section 16 boiler house, Lake Superior Mines, Ishpeming, Michigan.

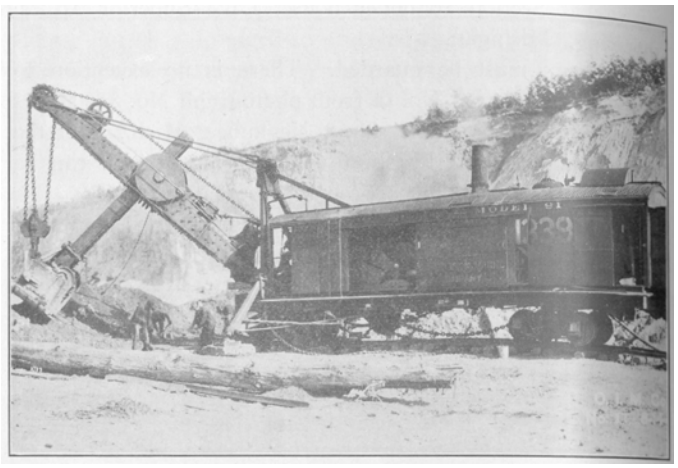
All gears must be guarded. There is no exception to this rule. Illustration No. 9, from photograph No. 86, shows two lathes at Queen mine shops, Negaunee, Mich., with the change gears covered by sheet metal casings which can be opened.



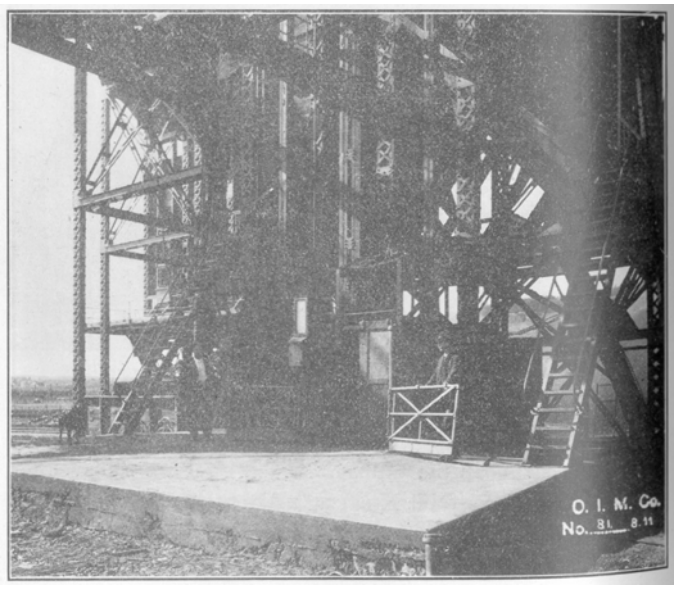
No. 10—Virginia Headquarters, Locomotive Crane, Virginia, Minn.

A locomotive crane at Virginia headquarters is shown in Illustration No. 10, from photograph No. 52. In addition to all gears above the car being protected, the propelling mechanism underneath is entirely covered by heavy sheet iron guards.

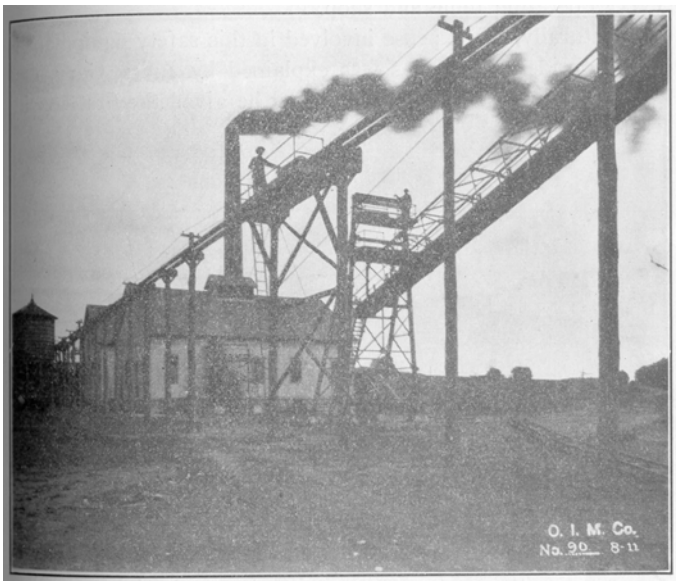
A steam shovel in the Canisteo Pit is shown in illustration No. 11 from photograph No. 17. Attention is called to the guards over the hoisting engine, the propelling gear and shipper shaft gear and pinion. A steel ladder with hand-rail which is permanently fixed to the boom, is provided, so that a man can go to the point of the boom and oil the sheaves with perfect safety.



No. 11—Canisteo Pit, Steam Shovel, Coleraine, Minn.



No. 12—Section 16, Steel Head Frame, Ishpeming, Mich.



No. 13—Prince of Wales Mine, Steam Line and Idler Bridge, Negaunee, Mich.

Illustration No. 12, from photograph No. 81, shows the headframe at Section 16, Lake Superior Mines, Ishpeming, Mich. The safety gates at the collar of the shaft are built of pipe with toe-boards, and are so hung that they close automatically. The cage is enclosed so that it is impossible for a man to get his arm through and be caught on a shaft set. The signal box is so located that signals can be given from the cage. At the collar of the shaft is built a large slab of concrete. This is for the sake of convenience in unloading material to be sent down, and also is in the interest of neatness and order. All steel shaft houses are equipped with stairways.

Where ladders are required, rests must be provided at least every 25 feet. Where it is necessary to frequently do overhead work, platforms equipped with hand-rails and toe-boards must be installed. Illustration No. 13, from photograph No. 90, shows the steam line and idler bridge, with platforms, from the engine house to the shaft at Prince of Wales mine, Negaunee, Michigan.

These illustrations are selected as being typical of the work done by the Oliver Iron Mining company along the lines of safety appliances, and similar illustrations could be taken at every operating mine and shop.

Naturally, the expense involved in this safety equipment is very considerable, but as was explained by Judge Gary, cost is a subordinate matter; safety must be given the first consideration.

DIVERSION OF THE STURGEON RIVER AT THE LORETTO MINE.

BY CHARLES H. BAXTER, LORETTO, MICH.

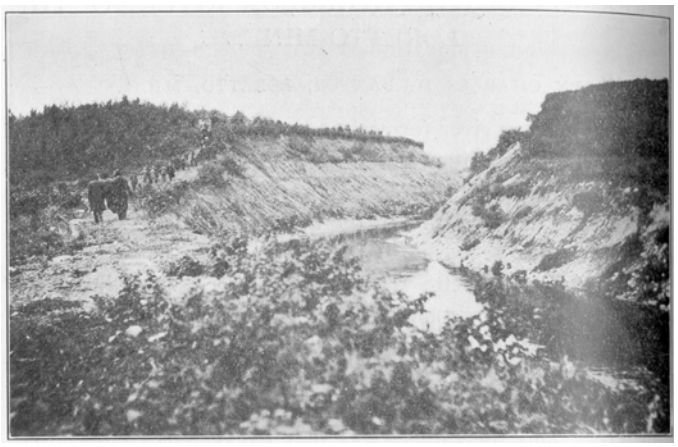
The Sturgeon river formerly passed over the Loretto mine, pine creek entering the river just south of the ore body. The ore was mined out in square set rooms, pillars being left to support the surface. By this method 40 per cent of the ore was removed, 60 per cent being left in pillars.

In 1907, the Loretto Iron Company decided to divert the courses of the Sturgeon river and Pine creek to the west of the mine in order that the whole of the ore body could be mined. The work was commenced in December, 1907, and completed in July, 1908. The lower part of the cut, between Pine creek and the outlet, was first excavated, so that material from the upper portion could be wasted in the Pine creek valley, forming an earth dam which diverted Pine creek into the new channel. When the whole canal was completed, two more earth dams were built, one to divert the Sturgeon river into the new channel and one across the old river bed above the outlet of the canal, to prevent water from backing up to the mine.

The excavation was made with 70 ton steam shovels and waste material handled by small locomotives with trains of four yard dump cars.

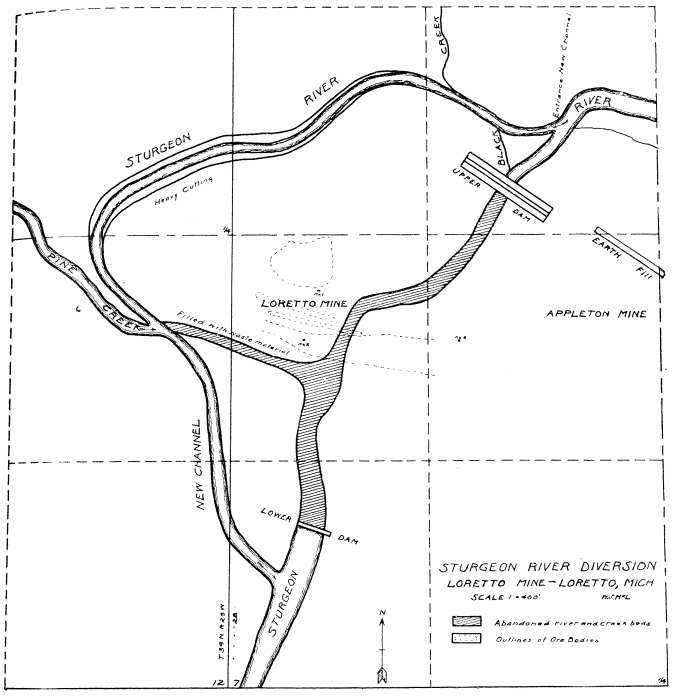
DIMENSIONS AND DETAILS.

Length	5440	feet.
Bottom width	45	feet.
Greatest depth	50	feet.
Average depth	20	feet.
Side Slopes—Earth	1 to 1	
Rock	¼ to 1	
Excavation—Earth	220,000	cu. yds.
Rock	40,000	cu. yds.
Grade	0.1%	



Loretto Mine—Showing new channel made in changing course of Sturgeon River.

Upper Dam—Height	24	feet.
Length	585	feet.
Bottom width	100	feet.
Top width	24	feet.
Lower Dam—Height	12	feet.
Length	200	feet.
Top width	16	feet.



RAISING SHAFT ON TIMBER IN HARD ROCK AT THE ARMENIA MINE.

BY S. J. GOODNEY, CRYSTAL FALLS, MICH.

When the shaft was raised from the 7th level at the Armenia mine, of Corrigan, McKinney & Co., the following method was used.

A winze was sunk a short distance from the main shaft on the 6th level where the best ore and least amount of water would be expected, and carried down 125 feet. Drifts were driven from the bottom of the winze both ways at the same time; one drift to open up the new level so that when the shaft was completed the new level would be developed for some distance, the other drift going to a, point directly tinder the shaft. At this point a mom was opened up the full size of the shaft, and a sink cut taken up about six feet deep. The hitches were then cut and the shaft bearers put in, also die level-set of shaft timber. This was lined up and squared with the transit, and the set blocked up solid and covered with 8 foot lagging or flat timber (Fig. 1). The back was then blasted out to make room for the station sets of the shaft. After these were in place, room was made and four sets of round timber put in the level station.

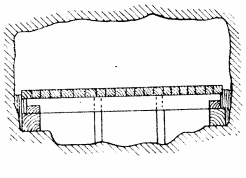


Fig 1

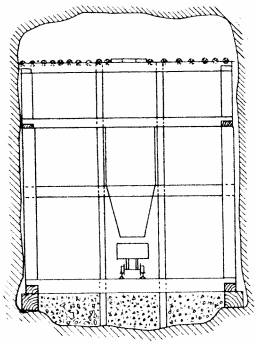


Fig 2

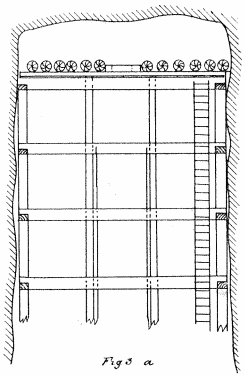


Fig 3 a

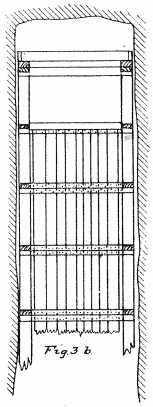


Fig 3 b

The shaft having three compartments, a rock chute was built in the center compartment by spiking plank on the inside of the divides, the plank being extended up to the second set from the top. By having one set open it insures perfect ventilation (Fig. 2). The north compartment was used as an air-way and the south compartment for the air pipe, ladder road, and bucket way to hoist drills, tools, timber, etc. A small puffer and ⅝" wire rope was used. The top set was covered with a piece of maple timber, 6"x8", laid on top of the wall plates (Fig. 3a and 3b) to protect them in blasting. The shaft was lagged over on top of the flat timber with 10" round maple timber, hewn off a little on each end to prevent rolling. A two foot space in the center was left open for the broken rock to pass through into the chute, and for the miners to pass up to their working places. Two pieces of flat timber were put in between the round timber, one at each end, and spiked to prevent the lagging getting out of place when blasting. With the ladder road covered in this manner the danger to me men in going up the shrift after a blast is reduced to the minimum. By tramming enough rock from the chute so that it will hold all the rock from one blast, there is no danger of breaking the air pipes or ladders, and with the chute nearly full all the time it makes the ventilation almost perfect, as the farther the shaft was advanced the better the ventilation.

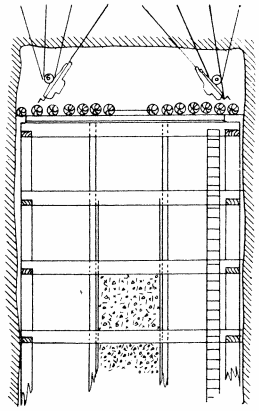


Fig 4

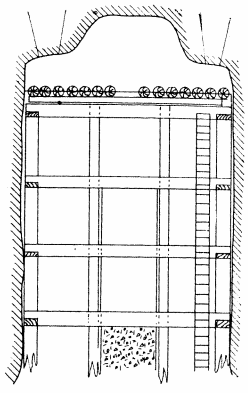
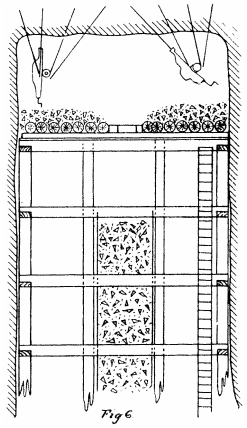


Fig 5

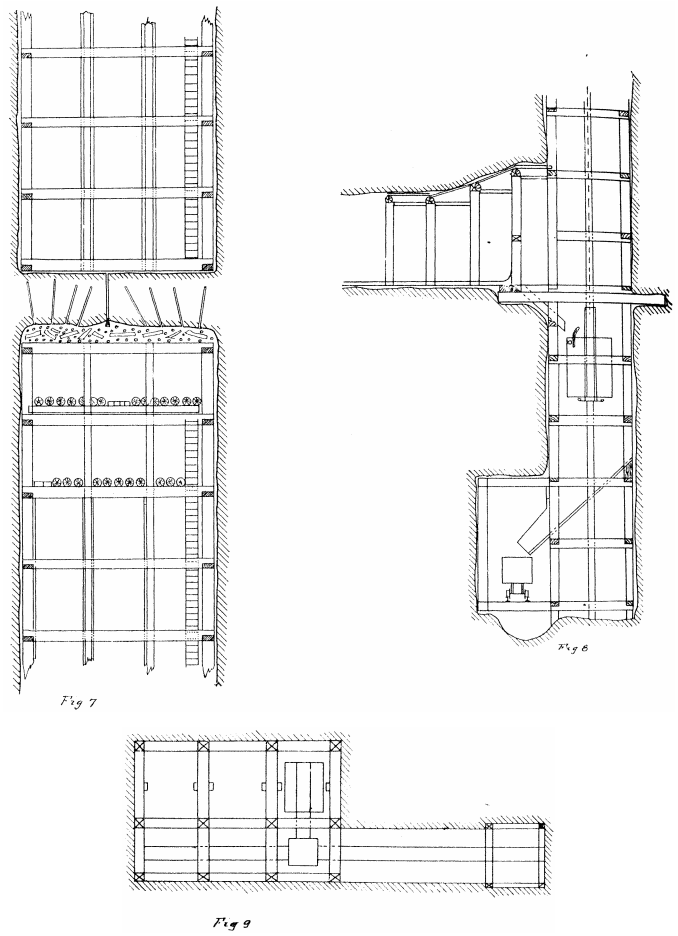
At first there were four miners on each shift of 10 hours each, with four hammer drills. The rock being a hard jasper and very blocky the progress was very unsatisfactory. The hammer drills were taken out and four No. 3 Rand piston drills put in mounted on ordinary 8 foot shaft bars and clamps. Two more miners were put on each shift, making three men at two drills at each end of the shaft. The rounds consisted of 32 holes drilled six feet deep, as shown in Fig. 4. All holes were fired with fuse, the electric blast was considered too heavy on the timber, the 16 cut holes being fired first. After trimming the back, a set of shaft timber was put in (Fig. 5) and lined up with the station set, (all sets being lined from station set) and blocked securely. Flat timber was put on this new set with round maple lagging and secured the same as the last set. The tools were all passed up, and the chute and ladder road extended. The remaining 16 holes, 8 on each end, were then fired. The cut being already blasted out these holes are not as heavy and do not affect the timber to any great extent. As much rock as possible from this blast was kept on the lagging making the best possible protection to the new set of shaft timber from the cut holes of the next round (Fig. 6). With this system progress was much more satisfactory, considering the hard and blocky nature of the rock. Three sets of timber per week were put in,

10”x10” shaft timber and 4 foot studdle, making 4’-10” per set.



At the same time that the shaft raise was started, there was a drift driven 20 feet from the south side of the station, where a 5’x6’ winze was sunk 30 feet. A drift was driven along the hanging of the shaft from the bottom of this winze. When this drift had advanced to a point opposite the center line of the shaft it was turned at right angles for about 10 feet, and a small raise put up. By the time this raise was holed to the level the main shaft raise had advanced to a point where a six foot test hole was drilled through into the bottom of the shaft above. On being certain that there was only six feet of rock between the back of the raise and the bottom of the shaft above (Fig. 7) the last round of holes was drilled accordingly, and let stand until all was ready to fire them. The timber in the raise was extended up as far as possible so that when the pillar was shot out it would take only one set of timber to fill the space between the new and old shaft timber. The top set in the shaft was then lagged over and blocked up solid. Then the tools were sent down, the broken rock trammed out of the chute, the chute plank taken out, also the shaft raise cleaned down and skip sump stripped, and the broken rock passed through the small raise where it was trammed with a bucket on a truck and hoisted up to the level through the winze. After completing the sump the skip runners or guides were put in, the chutes built, the car dumps put in, and everything completed. The pillar was shot out at 11 o’clock Saturday night and on the following Monday at noon all was ready to hoist ore, only delaying the hoisting live hours.

As previously stated the drift from the bottom of the small winze was driven along the hanging of the shaft. Fig. 8 shows the reason for this, also the arrangement for cleaning out the skip pit of all ore or rock that may fall into the shaft from the skips being over-loaded. The chutes can be emptied at any time without interrupting the hoisting or ore, as it is not necessary for any one to be in this shaft. This eliminates the overtime, as this work was usually done after 11 o’clock on Saturday night. Two men can now do the work in the same time it took eight men before. The cars run under the chutes, and loaded the same as at any other chute, and then run to the turn sheet and put on the cage (Fig. 9) and hoisted to the next level (30 ft.) and then run back and dumped into the skip. In case the cage is in use lowering limber, or otherwise engaged, there is a truck and bucket to hoist the material through the winze dumping it in a car as usual. This, of course, takes two more men, one to land and dump the bucket and one to run the puffer.



ACCIDENTS IN THE TRANSPORTATION, STORAGE, AND USE OF EXPLOSIVES.

BY CHARLES S. HURTER, DULUTH, MINN.

The study of accidents in the handling, keeping and use of explosive materials may he undertaken with two objects in view: 1st, to prevent accidents by warning against improper manipulation, careless handling and dangerous methods of using and storing explosives, and 2nd, by minimizing the destructive effects of explosives where it is not possible to guard absolutely against accidents, as, for instance, by locating magazines for explosives in such places that the damage which would result from an explosion would be reduced to a minimum.

The British government has kept detailed records of all accidents in the manufacture, storage, transportation and use of explosives since the year 1875. The British

Explosive Act of 1875 was designed more to prevent accidents in the manufacture of explosives than to protect the users. The printing of the detailed reports of accidents in the annual reports of His Majesty's Inspectors of Explosives has been of inestimable benefit, to the users of explosives by showing the causes of accidents and discussing the same from all points of view.

The tables in these reports, showing the number and particulars of accidents from thawing, loading, striking unexplored powder in the debris, etc., show what operations are most likely to be attended by accident as well as those operations which are most dangerous. These figures show a much greater number of casualties from loading of blast holes than from manufacture of fulminate blasting caps and the separation of nitro-glycerine from the acids. The reason for this is easily discernible, as the first is frequently done by careless and ignorant laborers, while the others are the work of skilled and careful operators.

Technical Representative, E. I. Du Pont De Nemours Powder Co.

The English Blue Book is referred to because its issues form a compilation of every accident with explosives in the United Kingdom (England, Wales, Scotland and Ireland), since the year 1875. Whenever a man is killed or hurt in using, manufacturing, storing or transporting explosives, the particulars are at once given to the government inspector; so that they collect the details of the less serious as well as the more disastrous accidents, and it is from the former that the most valuable information can be gained. An explosion of a large quantity of powder generally obliterates any clues that might lead to tracing the cause of that explosion, while the lesser accidents, which only injure one man, often leave the man so that he is able to tell what happened.

In this country the E. I. DuPont de Nemours Powder Company has, for six years, made a systematic collection of newspaper clippings relating to accidents with explosives and it is from these that the writer has to obtain his data. This is not a very accurate source of information as compared with the English reports but it is the best obtainable in the United States up to the present time. While the larger accidents invariably get into the newspapers, sometimes in a very "highly colored" form, many of the smaller and possibly more instructive ones get no notice whatsoever. Also, the newspapers, in describing accidents, often omit what appear to be minor details, which on the other hand are of extreme importance to people interested in the safe methods of handling explosives. Even the kind of explosive causing the accident is quite frequently left out of the description, of that accident.

In this paper the writer has carried parallel tables of accident statistics for the year 1910 in the United States and Great Britain. Those taken from the English reports are given because they are an accurate compilation by government officials of the details of every accident with explosives in the United Kingdom. On the other hand the records of accidents in the United States are obtained solely from newspaper clippings obtained from various clipping bureaus. As everyone knows newspaper accounts are often not entirely accurate, details of interest to users and manufacturers of explosives are often lacking. In making a comparison of the accidents with explosives in the two countries, one must remember that the annual consumption of blasting explosives in Great Britain is about 30,000,000 pounds against about 227,000,000 pounds in the United States. In all the tables taken from the English reports, the writer has reclassified the explosives, for the sake of simplicity, according to the American standards. "Black powder class" covers not only gunpowder but nitrate mixtures where paraffine, etc., has been substituted in part for charcoal. "Dynamite" covers all classes of high explosives.

ACCIDENTS IN STORAGE.

The causes of accidents in storage are generally very difficult to ascertain, because the quantity exploded is as a rule so great as to leave no clue behind. It is only occasionally that a reasonable cause can be assigned to such an occurrence. Most of them are the result of the violation of rules of ordinary common sense, such as smoking, carrying naked lights, keeping detonators with explosives, brush fires where the ground around the magazines has not been properly cleared, bullets from careless marksmen, etc. To illustrate the causes of accidents in storage the following examples are given:

A terrific explosion occurred at Kimberly, South Africa, in the year 1884, of about 75,000 pounds of high explosives, and 16.000 pounds of gunpowder. The cause was laid to the probable presence of a Kaffir smoking in the shade of one of the corrugated iron magazines and igniting some gunpowder which may have leaked out through the cracks. Naturally all direct evidence of the cause of this explosion was obliterated

On January 6, 1906, a fire started from stumps of cigarettes that some boys had been smoking, caused the explosion of fifty pounds of gunpowder stored in a barn at Sacramento, Cal., resulting in considerable damage to property.

On January 5, 1909, at Plymouth, Penn., 1,500 pounds of dynamite in a magazine exploded, doing considerable damage to property and injurying several nearby inhabitants with flying glass. This magazine was heated by steam and some dynamite came into contact with the pipes.

On January 15, 1909, some miners at Vivian, W. Va., were filling their "jacks" with powder in a small shanty, when a park from one of their open lights caused the explosion of half a ton killing all four of them,

On April 11. 1909, at Beckley, W. Va., a man wished to kill a chicken for dinner. Being adverse to unnecessary exercise he took his rifle with him. The accounts do not

state whether he hit the chicken or not, but his bullet entered a shanty containing 180 pounds of dynamite, causing him to depart for his heavenly home accompanied by a loud noise, leaving a badly wrecked house for his heirs to repair.

On December 9, 1909, a man entered a magazine at Bulls Gap, Tenn., with a lighted pipe, thereby reducing the population of that place by three and leaving four cripples. The regrettable feature is not so much the loss of the fool as the good men he took with him.

At Eaton, Ohio, on October 13, 1910, a boy fixed a target on the end of a small dynamite magazine and began practicing with his ride. The boy escaped but the magazine disappeared and considerable damage was done to property in the immediate neighborhood.

A feature not applying to the Lake Superior district is the practice of contract miners, who use explosives in small quantities, of keeping them in their dwelling houses. This applies more to coal mining sections and is particularly true of some of the more ignorant classes of labor. Their children sometimes, when not observed, discover and get to playing with or about these explosives with the result of decreasing the population of the immediate neighborhood and keeping the medical profession busy.

In the far west, in locations distant from railroads where supplies have to he taken long distances in teams or on pack animals, miners on finishing assessment work on claims or other work, when moving, sometimes leave what explosives they do not use in the shacks where they lived. More than one prospector has lost his life through ignorance of the presence of explosives left in this manner.

The following tables show the accidents in storage of explosives in the United States and Great Britain, during the year 1910 as taken from a collection of newspaper clippings and the report of His Majesty's Inspectors of Explosives for 1910:

*TABLE I

Showing the total number and nature of accidents in the storage of the different kinds of explosives in the United States during the year 1910:

	Accidents Causing Loss of Life and Bodily Injury			Accidents Not Causing Loss of Life and Bodily Injury	Total Number of Accidents
	Number of Accidents	No. of Persons Killed	No. of Persons Injured		
Dynamite	13	36	61	9	22
Black Powder	3	18	6	3	6
Unspecified Explosives	3	3	20	2	5
Gunpowder	1	0	4	2	3
Blasting Caps	0	0	0	0	0
Dynamite & Black Powder	1	0	1	2	3
Dynamite & Blasting Caps	0	0	0	0	0
Fireworks	1	0	2	2	3
Ammunition	0	0	0	1	1
Nitroglycerine	3	5	0	4	7
TOTALS	25	62	94	25	50

*DuPont annual report for 1910.

*TABLE II

Showing the total number and nature of accidents in the storage of different kinds of explosives in the United Kingdom during the year 1910:

CLASS OF EXPLOSIVE	Nature of Explosion	Accidents Causing Loss of Life and Bodily Injury: Number of Accidents	No. of Persons Killed	No. of Persons Injured	Accidents Not Causing Loss or Bodily Injury	Total No. of Accidents
Gunpowder	Gunpowder	6	2	8	0	6
Nitrate Mixture (Black Powder Class)	——	0	0	0	0	0
Ammunition High Explosive	Shells (Dynamite in the American Classification)	3	1	3	——	3
		0	0	0	0	0
TOTALS		9	3	11	2	11

*Report of His Majesty's Inspectors of Explosives for 1910.

The vast difference in the amounts of explosives used annually in the United States and the United Kingdom, 227,000,000 pounds vs. 30,000,000 pounds, is one of the most important reasons for the great difference shown in these two tables.

In regard to the prevention, or rather reduction, of accidents in the storage of explosives, it is of the utmost importance not to keep blasting caps or electric fuzes in the same magazine or place with explosives. These are the most sensitive and dangerous of the materials used in blasting. If anything happens to them when kept separately, the damage is, as a rule, very small. On the other hand if kept with explosives and anything happens to them, the result is often a disastrous explosion involving loss of life and great property damage. This rule should be rigidly enforced at all times. Some authorities, owing to the fact that a very small spark will ignite black powder, recommend the keeping of black powder and high explosives in separate magazines. The following accident illustrates clearly the advantage of storing detonators in separate magazines from other explosives:

On July 21, 1909, at Coplay, Pa., fire caused the destruction of a magazine containing blasting caps, injuring nobody and, causing no outside damage. This illustrates very strongly the advantage of storing detonators and explosives in separate magazines. If dynamite had been stored in this magazine, the results might have been very disastrous.

The proper storage of explosives is now receiving attention from a number of state legislatures. The following shows very clearly the advance in the matter of precautions between the old and new regulations in Michigan.

OLD LAW.

Provides that no person shall manufacture, sell, keep for sale, or offer for sale, any high explosives which are not marked, branded or stamped as in this act provided, i. e, a brand or mark on each case distinctly showing the percentage of disruptive force contained in each cartridge of said case, and the name or trade mark and the address of the manufacturer, and no person by himself, agent, or servant, shall sell, keep for sale, or offer for sale any dynamite, or other high explosive not branded, or marked as provided herein. To falsely brand mark or stamp any such explosive, or sell, keep for sale, or offer for sale any high explosive bearing any false brand or mark is a misdemeanor and punishable as such. Any violation of this act is a misdemeanor and punishable as such.

The state of Michigan at its 1909 session adopted the federal act of March 9, 1909, entitled "An act to promote the safe transportation of explosive and other dangerous articles," and therefore, the federal regulations covering the transportation of explosives are by this statute made state regulations for intra-state transportation of explosives.

NEW LAW.

At the 1911 session of the Michigan legislature an act effective April 14, 1911, entitled "An act for the prevention of fire waste, and the creation of the office and the appointment of a state fire marshall, for the appointment of his assistants, to prescribe the duties powers and authority of each, to fix the salaries for the same and to provide for salaries and necessary expenses," was passed,

This act deals generally with the powers and duties of a state fire marshal and among other powers provides as follows:

The state fire marshal shall make regulations for the keeping storage, use, manufacture, sale, handling, transportation or other disposition of highly inflammable materials and rubbish, gun powder, dynamite, crude petroleum or any of its products, explosive or inflammable fluids for compounds, tablets, torpedoes or any explosives of a like nature, or any other explosives, including fire works and fire crackers, and may prescribe the materials and construction of receptacles and buildings to be used for any of the said purposes.

(Note): The provision last quoted was not in the bill as originally introduced; was inserted by amended bill shortly before it was enacted. As the act of 1909 above referred to expressly provides that the regulations formulated by the Interstate Commerce Commission, pursuant to section 2 of an act of congress (the federal explosive transportation act) shall be binding upon all common carriers engaged in intra-state commerce within the state of Michigan, which transport explosives by land, there would seem to be a conflict between the 1911 act, above referred to, and the 1909 act just mentioned, in this, if the fire marshal undertakes to make rules and regulations for the keeping, storing, use, manufacture, sale, handling and transportation, or other disposition of highly inflammable materials and rubbish, gunpowder, dynamite, etc., which conflict with the Interstate Commerce Commission rules, the question would arise as to which rules were effective. In my opinion the interstate Commerce Commission rules and regulations, covering transportation of explosives, cannot in the way attempted by the legislature of Michigan become a part of the criminal law of Michigan, and therefore, section 2 of the Michigan act of 1909, attempting to make the Interstate Commerce Commission rules binding on state carriers, is inoperative. Therefore, the rules, if any, promulgated by the state fire marshal would not be held invalid, because of conflict with a prior legislative act. It is, therefore, important, in event the state fire marshal undertakes to make rules touching the manufacture, storage, sale or transportation of explosives, that we take such part as we may be permitted to take in the formation of these rules to the end that they be workable and satisfactory to the interests affected thereby.

Section 7. No person, firm or corporation, keeping dynamite for sale or use, shall store or permit to be stored within the state of Michigan, any dynamite within a building used for any other purpose.

Any building containing dynamite must be labeled "Dynamite" in letters not less than six (6) inches in height, or two inches in width, on said building. The word "Dangerous" must also be painted in plain sight of all passers by, on all sides of buildings containing dynamite.

Section 9. These regulations shall take effect and be in force from and after the 14th day of April, 1911, in accordance with Act 79 of the Public Acts of 1911, which gives the state fire marshal authority to make these regulations.

Section 10. Any person, firm or corporation who shall violate any of The provisions of these regulations, shall be deemed guilty of a misdemeanor, and upon conviction thereof shall be fined not less than ten ($10.00) dollars, and not more than one hundred ($100.00) dollars.

ACCIDENTS IN TRANSPORTATION.

The DuPont Company has records and full descriptions of quite a number of accidents to explosives in transit, where no explosions occurred, all of a sensational character. Minor ones, of which there may be hundreds, are not included. Several years ago a carload of dynamite was in a wreck at Potsdam, N. Y. The car containing the explosives was badly damaged boxes were burst open and cartridges actually fell on the tracks and were passed over by car wheels without any explosion occurring. While the fire, which destroyed the piers of the D. L. & W. R. R. at Hoboken, May 30, 1904, was in progress, a car loaded with dynamite intended for use in the tunnel was pulled out, a mass of flames. The car, blazing fiercely, was rushed back into the yard and water from a dozen lines of hose turned on it, finally extinguishing the fire. There was no explosion.

A sensational accident was reported to have occurred on April 13, 1906, in amine near Salt Lake City, Utah. While driving a mine train of nine cars loaded with dynamite into the tunnel of a mine, one of the cars was overturned, the dynamite exploded and the driver, who was hurled back a distance of forty feet, was stunned but not seriously hurt. None of the other cars exploded. Each car contained 200 pounds of dynamite. Blasting caps were probably being transported with the dynamite and caused it to explode. On the other hand in the same collection are found a fairly large number of accounts of accidents to explosives in transportation that resulted in serious explosions. Over half were caused by fire and the rest by collision.s

Shooting at marks which present themselves along highways and railroads is a favorite pastime of some people. Trespass signs, semaphores, notices, guide boards, tool houses and abandoned buildings peppered with shot are common sights all over the country. Boys shooting into structures supposed to be unoccupied has always helped toward keeping down the tramp population. The records are full of accounts of explosions caused by ignorant people shooting into magazines or cars containing explosives. While it is a comparatively simple matter to construct magazines with walls that will stop a high power rifle bullet, this is hardly practicable in the case of freight cars. The cause of a disastrous explosion of three cars of dynamite at Johannesburg, South Africa, several years ago, is laid to

a stray bullet. About fifty people were killed in this accident.

About the most appalling accident in the history of explosives occurred on November 3, 1893, when the Spanish steamer "Cabo Machichaco," arriving at the harbor of Santander, Spain, was found to be on fire. Her cargo consisted of wine, flour, petroleum and 1,810 cases (47 tons) of dynamite. Until thirty cases of dynamite, stated to be the entire amount on board, were taken out, the ship was not allowed to come alongside the quay, which became crowded with spectators watching the sight of a ship on fire. After burning for two hours and a half, a terrible explosion occurred, which killed 520 persons and injured about 1,000 more, besides doing an immense amount of structural damage to the town. Compared with the Santander disaster the accidents in the transportation of explosives in this country have been comparatively mild.

On June 8, 1900, train No. 61, local freight on the D. L. & W. R. R., containing a carload of dynamite placed next to the caboose, in violation of the railroad's regulations, stopped at Vestal, N. Y., and the train was left standing on the main track, while the engine went to the water tank just beyond the station. Through a misunderstanding of signals a "wild cat" engine crashed into the rear of the train, No. 61, exploding the car of dynamite. Five persons were killed and many injured. The property damage was several thousand dollars. Since that time the "Bureau for the Safe Transportation of Explosives" has been organized, which has made an ironclad rule that cars containing explosives must be carried in the middle of freight trains. The excellence of the above rule is shown by the results of the following accident. On December 18, 1909, a carload of dynamite was exploded near Dunkirk, N. Y., by a rear end collision between freight trains. The explosion did considerable damage to property but nobody was killed or injured. The car was in the middle of the train. The following is a good example of the result of carelessness. On December 10, 1909, an explosion of 35 kegs of blasting powder and a keg of smokeless powder in a freight car occurred in the Minnesota transfer yards at St. Paul, Minn., killing one and injuring two men. This was caused by a man driving a nail into a keg while bracing the powder for shipment.

One of the most disastrous accidents in the transportation of explosives in this country occurred at Harrisburg. Pa., on May 11, 1905, causing the death of about twenty-five passengers. There was a collision between a westbound express and a "buckled" car containing a low grade nitroglycerin explosive in an eastbound freight train, which fell across the track in front of the express. There was no explosion due to the collision but in the fire which immediately followed, at least four explosions occurred. There was no suspicion of a crater where the car of explosives must have been, so that it is hard to believe that a large quantity of powder was involved in any one of the explosions. Parts of a great many boxes which contained the powder were scattered al around, showing without doubt, that not all had exploded.

In the transportation by water care must be taken to prevent water coming in contact with the explosives. In the cases of blasting powder and blasting caps these are ruined and rendered comparatively harmless by contact with water. On the other hand water will dissolve the nitrate of soda in the dope of the American dynamites and replace more or less of the nitroglycerin in all but the gelatins. This exuded nitroglycerin is liable to collect in the bottom of vessels, or be absorbed by wooden planks, making an accident liable to occur at any time. In the transportation of explosives care .must lie taken at all times to keep blasting caps and electric fuzes apart from other explosives. Detonators are the most sensitive and dangerous of all explosive's but when kept apart the result of any accident to them is usually insignificant to what it would be if they were close enough to set off other explosives. Detonators should not be transported in the same car with explosives or in the same hold or compartment in vessels. In the case of team deliveries small quantities of blasting caps can safely be carried in strong padded wooden boxes arranged so that the boxes containing the detonators cannot move. Also, explosives should not be carried with matches, inflammable oils, pig iron, heavy steel castings, etc. A fair comparison, of the accidents in the transportation of explosives in the United States and the United Kingdom is impossible. The rail hauls in the United Kingdom are few and short. Explosives are carried as much as possible by water in steamers owned by the companies with, the result that accidents in transit are very rare.

To show the beneficial effect of the rules laid down by the Bureau for the Safe Transportation of Explosives, the following *comparative table of accidents in transportation, during the years 1906 and 1910, is shown:

YEAR	Accidents Causing Loss of Life and Bodily Injury			Accidents Not Causing Loss or Bodily Injury	Total Number of Accidents
	Number of Accidents	Number of Persons			
		Killed	Injured		
1906	20	43	337	5	25
1910	2	1	4	5	7

*Taken from DuPont annual reports.

The 1906 list contains the Jellico, Tenn., accident which killed to and injured 200 people. One of the causes advanced for this explosion was that the car of dynamite was bumped by one containing pig iron. The other was that it was shot into by a careless marksman. The rules laid down by the bureau not only decrease the possibility of accident but reduce the probability of loss of life and damage to a minimum. At the present time accidents in the actual shipment of explosives by rail in the United States are almost unknown. It is interesting to note that none of the accidents to blasting explosives in transit in 1910 caused, either loss of life or injury to people.

The writer feels that he cannot leave the subject of accidents in the transportation of explosives without mentioning the valuable work done by Maj. B. W. Dunn and the "Bureau for the Safe Transportation of

Explosives." The rules covering the transportation of explosives laid down by this bureau are second to none in the world and have doubtless prevented many accidents and saved many lives. The excellent work done by Major Dunn and his associates deserves the commendation of everybody connected with the manufacture, transportation, use of explosives and in particular that of the general public.

ACCIDENTS IN THAWING DYNAMITE.

While accidents in thawing dynamite really belong under the heading of "Accidents in the Use of Explosives" the writer considers this subject one of the sufficient importance to be treated by itself. This class of accidents is interesting in that it offers more chances for mitigating its dangers, and more promise of returns from educating the consumers, than any other. The man who designs or uses the thawing house is generally of a higher intelligence than a laborer and is more amenable to reason. A blaster may "know it all" in regard to the correct method of loading and firing his blasts, but the "boss" is generally willing to accept suggestions regarding the methods of thawing. A method often found at places where more than a case per day is used, is a box or house with a steam coil on the floor over which the dynamite is supported by slats or boards. This method offers an excellent opportunity for the nitroglycerine to exude if the temperature becomes unduly high and for it to drop on the hot iron pipe. It has been a generally accepted theory that when nitroglycerine is dropped form a height of a foot or so on a hot metallic surface it will explode, and it has been known positively to do so when the heated metal is a stove lid. A thawing house in Connecticut, which was constructed so that exuded nitroglycerine could drop on the steam coils, exploded not long ago and the accident was explained on this theory. The danger is greater with high grade straight dynamites than with the gelatins or ammonia dynamites.

As to frequency of accidents from the various methods of thawing, reference will be made again to the British government reports, which cover all accidents in thawing dynamite from the year 1872 to December 31st, 1910. These are given in order of frequency:

1. Heating over or in front of a fire.....41
2. Reheating water in which dynamite has been placed to thaw 11
3. Placing explosives in water, then heating it over a fire 10
4. Placing dynamite in ovens 8
5. Thawing cartridges in the hands over a lighted lamp or candle 7
6. Placing dynamite in hot ashes..... 7
7. Placing cartridges on top of a stove..... 7
8. Warming on a shovel over a fire..... 5
9. On hot iron 4
10. On a steam pipe 2
11. Rubbing cartridges together to warm them by friction 1
12. Overheating 1

The casualty list in the United Kingdom gives during this period 80 killed and 129 injured by these accidents. The records in the United States, taken from newspaper clippings during the year 1910 show 24 accidents in thawing causing bodily harm with a casualty list of 31 killed and 22 injured. Four accidents in thawing occurred that did no bodily harm making a total of 36 accidents in thawing dynamite in this country during the year 1909.

A table showing the accidents in thawing in the United States in order of frequency for the years 1909 and 1910 is as follows:

		1909.	1910.
1.	Over or before an open fire	18	10
2.	Unknown causes	6	9
3.	Over or near a hot stove	5	3
4.	Over a hot boiler	2	
5.	Over a naked light	1	
6.	In contact with hot bricks	1	
7.	In water over a fire	1	1
8.	Rubbing in hands	1	
9.	Burying in quicklime	1	
10.	Thawing inside a miner's shirt		1

Every method of thawing dynamite given in these tables is specifically condemned by all manufacturers of explosives and warned against by nearly all existing literature on the subject. Two of these accidents were unique. On March 25, 1909, a man placed some hot bricks in a bag with some dynamite to thaw it. In this case the powder caught fire before exploding enabling the man to escape. On December 11, 1909, a negro, near Richmond, Va., was thawing dynamite before a fire, the result being the ignition of the explosive. The negro's sense of economy being better developed than that of the common variety, caused him to try and beat the fire out with a club. It took several men the best part of a day to collect enough of him from the local scenery so that his relatives and friends could have a bona fide funeral.

A great many blasters, in this country, toast dynamite over a collection of candle stumps; blow live steam into a box containing dynamite, thereby unintentionally extracting a considerable quantity of nitroglycerine, which lies in a dangerous puddle on the floor, roast dynamite around bonfires, on ton of and under hot boilers and soak the cartridges in buckets of hot water, which water is dumped outside where there is continuous travel, without accident, showing the amount of ill-treatment that nitroglycerine explosives will stand, sometimes.

The records show two specific instances where thawing houses, heated by a stove in the middle of the room, have exploded. These explosions took place in the middle of the night some time after the rooms had been locked. One took place in Kansas and the other in Pennsylvania. One of the favorite and dangerous methods of thawing dynamite in the United States appears to be toasting it in front of fires. The oven is also a popular receptacle for frozen powder. Past records show numerous accidents caused by thawing dynamite in hot-sand. The only variation, as a rule, is the time before action is obtained and the difference in size of the casually list.

The insertion of blasting caps and the making of primers in the same room in which dynamite is being thawed has undoubtedly been the cause of several bad accidents. Thai near the Murray Hill hotel, in New York city, on January 27th, 1902, was apparently from this latter cause, combined with a fire in the waste paper from the wrappers. For this reason the leading manufacturers recommend, that for outside work, the thawing houses be constructed so that it will be impossible for a man to get inside at all, except to repair radiator, etc. The door to this entrance should be locked at all other times. Overheating the thawing house by steam pipes has also caused several explosions. If it is impossible to substitute hot water (the safest method of heating) for steam, at least one should insist on the outlet of the steam pipe being left free and wide open, so that the steam is not under pressure. A valve should be placed on the pipe leading into the thawing house but never on the outlet.

The observance of a few simple precautions should prevent practically all possibility of accident in thawing explosives. Always keep the cartridges laying on their sides. Heating slowly at temperatures not to exceed. 80 to 85 degrees F., the lower temperature being best, always keep the dynamite in good condition, fake all possible precautions to prevent overheating and never place the dynamite directly above the source of heat. Never thaw dynamite by direct contact with steam, by placing in hot water or before open fires. And lastly, never keep blasting caps or electric fuzes in the thawing house. Since the introduction of low freezing dynamite, there has been a marked diminution of accidents from thawing in the United States. During the year 1906, two years before the introduction of the first low freezing dynamite, there were reported 64 accidents from thawing dynamite against 28 in 1910, the third year in which low freezing dynamite was on the market.

ACCIDENTS IN THE USE OF EXPLOSIVES.

The number and variety of ways that trouble can develop in this class seems to be infinite and new ones seem to be invented every day. The accidents in which people have been killed or injured by not taking proper care in the use of explosives are all carefully reported in the United Kingdom, but are rarely given in the newspapers of the United States, where the accidents are not of a serious nature. In the English report, for 1910 there were 6 cases mentioned where shots blew through into another working place injuring men working there. Such accidents are entirely unnecessary if proper warnings are given and heeded. Aside from this, one of the most common operations in which accidents, in the use of both dynamite and black powder in the United Kingdom occur, is the loading and tamping of charges. It is interesting to note from the English report for 1910, that with dynamite four cases occurred and seven with black powder, where copper, brass, iron, or composition tamping rods were used. This shows that all metal tamping sticks should be avoided, only wood being a safe material.

In reference to accidents in the loading and tamping of charges, the following quotation is taken from the "Report of His Majesty's Inspectors of Explosives for the year 1910." In part this does not apply to the United States, as explosives here are packed in cartridges of standard outside dimensions all over the country:

"There were 36 accidents in ramming or stemming the charge, causing seven deaths and injury to 36 persons. In ramming charges into a borehole there must always be some danger, and it cannot be too strongly urged that this operation should be carried out with the least possible exercise of force; but there can be little doubt that in all these cases undue force was applied. The best method of preventing this class of accident is to insure that the men are not allowed to use drills which have become much worn, and also that the diameter of the cartridge is such as to give good clearance even with a slightly worn drill. It is most important that the cartridge shall not stick in the bore hole, as if it does the miner is quite certain to use sufficient force to get it to the bottom of the hole, as to fire the charge half-way down the hole would entail him the loss of half his work. We have suggested to various members of the explosive trade the advisability of standardizing the diameters of the cartridges supplied by them to the mines. In the manufactures of blasting cartridges some little difference in practice obtains; some firms considering that a 1-inch cartridge is one that has been squirted through a 1-inch die, others making an allowance for the paper wrappers. Consequently in a mine in which the men have been in the habit of using a cartridge made by one of the latter firms they would find the drills a shade too small to work with the cartridges of the former's production. Our proposal has been that the cartridges should be made exclusively of certain standard "over all" diameters (22, 33 and 44 millimeters have been suggested) and that these cartridges should be known as sizes 2, 3, 4, etc., and that intermediate sizes should not be made after a given date. This would cause a slight expense in altering drills at some mines, but we learn that the cost of this in a certain large mine was only about £7, so that this should form no insuperable obstacle. After the care which should be devoted to the drills, the other points which require attention are (I) to avoid bunching the cartridges (i. e., tying two or three together or otherwise inserting several at the same time), (II) the use of wooden rammers, (III) the thorough softening of all nitroglycerine explosives before use. Even with all the above precautions, however, the use of undue force may always cause an accident. A general impression seems to exist that, at any rate in the case of gunpowder, no amount of ill-treatment with wooden, or even copper, tools can possibly lead to danger, whereas, as a matter of fact, sufficient heat to ignite gunpowder may without much difficulty be produced by the contact of two particles of flint or other hard substance without the intervention of iron or steel—the absence of which therefore merely reduces the risk."

Frozen nitroglycerine has some very contradictory properties. It is more insensitive to the shock from a fulminate cap or a rifle ball when in that condition but on the other hand it appears to be more liable to explode on breaking, crushing, tamping, etc. Every year there are numerous accidents due to users tamping frozen dynamite and there is an average of five to six cases each year where workmen have been killed or injured simply by breaking a frozen cartridge of dynamite in their