shovel had stripped off the overburden over a considerable area. However, after concreting operations were started it was found that this little Erie shovel could not do the loading and keep ahead with the stripping of the overburden. Accordingly, a 70-ton shovel, having a 2½ yard dipper, was moved to the pit. This shovel was used in loading the cars, while the Erie did the stripping. Later on this 70-ton shovel was taken away, as it was needed to load ore. It was replaced with a McMyler R. R. crane, equipped with a 1½ yard orange peel bucket. This crane was used for stripping. In July it was moved to the dam to start work on the earth levee, and a 5/8 yard Marion shovel was moved to the pit to do the stripping.

The L. S. & I. did all the necessary switching in the pit, bringing in the empty ore cars and taking away the loaded ones and delivering them to Whitman. From Whitman the loaded cars were brought to the mixing plant by our own engine and later returned to Whitman.

From the early explorations made it was thought that this pit would furnish enough gravel to complete the dam. However, on account of the unexpected configuration of the underlying ledge, which was not indicated by the test pits dug, there was a shortage. To make up this shortage 12,760 tons of bank run gravel were purchased from the Champion Sand & Gravel Co. All told, for the dam proper 68,416 tons of gravel were used during the year.

The operation of gravel pit required an average crew of six men.

Comparative cost of gravel, delivered at Whitman, from the two sources was as follows:

From our own pit near Marquette - $1.04 per ton.

From Champion Sand & Gravel Co. - $1.28 " "

CEMENT

Four different brands of Portland cement were used; namely, Huron, Petoskey, Universal and Lehigh. Only a very small amount of Universal and Lehigh was used. Huron and Petoskey were used in about an equal amount.

The cement was delivered by the L. S. & I. Ry. to Whitman, from where it was delivered to the dam by our own locomotive. Here it was unloaded from

the cars directly to the mixer as needed, except when several cars arrived at the same time, when, in order to avoid paying demurrage, some of the cars were unloaded into a 4,000 bbl. cement storage shed adjacent to the mixing plant and from which the cement could be wheeled to the mixer as needed. The unloading of cement into storage shed was never done unless it was absolutely necessary, because it required extra handling and increased the cost an average of four cents a bbl. It was cheaper to pay two days demurrage than to unload into storage, and unless there was no possibility of unloading a car directly to the mixer within a period of four days, cement was never put into storage.

All told 51,119 bbls. of cement were used. All but 1,800 bbls. were used in the dam. Of these 1,800 bbls., 1,627 bbls. were used last year on the intake structure and 173 bbls. were in storage on the first of January, 1924.

Up to the last of December 191,100 empty cement sacks had been returned and credit had been received for 161,615. Credits for the remaining sacks shipped will undoubtedly come through in a very short time. We have on hand about 5,000 empty Lehigh sacks, which will be returned at the first opportunity. The probable recovery on empty sacks will be about 93%.

PREPARATION OF DAMSITE

Ledge, for almost the entire length of concrete section of dam, outcropped at the surface.

This ledge rock was badly shattered and weathered, so that it was necessary, in order to get a satisfactory foundation, to excavate from two to eight feet. The top six to 24 inches was rather finely broken up by freezing and by weathering, so that it was possible to wash this portion away, leaving in places a satisfactory foundation. Generally, this was not the case. The rock was shattered and broken up to a depth of from two to six feet deeper, to which depth it was necessary to excavate in order to get a satisfactory foundation. This lower part of the excavation was much more difficult and expensive, as the rock was shattered and broken in large pieces which could not be washed away but had to be picked and barred loose and then loaded by hand into wheelbarrows and wheeled outside the limits of the dam.

Previous to January, 1923, only 300 ft. of the dam foundation had been cleared. The remaining length, about 2,100 ft., was prepared during the past year.

Approximately 7,000 cubic yards of broken rock were removed in preparing the foundation. This excavation, of course, had to be replaced by an equivalent number of yards of concrete, thus increasing the estimate by the cost of removing the rock and by the cost of placing the additional yardage of concrete.

MIXING AND PLACING CONCRETE

Gravel was delivered in L. S. & I. ore cars to a gravel bin directly over the mixer. From this bin the gravel passed by gravity, through a measuring box, to the mixer.

The mixer discharged directly into a tower skip, in which the concrete was hoisted to the elevation of the chutes, into which the skip dumped, and in which the concrete was carried to the dam.

Direct distribution of the concrete from the chutes to the dam was possible for about 65% of the total yardage. For the ends beyond the chuting range of the tower the concrete was carried as far as possible in the chutes to an auxiliary hopper on top of the dam, from which the concrete was hauled in a dump car by a gasoline locomotive on a track laid on the finished part of the dam.

For the main bulk of the concrete four bags of cement per batch were used. The batches averaged 25.5 cubic feet. This, as the sand content was usually about 50% of the bank run aggregate, made a mix of about 1:3.2:3.2. Occasionally, due to variation in the sand content of the bank run aggregate, or to the necessity of producing a specially strong and sound concrete for certain portions of the dam subject to severe service, the cement was increased. In such cases five bags of cement to the batch were used.

For mixing a T. L. Smith one cubic yard mixer was used. This mixer had seen considerable service previous to being sent to the dam, and by the end of the job was so badly worn that numerous and frequent repairs were necessary.

Iron chutes having an exceptionally large cross section were used.

These were made up locally according to our own designs. About 600 ft. were in use during the concreting of the dam. At the end of the job approximately 50% were practically worn out. However, nearly all of them can be repaired at a reasonable cost and made serviceable again if the need should arise.

For hoisting a one drum electric driven hoist was used. This hoist, as remodelled after it came on the job, was driven by a 50 H.P. motor.

Ordinarily, for mixing and placing, a crew of 16 men were employed.

From January to September inclusive, a period of nine months, the average amount of concrete placed per month was 4,000 cubic yards. After October, progress was much slower on account of the long distances the concrete had to be hauled and also on account of the frequent breakdowns of the mixer and hoist.

FORMS

Wooden forms were used throughout. Two inch by twelve inch dressed Douglas Fir plank were used for lagging and 4" x 6" timbers for uprights. The uprights were spaced 4 ft. apart. Forms were held against the pressure of the green concrete by means of anchor bolts extending through the 4" x 6" post and the 2" plank. The inside end of the bolt was fitted with a hook, to which wires were stretched to anchors set in the previously poured concrete.

Forms were built, usually, in 5 ft. lifts and in 48 ft. lengths. After a lift had been poured and the concrete set up so that a man could walk on it another lift was raised. The lower forms were removed as soon as the concrete was set up. The timber was raised and used in building an upper lift. Usually three lifts of forms were in place at one time.

To remove the forms the anchor bolts were screwed out from the back of the form, leaving the hook and wires imbedded in the concrete. The uprights were then pried loose and them the planks removed.

A crew of 18 carpenters and helpers built the forms and did all other miscellaneous carpenter work required.

SAND LEVEE

The railroad, as originally built to the log hoist, extended through

a deep cut. The bottom of this cut was at elevation 1312, and at that elevation would permit the escape of the water from the reservoir unless some sort of barrier was constructed.

Test holes showed ledge to be at such a depth as to make the cost of a concrete dam across this gap, prohibitive. Consequently, a large sand levee was built a short distance above the upper end of this cut. This levee is to be raised to elevation 1356, three feet higher than the highest part of the concrete dam and eleven feet higher than the permanent spillway, thus insuring against any possibility of overtopping the fill.

When completed this earth fill will be about 1200 ft. long, joining onto the concrete dam on one end and extending to the hill on the opposite side of the cut. This earth fill will be 50 ft. wide on top, 43 ft. high, and have side slopes of 4 to 1 on the upstream face and 2 to 1 on the downstream face.

Previous to the placing of any fill, the site was cleared of all brush and trees, the portion of the railroad track within the area of the fill was removed, and a cut-off trench 10 ft. deep and 35 ft. wide was dug parallel with the longitudinal axis of the proposed fill and about 60 ft. inside of the final upstream limit of the finished fill.

The purpose of this trench was twofold; first, to break up the original ground surface so that the bottom of the fill would be thoroughly bonded to it, so that there would be no continuous plane of separation between the original ground surface and the bottom of the fill along which an excessive amount of seepage water might pass; second, to get material to build a dike along the upstream toe of the fill to retain material which later would be sluiced into place.

The building of the levee was started on August 21st. The material was dug by steam shovel from a pit east of the south end of the levee, as shown on the attached map, and loaded into 5 yard side dump cars. These loaded cars were hauled to the dam by a light steam locomotive. The cars were dumped from a trestle and the dumped material washed towards the upstream toe. The fill,

beginning at elevation 1346, was extended out from the south hill on a slightly rising grade until elevation 1356 was reached, from where the fill was carried across level to the junction with concrete section of the dam, embedding 100 ft. of concrete core wall extending out from the concrete dam.

Up to the end of the year 87,145 cubic yards of earth had been placed. As the water in the reservoir can not be raised above elevation 1339 on account of submerging some privately owned lands, and as the levee then was high enough to safely store water to this height, further work on the levee was discontinued for the winter. The remaining yardage in the levee will be placed next spring after the frost has gone out of the ground, when the work can be done considerably cheaper.

For this feature of the job a crew of 18 men and one team were employed.

PENSTOCK AND SURGE TANK

Owing to the extreme shortage of water and consequent shortage of electric power, it was impossible to shut down the Hoist Power Plant for a long enough period to build a new penstock. This work will be done next spring during the period of high water, at which time the Hoist Plant can be shut down and the load carried by the other plants.

Everything is in readiness for doing this work. New steel pipe, 7 ft. in diameter, has been fabricated and delivered to the site.

The top of the surge tank was at elevation 1310. Last fall, when the water storage was built up above this elevation, it was necessary to close the surge tank. This was done by laying three 8 ft. sections through the tank, thus closing the gap between the lower end of the tunnel and the upper end of the present wood stave penstock. The steel pipe was incased in concrete. The new penstock will join onto this steel pipe extending through the surge tank.

GENERAL

Test holes for the exploration of the site for the sand levee, seemed to indicate that the preglacial channel followed very closely the line of the present railroad cut to the old log hoist. Also, immediately below the east

end of the railroad cut was a considerable area of swamp land. This swamp was fed by seepage water, partly at least, from the river above. Both of these conditions indicated a possible source of weakness.

The site of the sand levee was chosen well upstream of the upper end of the cut, so that the length of travel of the seeping water would be a maximum, and also in case excessive seepage did develop and cause slides these slides could not extend to the downstream toe of the levee and thus endanger the stability of the fill, at least, not before remedial measures could be taken.

However, to allay any feeling of uneasiness that might exist, Mr. Chas. H. Paul, a Consulting Engineer of wide and varied experience, was called. In his report, a copy of which is herewith attached, he made a number of recommendations, all of which have or are being carried out.

COPY

Chas. H. Paul
Conservancy Building
Dayton, Ohio

Dec. 8, 1923.

Mr. O. D. McClure,
Chief Mechanical Engineer,
The Cleveland-Cliffs Iron Co.,
Ishpeming, Michigan.

Dear Sir:-

In response to your request, I made a trip to Ishpeming this week, and in company with you and Mr. Pauls, examined the conditions at the Dead River Storage Dam, with special reference to the earth fill section of the dam, and the seepage into the bog below the damsite.

This bog has been in existence for many years, and is fed by a great number of springs at the foot of the steep slope along its edge. Some of the seepage may come from the river, whose winding bed has considerable fall at the damsite; much of it undoubtedly is due to natural ground water seepage from the broad area of higher ground to the west and north. Prior to the construction of the present dam there had been a low dam just above this site. The seepage into the bog may or may not have been affected by that dam. There is no definite information as to that, but it is known definitely that the bog was there before the first dam was built. Unfortunately, no records of flow through this bog in the past are available, although its discharge into the river is concentrated at one point. A weir has been installed recently, and such records will be available for future studies, and will be of greatest value in determining the effect of the present construction on seepage conditions.

The concrete portion of the dam, and the core wall at the west end, are founded on bed rock, and should cut off absolutely any seepage from the reservoir along that section. The earth-fill section joining the core wall at the west end is tied in to bed rock for some distance farther west by means of a cut-off trench, refilled with puddled material. The rock surface drops

off gradually from the end of the core wall and it was considered impracticable and unnecessary to carry a positive cut-off all the way to bed rock under the whole of the earth fill section. I agree with that conclusion. As things now stand, any seepage from the reservoir to the bog must travel a distance of not less than 750 feet, which seems to be amply safe. This condition is secured by the conservative location of the earth fill section, which is thrown out around the end of the old railroad cut instead of being carried straight across on higher ground, thus putting the toe of the fill farther down into the reservoir, and materially increasing the length of seepage travel over what it otherwise would have been.

The earth section of the dam is a well built fill of sandy material dumped into place from a trestle, settled and puddled by sluicing. Operations are so conducted that the upstream face is sluiced out on a flat slope, and is thoroughly compacted. It will be protected from wave wash by a mat of drift, tied together and held in place by means of wire cables. The cross-section of the fill is liberal. This construction has already reached the stage where it is believed to be ample, for present purposes, and future work on it will consist of raising and sluicing out on the upstream face. By this process the toe material will be settled into place through the water ponded behind the dam, which is an ideal condition. Special care should be taken in sluicing this material around the end of the concrete core wall, so as to make a tight bond. This may be helped by roughening the concrete with vertical grooves or corrugations, before the fill is puddled against it. I see no reason why any trouble from seepage should be expected through this fill.

For the purpose of studying seepage conditions under the earth fill and through the natural ground between the reservoir and the bog, a number of pipes have been sunk at controlling points, and the flow from the springs is being studied. Before construction was begun a number of borings were made for the purpose of locating bed rock and the ground water elevations in these holes were noted. For seepage studies the most useful of these holes are;

No. 3, at the south-east end of the old R. R. cut, near the edge of the bank above the bog.

No. 6, at the downstream toe of the earth fill just east of the upper end of the old R.R. cut.

No. 0, recently put down at the downstream toe of the earth fill about on the line of the old R.R. cut.

A test pit was dug recently near hole No. 3, in which a water bearing sand was encountered at an elevation several feet above that at which the water stands in hole No. 3 alongside. Evidently this water bearing stratum is cut off from hole No. 3 by its casing, hole No. 3 being fed only by water from a lower stratum. I recommend that periodic readings be taken at this test pit, also that another pipe be put down to a corresponding elevation close to hole No. 0, and that similar readings be taken there. With the data furnished by periodic readings on these holes, together with water level readings in the reservoir, observations at the springs, and a record of the flow from the bog, the effect of the new construction will be easy to determine.

The following records are available at the present time:-

Date	Water surface in Reservoir	Hole No. 6	Hole No. 0	Hole No. 3
Nov. 10	1317.5	1295.4		1280.0
" 15	1317.6	1295.4		1279.8
" 22	1318.7	1295.6		1280.3
" 23	1318.7	1295.8		1280.0
" 24	1318.8	1295.8		1280.2
" 27	1319.7	1295.9	1295.1	1280.1
" 28	1319.7	1296.3	1295.3	1280.2
" 30	1319.8	1296.2	1295.3	1280.2
Dec. 4	1320.2	1295.9	1295.2	1280.2
" 5		1295.8	1295.4	1280.2

Hole No. 6 Downstream toe of fill east of R.R. cut.

" " 0 " " " " opposite R.R. cut.

" " 3 Downstream end of R.R. cut at bank above bog.

The water surface in the reservoir has been rising steadily, standing 22 to 24 feet higher than the water in holes No. 6 and No. 0, and some 38 to 40 feet higher than that in hole No. 3

During this period the water in hole No. 6 rose from 1295.4 on Nov. 10 to 1296.3 on the 28th, and dropped to 1295.8 on Dec. 5th,- evidently not affected, primarily, as yet, by the water in the reservoir, as that has

been steadily rising. This hole, however, may very likely be affected by the sluicing water in the fill, either by gradual seeping away of this water out of the fill itself, or by surface drainage from the nozzles. In fact it seems that on Nov. 22, six days prior to the beginning of the gradual drop in this hole, sluicing water on the fill was cut down from two nozzles to one. This may be a coincidence, but certainly there is nothing in this record to indicate that hole No. 6 is controlled up to this time by the water in the reservoir. It is true that the water in this hole stands some 7 feet higher than when it was originally put down, but regular readings were not taken in the meantime, and that rise may be as easily accounted for as a result of the sluicing as by the filling of the reservoir. Not that some effect from the latter source would be unexpected. But if there is any such effect, its extent is not evident from the present data.

The record on hole No. 0, is for a short period only, and as in the case of No. 6 is more suggestive of the effect of sluicing operations, than that of the filling of the reservoir. Subsequent records on both these holes will be instructive.

The water in hole No. 3 has not changed much as far as the record shows, but has risen and fallen slightly with no regularity. The indications are that this hole is affected more by rainfall seepage from the adjacent area, or by sluicing operations, than by any other cause. A rise of about five feet is indicated since this hole was first put down. There is some question as to the accuracy of this. If it were due to the filling of the reservoir the water in the hole would be expected to continue to rise gradually, which it has not done. The irregular behavior of this hole, as in the case of No. 6, is more easily accounted for as a result of rainfall or sluicing.

Surface water in evidence near the toe of the fill just below hole No. 0, is apparently the result of sluicing. It is being drained out along the railroad cut by a pipe which discharges over the bank into the bog at the lower end of the cut. The discharge through this pipe should be observed, and recorded with the other data.

The steep bank around the edge of the bog is covered with trees, brush and other vegetation. This growth is valuable in holding the bank from washing or sloughing, but the roots form a mat which tends to hold back the flow of seepage water and back it up higher, at the foot of the slope, than it otherwise would be. At the same time, however, it holds back the quicksand which otherwise would flow out with the water at that point. Attempts to open up the springs to get a free flow for the water have resulted in localized slides due to the moving of the quicksand, as the springs were opened up. Otherwise these slopes have shown no tendency to move since the new dam was put into commission. I should expect no serious trouble at that point. The bank from which these springs emerge is several hundred feet from the earth fill at the nearest point. The springs have always been there. In case it should develop that the filling of the reservoir increases the flow of the springs, and if sloughing of the banks results, there is plenty of room, and will be plenty of time, to take care of the situation as it develops. Mats of brush and trees (laid with tops downstream) weighted down with rock, at the toe of the slope, and carried up the slope a short distance if necessary, will provide free drainage and furnish a stable toe for the readjusted bank. Very likely the thing would adjust itself without any such treatment, but by waiting for the instability, if any, to show itself, no money will be wasted in doing a lot of work prematurely, that may never be needed. The necessary material is available at the site and what work may be necessary can be done just as cheaply later, as now. In the meantime the records which you will have obtained will be of value in analyzing the situation. I recommend that nothing be done at that point until such time as the necessity shows itself, when whatever work is required can be done effectively, and a considerable net saving will result.

The data which I have, shows the ultimate top of the earth fill as three feet lower than that of the concrete section adjacent. This may be in error. The earth fill should be somewhat higher (at any rate not lower) than the concrete section, including allowance for settlement, so that by no chance could the former be overtopped in case of extreme flood. Paving the slope of the

fill where it tails out at the junction with the core wall would prevent cutting away by possible overflow in such case. Even with an ample spillway section these precautions are wise, and in this case comparatively inexpensive. The top width of the earth section could be narrowed up correspondingly to take care of the additional height.

Summary of Recommendations.

Continue regular records of sluicing operations, water levels in reservoir, and in holes No. 6, No. 0 and No. 3.

Install short pipe near Hole No. 0, and take regular readings on it and on the test pit near hole No. 3.

Observe flow through drain pipe in connection with other data.

Continue observations of flow from springs and measurements of flow from bog.

Postpone possible protection measures at bank around edge of bog until such time as need develops.

Take special care in bonding earth fill to core wall.

Bring ultimate top of earth fill to an elevation somewhat higher than that of the concrete section adjacent.

Pave end of earth fill at junction with concrete section to prevent possibility of wash by overflow.

In general I find your methods to be conservative, both as to design and construction, and believe them to be amply safe.

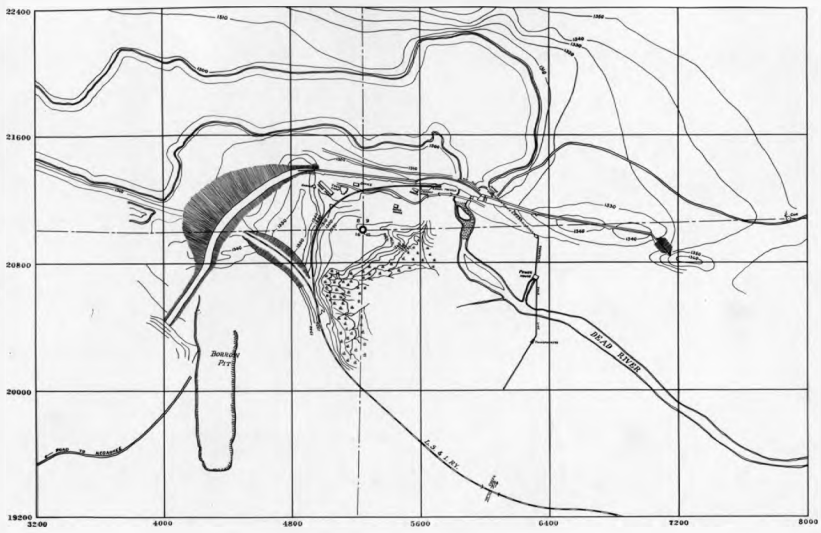
Sincerely yours,

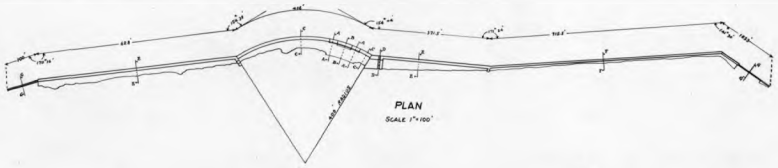
(Signed) Chas. H. Paul

Consulting Engineer.

DEAD RIVER STORAGE DAM

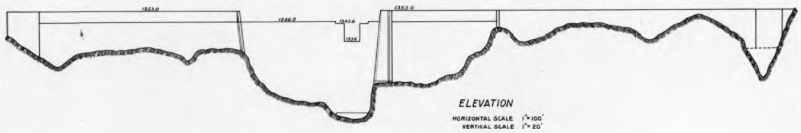
LOCATION OF DAM





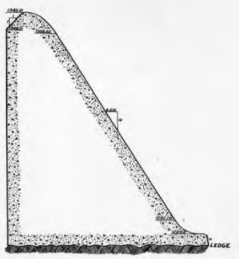
PLAN

SCALE 1"=100'



ELEVATION

HORIZONTAL SCALE 1"=100'
VERTICAL SCALE 1"=20'



SECTION AA

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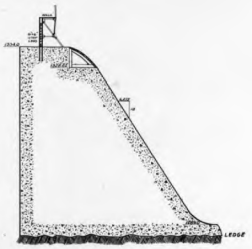

SECTION BB

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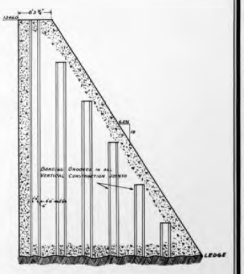

SECTION CC

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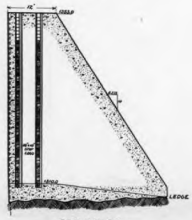

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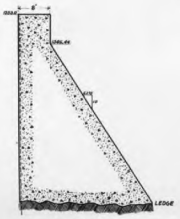

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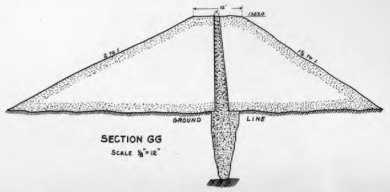

SECTION GG

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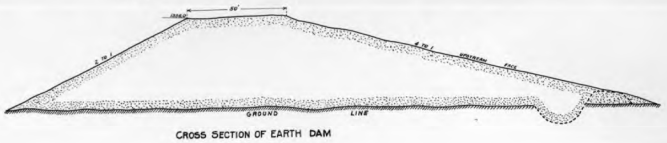
SECTION FF

SCALE 1/8"=1'



CROSS SECTION OF EARTH DAM

SCALE 1/16"=1'

ELECTRICAL DEPARTMENT

The year 1923 was a very unusual one for the operation of hydro-electric plants. Precipitation of 21.9" was 36% less than the average annual precipitation during the past 40 years, and 17% less than the lowest previous record in this period. This condition necessitated the operation of steam reserve plants during nine months of the year, and we had very little surplus power for sale to those customers who have previously been supplied. Our records indicate that even under these conditions if the new storage on Dead River had been completed we would have had sufficient water for all the mining operations without the use of steam plants, and in addition a considerable amount of surplus power would have been available for outside customers. At two different times during the year it was necessary to limit the use of power at the mines for one day intervals.

Transformer at McClure Plant, which was burned out in December, 1922, was repaired and again put in service in March. It has been in satisfactory operation since that time.

A small electric fire occurred at the Maas Substation due to short circuit across Hoist line terminals. Thiswas repaired and did not cause any delay in mining operations.

The thrust bearing on the water wheel at the Hoist Plant caused considerable trouble and was replaced by a "Gibbs" type bearing.

A timber fire in the vicinity of Au Train threatened our transmission line, but was extinguished before serious damage occurred.

Both circuits of the Ishpeming-Princeton line broke down due to lightning, resulting in a short shut-down of the Gwinn District mines until repairs were made.

Two staves in the Carp Plant wood pipe line broke down and were replaced by new ones. The Carp Plant was idle less than two days while repairs were being made. This did not cause any delay to mining operations.

The original insulators on tower lineshave gradually deteriorated and must all be replaced. About 200 were put on during the past year and the remainder should be replaced during the coming year.

MECHANICAL DEPARTMENT

ELECTRICAL DEPARTMENT (Cont'd)

A considerable amount of trouble develops on the Au Train-Gwinn line and we will probably wish to overhaul this line in the near future.

Automatic operation has been developed and installed at the Au Train and Hoist plants which will shut down the plants in the event of trouble. While some minor details caused trouble at first, we think it is now entirely reliable and satisfactory.

On account of the failure of a circuit breaker to operate, one generator was burned out at Au Train. Material for repairing this has not yet been received, but is expected next month.

In general, the service at all points has been entirely satisfactory and reliable, and with the near completion of the Hoist storage we feel confident of even better results in the future.

The usual tables and graphic charts are attached.

ELECTRICAL DEPARTMENT (Cont'd)

SUMMARY OF OPERATING CONDITIONS - 1 9 2 3 .

Month	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Precipitation	1.46	0.45	1.97	1.13	1.57	2.24	4.62	2.04	2.82	1.44	1.15	1.01

Total Precipitation for 1923 (Ishpeming) - 21.9 inches.

Average " at Marquette - 32.8 " (46 years record)

CARP RIVER HYDRO-ELECTRIC PLANT

Drainage area above Intake Dam,	66.66 sq. mil
Cubic feet Precipitation in 1923,	3,391,532,813
K. W. Hrs. generated " "	11,852,300
Cubic feet water utilized (90 cu. ft. = 1 KWH)	1,066,707,000
" " " in Carp Storage Basin Jan. 1, 1923,	240,855,120
" " " " " " " Dec.31, "	160,162,040
" " " drawn from Storage Basin,	80,693,080
" " " wasted over Intake Dam in 1923,	106,041,600
Total run-off for the year 1923,	1,253,441,680
Run-off per sqaare mile of drainage area,	18,803,505

	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923
Total Precipitation,	30.11	26.53	38.4	36.83	25.46	31.05	29.50	27.40	30.38	33.67	21.90"
Second ft.per sq.mile,	1.03	.67	.93	1.29	.70	.79	.83	.73	.68	1.06	.59

McCLURE HYDRO-ELECTRIC PLANT

Drainage area above Intake Dam,	140.52 sq. mi.
Cu. ft. Precipitation in 1923, (Hoist Plant 26.6")	8,683,731,302
K. W. Hrs. generated at McClure Plant in 1923,	21,759,500
Cubic feet water utilized (125 cu. ft. = 1 KWH)	2,719,937,500
" " " wasted over Intake Dam in 1923,	1,060,400,000
Total run-off for the year 1923,	3,780,337,500
Run-off per square mile of drainage area,	26,902,487

	1920	1921	1922	1923
Second ft. per sq. mile,	1.22	1.02	1.54	0.85

MECHANICAL DEPARTMENT

ELECTRIC POWER SYSTEM

SUMMARY OF OPERATIONS - 1923.

	KILOWATT HOURS GENERATED							Used by Auxiliaries	Delivered to Line	K. W. H. Sold	Losses	Cost Per K. W. H. (Incl. Depr.)
	McClure	Carp	Hoist	Au Train	Maas	Princeton	TOTAL					
Jan.	2,175,200	1,228,000	505,000	113,080	0	0	4,021,280	9,934	4,011,346	3,452,562	13.93%	$.00647
Feb.	1,962 300	1 571 200	426 000	69 900	0	0	4 029 400	9 500	4 019 900	3 496 245	13.02	.00586
March	1 977 300	1 323 000	*344 000	69 110	339,400	0	4 052 810	33 392	4 019 418	3 458 863	13.94	.00858
April	1 527 200	892 800	343 000	165 510	540 400	447,000	3 915 910	87 884	3 828 026	3 351 459	12.45	.01273
May	2 310 800	902 900	696 000	477 790	0	0	4 387 490	8 340	4 379 150	3 767 816	13.96	.00679
June	1 975 100	1 421 200	478 000	292 980	0	78 450	4 245 730	22 380	4 223 350	3 628 111	14.09	.00736
July	1 969 400	1 185 600	519 000	151 680	0	219 150	4 044 830	35 660	4 009 170	3 495 104	12.82	.00806
Aug.	1 863 900	1 025 900	485 000	105 050	56 200	434 600	3 970 650	68 656	3 901 994	3 360 630	13.87	.01037
Sept.	1 692 500	770 100	402 000	102 410	310 400	498 400	3 775 810	96 636	3 679 174	3 175 525	13.68	.01256
Oct.	1 326 000	767 300	350 000	104 940	516 900	573 500	3 638 640	108 346	3 530 294	2 990 333	15.29	.01346
Nov.	1 324 500	368 600	381 000	244 860	526 400	570 950	3 416 310	108 248	3 308 062	2 828 394	14.49	.01366
Dec.	1 655 300	395 700	479 000	195 500	173 500	523 500	3 422 500	86 960	3 335 540	2 883 459	13.55	.01240
TOTALS	21,759,500	11,852,300	5,408,000	2,092,810	2,463,200	3,345,550	46,921,360	675,936	46,245,424	39,888,501	13.74	$.00965

The following alternating current motors are installed and operating as needed:

	INSTALLED TO JAN. 1, 1923	INSTALLED IN 1923	TAKEN OUT IN 1923	CONNECTED JAN. 1,1924 TOTALS
ANGELINE MINE -				
Hoist	250 HP.			
Underground Haulage Set	150			
				400 HP.
CLIFFS SHAFT MINE -				
Shop	25			
No. 8 Crusher	125			
No. 5 Crushers - 2 @ 25 HP motors	50			
Screens	15			
Top Tram	50			
Lower Tram #1	35			
Underground Haulage Set #1	100			
Hoist for "A" Shaft	500			
Underground Plunger Pump No. 1	180			
" Centrifugal Pump	250			
Compressor - Allis-Chalmers	175			
Hoist for "B" Shaft	500			
Underground Plunger Pump #2	200			
Laboratory Crusher	5			
Coal Crushing Plant	15			
" " " Exhaust Fan	½			
Cooling Water Pump for Compressors	10			
Ingersoll-Rand Compressor #1	400			
" " " #2	400			
Lower Tram #2	50			
Heating Plant Condensing Water Pump	2			
Underground Haulage Set #2 (From Lake Mine)	2	215		
Scraper on 1st Level,"B" Shaft (From Hoist Dam)		25		
" " 2nd " " " (From Lake Mine)		15		
Conveyor Belts - New Crushing Plant - 2 motors		40		
Jaw Crusher - " " "		75		
Feeder Belt - " " "		5		
Magnetic Separator " " "		1½		
				3,464
HARD ORE SHOPS -				
Machine Shop	7½	10	7½	
Carpenter Shop	25			
Blacksmith Shop Punch	3			
Armature Banding Machine	2			
" " "	½			
" " "	1/8			
Lathe Grinder	1			
Portable Drill	¼			
" " - Large	¼			
Commutator Slotter	1/8			
Air Compressor	10½			
Water Supply Pump	7½			
Blacksmith Shop Blower		¼		
Hacksaw		½		
				61
BROWNSTONE SUBSTATION -				
Test Set	½			
Oil Filter Press	¼			
BatteryCharging Motor-Generator Set	3			
				3¾
fwd.	3,549 HP.	387¼ HP.	7½ HP.	3,928¾ HP.

ELECTRICAL DEPARTMENT (Cont'd)

	INSTALLED TO JAN. 1, 1923	INSTALLED IN 1923	TAKEN OUT IN 1923	CONNECTED JAN. 1,1924 TOTALS
brt. fwd.	3,549 HP.	387¼ HP.	7½ HP.	3,928¾ HP.
HOLMES MINE -				
Air Compressor	340			
" " Cooling Water Pump	3			
Skip Hoist	400			
Cage "	400			
Underground Haulage Converter	150			
Machine Shop	7½			
Top Tram	25			
No. 8 Crusher (From South Jackson)	100	150	100	
No. 6 Crushers - 2 - 40 HP. motors	80			
Screens	20			
Laboratory Crusher	2			
Underground Plunger Pump	250			
" Centrifugal Pump	400			
				2,227½
LAKE MINE -				
Underground Haulage Set (To Cl.Shaft)	215		215	
Coal Crushing Plant " "	15		15	
				0
SALISBURY MINE -				
Hoist	400			
Underground Centrifugal Pump	400			
" Plunger "	100			
" Ventilating Fan	7½			
Compressor Cooling Water Pump	2			
Surface Drainage Pump	30			
Compressor	150			
Water Supply Pump	5			
				1,094½
ATHENS MINE -				
Cage Hoist	400			
Compressor	325			
" Cooling Water Pump	3			
Auxiliary Compressor for Hoist Brakes	5			
Underground Ventilating Fan	15			
Sinking Pump - 2400' Station	50			
Skip Hoist Set	850			
" " " Oil Pump	1			
Shop	10			
Underground Haulage Converter	150			
Skip Pit Pump	2			
Laboratory Crusher	5			
Underground Plunger Pump #1	400			
Top Tram - 2 -50 HP. motors	100			
Carpenter Shop	20			
Underground Ventilating Fan	15		15	
" Plunger Pump #2	400			
Ore Crusher	25			
Battery Charging Motor-Generator Set	¼			
Underground Ventilating Fan	40			
Ingersoll-Rand Compressor	450			
				3,251¼
fwd.	10,317¼HP.	537¼ HP.	352½ HP.	10,502 HP.

ELECTRICAL DEPARTMENT (Cont'd)

	INSTALLED TO JAN. 1, 1923	INSTALLED IN 1923	TAKEN OUT IN 1923	CONNECTED JAN. 1,1924 TOTALS
brt. fwd.	10,317¼ HP.	537¼ HP.	352½ HP.	10,502 HP.
MAAS MINE -				
Turbine Auxiliaries (Circulating Pump	40			
(Injection "	25			
(Exciter	33			
Underground Haulage Set	215			
Shop	10			
Underground Centrifugal Pump	350			
" Hoist	50			
" Plunger Pump #1	320			
Winze Pump - 4th Level	15			
Compressor Cooling Water Pump	5			
Skip Pit Hoist	15			
Ore Tram - 2 - 50 HP. motors	100			
Coal Crushing Plant	15			
Underground Plunger Pump #2	250			
Ingersoll-Rand Compressor #1	400			
" " " #2	400			
Small Air Compressor for U.G. Pumps	2			
Compressor Cooling Water Pump (to Spies)	3		3	
Rock Tram	50			
Skip Hoist	700			
Cage "	400			
Boiler Room Fan	½			
Skip Hoist Rheostat Pump	2			
Carpenter Shop Saw		15		
				3,412½
MAAS CRUSHING PLANT -				
Crusher	100			
Pan Conveyor	50			
Belt "	50			
				200
NEGAUNEE MINE -				
Underground Haulage Set	215			
"Ilgner" Hoist Set	450			
Top Tram - 2 - 50 HP. motors	100			
Laboratory Crusher	5			
Auxiliary Compressor for Hoist Brakes	3			
U.G.Plunger Pumps - 2 - 300 HP. motors	600			
" Centrifugal Pump	350			
" Suction Pumps - 2 - 15 HP. motors	30			
Compressor Cooling Water Pump	3			
Nordberg Air Compressor	325			
Shop	15			
Skip Pit Pump	5			
Ore Crusher	25			
Ingersoll-Rand Compressor	400			
Commutator Grinder	1			
12th Level Plunger Pump	15			
11th " " Pumps 2 - 75 HP.motors	150			
Exciters for U.G. Pump Motors (2)	40			
Signal System Motor-Generator Set	½			
				2,732½
SOUTH JACKSON CRUSHING PLANT -				
Hoist	75			
Crusher (Sent to Holmes Mine)	150		150	
Compressor	100			
				175
fwd.	16,975¼ HP.	552¼ HP.	505½ HP.	17,022 HP.

MECHANICAL DEPARTMENT

ELECTRICAL DEPARTMENT (Cont'd)

	INSTALLED TO JAN. 1, 1923	INSTALLED IN 1923	TAKEN OUT IN 1923	CONNECTED JAN. 1,1924 TOTALS
brt. fwd.	16,975¼ HP.	552¼ HP.	505½ HP.	17,022 HP.
BARNES-HECKER MINE				
Cage Hoist	400			
Skip "	400			
Water Supply Pump	10			
Underground Haulage Converter	150			
" Centrifugal Pump - 2nd Level	400			
" " " - 3rd "	400			
" Plunger Pump - " "	350			
Top Tram	50			
				2,160
LLOYD MINE				
Skip Hoist	400			
Cage "	400			
Top Tram - 2 - 40 H.P. motors	80			
Ore Crusher	25			
Water Supply Pump installed Underground	50			
				955
MORRIS MINE				
Skip Hoist	400			
Cage "	400			
Shop	25			
Water Supply Pump (taken out and stored)	40		40	
" " " " " " "	50		50	
Ingersoll-Rand Air Compressor	250			
4th Level Plunger Pumps - 2 - 350 HP.motors	700			
7th " " Pump	100			
" " Centrifugal Pump	175			
Centrifugal Pump unwatering North Lake	125			
Laboratory Crusher	5			
Carpenter Shop	25			
Nordberg Air Compressor	325			
Compressor Cooling Water Pump	5			
Top Tram - 2 - 50 HP. motors	100			
Underground Haulage Set	150			
Centrifugal Water Supply Pump (from storage)		50		
Heating Plant Condensing Water Pump		2		
				2,837
SECTION 6 SHAFT				
Hoist	200			
Water Supply Pump	3			
				203
AUSTIN MINE				
Laboratory Crusher	3			
Hoist	200			
Top Tram	25		25	
" "		50		
				253
fwd.	23,396¼ HP.	654¼ HP.	620½ HP.	23,430 HP.

MECHANICAL DEPARTMENT

ELECTRICAL DEPARTMENT (Cont'd)

	INSTALLED TO JAN. 1, 1923	INSTALLED IN 1923	TAKEN OUT IN 1923	CONNECTED JAN. 1,1924 TOTALS
brt. fwd.	23,396¼ HP.	654¼ HP.	620½ HP.	23,430 HP.
FRANCIS MINE				
Underground Ventilating Fan	7½			
Air Compressor	403			
Underground Centrifugal Pump	400			
Skip Hoist	400			
Compressor Cooling Water Pump	3			
Shop	5			
Top Tram	50			
Underground Haulage Converter	150			
Cage Hoist	400			
Underground Plunger Pump	350			
Ore Tram	37			
6th Level Plunger Pump	35			
" " Ventilating Fan	100			
				2,340½
GWINN MINE				
Skip Hoist	400			
Cage "	400			
Underground Centrifugal Pump	400			
" Plunger "	350			
Ore Tram	37			
Rock "	10			
Underground Haulage Set	150			
Shop	5			
11th Level Plunger Pump	50			
				1,802
GWINN CRUSHING PLANT				
Crusher	85			
Pan Conveyor	50			
Belt "	40			
				175
GARDNER MINE				
Top Tram	25			
				25
MACKINAW MINE				
Hoist	400			
Air Compressor	325			
Compressor Cooling Water Pump	3			
Shop	7½			
Water Supply Pump	7½			
Top Tram	25			
Underground Haulage Converter	150			
" Quintuplex Pump	350		350	
" Triplex "	75		75	
				918
PRINCETON MINE #2				
Hoist	200			
Top Tram - 2 - 50 HP. motors	100			
Underground Plunger Pump	150			
" Centrifugal Pump	125			
				575
PRINCETON MINE #3				
Hoist	75			
				75
fwd.	29,731¾ HP.	654¼	1,045½ HP.	29,340½ HP.

MECHANICAL DEPARTMENT

ELECTRICAL DEPARTMENT (Cont'd)

	INSTALLED TO JAN. 1, 1923	INSTALLED IN 1923	TAKEN OUT IN 1923	CONNECTED JAN. 1,1924 TOTALS
brt. fwd.	29,731¾ HP.	654¼ HP.	1,045½ HP.	29,340½ HP.
STEPHENSON MINE				
Skip Hoist	400			
Cage "	400			
Top Tram - Bessemer	50			
" " - C. & N. W.	50			
" " - #2 Bell	50			
Rock "	25			
Aldrich 5th Level Plunger Pump	250			
Prescott " " " "	250			
5th Level Centrifugal Pump	275			
6th " " "	50			
" " Plunger "	50			
				1,850
PRINCETON CENTRAL POWER PLANT				
Turbine Auxiliaries (Circulating Pump	50			
(Injection "	25			
(Exciter	33			
Underground Haulage Set	215			
Air Compressor	625			
" " Cooling Water Pump	7½			
Boiler Room Fan	50			
Coal Handling Machinery	10			
" " "	5			
				1,020½
PRINCETON CENTRAL SHOPS				
Shop Motor	25			
Grinder	3			
				28
PRINCETON CENTRAL PUMP STATION				
Centrifugal Pump	100			
				100
CARP PLANT				
Auxiliaries - 2 - 15 HP. pump motors	30			
Water Supply Pump	1			
				31
HOIST PLANT				
Exciter Motor-Generator Set	20			
				20
McCLURE PLANT				
Water Supply Pump	2			
				2
DEAD RIVER STORAGE DAM				
Centrifugal Pump for Hydraulic Work	100			
Water Supply Pump	5			
Concrete Mixer (Stored at Cliffs Shaft)	10	30	10	
" Hoist (Used " " ")	25	50	25	
Wood Saw	10			
Pump		200	200	
Air Compressor		50		
Small Pump		3		
Bag Cleaner		½		
				248½
fwd.	32,933¼ HP.	987¾ HP.	1,280½ HP.	32,640½ HP.

MECHANICAL DEPARTMENT

ELECTRICAL DEPARTMENT (Cont'd)

	INSTALLED TO JAN. 1, 1923	INSTALLED IN 1923	TAKEN OUT IN 1923	CONNECTED JAN. 1,1924 TOTALS
brt. fwd.	32,933¼ HP.	987¾ HP.	1,280½ HP.	32,640½ HP.
ISHPEMING HOSPITAL				
Passenger Elevator	7½			
Dumb Waiter	3			
Large Washer	2			
Small "	1			
Extractor	2			
Vacuum Cleaner	3			
" Pump	1			
				19½
REPUBLIC MINE				
Screen at #9 Shaft	25			
Crusher	100			
Auxiliary Compressor for Hoist Brakes	5			
Pump in Engine House	7½			
Centrifugal Pump in Engine House	20			
Coal Tram	7½			
Pump	20			
Machine Shop	5			
Pump - 4th Level	15			
" - 3rd "	50			
Pascoe Shaft Underground Pump	50			
#9 Shaft Rock Tram	15			
Portable Hoist	7½			
Laboratory Crusher	3			
Picking Belt	5			
Screen at Crusher	10			
Carpenter Shop	20			
#9 Shaft - 2 - 500 HP. motors	1,000			
Motor-Generator Set for Underground Haulage	30			
Underground Hoist	100			
9th Level Winze Hoist	50			
#9 Shaft Top Tram - 2 - 50 HP. motors	100			
Pump - 11th Level Pascoe Shaft	10			
				1,655½
TOTAL MINING DEPARTMENT	34,608¼ HP.	987¾ HP.	1,280½ HP.	34,315½ HP.
PIONEER FURNACE				
Motor-Generator Set	750			
Sawmill (8 motors)	445			
				1,195
L. S. & I. RY.				
Shops, Sawmill, Ore Dock & Pumps	800			
				800
LAND DEPARTMENT				
Sawmill at Munising - 2 motors	125			
Grand Island	10½			
				135½
LUMBERING DEPARTMENT				
Dixon Location Water Supply Pump	5			
				5
ELECTRIC LIGHT & POWER CO., MUNISING				
City Pumping	125			
				125
REPUBLIC TOWNSHIP				
Water Supply Pump	25			25
GRAND TOTAL CONNECTED LOAD	36,893¾ HP.	987¾ HP.	1,280½ HP.	36,601 HP.
MUNISING WOODENWARE COMPANY				
Breakdown Service	695 HP.			695 HP.

MECHANICAL DEPARTMENT

The following motors are not connected to our General Power System:

	INSTALLED TO JAN. 1, 1923	INSTALLED IN 1923	TAKEN OUT IN 1923	CONNECTED JAN. 1,1924 TOTALS
SPIES MINE				
Hoist	200 HP.		200 HP.	
Underground Triplex Pump	50			
Crusher	50			
Air Compressor	200			
Grinder in Shop	3			
Compressor Cooling Water Pump		3		
Hoist		400		
Boiler Feed Pump		2		
Top Tram		25		
4th Level Pump		50		
				783 HP.
MESABA RANGE				
BOEING MINE				
Sinking Hoist	35			
Air Compressor	225			
Underground Plunger Pump	100			
" Centrifugal Pump	125			
" Haulage Set	150			
Hoist	200			
Top Tram	50			
Compressor Cooling Water Pump	2			
Shop	10			
Centrifugal Pump in Pit	85			
" "	125			
" " (From Crosby Mine)		85		
				1,192
CROSBY MINE				
Plunger Pump	50		50	
Centrifugal Pump (Sent to Boeing Mine)	85		85	
Conveyor Belt	40			
Screen	20			
Picking Belt	3			
Log Washer	20			
Chip Screen	3			
Tables	20			
Feeder Motor	20			
Shop (Stored at Hill-Trumbull Mine)	5		5	
Sump Pump(" " " " ")	5		5	
Electric Drill (to " " ")		¼	¼	
Turbo for Washing Plant		7½		
				133½
HELMER MINE				
Hoist	200			
Sump Pump (Stored at Wade Mine)	5		5	
				200
fwd.	2,086 HP.	572¾ HP.	350¼ HP.	2,308½ HP.

ELECTRICAL DEPARTMENT (Cont'd)

	INSTALLED TO JAN. 1, 1923	INSTALLED IN 1923	TAKEN OUT IN 1923	CONNECTED JAN. 1,1924 TOTALS
brt. fwd.	2,086 HP.	572¾ HP.	350¼ HP.	2,308½ HP.
WADE MINE				
Hoist	125			
Air Compressor	150			
" " Cooling Water Pump	2			
Underground Haulage Set	150			
Machine Shop	10			
Pump - Triplex Underground	50			
Centrifugal Pump "	100			
Sump Pump	5			
Ventilating Fan	15			
Top Tram	50			
Locomotive Water Pump	5			
Clear " "	15			
				677
HILL-TRUMBULL MINE				
Log Washer	25			
" "	40			
Turbos - 4 - 5 HP. motors	20			
Picking Belt	2			
Chip Screens 2 - 2 " "	4			
Crusher	100			
Sand Pumps - 2 - 10 " "	20			
Prescott Plunger Pump	125			
Centrifugal Pump	125			
Tables	20			
Shops	30			
Punch & Shear Machine in Shop	5			
Band Saw in Carpenter Shop	5			
Compressor in Shop	50			
Screen	20			
Conveyor	100			
Planer in Shop	3			
Variety Saw in Shop	5			
Forge Fan	2			
Electric Drill (From Crosby Mine)		¼		701¼
TOTAL	3,464 HP.	573 HP.	350¼ HP.	3,686¾ HP.

The following motors are on hand (Dec. 31, 1923), but are not installed:

CLIFFS SHAFT MINE		
Top Tram (stator only)	50	
Signal System Motor-Generator Set	¼	
From Concrete Mixer at Hoist Storage Dam	10	
Spare Top Tram	50	
		110¼ HP.
GENERAL STOREHOUSE		
Spare Motor-Generator Set	15	
" from Republic concrete mixer	5	
" General Electric pump	50	
" Westinghouse Motor-Generator Set	220	
" Pump from Lake Mine	75	
" from Stephenson plunger pump	250	
" " " centrifugal pump	275	
" " Salisbury compressor	150	
" " Lake Mine centrifugal pump	20	
" " Hard Ore #3 Shaft centrifugal pump	150	
" " " " " " plunger "	35	
" " Mackinaw Mine plunger pump	35	
" Auxiliary Air Compressor	2	
" General Electric	7½	
" from Holmes Mine crusher	100	
" " reclaimed Cliffs Shaft motor	50	
" Pump motor from Dead River Storage Dam	200	
		1,639½
ATHENS MINE		
Sinking Pump		35
NEGAUNEE MINE		
Flywheel Hoist Set		350
MORRIS-LLOYD MINE		
Underground Haulage Set Motor	150	
Winze Plunger Pump (stored)	50	
" Centrifugal " "	50	
" Triplex " "	50	
Ventilating Fan Motor from Barnes-Hecker	15	
Pump Motor	40	
McClure Plant Centrifugal Pump	50	
		405
FRANCIS MINE		
Rock Crusher		25
AUSTIN MINE		
Top Tram		25
MACKINAW MINE		
Quintuplex Pump	350	
Triplex "	75	
		425
PRINCETON CENTRAL POWER PLANT		
U.G. Centrifugal Pump from Princeton		50
Rock Crusher from Francis Mine		25
STEPHENSON MINE		
Layne & Bowler Pump #2		350
fwd.		3,439¾ HP.

ELECTRICAL DEPARTMENT (Cont'd)

brt. fwd.		3,439¾ HP.
REPUBLIC MINE		
Spare	15	
"	10	
"	30	
"	7½	
		62½
ISHPEMING HOSPITAL		
Spare for Dumb Waiter		3
TOTAL		3,505¼ HP.

Spare motors on Mesaba Range; on hand Dec. 31st, 1923:

BOEING MINE		
Sump Pump	7½	
Pump	20	
		27½ HP.
CROSBY MINE		
Centrifugal Pump		50
HILL-TRUMBULL MINE		
Log Washer	25	
Conveyor	50	
Pump	20	
"	3	
Sump Pump	5	
" "	5	
		108
WADE MINE		
Pump	5	
"	5	
		10
TOTAL		195½ HP.

SPIES MINE (Stored, ready to be installed)

Underground Haulage Motor-Generator Set	150	
5th Level Pump #1	150	
5th " " #2	150	
Machine Shop	5	
		455 HP.

Total C.C.I.Co. load connected to General Power System -		34,315½ HP.
" Outside " " " " " " " -		2,285½ "
Breakdown service " " " " " " " -		695 "
		37,296 "
Total connected load at Spies Mine	-	783 "
" " " " Minnesota Mines	-	2,903¾ "
Total Spare Motors on hand 12/31/23 - Ishpeming Dist.	-	3,505¼ "
" " " " " " - Minnesota Mines	-	195½ "
" " " " " " - Spies Mine	-	455 "

ELECTRICAL DEPARTMENT (Cont'd)

The following direct current generators and exciters are installed and operating as needed:

	INSTALLED TO JAN. 1, 1923	INSTALLED IN 1923	TAKEN OUT IN 1923	JAN.1,1924 TOTALS
AU TRAIN WATER POWER PLANT				
Exciters (2)	34 KW.			34 KW.
CARP RIVER WATER POWER PLANT				
Exciters (2)	150			150
HOIST PLANT				
Exciter	17½			17½
McCLURE PLANT				
Exciters (2)	110			110
MAAS PLANT				
Motor Driven Exciter	22½			
Turbo "	22½			
Compressor Motor Exciters (2)	20			
				65
PRINCETON CENTRAL POWER PLANT				
Motor Driven Exciter	22½			
Turbo "	22½			
Compressor Motor Exciter	12			
				57
REPUBLIC MINE				
Exciter in #5 Engine House	7½			
" " Water Power Plant	17			
				24½
CLIFFS SHAFT MINE				
Compressor Motor Exciters (2)	20			20
HARD ORE & BROWNSTONE SUBSTATION				
Battery Charging Set	2			
Line Testing Set	½			
				2½
HOLMES MINE				
Compressor Motor Exciter	10			10
ATHENS MINE				
Nordberg Compressor Motor Exciter	10			
Flywheel Set Exciter	15			
Skip Hoist Generator	700			
Battery Charging Motor-Generator Set	½			
Ingersoll-Rand Compressor Motor Exciter	10			
				735½
NEGAUNEE MINE				
Skip Hoist Generator	400			
Cage " "	150			
Flywheel Set Exciter	25			
Exciters for Underground Pump Motors (2)	28			
Ingersoll-Rand Compressor Motor Exciter	10			
Nordberg " " "	10			
Bell Signal Set	½			
				623½
fwd.	1,849½ KW.	0	0	1,849½ KW.

MECHANICAL DEPARTMENT

ELECTRICAL DEPARTMENT (Cont'd)

	INSTALLED TO JAN. 1, 1923	INSTALLED IN 1923	TAKEN OUT IN 1923	JAN.1,1924 TOTALS
brt. fwd.	1,849½ KW.	0	0	1,849½ KW.
MORRIS MINE				
Ingersoll-Rand Compressor Motor Exciter	12			
Nordberg " " "	10			
				22
FRANCIS MINE				
Compressor Motor Exciter	10			10
MACKINAW MINE				
Compressor Motor Exciter	10			10
TOTAL	1,891½ KW.	0	0	1,891½ KW.

Underground haulage generators:

ANGELINE MINE				
Motor-Generator Set	100 KW.			100 KW.
CLIFFS SHAFT MINE				
Motor-Generator Set	100			100
" " " (From Lake Mine)		100		100
HOLMES MINE				
Converter	100			100
LAKE MINE				
Motor-Generator Set (to Cliffs Shaft)	100		100	0
ATHENS MINE				
Converter	100			100
MAAS MINE				
Motor-Generator Set	100			100
NEGAUNEE MINE				
Motor-Generator Set	100			100
BARNES-HECKER MINE				
Rotary Converter	100			100
MORRIS-LLOYD MINE				
Motor-Generator Set	100			100
FRANCIS MINE				
Rotary Converter	100			100
GWINN MINE				
Motor-Generator Set	100			100
MACKINAW MINE				
Rotary Converter	100			100
PRINCETON CENTRAL POWER PLANT				
Motor-Generator Set	100			100
REPUBLIC MINE				
Battery Charging Set for Storage Battery Locomotives	20			20
TOTAL	1,320KW.	100 KW.	100 KW.	1,320 KW.

MECHANICAL DEPARTMENT

ELECTRICAL DEPARTMENT (Cont'd)

The following direct current motors are installed and operating as needed:

		INSTALLED TO JAN. 1, 1923	INSTALLED IN 1923	TAKEN OUT IN 1923	JAN.1,1924 TOTALS
AU TRAIN WATER POWER PLANT					
Governor Control Motors	(2)	¼ HP.			¼ HP.
CARP RIVER WATER POWER PLANT					
Rheostat Control	(2)	¼			
Governor "	(2)	¼			½
McCLURE PLANT					
Valve Control	(2)	2			
Rheostat "	(2)	½			2½
CLIFFS SHAFT MINE					
Portable Hoist Motor		10			
Re-crushing Plant Conveyors	(2)	4	4		
Sturtevant Fan			1½		15½
HOLMES MINE					
Sturtevant Fans	(2)	3			3
ATHENS MINE					
Skip Hoist Motor		900			
Ventilating Fans	(2)		30		930
MAAS MINE					
Timber Hoist - 2nd level		10			
" " - 4th "		10			
Bilge Pump		5			25
NEGAUNEE MINE					
Skip Hoist Motor		500			
Cage " "		200			
Timber Hoist - 9th Level		10			
" " -10th "		10			
Fan Motor		15			735
MORRIS MINE					
Ventilating Fan		15			
Sturtevant "	(Sent to Cliffs Shaft)	1½		1½	
Ore Loader	(" " " ")	2		2	
" "	(" " " ")	2		2	
" "	(Stored at Morris)	2		2	
" "	(" " ")	2		2	15
GWINN MINE					
Hoist - 9th Level		15			
Ventilating Fan		15			
" "		15			45
PRINCETON MINE					
Bilge Pump		5			5
	TOTAL	1,750¾ HP.	35½ HP.	9½ HP.	1,776¾ HP.

MECHANICAL DEPARTMENT

Spare direct current motors on hand December 31st, 1923:

CLIFFS SHAFT MINE			
Motor			6½ HP.
MORRIS LLOYD MINE			
Fan Motor from Barnes-Hecker		15	
Crane Motor		10	
Underground Loaders	(2)	4	
			29
GWINN MINE			
Pump Motor			20
	TOTAL		55½ H.P.

Spare underground haulage generators on hand December 31st, 1923:

GENERAL STOREHOUSE		
Motor-Generator Set		150 KW.
MORRIS-LLOYD MINE		
Motor-Generator Set		100
TOTAL		250 KW.

Spare generators and exciters on hand December 31st, 1923:

CLIFFS SHAFT MINE			
Signal Set			½ KW.
GENERAL STOREHOUSE & HARD ORE			
Old Hoist Exciter		22	
Motor-Generator Set used for battery charging in Hard Ore Shop		10	
			32
NEGAUNEE MINE			
Skip Hoist armature only			500 H.P.
HOIST PLANT			
Spare Exciter			18 K.W.
	TOTAL		50½ K.W.

ELECTRICAL DEPARTMENT (Cont'd)

MESABA RANGE

Exciters and generators installed up to December 31st, 1923:

BOEING MINE	
Compressor Motor Exciter	6 K.W.

Underground haulage generators installed up to Dec. 31st, 1923:

BOEING MINE	
Motor-Generator Set	115 K.W.
HILL-TRUMBULL MINE	
Motor-Generator Set	55
WADE MINE	
Rotary Converter	100
TOTAL	270 K.W.

Direct current motors installed up to December 31st, 1923:

HILL-TRUMBULL MINE	
Feeder Motor	60 H.P.

Total Exciters and Generators installed	12/31/23	-	6 K.W.
" Underground Haulage Generators	"	" -	270 K.W.
" Direct Current Motors	"	" -	90 H.P.

ISHPEMING DISTRICT

Total D.C. Generators and Exciters installed to	12/31/23	-	1,891½ K.W.
" Underground Haulage Generators	"	" " -	1,320 K.W.
" Direct Current Motors	"	" " -	1,776¾ H.P.
Total Spare D.C. Generator and Exciters on hand		" -	50½ K.W.
" " Underground Haulage Generators on hand		" -	250 K.W.
" " Direct Current Motors		" " " -	55½ H.P.
Spare Direct Current Motor Armature		" " " -	500 H.P.

MECHANICAL DEPARTMENT

ELECTRICAL DEPARTMENT (Cont'd)

Substation transformers installed up to Dec. 31st, 1923:

33,000/2300 Volts	NO.	K.V.A.	PHASE	TOTAL K.V.A.	
Brownstone Substation	3	400	1	1,200	
Cliffs Shaft-Holmes Substation	3	500	1	1,500	
Morris-Lloyd Substation	3	590	1	1,770	
Barnes-Hecker "	3	250	1	750	
Republic "	3	400	1	1,200	
Maas "	6	590	1	3,540	
Princeton "	3	590	1	1,770	
Gwinn "	3	625	1	1,875	
Munising "	3	200	1	600	
McClure Plant	2	5,000	3	10,000	
Carp "	3	1,900	1	5,700	
Au Train "	1	1,250	3	1,250	
			TOTAL		31,155 K.V.A.
13,000/2300 Volts					
Maas Substation	1	1,250	3	1,250	
Hoist Plant	1	1,250	3	1,250	
			TOTAL		2,500 K.V.A.
6,600/2300 Volts					
Carp Plant	6	185	1	1,110	
Gwinn Substation	3	350	1	1,050	
Mackinaw "	3	350	1	1,050	
			TOTAL		3,210 K.V.A.
33,000/2300 Volts					
Spare at Cliffs Shaft Substation	1	500	1	500	
" " " " "	1	500	1	500	
			TOTAL		1,000 K.V.A.

Transformers used for Underground Haulage installed to 12/31/23:

Athens Mine converter	3	35	1	105	
Francis " "	3	35	1	105	
Holmes " "	1	100	3	100	
Barnes-Hecker "	1	110	3	110	
Mackinaw Mine "	3	35	1	105	
			TOTAL		525 K.V.A.

Distribution Transformers installed up to Dec. 31st, 1923:

2300/220-110 Volts	NO.	K.V.A.	PHASE	TOTAL K.V.A.
ANGELINE MINE				
Hoist Control	1	7½	1	
				7½
CLIFFS SHAFT MINE				
Office Lights	1	10	1	
" "	1	15	1	
Laboratory	1	5	1	
"A" Shaft Hoist	1	7½	1	
"B" " "	1	10	1	
Coal Crusher	2 (7½)	15	1	
Pump House Lights	1	1	1	
Crusher House Lights	2 (1)	2	1	
Crushers	3 (10)	30	1	
Underground Scrapers	2 (15)	30	1	
				125½
HARD ORE & BROWNSTONE				
Light & Power	1	15	1	
Light	1	¾	1	
Light & Power	1	7½	1	
Shop	1	30	1	
				53¼
HOLMES MINE				
Shop Power	3 (10)	30	1	
Engine House Lights & Power	1	5	1	
Skip Hoist Control	1	10	1	
Cage " "	1	10	1	
4th Level Pump House Lights	1	2	1	
Cage Bell Circuit	1	¾	1	
Skip " "	1	½	1	
Shaft House Lights	1	¾	1	
Pump " "	1	¾	1	
Change " "	1	¾	1	
Shaft " "	1	½	1	
Engine " "	1	7½	1	
				68½
LAKE MINE				
Engine House Lights	1	5	1	
Shaft Lights	1	¾	1	
				5¾
SALISBURY MINE				
Water Supply Pump	2 (2)	4	1	
Engine House Lights & Circulating Pump	1	5	1	
" " " " "	1	2	1	
Ventilating Fan	2 (7½)	15	1	
Hoist Control	1	7½	1	
Lights	1	½	1	
				34
		fwd.		294½

ELECTRICAL DEPARTMENT (Cont'd)

Distribution Transformers. (Cont'd)

	NO.		K.V.A.	PHASE	TOTAL K.V.A.
				hrt. fwd.	294½
ATHENS MINE					
Crusher	3	(7½)	22½	1	
Machine Shop	2	(10)	20	1	
Surface Lights & Lab. Hot Plates	3	(10)	30	1	
Pump House Lights	1		5	1	
" " "	1		2	1	
100 G.P.M. Pump	1		40	3	
Signal System	1		1	1	
Engine House Lights	1		5	1	
" " "	1		4	1	
					129½
MAAS MINE					
Lights & Injection Pump	3	(10)	30	1	
Coal Crusher & Shop	2	(10)	20	1	
Signal System	1		½	1	
Top Tram Control	1		2	1	
4th Level Pump	3	(5)	15	1	
3rd Level Pump House	2	(5)	10	1	
Bell Signal at 55 Winze	1		1	1	
Cage Hoist Control	1		10	1	
Skip " "	1		2	1	
" " "	1		3	1	
Rock Tram "	1		1	1	
Crusher Lighting	1		2	1	
					96½
NEGAUNEE MINE					
Shop Light & Power	1		7½	1	
" " " "	2	(10)	20	1	
Engine House Lights & Power	2	(10)	20	1	
" " " " "	1		5	1	
Signal System	1		½	1	
Pump House Lights, etc.	3	(7½)	22½	1	
12th Level Pump	3	(5)	15	1	
Barn	1		5	1	
					95½
SOUTH JACKSON CRUSHING PLANT					
Hoist Brake	1		5	1	
Lights	1		2	1	
					7
BARNES-HECKER MINE					
Lights	1		5	1	
"	1		7½	1	
Top Tram Control	1		1	1	
Skip Hoist Control	1		10	1	
Cage " "	1		10	1	
Pump House Lights	1		1	1	
					34½
LLOYD MINE					
Lighting	1		3	1	
Cage Hoist Control	1		7½	1	
Skip " "	1		7½	1	
Water Supply Pump House Lights	1		2	1	
					20
				fwd.	677½

MECHANICAL DEPARTMENT

ELECTRICAL DEPARTMENT (Cont'd)

Distribution Transformers. (Cont'd)

	NO.	K.V.A.	PHASE	TOTAL K.V.A.
		brt. fwd.		677½
MORRIS MINE				
Cage Hoist Control & Lights	2	(5) 10	1	
Skip " "	1	7½	1	
Signal System Lights	1	½	1	
Shop & Lights	3	(10) 30	1	
North Lake Pump & Lights	1	2½	1	
7th Level Pump House Lights	1	2	1	
				52½
SECTION 6 SHAFT				
Hoist Control	1	7½	1	
Lighting	2	(2) 4	1	
				11½
AUSTIN MINE				
Lighting	1	10	1	
Top Tram	2	(10) 20	1	
Shop	1	10	1	
				40
FRANCIS MINE				
Cage Hoist Control	1	10	1	
Skip " "	1	10	1	
Compressor Circulating Pump	2	(2) 4	1	
Lighting	1	5	1	
Shop	2	(10) 20	1	
Pump House Lighting	1	½	1	
				49½
GWINN MINE				
Substation Lighting	1	1	1	
Cage Hoist Control	2	(5) 10	1	
Skip " "	1	7½	1	
Engine House Lights	1	10	1	
Shaft " "	1	1½	1	
7th Level Pump House Lights	1	4	1	
11th " " " "	1	1	1	
9th " "	3	(15) 45	1	
				80
GARDNER MINE				
Tram	3	(10) 30	1	
				30
MACKINAW MINE				
Machine Shop	2	(5) 10	1	
Hoist Control	1	7½	1	
Signal System	1	1	1	
Top Tram	3	(10) 30	1	
				48½
PRINCETON MINE				
Top Tram Lights	1	3	1	
#2 Pump House Lights	1	2½	1	
				5½
PRINCETON CENTRAL POWER PLANT				
Coal Crusher	3	(7½) 22½	1	
Power Plant Lighting	1	10	1	
Injection Pump	2	(15) 30	1	
Boiler Room Fan	2	(10) 20	1	
				82½
PRINCETON CENTRAL SHOPS				
Power & Light	2	(10) 20	1	20
			fwd.	1,097½

MECHANICAL DEPARTMENT

Distribution Transformers. (Cont'd)

	NO.		K.V.A.	PHASE	TOTAL K.V.A.
				brt. fwd.	1,097½
PRINCETON DISTRICT LABORATORY					
Hot Plates	3	(10)	30	1	
					30
STEPHENSON MINE					
Rock Tram	3	(10)	30	1	
Skip Hoist Control	1		10	1	
Cage " "	1		10	1	
					50
REPUBLIC MINE					
G. E. Tram	2	(15)	30	1	
Lighting	3	(2)	6	1	
" & Pump	1		10	1	
" " "	1		10	1	
Engine House Lights	1		7½	1	
Hoist Control	1		25	1	
Top Tram Controls	2	(1)	2	1	
Office Lights	1		3	1	
Motor-Generator Set & Pumps	3	(7½)	22½	1	
Pascoe Shaft Hoist Control	1		7½	1	
#9 Shaft - 3rd and 4th Levels	3	(20)	60	1	
Power & Lights on Surface	3	(10)	30	1	
Water Power Plant Lights	1		1½	1	
Screen Motor & Lights	3	(3)	9	1	
Portable Hoist	1		10	1	
					234
AU TRAIN WATER POWER PLANT					
Power Plant Lights	1		1	1	
Operator's Dwelling Lights	1		2	1	
Control	1		2	1	
Power & Lights, Dixon Location	2	(5)	10	1	
" " " Grand Island	2	(5)	10	1	
					25
CARP RIVER WATER POWER PLANT					
Power & Light	1		10	1	
" " "	1		20	1	
Pump	2	(1)	2	1	
					32
HOIST PLANT					
Power & Light	1		7½	1	
" " "	2	(5)	10	1	
					17½
McCLURE PLANT					
Power & Lights	2	(10)	20	1	
					20
DEAD RIVER STORAGE DAM					
Lights	1		5	1	
Power	3	(10)	30	1	
Lights	2	(3)	6	1	
					41
			GRAND TOTAL		1,547 K.V.A.

ELECTRICAL DEPARTMENT (Cont'd)

Spare Transformers on hand Dec. 31st, 1923:

	NO.	K.V.A.	PHASE	TOTAL K.V.A.
GENERAL STOREHOUSE				
General Electric	1	15	1	
Fort Wayne	1	5	1	
Allis-Chalmers (From Lake Mine)	1	7½	1	
General Electric	2 (5)	10	1	
Sinking Pump Transformers	3 (100)	300	1	
General Electric	5 (15)	75	1	
" "	1	3	1	
				415½
ANGELINE MINE				
General Electric	1	1	1	
				1
MORRIS-LLOYD MINE				
General Electric	1	15	1	
" "	1	15	1	
" "	1	15	1	
" "	1	15	1	
				60
GWINN MINE				
General Electric (Sump Pump)	1	3	1	
				3
REPUBLIC MINE				
General Electric	3 (10)	30	1	
" "	1	4	1	
				34
		GRAND TOTAL		513½ K.V.A.

COMPARATIVE TABLES

YEAR	TONS COAL BURNED	TONS ORE & ROCK HOISTED	CU. FT. AIR USED	CUBIC FT. AIR PER TON HOISTED	GALLONS OF WATER PUMPED
			CLIFFS SHAFT MINE		
1910	8 895	252 793	904 379 312	3 577	156 948 550
1911	8 095	246 334	898 424 112	3 647	165 101 640
1912	8 047	276 211	810 020 228	2 932	218 555 480
1913	8 027	295 105	833 987 419	2 826	276 582 240
1914	7 496	316 986	1 054 320 348	3 326	281 392 090
1915	5 181	347 955	889 280 382	2 555	283 489 900
1916	5 226	388 090	878 041 710	2 262	398 818 855
1917	4 500	377 177	885 993 944	2 349	345 847 725
1918	5 135	382 804	861 374 720	2 276	315 252 828
1919	3 494	277 901	907 895 024	2 402	298 889 689
1920	3 854	334 347	872 225 408	2 638	262 308 003
1921	2 094	67 454	273 648 228	4 057	274 901 402
1922	891	138 702	419 382 000	3 023	399 874 439
1923	2 359	305 727	734 645 710	2 403	377 383 675
			HOLMES MINE		
1916	729	32 951	--- --- ---	- ---	--- --- ---
1917	739	90 225	425 227 500	4 712	--- --- ---
1918	700	130 295	368 456 686	2 840	--- --- ---
1919	947	173 178	521 145 000	3 009	(8 months) 25 471 515
1920	682	260 118	448 965 000	1 726	26 099 690
1921	832	191 147	275 057 000	1 439	38 456 053
1922	911	231 306	346 466 000	1 497	73 009 389
1923	704	289 984	431 820 000	1 489	82 640 803

COMPARATIVE TABLES

YEAR	TONS COAL BURNED	TONS ORE & ROCK HOISTED	CU. FT. AIR USED	CUBIC FT. AIR PER TON HOISTED	GALLONS OF WATER PUMPED
			HARD ORE #3 HEATING PLANT		
1914	810				
1915	883				
1916	922				
1917	1,038				
1918	955				
1919	970				
1920	801				
1921	1,014				
1922	1,182				
1923	1,033				
			SALISBURY MINE		
1907	3 892	139 986	215 971 327	1 551	86 056 044
1908	3 606	116 724	218 591 828	1 895	66 957 839
1909	3 537	99 140	218 841 412	2 228	61 699 506
1910	3 308	113 574	162 828 098	1 433	63 430 079
1911	3 158	111 272	148 067 843	1 330	61 654 458
1912	2 788	118 635	154 493 210	1 301	55 855 799
1913	848	125 178	120 039 019	958	51 358 400
1914	583	97 318	94 530 000	971	56 786 400
1915	522	27 150	164 776 200	---	53 503 200
1916	496	100 803	273 558 000	2 713	126 831 364
1917	445	104 082	188 563 500	1 811	104 560 277
1918	436	113 073	166 455 000	1 472	100 958 079
1919	617	115 764	228 578 500	1 974	144 138 375
1920	482	112 603	216 351 000	1 921	152 694 797
1921	157	21 228	43 087 500	7 009	148 802 543
1922	3	--- ---	--- --- ---	- ---	168 957 807
1923	90	768	--- --- ---	- ---	126 790 996

COMPARATIVE TABLES

YEAR	TONS COAL BURNED	TONS ORE & ROCK HOISTED	CU. FT. AIR USED	CUBIC FT. AIR PER TON HOISTED	GALLONS OF WATER PUMPED
			ATHENS MINE		
1914	231	7 404	120 048 750	- ---	--- --- ---
1915	385	21 245	242 196 750	- ---	--- --- ---
1916	419	26 930	222 840 000	- ---	--- --- ---
1917	277	23 988	211 612 500	- ---	--- --- ---
1918	609	101 394	498 600 000	- ---	--- --- ---
1919	740	155 643	414 045 000	2 660	85 503 850
1920	593	214 601	505 035 000	2 353	82 794 824
1921	515	177 065	359 055 000	2 027	73 114 028
1922	683	193 711	456 615 000	2 357	86 235 707
1923	971	246 704	635 535 000	2 576	103 329 157
			NEGAUNEE MINE		
1908	11 294	300 007	210 799 982	696	638 488 540
1909	9 088	316 072	263 322 702	911	623 789 512
1910	7 913	364 111	361 923 373	993	610 209 058
1911	7 805	368 352	599 630 043	1 627	634 100 040
1912	8 003	298 308	825 468 516	2 767	696 210 397
1913	7 647	368 956	741 224 169	2 008	789 153 091 (# 2 Shaft)
1914	5 269	337 792	613 144 000	1 798	395 877 353
1915	1 703	404 020	363 242 060	933	--- --- ---
1916	1 223	526 237	474 099 050	900	--- --- ---
1917	1 414	548 083	455 525 250	831	780 000 000
1918	1 293	524 869	443 996 750	845	828 575 874
1919	1 320	525 894	591 104 600	1 185	603 198 543
1920	1 095	569 895	729 139 000	1 279	610 132 854
1921	838	258 967	306 315 000	1 183	597 401 853
1922	1 075	300 031	414 765 000	1 382	613 603 672
1923	996	383 914	655 695 000	1 708	582 912 109

COMPARATIVE TABLES

YEAR	TONS COAL BURNED	TONS ORE & ROCK HOISTED	CU. FT. AIR USED	CUBIC FT. AIR PER TON HOISTED	GALLONS OF WATER PUMPED
			MAAS MINE		
1909	6 494	141 510	291 338 833	2 095	231 101 590
1910	8 219	196 052	541 169 843	2 760	209 688 862
1911	7 252	--- ---	646 245 479	- ---	--- --- ---
1912	6 502	55 603	355 459 673	- ---	--- --- ---
1913	8 903	287 784	915 881 473	3 182	--- --- ---
1914	6 819	213 423	720 319 949	- ---	(3 Months) 8 336 357
1915	4 325	85 150	486 626 678	- ---	190 534 750
1916	8 062	272 802	763 134 066	2 797	363 273 050
1917	8 656	333 290	879 808 672	2 639	337 467 390
1918	9 351	312 634	935 128 335	2 991	510 265 180
1919	9 639	343 810	644 597 449	1 874	573 373 848
1920	5 097	351 521	571 224 659	1 625	513 176 403
1921	735	211 616	373 275 000	1 764	517 238 661
1922	628	219 776	458 010 000	2 083	516 431 109
1923	548	228 528	472 220 000	2 066	509 330 141
			SOUTH JACKSON MINE		
1913	483	1 940	--- --- ---	- ---	--- --- ---
1914	0	15 281	--- --- ---	- ---	--- --- ---
1915	0	56 026	--- --- ---	- ---	--- --- ---
1916	0	0	(No ore taken out)	- ---	--- --- ---
1917	0	46 994	--- --- ---	- ---	--- --- ---
1918	0	15 879	13 203 000	931	--- --- ---
1919	0	56 840	--- --- ---	- ---	--- --- ---
1920	162	69 222	30 001 500	434	--- --- ---
1921	48	5 051	1 935 000	383	--- --- ---
1922	88	16 101	4 590 000	- ---	--- --- ---
1923		12 812	5 850 000	- ---	--- --- ---

COMPARATIVE TABLES

YEAR	TONS COAL BURNED	TONS ORE & ROCK HOISTED	CU. FT. AIR USED	CUBIC FT. AIR PER TON HOISTED	GALLONS OF WATER PUMPED
			BARNES-HECKER MINE		
1919	603	29 731	--- --- ---	- ---	(8 Months) 5 481 940
			(From Morris-Lloyd)		
1920	410	62 426	272 817 000	4 370	137 026 242
1921	120	3 712	38 406 000	1 034	585 904 565
1922	302	32 068	156 250 000	4 872	546 633 174
1923	467	38 536	153 900 000	3 993	391 860 539
			MORRIS-LLOYD MINE (Including Sec.6 Shaft)		
1912	- ---	181 544	--- --- ---	- ---	--- --- ---
1913	726	209 667	--- --- ---	- ---	--- --- ---
1914	615	242 476	655 199 000	2 701	363 889 057
1915	533	298 816	722 622 750	2 418	322 295 660
1916	1 004	304 849	--- --- ---	- ---	320 074 400
1917	886	296 589	667 908 000	2 370	319 198 700
1918	959	299 360	681 964 000	2 378	315 454 220
1919	1 132	313 887	936 264 700	2 982	340 883 140
1920	971	283 400	802 952 000	2 832	311 061 125
1921	848	234 809	681 918 000	3 067	321 064 176
1922	931	241 065	596 225 500	2 473	276 149 791
1923	1 031	273 124	826 038 000	2 460	267 210 477

COMPARATIVE TABLES

YEAR	TONS COAL BURNED	TONS ORE & ROCK HOISTED	CU. FT. AIR USED	CUBIC FT. AIR PER TON HOISTED	GALLONS OF WATER PUMPED
			AUSTIN MINE		
1911	- ---	145 360	128 013 967	880	--- --- ---
1912	- ---	121 191	153 118 878	1 263	--- --- ---
1913	- ---	67 494	--- --- ---	- ---	--- --- ---
1914			(Mine idle entire year)		
1915			(Mine idle entire year)		
1916	- ---	23 697	--- --- ---	- ---	--- --- ---
1917	- ---	54 167	--- --- ---	- ---	--- --- ---
1918	- ---	759	(Mine flooded in January)		
1919	- ---	19 212	--- --- ---	- ---	--- --- ---
1920			(Mine idle entire year)		
1921			(Mine idle entire year)		
1922	- ---	56 429	126 617 590	2 243	--- --- ---
1923	14	93 238			--- --- ---
			FRANCIS MINE		
1917	1 223	21 420	353 070 000	0 ---	66 723 400
1918	796	65 739	565 920 000	- ---	49 625 600
1919	499	102 651	291 060 000 (Air used in Francis & Gwinn Mines)	- ---	45 865 547
1920	479	93 548	420 340 000 (Air used in Francis & Gwinn Mines)	- ---	45 855 040
1921	344	80 104	258 042 600	- ---	39 415 502
1922	403	108 249	264 570 000	2 444	45 016 618
1923	472	118 040	303 435 000	2 570	62 237 673
			GARDNER & MACKINAW MINES		
1917	443	29 235	323 595 000	- ---	--- --- ---
1918	553	37 883	388 395 000	- ---	--- --- ---
1919	412	93 501	325 845 000	3 485	26 941 948
1920	387	139 057	367 830 000	2 645	36 770 855
1921	6	- ---	--- --- ---	- ---	43 912 856
1922	9	- ---	--- --- ---	- ---	55 783 895
1923	9	- ---	--- --- ---	- ---	51 778 825

COMPARATIVE TABLES

YEAR	TONS COAL BURNED	TONS ORE & ROCK HOISTED	CU. FT. AIR USED	CUBIC FT. AIR PER TON HOISTED	GALLONS OF GF WATER PUMPED
			GWINN MINE		
1911	3,400	2,548	136,216,025	- ---	--- --- ---
1912			(Mine idle entire year)		
1913	1 583	14 376	--- --- ---	- ---	--- --- ---
1914	1 400	95 510	--- --- ---	- ---	90 245 720
1915	807	151 474	--- --- ---	- ---	131 676 720
1916	871	186 839	--- --- ---	- ---	131 783 700
1917	976	191 080	--- --- ---	- ---	148 022 900
1918	844	177 051	--- --- ---	- ---	168 172 800
1919	1 132	154 002	--- --- ---	- ---	199 404 200
1920	921	115 497	(Air supplied by Francis Mine) (Air supplied by Francis Mine)		165 004 020
1921	386	48 216	--- --- ---	- ---	111 928 220
1922	15	42	18 629 865 (Air supplied by C.P.P.)	- ---	102 326 460
1923	5	194	(Mine idle entire year)		94 461 920
			PRINCETON MINE		
1911	570	100,150	171,032,509	1,707	--- --- ---
1912	184	22 639	48 083 876	2 123	107 537 270
1913	467	74 297	--- --- ---	- ---	108 366 555
1914	64	772	--- --- ---	- ---	99 939 295
1915	87	2 833	--- --- ---	- ---	94 629 250
1916	105	2 636	--- --- ---	- ---	136 569 170
1917	101	734	--- --- ---	- ---	109 949 035
1918	334	182 760	--- --- ---	- ---	112 926 605
1919	468	219 230	------- ---	- ---	131 496 940
1920	476	184 912	--- --- ---	- ---	129 512 469
1921	275	105 674	--- --- ---	- ---	111 468 005
1922	0	108	18 629 865 (Air supplied by C.P.P.)	- ---	116 542 468
1923	6	0	(Mine idle entire year)		92 190 881

COMPARATIVE TABLES

YEAR	TONS COAL BURNED	& ROCK HOISTED	CU. FT. AIR USED	CUBIC FT. AIR PER TON HOISTED	GALLONS OF WATER PUMPED
			PRINCETON CENTRAL POWER PLANT		
			(Output)		
1911	7 493		819 304 399		
1912	4 104		661 681 550		
1913	2 360		--- --- ---		
1914	5 900		--- --- ---		
1915	7 092		--- --- ---		
1916	5 322		1 375 169 052		
1917	2 121		1 051 739 302		
1918	6 279		971 385 234		
1919	3 614		1 236 341 627		
1920	2 598		1 264 675 500		
1921	3 754		839 610 000		
1922	1 630		620 995 500		
1923	7 405		623 700 000		
			PRINCETON PUMPING STATION		
1911	497				153 854 205
1912	569				158 661 990
1913	633				172 438 180
1914	675				184 799 040
1915	794				202 554 240
1916	814				224 152 095
1917	986				275 717 100
1918	917				262 232 600
1919	920				237 147 315
1920	890				233 913 900
1921	259				309 992 940
1922	71				313 859 370
1923	71				315 072 000

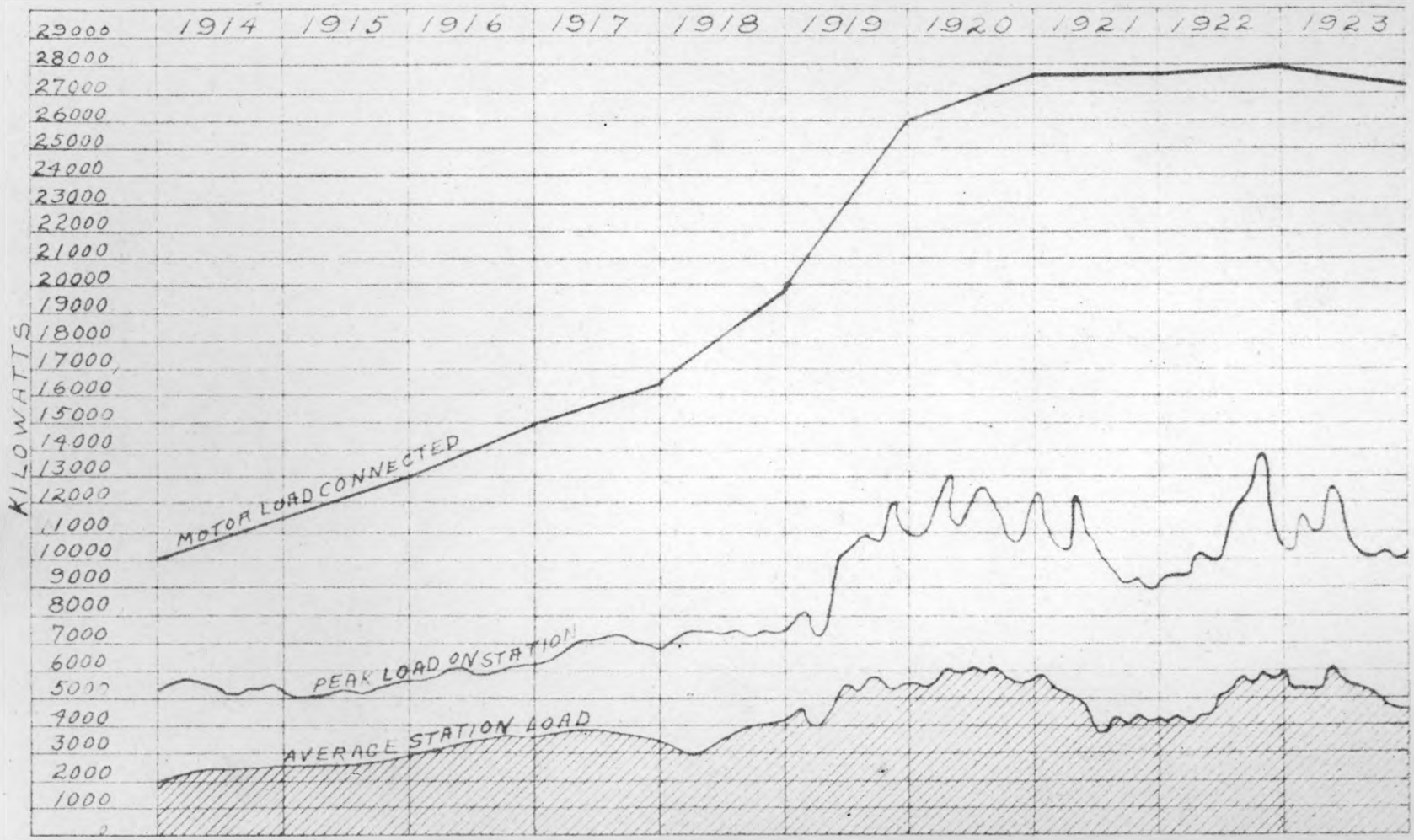
COMPARATIVE TABLES

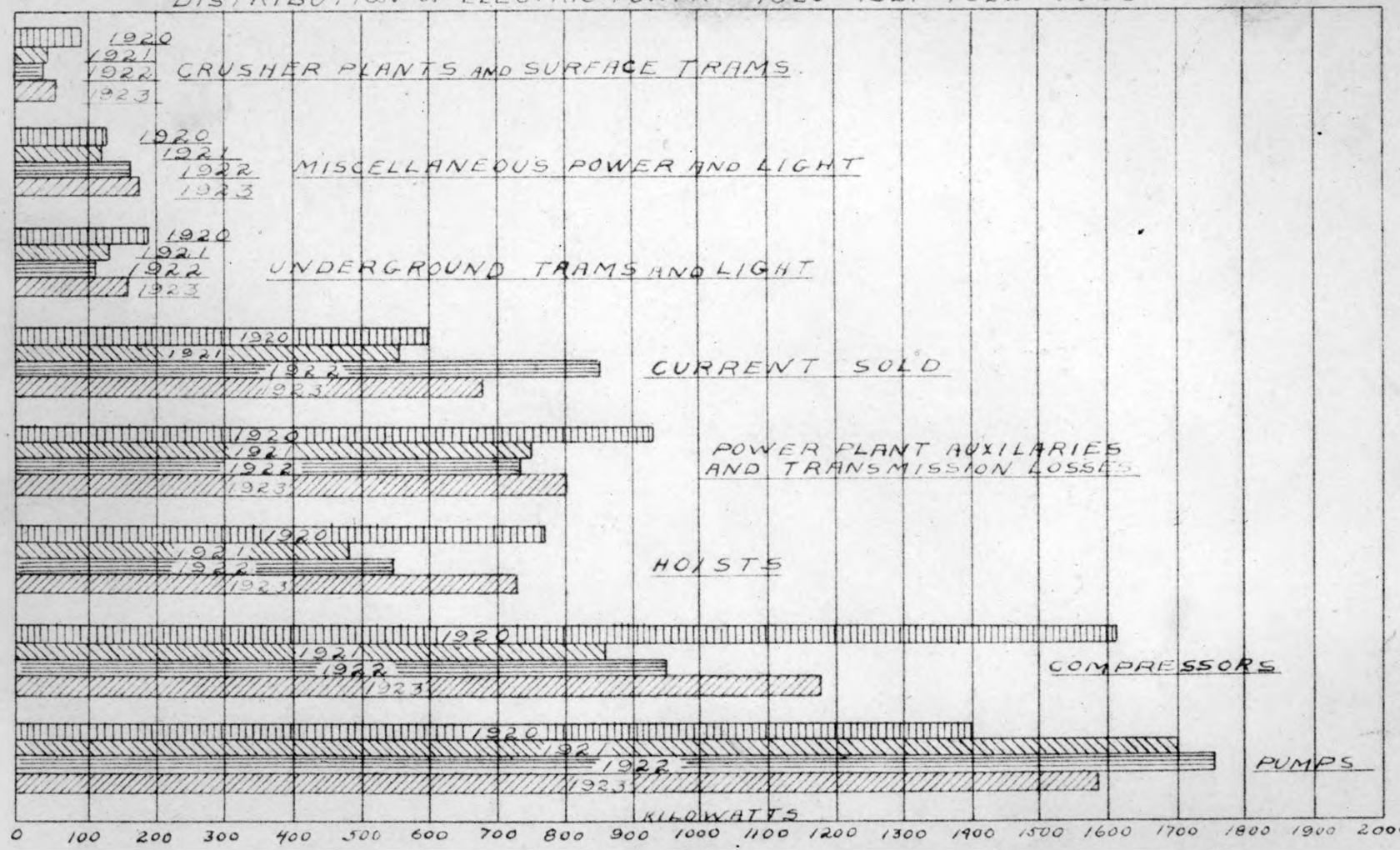
YEAR	TONS COAL BURNED	TONS ORE & ROCK HOISTED	CU. FT. AIR USED	CUBIC FT. AIR PER TON HOISTED	GALLONS OF WATER PUMPED
			STEPHENSON MINE		
1913	3,420	283,146	--- --- ---	- ---	1,028,287,849
1914	2 281	238 739	--- --- ---	- ---	772 327 870
1915	2 220	230 575	--- --- ---	- ---	763 638 450
1916	1 658	327 395	--- --- ---	- ---	785 501 510 (11 Months)
1917	3 073	256 756	--- --- ---	- ---	961 713 000
1918	1 560		(Mine flooded in December 1917)		
1919	724	1 662			
1920	2 064	205 366			1 381 633 440
1921	2 163	219 145			1 215 685 840
1922	1 876	221 559	413 913 500	1 868	1 258 504 848
1923	868	266 211			1 234 675 108
			CROSBY MINE		
1913	3,305 (10 Mo.)	207,728 (8 Mo)	--- --- ---	- ---	--- --- ---
1914	2 151	23 221	--- --- ---	- ---	--- --- ---
1915	250	-- ---	--- --- ---	- ---	--- --- ---
1916	2 069	127 373	--- --- ---	- ---	--- --- ---
1917	2 504	300 142	--- --- ---	- ---	--- --- ---
1918	3 097	255 787	--- --- ---	- ---	--- --- ---
1919	2 578	208 449	--- --- ---	- ---	--- --- ---
1920	1 280	263 478	--- --- ---	- ---	--- --- ---
1921	72	89 754	--- --- ---	- ---	--- --- ---
1922	362	-- ---	--- --- ---	- ---	--- --- ---
1923	---	-- ---	--- --- ---	- ---	--- --- ---
			HELMER MINE		
1919	1,274	71,867	--- --- ---	- ---	--- --- ---
1920	(See Wade) (Wade-Helmer)	42 159	--- --- ---	- ---	--- --- ---
1921	855 (Wade-Helmer)	70 578	--- --- ---	- ---	--- --- ---
1922	5	-- ---	--- --- ---	- ---	--- --- ---
1923	-	-- ---	--- --- ---	- ---	--- --- ---

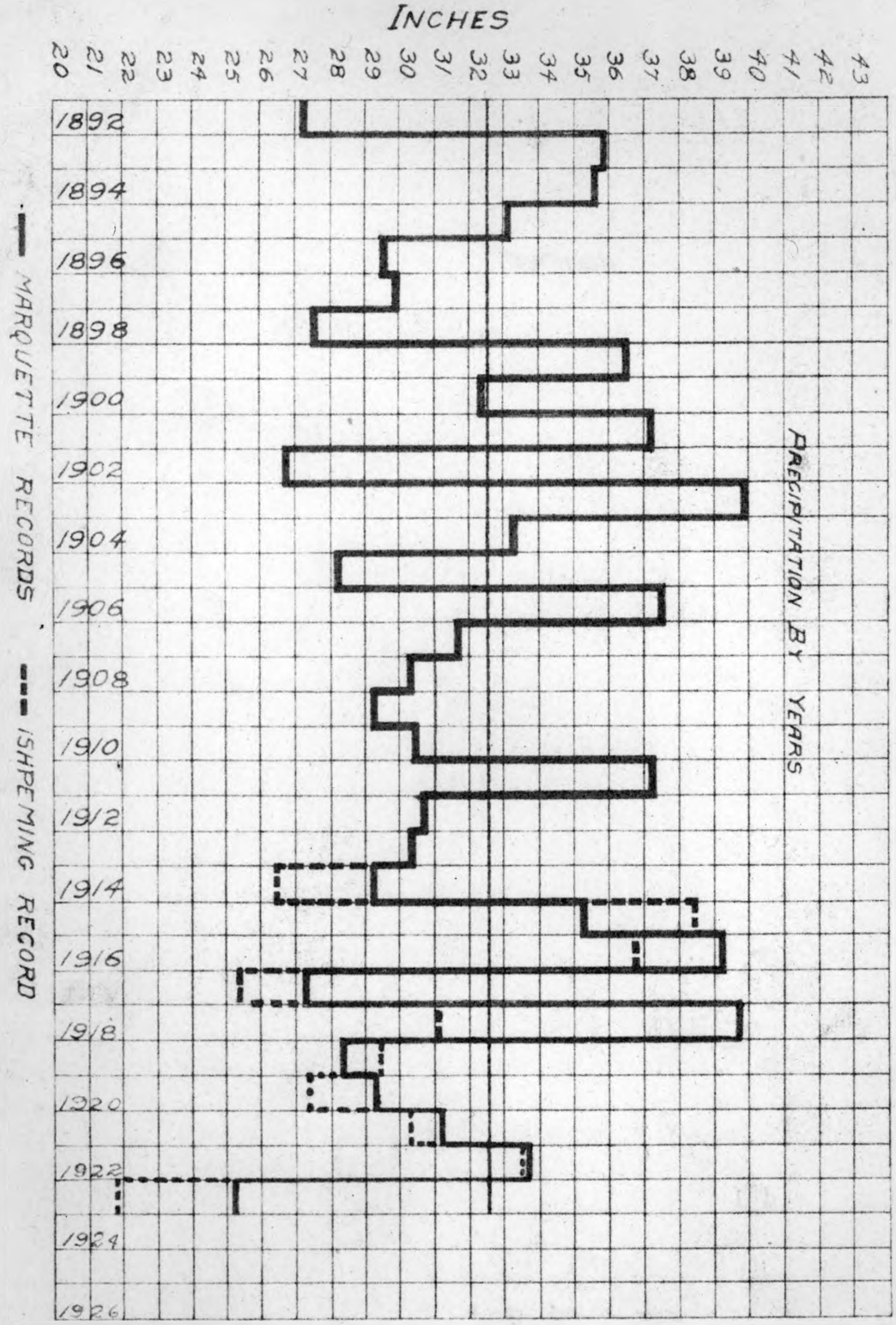
MECHANICAL DEPARTMENT.

COMPARATIVE TABLES

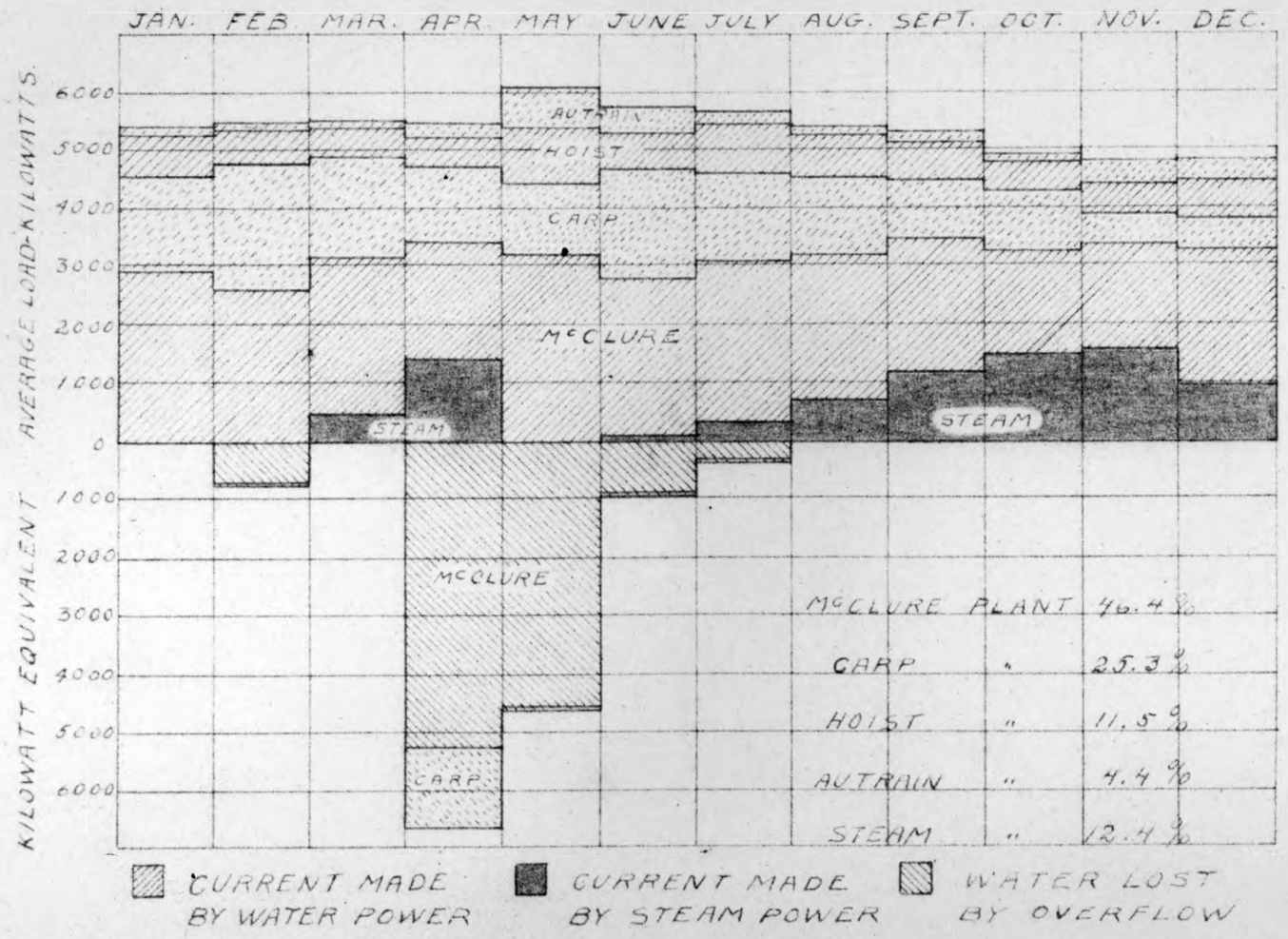
YEAR	TONS COAL BURNED	TONS ORE & ROCK HOISTED	CU. FT. AIR USED	CUBIC FT. AIR PER TON HOISTED	GALLONS OF WATER PUMPED
			BOEING MINE		
1920	491	34,428	--- --- ---	- ---	--- --- ---
1921	212	26 190	--- --- ---	- ---	--- --- ---
1922	132	266 862	--- --- ---	- ---	--- --- ---
1923	3 851	501 895	--- --- ---	- ---	--- --- ---
			HILL TRUMBULL MINE		
1921	4,983	333,595	--- --- ---	------	--- --- ---
1922		352 651	--- --- ---	------	--- --- ---
1923	3 829	311 012	--- --- ---	------	--- --- ---
			WADE MINE		
1919	5,516	238,644	--- --- ---	------	--- --- ---
1920	4 095	200 254	--- --- ---	------	--- --- ---
1921	855 (Wade-Helmer*)	70 578	(See Helmer Mine)		
1922	5	-- ---	--- --- ---	------	--- --- ---
1923	6	-- ---	--- --- ---	------	--- --- ---
			REPUBLIC MINE		
1918	6,780	172,955	1,141,454,000	6,605	--- --- ---
1919	5 709	185 383	1 228 202 000	6 625	34 770 380
1920	3 972	181 058	1 347 129 000	7 440	35 559 650
1921	1 436	79 761	954 242 000	11 964	35 132 398
1922	1 302	113 108	1 112 788 000	9 838	41 620 635
1923	1 816	137 181	1 279 858 000	9 329	37 204 860
			SPIES MINE		
1919	962	71,000	--- --- ---	- ---	-- --- ---
1920	377	93 519	--- --- ---	- ---	-- --- ---
1921	350	46 878	87 360 300	- ---	-- --- ---
1922	192	5 432	--- --- ---	- ---	-- --- ---
1923	495	19 732	--- --- ---	- ---	-- --- ---


1914
1915
1916
1917
1918
1919
1920
1921
1922
1923
KILOWATTS
29000
28000
27000
26000
25000
24000
23000
22000
21000
20000
19000
18000
17000
16000
15000
14000
13000
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
MOTOR LOAD CONNECTED
PEAK LOAD ON STATION
AVERAGE STATION LOAD


DISTRIBUTION OF ELECTRIC POWER 1920—1921—1922-1923.
1920
1921
1922
1923
CRUSHER PLANTS AND SURFACE TRAMS.
MISCELLANEOUS POWER AND LIGHT
UNDERGROUND TRAMS AND LIGHT
CURRENT SOLD
POWER PLANT AUXILARIES AND TRANSMISSION LOSSES
HOISTS
COMPRESSORS
PUMPS
KILOWATTS
0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000


INCHES
20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43
1892
1894
1896
1898
1900
1902
1904
1906
1908
1910
1912
1914
1916
1918
1920
1922
1924
1926
PRECIPITATION BY YEARS
MARQUETTE RECORDS
ISHPEMING RECORD

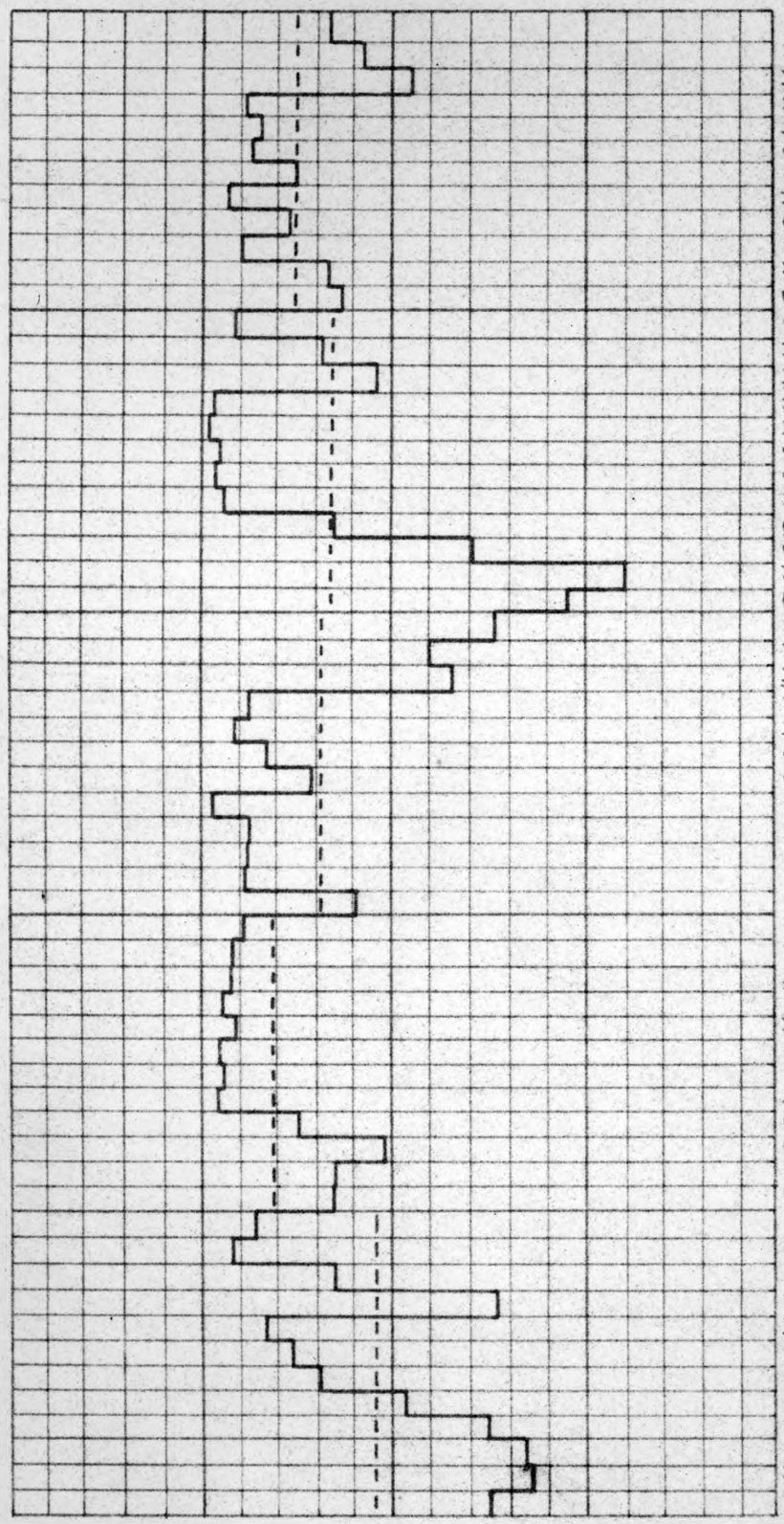
1923



MECHANICAL DEPARTMENT

1923

COST DIAGRAM.



ANNUAL REPORT

OF THE (1923)

SAFETY DEPARTMENT

The Annual Report of the Safety Department for 1923 is herewith given under the following subjects; fatal, serious and slight accidents; safety inspection; special safety measures; first aid and mine rescue work and training, and statistical tables. The safety work was in charge of William Conibear, first aid and mine rescue training was given by J. Henry Williams and stenographic and clerical work by Miss Elsie Baker.

Fatal Accident Record

We suffered a loss of six men by fatal accidents last year. Two occurred at the Stephenson mine, one each at the Holmes, Francis, Boeing and Athens mines. Four were caused by falls of ground, one by explosion of dynamite and one by mechanical haulage. Thus three of the four principal causes of our fatal accidents since 1898 continued to add to the total loss, and the fourth principal cause, falling down a raise, was responsible for the one fatality which was sustained in 1922. The Central Safety Committee classified five of the 1923 fatalities trade risks and one preventable. Two of the fatalities by falls of ground occurred at the working places of the drifts where miners were engaged in daily routine work. Another occurred just as a miner reached his working place, and the other occurred at a shaft station, where the unfortunate man was waiting for the cage, at the end of the shift, to go to surface. The fatality by an explosion was the result of a miner striking a pick in a small piece of dynamite that had been left intact at the bottom of a discharged hole as,he was picking ground to make room to advance sollar boards. The accident by mechanical haulage was caused by events that happened

without coming under the direct observation of one man, and is another example of a preventable accident that revolves around the so-called human element.

During the thirteen years since the organization of the Safety Department the Company has lost 91 employees at the mines by fatal accidents, an average of seven fatalities per year. There were five years when the number of men killed annually was less than six and eight years when the number was six or more. There were 121 men killed in the thirteen year period prior to 1911, or an average of nine and one-third fatalities annually. For this period the record shows three years when the annual loss was less than six men and ten years when the number was six or more. The difference in the accident rates for these two periods is made more apparent, however, by comparing the fatality rates on the basis of the number of men employed. The average number of men employed annually from 1898 to 1910, inclusive, was 1878, and the average annual fatality rate was 4.95 per 1000 men employed. The average number of men employed annually from 1911 to 1923, inclusive, was 2,931 and the average annual fatality rate was 2.39. Hence, there has been a reduction of more than 50% in the average number of fatalities. If the average annual rate prior to 1911 had continued to prevail until the end of 1923, the Company would have lost a total of 198 men or 107 men more than was actually lost.

There was employed at the mines last year approximately an average of 2,738 men on the basis of 300 working days per man, and the six fatalities give a rate of 2.19 per 1000 men employed. The average rate since 1911 is 2.39 per 1000 men. This is the sixth year since 1911 that the annual rate has been below the average for the entire period.

Description of Fatal Accidents

Number One

Rinaldo Bettenaschi, a miner, employed at the Stephenson Mine, Princeton, was instantly killed by a fall of ground February 3rd, 1923.

This man and Herman Laurella worked in Contract No. 40, mining on a sub-level twelve feet above the 5th level. On the day previous to the accident,

they blasted four holes on the left side of the drift, starting a new slice. The ore broken by this blast was trimmed during the morning of February 3rd, and, in order to have room for a set of timber, a number of shallow holes were fired at 11:30 a. m. When they returned to work at 1:00 p. m., they placed several poles in the back of the drift for protection while making room for the set of timber. They had the poles in position when the miners of No. 23 Contract, who were working on the 5th level, asked for assistance in lifting a heavy cap of timber. When returning Betteneschi went direct to his working place but Laurella stopped at the chute to fill a locomotive car, as the chute was full of ore and they could not tram. While loading the car, Laurella heard a noise like the sound of falling ground. He gave it no particular thought and finished filling the car. When he reached the top of the ladder to the sub-level he could not see his partner's light. He immediately investigated and found that Betteneschi had evidently just stepped into the new slice and was caught by a fall of ground. The miners of No. 37 Contract were notified by Laurella and in a few minutes his body was recovered.

When Betteneschi and Laurella were helping the miners of No. 37 Contract, James Garfield, the mine sampler, was in No. 35 Contract and took a sample. So far as he observed the place was safe. The fall of ground that killed Betteneschi must have occurred a few minutes after Garfield had left. The miners were about to trim the back at the time they were asked to go to the other contract.

Betteneschi was an Italian, aged 37 years. He is survived by a widow and five children. Classified non-preventable.

Number Two

William Ranta, a miner, employed at the Stephenson Mine, Princeton, was injured by striking his pick into a piece of dynamite on February 12th, 1923, and died under the care of a physician at Milwaukee, Wisconsin, February 13th, 1923.

Ranta and his partner, Charles Jacobson, worked in Contract No. 45, on the 4th sub-level below the 5th level, and were drifting in hard ore under

the hanging wall. On Saturday, February 10th, at 11:30 a. m., they blasted seven holes, five feet deep, three in the top of the breast and four in the bottom, using either two and a half or three sticks of 50 percent dynamite in each hole. They heard six holes explode, but they did not report to the shift boss that they had a missed hole, as they knew they would be the first to return to inspect the place. After lunch they found a large pile of broken ore at the breast, but there was no sign whatever of a missed hole. They spent the entire afternoon shoveling ore. Jacobson testified that he found a small piece of powder at about 3:00 p. m., that was resting loosely in the dirt pile. They were visited during the afternoon by Shift Boss Peter Nordeen, who made an inspection of the place and found it in a safe condition. The miners did not tell him then that they had failed to hear the report of one of the holes or that they had found a piece of powder in the dirt pile.

The two miners continued mucking Monday morning, and a second small piece of powder was found by Jacobson, which also was taken from broken ground. Nordeen visited them at 9:40 a. m. He found no broken ore on Ranta's side of the drift but there was about a buggy of dirt left on Jacobson's side. Ranta was picking the bottom of the drift, making room to advance the sollar boards, and Jacobson was loading the pile in front of him. Again nothing was said about a missed hole or loose powder. A few minutes later, while Jacobson was shoveling and Ranta probably picking, an explosion occurred, knocking both men to the ground and extinguishing their lights. Jacobson was stunned slightly but found his way to another contract. Several men arrived immediately and Ranta was removed to the Gwinn Hospital. It was apparent that Ranta's left eye was severely injured and he was taken that evening to Milwaukee. An operation proved that a substance had passed through the eye into the brain and he did not recover from the operation. It is not known whether the substance was the point of the pick or a piece of ore as it was not removed. Class

Ranta was of Finnish descent, single, aged 22. Classified trade risk.

Number Three

Mike Ritari, a miner, employed at the Holmes mine, Ishpeming, was instantly killed at 10:00 a. m., March 7th, 1923, by fall of ground.

Ritari and his partner, William Thomas, at the time of the accident had cut out for a side-set of timber under the hanging wall in the hard ore vein. Both legs were in place and they were ready to put up the cap. Thomas thought that one of the poles of the staging was not strong enough and he went out to get another one. As he started out a heavy fall of ground occurred, crushing the place where Ritari was standing.

Captain William Tamblin was on the main level drift, about 100 feet distant, when the accident occurred, and was on his way to this contract. He took charge of the work of recovering Ritari's body. As a large quantity of ground had fallen it was necessary to drive spiling in order to make progress. The side slice and a portion of the main drift was completely filled with loose ground. It took twenty-four hours to recover the body.

Ritari was a Finn, aged 26, and left a widow and nine children. Classified trade risk.

Number Four

John Koski, a miner, was injured at the Francis Mine, at 4:45 p. m., on April 10th, 1923, which resulted in death four hours later.

This accident occurred on the 6th level station. Koski and two men were sitting on a bench, against a rock pillar, facing the cage compartment, and two other men were sitting on a bench near the chute compartment. While waiting for the cage, a small piece of rock fell from the top of the pillar, back of the seat where the three men were sitting, striking Koski a glancing blow on the head. It was thought at first that Koski suffered but a slight injury. He walked to the change house and from there was transported to the Gwinn Hospital, where a physician examined him. There was no visible evidence of injury excepting two small cuts on his head. It was thought that his injuries were but minor and he was taken home. About 9:00 o'clock in the evening he

suffered a relapse. Physicians were summoned but were unable to revive him. Later it was concluded that he suffered a fracture at the base of the skull.

Koski was a Finn, aged 30 years and is survived by a widow and two children. Classified trade risk.

Number Five

Nick Cuik, a miner, was suffocated under a pile of sandy ore at the Boeing Mine at 1:15 p. m., July 24th, 1923. Ciuk and his partner, Nick Drobac, had started to work at the Boeing Mine on the day before the accident, and they were placed in Contract No. 1 in a cross-cut on the 1780' sub-level. A small pillar of ore 35 feet x 9 feet wide was being mined. At the time of the accident they were blocking up the back preparing to place in a set of timber. Drobac was at the breast chopping poles and lagging and handing them to Ciuk, who was blocking the back. Without warning about five motor cars of sandy ore came down from a small area in the back, completely burying Ciuk.

The accident was not discovered until 2:20 p. m., when a miner, from No. 16 Contract, was passing near this place on his way for water noticed there were no lights in the drift. Upon investigation he found the place down and filled with sand. At first it was thought that both men were killed, as the breast was full of sand no sound could be heard. It was necessary to drive fore-poles to put in timber to advance the work of recovery. At 5:40 P. M., the body of Ciuk was removed and about an hour later it was ascertained that Drobac was uninjured. He was extracted at 7:00 and found to be slightly nervous, suffering from shock.

No timber was broken nor was there any other evidence that the run of sand gave warning. It came down directly from the center of the drift, where Ciuk was blocking, as the blocking was mixed in with the dirt. The ore is being mined close to the sand, and on this account it was impossible to avoid the hazard of encountering runs of sand.

This man was single, aged 20 years. Classified trade risk.

Number Six

Algot Carlson, a chuteman, was instantly killed at the Athens Mine at 8:45 a. m., October 29th, 1923, by a locomotive train colliding with a ventila-

tion door. At the same time, Russell Johnson, a chuteman, was seriously injured and Leslie Wills, a brakeman, slightly injured.

The accident occurred on the 6th level, about 200 feet from the shaft. About 20 feet inside this door the ground was loose, and falling dirt had stretched the control wires so that the door could not be operated by the levers. On Thursday and Friday the timber gang worked at this point repairing the back and putting in steel sets. As the door was out of commission it was hooked back, On Saturday the timberman cleaned the skip pit. On Monday morning, when the timbermen again started work near the door, they found the door open and assumed that it had not been touched since Friday and that it was still hooked. When the door is open a contact is formed which lights green lights on either side of the door. The inside set of lights had been taken down but those on the shaft side of the door were in working order. Kanniainen's motor train was the first one to come out on Monday morning and as he approached the door he saw the green lights beyond. He glanced down to see if the way was clear and when he again looked ahead he saw the door closing, but he was too near to avoid a collision.

It is the duty of the pumpman helper to make the rounds at night and see that all ventilation doors are closed. It is also understood throughout the mine that when a door is hooked back that it is out of order and should not be closed. Upon investigation it was found that this door had been closed on Sunday night and on Monday morning a miner pulled the wire and opened it. As there were other men following him he did not close the door. About three weeks before the accident occurred this door was gunited and some of the gunite had fallen on the wires. In pulling the wire this gunited section was pulled into the opening in the door frame and jammed there and it is thought that the jarring by the train, or the timbermen leaning against the wire, may have loosened it, allowing the cylinder to operate and release the door, which had a 300 pound counterweight.

Carlson was a married man, and is survived by a widow and a child three weeks old. The Central Safety Committee classified the accident as pre-

ventable. It was regarded due to negligence on the part of timber foreman in not seeing that the door was hooked back before they started to work on the morning of the accident.

Table I

Classification of fatal accidents 1911 to 1923, inclusive,
By the Central Safety Committee.

I.	Trade Risk		46
II.	Negligence of Company:		
	Violation of Rules	4	
	Failure to Provide Safety Devices	4	
	Improper Method of Doing Work	3	
	Failure to Instruct Men	1	
	Failure to Provide Tools	1	
			13
III.	Negligence of Workman:		
A. Injured Men:	Improper Method of Work	6	
	Carelessness	5	
	Violation of Rules	4	
	Failure to Use Tools or Appliances	2	
	Failure to Use Safety Devices	1	
			18
B. Other Workman:	Improper Method of Work	9	
	Violation of Rules	3	
	Carelessness	2	
			14
			91.

Table II.

Showing number of fatalities and rates per 1000 employees for thirteen years prior to safety work and also for thirteen years of Safety Work.

Year	Fatalities	Rate	Year	Fatalities	Rate
1898	6	5.63	1911	5	1.89
1899	4	3.41	1912	4	1.71
1900	4	2.80	1913	11	4.12
1901	9	6.83	1914	10	4.10
1902	8	5.38	1915	5	2.15
1903	8	5.15	1916	8	2.61
1904	4	2.97	1917	6	1.73
1905	12	6.54	1918	13	3.45
1906	10	4.13	1919	11	2.79
1907	17	5.97	1920	5	1.21
1908	6	2.52	1921	6	2.60
1909	13	5.15	1922	1	.43
1910	20	6.88	1923	6	2.19
	121	4.95		91	2.39
Tons of ore miner per fatality		176,356			384,389

SAFETY DEPARTMENT.

Serious and Slight Accidents

A total of 453 accidents were reported last year, 6 fatal, 277 serious and 176 slight. Serious accidents are those that caused workman to remain at home two weeks or longer. Compared with the Annual average rate of previous years these numbers show a slight reduction, but not of sufficient significance to be praiseworthy. 349 accidents or 77% were classified trade risk by the Central Safety Committee. Two employees were injured three times each and twenty-eight employees twice each. Thus thirty men are accountable for sixty-two of the total number of accidents.

Ten causes were responsible for 358 accidents. They are the same principal causes as prevailed in previous years. For instance, 74 happened by falls of ground, 54 by squeezing finger, hand or foot between chunks of ore, pieces of timber, etc; 53 by being struck by glancing dirt, tools, timber, etc. The Holmes, Republic and Cliffs-Shaft mines had the highest frequency rate. These mines produce hard ore, which contribute largely to the causes resulting in many of these accidents. Hard ore is mined at the Holmes by the caving system. It is very heavy, and if a small piece falls from the side, back or through lagging and happens to strike a workman, it usually results in a lost time accident. At the Republic and Cliffs-Shaft many men are injured by lifting large chunks. The Holmes, Francis and Austin mines had the highest severity rates. There was approximately a loss of thirteen days by injuries for every 1000 days worked during the year. The number of accidents per 1000 days labor and the number of working days lost per 1000 days of labor are given in Table XIX.

The serious accidents which incapacitated workmen three months or longer are as follows:

Austin Mine: Louis Pesotti and James Gianfichi were drilling a bottom hole in a drift when four sets of timber and seven or eight tons of ore caved upon them. This accident occurred October 17th, and both men were unable to return to work at the end of the year. They sustained severe bruises and strains. Classified trade risk.

SAFETY DEPARTMENT.

Cliffs-Shaft: Victor Ollikainen, a trammer, was asked by a locomotive operator to ride on a locomotive in order to give it more weight, as the locomotive wheels were spinning around and the operator was unable to pull the train. Ollikainen got his hip squeezed between the locomotive and the drift, which was very narrow. He lost thirteen weeks. Classified preventable, as the motorman violated a rule.

Francis: Ely Brazeau, a teamster helper, aged 64 years, was injured January 18th, and was unable to resume work the balance of the year. He was leaning on a platform of a sleigh going to the Gwinn mine barn, when the horses jerked ahead throwing him off. He received a severe strain of the right groin. Classified preventable.

Morris-Lloyd: John Wirtala and his partner were putting in back holes at the breast of a drift when a piece of ore dropped from the back, fracturing his pelvis. He is slowly recovering. The accident was classified preventable as the man and his partner had an opportunity to trim the pile before it gave away.

Alec Niemi, a miner, was helping miners of another contract to lift a cap. The cap slipped, striking him on the right leg, causing a fracture. This accident occurred December 17th and will probably incapacitate him three months. It was classified preventable because the men failed to use proper precautions.

Barnes-Hecker: John Nancarrow, a miner, was pushing a car of ore to chute and slipped on plank, resulting in hernia. He received twenty weeks compensation. Classified trade risk.

Negaunee: Victor Vaisanenen was in the act of pushing out a loaded car of ore when a chunk of ore rolled down the pile, fracturing his leg. He lost fifteen weeks. It was classified trade risk, as the pile had been trimmed a short time before the accident occurred.

Fred Hynnonen was walking down a 35° raise, carrying a drill. He slipped, falling a distance of five feet, which resulted in hernia. Classified trade risk.

Stephenson: Joseph Brazeau, a surface employee, was loading timber on a truck when his foot slipped, resulting in a strained back. He lost thirteen weeks. Classified trade risk.

Joseph Benaglio, a trammer, was switching a car when his foot slipped and in putting out his hand to save himself from falling, he struck the side of the drift. He lost thirteen days. It was classified trade risk.

Holmes: John Austin, a miner, was helping to change a leg of timber when a chunk of ore fell from the back, striking him on his left shoulder. He has been home thirty-three weeks, claiming to suffer from internal injuries. It was classified trade risk.

Chas. Kenward, a miner, was repairing timber and a cap slipped off from the prop. He was standing by one of the legs which rebounded, fracturing his wrist. He lost eighteen weeks. It was classified trade risk.

Emil Maki, a miner, was injured by a small piece of ore falling from the back striking him on the thumb. He lost eighteen weeks. Classified trade risk.

Carl Silas, a timber trammer, was loading a hemlock log on a skid in a timber yard when the timber slipped. In lifting the extra weight he ruptured himself. He lost thirteen weeks. Classified trade risk.

William Youren, a trammer, was filling a car at chute, August 14th, and was struck by a small chunk on his hand. It became infected, causing him to lose the balance of the year. Classified trade risk.

Boeing: Arthur Koski, a miner, was lifting a large piece of timber, by means of a rope and a block, and ruptured himself. He lost thirteen weeks. Classified trade risk.

Jalmer Wiren, a miner, was climbing a ladder between two sub-levels. There was a loose rung and his foot slipped to the lower rung. The jar resulted in hernia. He lost thirteen weeks. Classified trade risk.

Chas. Piironen, a miner, was making a wedge and cut his hand with an axe. This occurred September 4th and he had not returned to work at the end of the year. Classified trade risk.

Boeing (Cont'd.) Fred Mannila, a locomotive brakeman, had a finger caught while riding an engine around a sharp curve in the yard. He sustained a loss of the point of a finger and was unable to return to work at the end of the year. The accident was classified preventable because the curve did not provide ample room for safe passageway.

Wade-Helmer: Nick Drobac, a miner, was injured by a run of sand, July 24th. Nick Ciuk, his partner, was killed at the same time. This accident has already been described. Drobac had not returned to work at the end of the year. Classified trade risk.

Table III

Table giving the average number of employees, the number of serious accidents, the total number of accidents and the rates per 1000 men employed for the years 1913 to 1923, inclusive.

Year	Average Number of Employees.	Number of Serious Accidents	Rate per 1000 Employees	All Accidents	Rate per 1000 Employees.
1913	2621	201	80	628	244
1914	2435	179	82	443	182
1915	2308	155	67	427	185
1916	3063	263	86	592	193
1917	3457	264	76	639	184
1918	3765	230	61	596	156
1919	3938	241	61	670	170
1920	4125	220	54	708	171
1921	2237	145	64	350	156
1922	2309	160	69	344	144
1923	2738	181	66	453	165

Table IV

Table giving the number of accidents by mines, number receiving compensation and the number of slight accidents.

Mine	Number of Accidents	Received Compensation	No Compensation
Athens	37	23	14
Austin	15	15	--
Barnes-Hecker	11	7	4
Boeing	29	24	5
Cliffs-Shaft	59	27	32
Dead River Storage Dam	16	10	6
Francis	19	11	8
General Storehouse	4	2	2
Hill-Trumbull	6	5	1
Holmes	66	39	27
Maas	16	11	5
Morris-Lloyd	41	22	19
Negaunee	38	22	16
Princeton	2	2	--

Table IV. (Cont'd.)

Mine	Number of Accidents	Received Compensation	No Compensation
Republic	48	27	21
Salisbury	1	1	--
Spies	2	-	2
Stephenson	42	29	13
Wade-Helmer	1	--	1
	453	277	176

Table V

Comparative accident record per 1000 men employed in the metal mines of the United States and the Company.

Year	Company	U. S. Metal Mines.
1913	244	179
1914	182	211
1915	185	248
1916	193	250
1917	184	240
1918	156	237
1919	170	233
1920	171	242
1921	156	249
1922	144	232
1923	165	
AVERAGE	177	232

Safety Inspection

The mines were inspected by the Safety Inspector, a Committee of Superintendents, a Committee of Shift Bosses, a Committee on Mechanical and Surface Equipment, a Committee on Ventilation and Workmen Committees.

Safety Inspector

All the mines in Marquette County were visited every month by the Safety Inspector, either making a personal inspection or accompanying the committees. The Spies Mine was inspected twice, once by the Committee of Superintendents and once by the Safety Inspector. The Boeing and Hill-Trumbull mines were inspected jointly by F. C. Stanford and the Inspector.

Workmen Committees

All the mines of Marquette County were inspected by Workmen Committees from May 19th to June 6th. Ten committees, comprising thirty employees,

engaged in this work. Table No. VII. gives the number of workmen by mines, who had served in this capacity since the beginning of safety work.

Foremen Committees

All of our underground shift bosses or foremen have been members of the Annual Foremen Inspection Committee, excepting a few men who have been appointed foremen recently. It was decided by the Central Safety Committee to select men who had formerly served in this capacity to act again.

The Committee this year consisted of Wm. Bath, Stephenson Mine, John Fredrickson, Negaunee Mine and Wm. Nault, Morris-Lloyd Mine. These three men are among the Company's most able and efficient underground foremen. The mines of the County were inspected October 29th to November 7th.

Committee on Mechanical and Surface Equipment.

This Committee was appointed by the Central Safety Committee and consisted of E. S. Bonnell, Ass't. Mechanical Engineer, R. K. Durland, Electrician, and Albert Decaire, Surface Foreman, Holmes Mine. An inspection of the surface equipment of the local mines was made October 2nd to October 6th.

Committee of Superintendents

On recommendation of the Safety Inspector it was decided to appoint a new committee, consisting of officials who hold higher positions of responsibility than are held by the men who have been designated in the past to act on the other committees. It was thought that foremen as well as the workmen would be more favorably impressed with the importance of maintaining constantly the work of accident prevention. Mr. Elliott, Mr. Stakel and Captain Rough were the members of this Committee. The local mines and the Spies were inspected during the summer months. The Committee found the safety condition very satisfactory and submitted very few recommendations. The Safety Inspector is of the opinion that it is worth while to continue an annual inspection of the mines by a committee of this kind.

The Central Safety Committee

This Committee held a regular meeting each month for the classification of accidents and consideration of safety matters. Special meetings were held February 11th and May 12th to act upon a report which was submitted by the Committee on Ventilation and Fire Hazards. Two mining captains were in attendance at the last three meetings of the year, to assist in the classification of the accidents and to impress them with the seriousness of the work of accident prevention.

Rules and Regulations

The supply of general rules for the prevention of accidents in English was exhausted and a new issue of 2000 copies was printed. This book has been labelled Rule Book No. 11, and containes all the safety rules that have been adopted by the Company.

There were 1179 rule book receipts returned to the office of the Safety Department: 688 English, 358 Finnish and 133 Italian. This is the highest number distributed in one year since 1911, when printed rules were first given to employees.

Examination of Employees on Rules & Regulations

The Committee for this purpose, Messrs. Rough, Moulton and Conibear, examined 49 employees of the local mines in October. A total of 533 employees have been interviewed by the Committee. By occupation these men are divided as follows:

Table VI

Miners	311
Foremen	59
Surface Laborers	47
Motormen	32
Timbermen	33
Cage Riders	17
Shaftmen	5
Electricians, mechanics, etc.	21
Miscellaneous	8
	533

Table VII.

The following table gives the number of foremen and workmen by mines, who have served on Safety Inspection Committees since the beginning of Safety Work.

Mine	Foremen	Workmen
Athens	3	12
Austin	1	13
Barnes-Hecker	0	3
Cliffs-Shaft	8	48
Francis	1	15
Gardner-Mackinaw	1	6
Gwinn	3	33
Holmes	5	18
Lake	6	45
Maas	7	39
Morris-Lloyd	7	51
Negaunee	11	51
Princeton	3	21
Republic	6	33
Salisbury	5	36
Stephenson	7	44
Miscellaneous	10	21
	84	489

Inspection of Electrical Equipment

Quarterly inspection reports of electrical equipment of the local mines are now made by Electricians Andrews and Durland, of the Mechanical Department, who inspect the signals, telephones, shaft cables, trolley wires, haulage tracks, switch boards, ventilating fans, motors, etc., for the purpose of reducing accident and fire hazards. A number of valuable recommendations have already been received by these inspections, and the mine electricians are being educated to adopt the best methods possible when doing both temporary and permanent construction work.

List of Safety Inspection Reports Now Being Made.

Monthly inspections by the Safety Inspector.

Annual inspection by a Committee of Superintendents.

Annual inspection by an Underground Foreman Committee.

Annual inspection of surface equipment by a Committee consisting of a foreman, a mechanic and an electrician.

Annual inspection by Workmen Committees.

Quarterly inspection by Electricians.

Daily cage rider reports.

Daily inspection of hoisting ropes.

Weekly inspection of ladder and ladderway.

Weekly inspection of cages.

Quarterly inspection of fire hose and hydrants.

Semi-annual inspection of fire extinguishers.

Monthly inspection of mine rescue apparatus.

Monthly inreporton of first aid training.

U. S. Bureau of Mines

Mr. Daniel Harrington and Mr. W. H. Carrick, U. S. Bureau of Mines engineers, were at Ishpeming ~~on~~ May 5th to May 12th for the purpose of studying the ventilation problem at the Athens Mine. They also inspected the Francis mine and made a few recommendations to provide for ventilation there. Mr. Harrington is in charge of the Denver, Colo. district for the Bureau and Mr. Carrick is in charge of the Lake Superior Mine Rescue Car. The former has made a study of ~~the~~ metal mine ventilation in recent years and is the writer of a number of publications dealing with mine fires and ventilation, which have been issued by the Bureau of Mines.

The U. S. Bureau of Mines Rescue Car, which is assigned to the Lake Superior district, was at Ishpeming from July 1st to 14th, for the purpose of rendering first aid and mine rescue training. It was the sixth visit the car has made to the Company's properties on this range. Further information on this subject is given under mine rescue and first aid work.

Committee on Ventilation and Fire Hazards

Messrs. Eaton, Bush and Conibear were appointed late in 1922 to act as a committee on Ventilation and Fire Hazards. This Committee submitted a report to the Central Safety Committee in January recommending a set of rules and specifications for fire prevention and fire fighting, which could be used as a basis in determining the proper procedure to be taken and the policy to

be follwed at all of the Company's mines. The recommendations were based largely on the reports issued by the U. S. Bureau of Mines, on the rules drawn up by a Committee of the American Mining Congress at Cleveland in 1922 and the National Safety Council, etc. The report of the committee is divided under five headings and is outlined herewith in skeleton form.

1. Fire Prevention:

(a) Fire proof down-cast shafts and timber tunnels or equip with water sprays.

(b) Eliminate combustible material at all shaft stations.

(c) No lagging stored within 50 feet of timber tunnel portal.

(d) Fire proof buildings within 25 feet of collar of shaft.

(e) Eliminate wood in shaft houses, as much as possible.

(f) Extra good electrical insulation.

(g) Eliminate, as much as possible, combustible material in pump houses.

(h) Oil waste stored in metal containers.

(i) Fire-proof pump, fans and booster fan stations.

2. Extinction:

(a) Maintainence of carbon tetrachloride fire extinguishers at strategic places in a mine.

(b) Fire foam extinguishers kept in timber tunnels and surface buildings.

(c) Sufficient supply of standard $2\frac{1}{2}$ inch fire hose maintained on surface.

(d) Supply of fire hose maintained in pump stations.

(e) Maps, showing location of fire equipment and giving instructions on bulletin boards, placed at conspicious places on surface.

(f) Providing fire pails at buildings, shaft stations, etc.

(g) In mines piped for water for Leyner drills, keep a supply of 3/4 inch hose, together with proper fittings.

(h) In other mines, water tanks mounted on trucks should be provided.

3. Segregation:

(a) Erection of fire doors at all levels, close to shafts.

(b) At mines, having fans in operation, special rules be prepared for fire emergency.

4. Notification:

(a) Adoption of an alarm signal; the Stench method being recommended.

(b) Printed rules and directions to be given to employees once a year.

(c) Maps be prepared showing openings to surface, designating the safest methods of escape in time of fire.

(d) Second outlets be clearly marked and men trained to follow them.

(e) Signs of warning and directions be placed at all advantageous places.

5. Extraction:

(a) Maintainence of fire fighting and rescue equipment in each district and at each isolated mine, and crews trained in the use of the same.

(b) Appointment of a fire chief at each mine.

(c) Drawing up definite plans at each mine and the proper procedure to be followed in case of fire.

(d) Maintainence of a second outlet in each mine.

This report was very thoroughly discussed by the Central Safety Committee at a special meeting in February, but opinion was not unanimous as to the advisability of adopting all these recommendations. It was decided to consult Mr. Chas. A. Mitke, Consulting Engineer, Bisbee, Arizona, who has specialized in mine ventilation and mine fires, and also Mr. Daniel Harrington, Mining Engineer, with the U. S. Bureau of Mines, who has spent many years in Western mines studying the same problems for the Bureau. It was found later advisable to have Mr. Harrington come to Ishpeming for consultation, and also in order that he might inspect the local mines and get accurate information by personal investigation. Mr. Harrington and Mr. W. H. Carrick, who is in charge of the U. S. Bureau of Mines Rescue Car, with headquarters at Duluth, Minnesota, arrived here in May. They made a study of the Athens and Francis mines, where ventilation has been poor. They were present at the special Central Safety Committee meeting in May, when the recommendations, as previously outlined, were

discussed. They made a written report after they had departed from Ishpeming.

The actual benefits accruing from this study of mine ventilation and fire hazards may be summarized as follows:

1. The reduction of mine fire hazards, both underground and on surface.

2. Ventilation at the Athens and Francis mines has been improved.

3. Additional fire fighting equipment, such as fire extinguishers, water pails, etc. have been provided.

4. Fire doors, installed to limit smoke and gas areas until employees reach a safety zone, are being erected.

5. The fire problems of each mine are now being studied and special regulations for each are being formulated.

The Committee on Ventilation and Fire Hazards inspected the Francis, Holmes, Morris-Lloyd and Republic mines and gathered data for preparing special fire rules for each of these mines. Other local mines are yet to be visited. When this work is completed, a final report will be submitted to the Central Safety Committee.

Ventilation

The air in the Athens mine has been varible since 1920, being normal during cold weather, but rather unsatisfactory throughout the summer months, due to excessive humidity, high temperature and quantities of carbon dioxide. When these conditions started the Sturtovant fan, which had been used to ventilate the Lake mine and rated to throw 40,000 cu. feet of air per minute, was installed at the 2,400 foot level near the shaft. However, due to resistance in air deliveries and distribution it delivered at first approximately only one-half of the amount of air that it was supposed to throw. As the mine has but one shaft to surface, it was necessary to use the cage compartment for the downcast air and the skips compartment for the upcast air. The partition between these compartments was not air tight and consequently a considerable volume of poor air was being carried in a circuit and was not being discharged at surface. These difficulties were overcome by adopting a number of recommendations, which were suggested by Mr. Harrington. The shaft compartments were made separate

air passageways by guniting. The air restrictions were reduced by opening more raises between levels and by directing the air into splits, which were distributed throughout the working places on all the sub-levels. This distribution has been strengthened by using auxiliary fans and blowers. A new type of blower, called the coppus fano and which may be operated by air, was recently placed on the market. One of these blowers were installed in November and is proving a very satisfactory device. The installation is more simple than if the blower was driven by an electric motor, and there are no fire hazards, as exist by the installation of electric wires and a motor in a dry timbered drift that is crushing badly.

These improvements were not completed until the high temperature of last summer had passed and it will require the hot weather of another year to determine the effectiveness of the entire ventilation system of the mine. But judging by the volume of air now being returned at the collar of the shaft from the skip compartments, it is safe to predict that the problem has been solved and there will be little or no cause for complaint in the future.

The sub-levels between the 3rd and 4th levels of the Maas mine are below the elevation of the passageway to the Negaunee mine and because of the lack of mechanical ventilation the air became very stagnant during the hot weather of last summer. A small fan was installed on the 100 foot sub-level, between the 3rd and 4th levels, having a suction drawing air from a raise to the lower level and distributing it into the subs above the location of the fan. This installation resulted in relief but the time is probably not far distant when it will be necessary to install permanently a larger fan in order to be in a position to handle the situation satisfactory, because as deeper working places increase in number there will be a gradual increase in the consumption of the air that must be supplied mechanically.

The upper sub-levels at the Francis mine have been worked out and all the miners are now found working in the territory adjacent to the 5th level. This area is well ventilated. A small booster fan was used several months last summer but with the drop in surface temperature in October, its use was discontinued. There is very little likelihood that any more difficulty will be encoun-

tered at this property because of poor ventilation.

A raise was put up at the end of the 6th level drift, Morris shaft, to the bottom level of the Barnes-Hecker mine, providing a second outlet to the latter mine and improving the circulation of air in both mines. The sixth and seventh levels of the Morris shaft were connected by a raise and a small fan was installed at the bottom of the large stope, above the 6th level. It is necessary for car fillers at this level to blast large chunks that block the chute, resulting in much powder smoke. By operating this fan, the smoke is carried away.

It is gratifying to report that our underground circulation is now in first class condition at all the mines and that there is no cause for complaint on the part of the miners. Poor air and wet places make poor working conditions and cause men to lose time and reduces their efficiency, besides making them discontented. Fortunately, the Company's mines are dry, there being practically no wet places, although occasionally a wet place may be found, but it does not last very long.

Fire Protection

Additional Pyrene fire extinguishers have been placed in buildings or at stations where electrical equipment is extensive. A number of foam or acid soda extinguishers were purchased for other places that were regarded as not having ample protection. Water pails have been hung up conveniently in many surface buildings. Maps, showing the location of fire hose, hydrants and extinguishers and giving instruction in fire fighting, are being made for all mines; those for the Ishpeming mines have already been framed and erected at conspicuous places on surface.

Warning Signs

Several hundred signs, pointing to danger or giving orders relative to the prevention of personal injuries have been posted at all mines, both underground and surface. They are to be seen at railroad crossings, roadways under trestles, timber yards, change houses, collar of shafts, shaft stations, locomotive drifts, etc.

Skip Pits

It is necessary to clean the skip pits very frequently, either two or three times a week or as regular as once a day. A rule was made that when this work was performed employees must not ride the cage with a car of ore or rock, as had been the method in the past. Where the skip pit is not far below the bottom station the workmen climb, but where it is considerable distance extra men are employed to take the loaded cars off the cage, dump them, and return them to the skip pit, where they are filled by a second crew.

Miscellaneous Safety Measures

Among the safety measures that were adopted last year, other than those already enumerated, are the following:

Larger bonnets were attached to the hoisting cables, above the skips, Cliffs Shaft mine, for the protection of the skip riders.

The shaft houses at the Holmes, Negaunee and Athens mines, including top tram operator's rooms, etc. were made fire proof.

A new hoisting shaft, surface trestle and pocket, equipped with standard safety guards, were erected at the Austin mine.

The passageway from the bottom of the Austin Shaft to drift leading to Stephenson mine, was made larger so that when ice accumulates in winter a second outlet for each mine is assurred.

Newly undermined areas at the Morris-Lloyd and Austin mines were fenced.

Due to heavy crushing, many of the passageways in the Francis mine were constantly in need of repairs. Extra men were assigned to this work to avoid men being trapped.

Battery locomotives were installed at the Cliffs Shaft and Salisbury mines. Trolley wires are therefore not needed.

The ladderways in the Cliffs Shaft mine became very poor, due to the mine being idle. They have been repaired, and to lengthen their duration a treatment of cresote is being applied to them.

The Barnes-Hecker and Morris-Lloyd mines were connected by a raise from the 6th level of the Morris Shaft to the bottom level of the Barnes-Hecker, thus providing a second outlet for the Barnes-Hecker and the west end of the Morris.

A modern change house was built at the Republic mine, replacing the old frame building, which was a fire hazard. It is equipped with lockers, shower baths, toilets and ventilating flues.

All underground fan stations were made fire-proof.

The passageway through Cliffs-Shaft mine into No. 3 Shaft, or the Incline Shaft, was equipped with a fire or ventilation door.

The remodeled boiler plant of the Gwinn Power station was equipped with standard safety appliances.

The addition to the Cliffs-Shaft crusher was also likewise made safe.

The work of repairing both the underground and surface working places at the Salisbury to conform to all the Company's safety standards were started in December, but was not completed at the end of the year.

First Aid Work

Ten new first aid teams were organized in October and November of last year, one each at the Republic, Barnes-Hecker, Morris-Lloyd, Holmes, Cliffs-Shaft, Athens, Negaunee, Maas and Stephenson mines and one jointly between the Francis and Austin mines. Since the closing down of the Austin mine the team is made up entirely of men from the Francis mine.

Training has been carried on regularly each month, during the year, a total of 112 practices being held in which 96 men took part.

During July 1st to July 14th, the U. S. Bureau of Mines Car No. 10, in charge of Mr. W. H. Carrick, Engineer, Mr. M. A. Orfald, Foreman Miner and Ben A. Brockbank, First Aid Miner, was stationed at Ishpeming for the purpose of examining our men as to their proficiency in first aid and mine rescue work. 41 first aid men, then in training, were given a half day at the Car, where they were examined in first aid methods and were awarded Government certificates. The mannual of first aid practice, as adopted by the Bureau of Mines, is used as the standard text book in all of our training.

A total of 540 men have received more or less first aid training. Of this number, 362 have been awarded Company certificates: 19 others have practically completed the course, but due to the closing down of several mines in 1921

they were compelled to leave the Company's employment before receiving certificates, making a total of 381 who have received or are entitled to the Company's certificate. First aid supplies for the year cost $582.10.

Mine Rescue Work.

There were no calls made for use of Mine Rescue Apparatus during the year.

Practices were held once a month at each operating mine, a total of 112 practices being held in which 120 men took part. Thirty-seven men, who had not previously been trained under the direction of the Bureau of Mines, were given a half day at the Car during its visit here in July. They were examined and awarded Government Certificates for mine rescue work.

Since 1912, 350 men have received training in mine rescue apparatus, of which number 101 have left the employment of the Company, 5 are deceased and 75 have been disqualified, because of physical inability, leaving a total of 169 rescue men now employed by the Company. All of these men, with the exception of a very few who have but recently commenced training, are in possession of Bureau of Mines certificates.

Last year 25 sets of Paul apparatus were purchased to replace our 25 sets of Draegers, which are now considered as obsolete, at a net cost of $4854.74. We were given a salvage value of $35.00 on each Draeger returned.

As far as possible every man who had had previous training with the Draeger apparatus was given an opportunity to inspect and wear the Paul apparatus, and all of them, without exception, expressed a preference for the Paul over the Draeger. It is agreed that this machine is safer and more efficient.

Table VIII.

Showing Total number of First Aid Men Trained.

Total number receiving training	540
Total number receiving Certificates	362
Total number entitled to certificates	19
Total number deceased	7
Total number pensioned	2
Total number left employ of Company holding certificates or entitled to same	96
Total number now in employ of Company holding certificates	276

SAFETY DEPARTMENT.

Table IX

Showing total number of Mine Rescue Men Trained.

1912 to 1923.

Total number receiving training	350
Total number deceased	5
Total number disqualified	75
Total number left employ of Company	101
Total number now in employ of Company	169

Table X

First Aid Supplies for 1923.

200	lbs Roller Bandages	$ 242.00
17	doz. First Aid Packets	72.00
12	doz. Z. O. Plaster	48.00
10	Boxes Handy Fold Gauze	77.40
2	Boxes Handy Fold Picric Gauze	13.50
220	lbs. Absorbent Cotton	13.60
12	Gross Leather Finger Cots	72.55
6	Doz. Carbolated Vaseline	7.20
4	Doz. Glass Stoppered Bottles	5.60
3	Doz. Aromatic Spirits Ammonia	26.00
4	Gallons Iodine	22.40
	Freight	1.25
		$ 582.10

Table XI

Mine Rescue and First Aid Equipment and Supplies

New Equipment:

25	sets Paul/ apparatus @	198.75	$4968.75
28	Extra Cylinders	21.50	602.00
15	Refillable Regenerators	25.00	375.00
250	Regenerators	3.00	750.00
	Freight		76.49
	Total Gross Cost		$6772.24

Salvage, Return Old Draegers:

10	Draegers @	35.00	350.00
15	Draegers	32.00	480.00
27	Cylinders	17.00	459.00
174	Regenerators	2.75	478.50
100	Regenerators	1.50	150.00
			$ 1917.50

Total Net Cost New Equipment $4854.74

SAFETY DEPARTMENT.

Table XII

Mine Rescue Supplies for 1923.

1 Electric Soldering Iron	$ 5.98	
1 Set Pump Packing and Springs	3.55	
1 Gal Glycerine	2.30	
2 Gals. Euthymol	6.00	
4 Canaries	4.00	
200 Lbs. Caustic Soda	74.00	
10 Cylinders Oxygen	47.50	
Bird Cage Equipment	1.90	$ 145.23

Repairs: Pulmotor and Lungmotor.

4 Rubber Face Masks for Pulmotor @ 5.00	20.00	
2 Sets Respiration Tubes " 22.50	45.00	
Postage	.56	
4 Rubber Face Masks for Lungmotor 2.50	10.00	
4 Gas Bags 2.50	10.00	
Postage	.16	85.72

Table XIII

Number of Accidents, number classified Preventable and Percentage Preventable 1912-1923.

Year	Number of Accidents	Preventable Accidents	Percentage Preventable
1912	207	51	25
1913	316	77	24
1914	443	118	37
1915	427	97	23
1916	592	120	20
1917	639	149	23
1918	590	124	21
1919	670	159	22
1920	708	132	19
1921	351	63	18
1922	344	90	26
1923	453	104	23

Table XIV

Comparison of Fatality Rates for Coal Mines, Metal Mines, etc.
(Based on 300 working days per man.)

Year	U. S. Coal Mines	U. S. Metal Mines	Minn. Metal Mines	Mich. Metal Mines	Marquette* County	C. C. I. Company
1911	4.97	4.45	5.46	4.28	5.42	1.89
1912	4.46	4.09	3.15	3.22	3.32	1.71
1913	4.70	3.72	3.16	3.12	2.46	4.12
1914	4.66	3.92	2.93	3.97	5.00	4.10
1915	4.44	3.89	2.71	3.74	4.09	2.16
1916	3.94	3.62	2.59	3.76	4.27	2.61
1917	4.25	4.44	3.04	3.40	3.03	1.73
1918	3.94	3.57	3.25	3.31	.42	3.45
1919	4.27	3.43	3.09	2.99	4.20	2.79
1920	3.62	3.16	2.61	3.25	3.06	1.21
1921	4.11	3.09	2.51	3.63	0.00	2.60
1922					1.66	.43
1923					3.62	2.19
Average	4.30	3.76	3.14	3.51	3.12	2.38

* Exclusive Cleveland-Cliffs Company.

Table XV.

Classification of Non-Fatal Accidents

1922 and 1923.

	1922	1923
A. Fall of Ground or Timber:		
1. By fall from back or side (drift, raise or stope)	70	74
3. By fall of stray chunk or stick down raise or stope	8	11
4. By run of mud or sand.	3	--
5. By lagging, sprag, or timber falling from back or side.	1	1
T o t a l - - -	82	86
B. Shaft Accidents:		
1. By falling down shaft.	1	-
2. By rock or timber falling down shaft, etc.	-	1
3. By being struck or caught by cage, skip bucket or tool.	-	1
8. Miscellaneous shaft accidents.	2	2
T o t a l - - -	3	4
C. Use of Explosives:		
1. By explosion of powder, detonator, etc. T o t a l - - -	2	-
D. Mine and Railroad Cars:		
1. By being caught between cars or motor and drift.	4	16
2. By squeezing finger, hand or foot between box and truck, car and drift, chute, etc.	13	18
4. By being run over by railroad car or haulage car.	-	1
5. By cars falling back or off track.	1	-
7. By car running over foot.	-	3
8. By being struck by car handle, car rebounding, etc.	1	1
9. By being struck by motor or car.	1	-
10. By miscellaneous causes.	3	5
	23	44
E. Miscellaneous Causes:		
1. By falling down raise, stope or mill.	2	5
2. By falling from ladder, trestle or stage.	7	9
3. By falling with machine or tripod, drill breaking, etc.	-	1
4. By squeezing finger, hand or foot between pieces of timber, chunks of ore, etc.	48	54
5. By straining or wrenching arm, back, side or leg by lifting, etc.	46	23
6. By chunk rolling down dirtpile, stockpile, off car, etc.	27	31
7. By being struck by glancing dirt, tool or timber, etc.	21	53
8. By being struck by pick, shovel, hammer, timber, etc.	18	31
9. By tools or material falling or slipping from hand, staging or platform, etc.	17	25
10. By running nail into hand, foot or leg.	7	3
11. By stumbling or slipping causing a fall, etc.	13	29
12. By catching finger, hand or foot in blocks, gears, brakes, struck by windlass, parts of machinery, etc.	13	20
13. By wrench or tong slipping causing a fall, etc.	-	-
14. By blood poison or infection from various causes	2	13
15. By contact with electric wire.	3	1
16. By being scalded or burnt.	-	1
17. By blistering hand.	-	2
18. By sliver in finger, etc.	4	2
19. By miscellaneous underground causes.	2	4
20. By miscellaneous surface accidents.	3	6
	233	313
GRAND TOTAL -	343	447

SAFETY DEPARTMENT.

Table XVI.

Classification of Causes of Fatal Accidents
From Dec. 1st, 1898 to January 1st, 1924.

A. Fall of Ground or Timber:		
1. By fall from Back or side (drift, raise or stope.)	80	
2. By fall of chunk or ore from chute.	1	
3. By fall of stray chunk or stick down raise or stope.	2	
4. By run of mud or sand.	9	
5. By run of ore in stope.	1	
T o t a l -		93
B. Shaft Accidents:		
1. By falling down shaft.	12	
2. By rock or timber falling down shaft.	2	
3. By being struck or caught by cage, skip, bucket or tool.	8	
4. By falling from cage, skip or bucket.	11	
5. By falling from ladder in shaft.	5	
6. By being carried or pushed into shaft by car.	3	
7. By attempting to jump on or off cage, skip or bucket.	3	
8. By being struck by crosshead.	5	
T o t a l -		49
C. Use of Explosives:		
1. By explosion of powder.	14	
2. By premature blast.	3	
3. By fall of ground or timber due to blast.	4	
4. By being overcome by gas.	3	
5. By erysipelas resulting from blast.	1	
T o t a l -		25
D. Mine and Railroad Cars:		
1. By being caught by haulage cars.	10	
2. By riding or attempting to ride cars.	5	
3. By falling with car from trestle.	4	
4. By being run over by railroad car.	6	
T o t a l -		25
E. Miscellaneous Causes:		
1. By falling in raise or pocket.	5	
2. By falling from ladder, trestle or stage.	4	
3. By falling with machine or tripod.	2	
4. By being caught under pump rod.	2	
5. By (supposing to have) coming in contact with trolley wire.	2	
6. By asphyxiation due to mine fires.	3	
7. By being pulled into sheave.	1	
10. By contact with electric wire.	1	
T o t a l -		20
G r a n d T o t a l - - - - - - -		212

Average Percent of Accidents by Causes.

A. 44% B. 23% C. 12% D. 12% E. .09%

SAFETY DEPARTMENT.

Table XVII.

Classification of Fatal and Minor Accidents

For the Year 1923.

By the Central Safety Committee

I. TRADE RISKS, (INCIDENTAL & NON-PREVENTABLE)		Total -	349
II. NEGLIGENCE OF COMPANY:			
	6. Failure to Provide Safety Devices	1	
	7. Failure to Provide Proper Tools, Appliances or Place to Work.	5	
		Total -	6
III. NEGLIGENCE OF WORKMEN:			
A. Injured Men:	1. Failed to Use Safety Devices Provided.	1	
	3. Violation of Rules.	5	
	4. Improper Act or Selection of Improper Method of Doing Work. (By Workman.)	22	
	5. Carelessness. (By Workman.)	56	
		Total -	84
B. Other Workman:	1. Failed to use Safety Devices Provided.	1	
	2. Failed to use Proper Tools or Appliances Provided	2	
	3. Violation of Rules.	2	
	4. Improper Act or Selection of Improper Method of Doing Work. (By Workman.)	7	
	5. Carelessness. (By Workman.)	2	
		Total -	14
		Grand Total -	453

SAFETY DEPARTMENT.

Table XVIII.

Accident Frequency

Number of Accidents per 1000 days of labor

January to November 1923*

	Days of Labor	Number of Accidents	Rate per 1000 Days
Electric Generating Plants	6339	0	.000
Spies	14451	2	.138
Hill-Trumbull	24481	5	.204
Princeton	3770	1	.265
Maas	55254	15	.271
Wade-Helmer	2982	1	.335
General Storehouse	10601	4	.377
Negaunee	65148	32	.491
Francis	27424	16	.583
AVERAGE			.598
Boeing	42356	26	.614
Austin	24438	15	.614
Morris-Lloyd	58314	36	.617
Barnes-Hecker	16081	10	.622
Stephenson	57954	38	.656
Athens	51327	34	.662
Dead River Storage Dam	24009	17	.708
Cliffs-Shaft	75146	54	.719
Republic	60548	45	.743
Holmes	61658	65	1.054
TOTAL ALL PROPERTIES	693906	415	

Table XIX.

Accident Severity

Number of Working Days Lost per 1000 days of labor

January to November 1923*

	Days of Labor	Days Lost	Rate per 1000 Days
Electric Generating Plants	6339	0	.000
Spies	14451	6	.415
Hill-Trumbull	24481	62½	2.553
Princeton	3770	13	3.448
Wade Helmer	2982	16	5.366
Maas	55254	352½	6.380
Morris-Lloyd	58314	435½	7.468
Dead River Storage Dam	24009	192½	8.018
Republic	60548	502½	8.299
General Storehouse	10601	91	8.584
Cliffs-Shaft	75147	784½	10.440
Negaunee	65148	742	11.390
Athens	51327	640	12.469
AVERAGE			12.982
Barnes-Hecker	16081	233	14.489
Boeing	42356	761	17.967
Stephenson	57954	1066½	18.403
Austin	24438	515	21.074
Francis	27424	644	23.483
Holmes	61658	1961	31.804
TOTAL ALL PROPERTIES	693906	9008½	

* Data for December not available at the time of completing this report.

Table XX.

Expenses of the Safety Department for 1923.

Supplies

Office, printing, etc. - - - - - - - - -	$ 171.93	
Central Safety Meeting - - - - - - - - -	27.46	
Mine Rescue and First Aid - - - - - - -	30.99	
T o t a l -		$ 230.38

Traveling

Inspector - - - - - - - - - - - - - - - -	485.24	
Mine Rescue Foreman - - - - - - - - - - -	255.12	
Committees - - - - - - - - - - - - - - -	235.15	
T o t a l -		975.51

S a l a r i e s -	6924.80
Grand T o t a l -	$ 8130.69

Respectfully submitted,

William Considine
Safety Inspector.

ANNUAL REPORT

OF THE PENSION DEPARTMENT

FOR THE YEAR 1923

- - - - - -

PENSION SYSTEM:

The year 1923 completed the fifteenth year of the operation of the Pension System.

The following pensions were granted during the year:

No.	Name	Mine	Date Pension began	Monthly Payment.
160	Erick Johnson	Francis	Feb. 1, 1923	$ 36.58
161	Charles Malmgren	Barnes Hecker	May 1, 1923	34.65
162	Harry H. Marks	Angeline	Aug. 1, 1923	30.48
163	Isaac Tolonen	Cliffs Shaft	Oct. 1, 1923	19.83

The following Old Age Pensions ceased during the year:

No.	Name	Date Pensioned	Date Died
57	Fred La Breche	Oct. 1, 1914	Aug. 4, 1923
64	Nicholas Jobe	June 1, 1915	Sept. 15, 1923
65	Charles Paynter	Aug. 1, 1915	Mar. 4, 1923
70	Alfred Chapman	Feb. 1, 1916	May 19, 1923
72	John A. Silas	Nov. 1, 1916	Oct. 16, 1923
78	Charles Swanson	Sept. 1, 1917	Dec. 26, 1923
121	John A. Tonkin	June 1, 1921	Apr. 10, 1923
154	Andrew Erickson	Mar. 1, 1922	May 16, 1923

	1922	1923
Number of pensions granted during the year	8	4
Number of deaths	4	8
Number of Old Age Pensions in force on Dec. 31st	99	95
Average annual pension	$297.84	$305.28

PENSION DEPARTMENT

PENSION SYSTEM (Continued)

The following pensioners were added to the Furnace Department roll during the year:

No.	Name	Plant	Date Pension began.	Monthly Payments.
6	Joseph DeVet, Sr.	Kipling	Dec. 1, 1923	$ 30.05
7	Louis DeVet	Kipling	Dec. 1, 1923	31.29

There are five pensioners on the Furnace Department roll. The average annual pension is $370.80

Total amount paid to Old Age Pensioners, 1908 to 1923 inclusive:

Mining Department	$ 155,804.07	
Furnace Department	5,690.75	
Total -		$161,494.82

Total amount paid to Widows and Orphans, 1908 to 1923 inclusive:

Mining Department	$ 22,073.00	
Furnace Department	900.00	
Total -		$ 22,973.00
Total Pension Payments -		$184,467.82

Mining Department pensions paid in 1923 were as follows:

Old Age Pensions	$ 29,564.57	
Widows and Orphans	168.00	
Total -		$ 29,732.57

The estimated Old Age Pensions for the Mining Department for 1923 was $32,000.00

PENSION DEPARTMENT

PENSION SYSTEM (Continued)

The following men were put on the Republic Mine Pension Roll during 1923:

No.	Name	Date Pension began.	Monthly Payments.
16	Adolph Peterson	May 1, 1923	$25.05
17	Matt Hangas	May 1, 1923	18.00
18	Charles Pudas	Oct. 1, 1923	30.33
19	Joseph Geach	Nov. 1, 1923	50.92

There were no deaths among the Republic Mine pensioners during the year.

There are eighteen pensioners on the Republic Mine Roll. The average annual pension is $422.04.

The payments made from October 1st, 1920 to December 31st, 1923, are as follows:

1920	$ 278.61
1921	3427.97
1922	5672.84
1923	6641.51
	$16020.93

The estimated possible pensions for the year 1923 - $ 6082.00.

PENSION DEPARTMENT

PENSION SYSTEM (Continued)

Pension Payments for the years 1908 to 1923 inclusive are as follows:

Mining Department:

Year	Old Age	Widows & Orphans	Total
1908	69.10	48.00	117.10
1909	351.92	464.00	815.92
1910	896.44	1043.00	1939.44
1911	1690.37	2649.00	4339.37
1912	3865.95	3113.00	6978.95
1913	5133.62	3025.00	8158.62
1914	6179.57	3403.00	9582.57
1915	7910.35	2372.00	10282.35
1916	8787.02	1694.00	10481.02
1917	9327.22	1266.00	10593.22
1918	8889.14	944.00	9833.14
1919	9605.02	888.00	10493.02
1920	12613.29	814.00	13427.29
1921	21856.64	14.00	21870.64
1922	29063.85	168.00	29231.85
1923	29564.57	168.00	29732.57
	Totals $155804.07	22073.00	177877.07

PENSION SYSTEM (Continued)

Pension payments for the years 1910 to 1923 inclusive are as follows:

FURNACE DEPARTMENT:

Year	Old Age	Widows & Orphans	Total
1910	111.75		111.75
1911	268.20	120.00	388.20
1912	268.20	180.00	448.20
1913	268.20	180.00-	448.20
1914	268.20	180.00	448.20
1915	268.20	180.00	448.20
1916	268.20	60.00	328.20
1917	268.20		268.20
1918	268.20		268.20
1919	130.55		130.55
1920	223.80		223.80
1921	781.63		781.63
1922	1118.04		1118.04
1923	1179.38		1179.38
Totals	$ 5690.75	$ 900.00	$ 5590.75

PENSION DEPARTMENT

PENSION SYSTEM (Continued)

At the present time the pensioners on the Mining Department Roll live in the following localities:

Ishpeming	70	Pelkie, Baraga County	1
Negaunee	6	Oak Park, Ill.	1
Gwinn	4	Long Beach, Cal.	2
Detroit	4	Kingsbury, Cal.	1
Flint	1	Virginia, Minn	1
Lansing	1	Canada	2
Michigamme	1	Italy	1

Of the Republic Mine pensioners, sixteen live at Republic, one at Marquette, Michigan and one at Evanston, Illinois.

One of the Furnace Department pensioners lives at Marquette, one at Negaunee, one at Skandia and two at Mipling, all in Michigan.

Martin White, Pension No. 3, was added to the Railroad Department pension roll on June 1, 1923, his rate being $18.00 per month. There are now three pensioners on this roll. One lives at Marquette, one at Negaunee and one at Ishpeming.

PENSION DEPARTMENT

PENSION SYSTEM (Continued)

In March I attended a Pension Conference held on invitation of the Metropolitan Life Insurance Company at their office. It was a very representative gathering of large employers throughout the country. Since this meeting, this office has kept in touch with the Metropolitan Company and we have gathered together much pension data from different sources and the investigation of these matters is still being conducted.

PENSION DEPARTMENT

WORKMEN'S COMPENSATION:

The work of the Compensation Department has continued in the care of Mr. T. H. Bargh as Cashier since December 1912, three months after the law went into effect. The general plan of handling all cases as carried on in previous years, was continued during 1923. Special effort is made to see all injured men as soon as possible after the injury has occurred and very generally this has made it possible to readily effect a settlement with the injured man. In the majority of cases, the first compensation payment is ready at the time the agreement is presented which materially aids in effecting settlement and securing the man's signature to the settlement agreement blank furnished us by the Department of Labor & Industry at Lansing. Through the use of this plan the men generally are very well satisfied with the working of the Compensation Law.

During the year we have had several conferences with Commissioners and Deputy Commissioners of the Department of Labor & Industry concerning certain cases of serious injury and disability. Reference is made in the following paragraphs to the more important cases.

Jim Possillippo - Stephenson Mine Accident Report #537. This man was injured on April 7, 1921, while lifting a heavy piece of timber and he has not recovered so that he can do any work. He consulted with a number of physicians and was at the Ishpeming Hospital at two different periods for several weeks and was considerably benefited by this treatment. In 1922 he expressed a desire to return to Italy, thinking that he could re-open a little store which had been operated by his wife previous to the war. Consultations were held with a Commissioner of the Department of Labor & Industry when in Marquette and application was made for a lump sum settlement so that he could return to Italy. This was granted and he then later had a letter from his wife stating that business conditions were poor and instead of taking the full amount of the lump sum settlement agreed upon, he took only part of it and sailed for Italy on January 27th. He consulted physicians there but his condition was not especially benefited in any way. Within the six months allowed him by the immigration laws he returned to the United States and is now in New York City trying to do some very light work. Compensation payments at a reduced rate are

being made to him.

Gust - Wirtanen - Stephenson Mine Accident Report #510. This man was injured on February 17, 1921, receiving a Potts fracture of the ankle. This is one of the most seriously disabling injuries which our physicians have in their practice. He has not fully recovered from this injury, and although he has tried to do some work he has not been successful or satisfactory in it. He left the Gwinn District and we did not know of his whereabouts for several months and upon his return he asked for compensation during the period of his absence. This was refused by the Commissioner whose decision was that compensation should again be paid from August 1st, the date upon which he returned to Gwinn. He appealed from this decision to the Full Board who held that the Deputy Commissioner was without authority to make that kind of an award and granted compensation for the full time during which he was absent, and directed us to have him examined by some specialist who might possibly be able to so improve his condition that he could resume his regular occupation. We first sent him to a physician in Chicago and then later he was taken to Ann Arbor and a special shoe furnished for him which supports his ankle but which is used without a supporting brace. He went to work as Top Tram Engineer at the Stephenson Mine and continued until the cold weather when it became necessary to wear heavier boots which his ankle could not stand. After a conference with Mr. Graff and myself, Wirtanen left for Chicago where he expects to find some light work for the winter which he can do sitting down. The plan now is that if he somewhat improves, he will come back to work for us in the spring.

Matt Millimaki - Princeton Mine Accident Report #170. Millimaki was injured on August 4, 1921, suffering a fracture of the leg just above the ankle. He claims that he is unable to do his work on account of the lameness of his foot and ankle. A hearing was held in Marquette on February 2nd and the Deputy Commissioner agreed with us that this man should go to work. He did not continue regularly at his work and another hearing was held on his application on November 6th. This hearing was decided in our favor and we

have heard of no notice of appeal having been made by his attorney, they having ten days from the time of the mailing of the decision in which the appeal can be made. This man is working part of the time but he is not a satisfactory employee as the men do not like to work with him because he will not do his share. He was allowed to first select his own partner but in a short time this man refused to work with him and other men were assigned to work as his partners in regular mining work and they also in a short time refused to work with him. He has since been put on other work.

Unless he becomes more disabled this case will remain closed but if his ankle, for any reason, becomes worse, there is the possibility of the case being re-opened upon application by him. This would undoubtedly be done if we should discharge him and he found it difficult to find work elsewhere.

Herman Granlund - Maas Mine Accident Report #257. This man was injured on June 1st, 1920 by getting some foreign matter in his eye. This has caused him more or less trouble and evidently aggravated some existing condition of the eyes, and as a consequence of this, he has become nearly blind. He will never be able to resume his regular employment and for that reason, petition was made for a lump sum settlement which would practically be 60% of the difference in wages of what he was formerly earning and the work he was engaged in, part of this being laboring work at the new Dead River Dam. Settlement was effected on this basis and he was paid $2,556.32 as a lump sum settlement which enabled him to purchase a farm a short distance from Negaunee.

Dominic Francesco - Maas Mine Accident Report #320. This man was injured on October 31, 1922, the injury being to his back. He returned to work in November and worked off and on until the end of the year but following that time he was unable to continue at work. A hearing was held on April 17th but as this came about through a misapprehension of his and his attorney, the application was dismissed as we were continuing compensation to him. He became worse and his mental condition became such that it was found necessary to send him to Newberry where he remained for several months. He returned home and his