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ATHENS MINE:

Mechanical equipment in the engine house gave little trouble during the year. The M-G set force feed lubrication system was equipped with auxiliary electric motor driven pump which is pressure switch operated and set to cut in when pressure developed by direct driven pump drops to 12 psi. This arrangement has prevented bearing troubles as experienced last year. The reinforcing ribs of the cage hoist drum shell started to develop some cracks and these were repaired by welding. The west main bearing of the Nordberg compressor wiped during the year and had to be rebabbitted.

Surface subsidence about the plant area has been a subject of grave concern during the year. During September and continuing through to the year's end, ground subsidence under the miners' dry building was very pronounced and that brick building started to break up to the extent that water and steam lines had to be severed from rigid fastenings and allowed to move with the building. Machinery alignment in the engine house was checked from time to time as new cracks appeared in the floor, but no discernible misalignment has been noted.

In the shaft some anxiety was felt about possible rupture of the main 10" water discharge column in the upper portions as the collar of the shaft had moved 8" out of line. A new 8" line was purchased and installed in the drift connecting the Athens and Negaunee mines on the 11th level. Connections were made so that in case of rupture of the Athens water column above this point, the water could be conveyed to Negaunee 10th level where it could be relayed to surface. This installation is ready but had not been used at end of year as it is only for emergency service.

CAMBRIA-JACKSON MINE:

The major project at this property during the year was the sinking of an inclined winze from 8th to 9th level and the installation of a complete 30" belt conveyor system in same. The drive machinery and one third of the conveyor was installed prior to sinking the remaining distance so that the new conveying system could be used to elevate the excavated winze rock. A system of scraping the rock directly on the conveyor belt by means of three-drum tugger hoist was employed and the arrangement worked very well. At year's end the conveying equipment was completely installed, drive machinery and receiving bin completed and work begun on installation of load-end pan feeder and hopper into which main line cars unload.

In the engine house the only major breakdown was in April when a rotor coil blowout on the skip hoist motor caused a one and one-half day loss in production while spare was installed. In July the repaired motor was again installed. A new set of molded asbestos brake blocks were installed on the skip hoist in April.

Replacement of 230 ft. of main compressed air line in shaft was required. Inspection of main water column in shaft indicates replacement of several hundred feet in the near future.

Pumping system worked well during the year; however, the pumping load doubled during the spring breakup and the system was loaded to its capacity for a month's period.

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CLIFFS SHAFT MINE:

In the engine house the major repair job concerned "A" Shaft hoist. Years of operation had allowed the pinion shaft and main shaft bearings to wear to the point where poor engagement of the pinion and main gear was being experienced. This was corrected by rebabbitting the pinion shaft bearings and moving the hoist .092" toward the pinion shaft. The old system of using Lake Bancroft as a cooling pond for engine house cooling water was eliminated and replacement was made by the purchase and installation of a Binks Cooling Tower located on the west side of the engine house. The new system will allow for conditioning of the water to prevent algae growth and other contamination problems presented by using lake water.

A contract was awarded in September to MacDonald & Kaake, contractors, to remodel and enlarge the miners' dry. At the end of the year all outside work had been completed and work was progressing satisfactorily on interior changes. The completion of this project will provide a larger lamp room, new fuse room, additional miners dry facilities, modern toilet facilities and an enlarged and modernized foremen's and shiftbosses' change room.

The most important work completed during the year at this property concerned rehabilitation of "A" Shaft headframe by Intrusion-Prepakt, Inc. and the installation of steel sets and heavy steel lining plates from collar to new bearer sets, also in "A" Shaft. The original shaft had been lined from collar to ledge with 12 x 12 timber, skin to skin. At some later date as these original timbers started to give way, a lining set of the same size timbers was installed. The installation of the steel sets and liners inside of the double wall of fir timbers posed a real problem because of compartment space limitations. The job was successfully completed without shutting down the shaft by working afternoon shifts only, mortising the steel into the old timber on two sides and concreting the other two sides. The project was completed in July and results appear to be very satisfactory.

Considerable work has been done on the design of a new double drum top tram hoist and triple drum tugger hoist for this property. These design jobs have been carried on in conjunction with Lake Shore Engineering Company and 1951 should see new models of each of these units in service.

LAKE MINE DEFERRED:

Mechanical Department assistance to this open pit project consisted of arrangement of Euclid Truck garage and repair facilities in the old Lake Mine boiler house, acquirement and arrangement of pumping equipment and miscellaneous equipment repair service.

LLOYD MINE:

In the engine house the major mechanical repairs consisted of reconditioning of the Sullivan Angle Compound Compressor crankshaft which had worn out of round. All the main bearings of the compressor as well as its driving motor were rebabbitted at the same time and a new H.P. piston rod was installed as the piston was a loose fit on the old rod. Due to excessive rope fleet angle on the left hand side of the skip hoist, the rope had a tendency to climb the sides of the

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LLOYD MINE: (Continued)

ridges between drum shell grooves and ultimately the ridges broke off from the cast iron shell and allowed the rope to jump a groove when winding at greatest fleet. To correct this condition the ridges were built up with low temperature welding rod and then ground to contour. This means of repair has been successful to date.

The headframe gyratory crusher underwent major overhaul this year. The complete shaft with mantle from the identical unit in the old Negaunee headframe was installed and this unit should be good for many years at this property.

An emergency arose during the spring breakup period this year due to the increased amount of run-off water getting into the mine. Normally the Morris Mine of Inland Steel Company handles our excess water but this year, during the period of maximum inflow, they advised that they were just able to handle their own water and so we had to get busy and install extra centrifugal pumps on the 9th and 7th levels to relay the water to the 5th level. At one time the 5th level Aldrich plunger pump was averaging 719 GPM. This is a very high load factor for an 800 GPM pump. The pumping system was reviewed with the idea of getting equipped so as to be self-contained and an order placed for a new 484 GPM piston pump for the 8th level. This new Wheatley unit was being installed at the year's end and plans also going forward to install centrifugal 500 GPM stand-by on the 5th level to supplement the 800 GPM Aldrich.

The underground winze hoist was equipped with a coupling brake which is operated by a geared limit switch so as to provide overwind protection.

MAAS MINE:

In the engine house some trouble was experienced with overheated main bearings on the new M-G set; however, replacement was made without loss in production. The counterweight rope was retired after 12 years of service. Replacement was recommended on the basis of age rather than condition. The skip hoist gave trouble by having its main gear loosen on the hoist shaft. This is an old trouble and as it had previously been welded, the repair this time was done in a similar manner. It is expected that no further trouble will be experienced because the D.C. drive is much smoother than the original A.C. drive which undoubtedly caused the trouble.

In July an accident occurred which resulted in breakage of the south skip rope, damage to both skips and wreckage of the south skip road near bottom of shaft. The south skip dropped from surface to the shaft bottom. See monthly report for details. The mine was idle from July 5th to 10th, due to accident.

Major pump breakdowns occurred to the Worthington pumps during the year. In one case it was a broken connecting rod and in the other a broken piston rod. Due to installation of new railroad yarding facilities the surface location of the main water discharge pipeline was changed.

A single drum hoist was installed on the 5th level to handle cages in balance from 7th to 6th levels. This arrangement was provided in lieu of deepening the main shaft and all ore from the new 7th level is to be hoisted to the 6th via this transfer hoist. The unit went into hoisting service in June.

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MATHER MINE "A" SHAFT:

The largest single surface project handled by company men at this property this year took place about August 1st when the mine was shut down for 12 consecutive days to install new flow sheet machinery in the headframe consisting of new 6' wide Kennedy Van Saun Rock Feeder, Simplicity Shakeout Screen and Allis-Chalmers 36 x 24 Jaw Crusher. At the same time the dump plates were changed to accommodate a new Lake Shore Engineering Company's bottom dump skip in the south skip road. Prior to the installation of the new equipment the original 16" Allis-Chalmers gyratory crusher was removed. At the end of the year all of this equipment was in successful operation and operating troubles had been ironed out without loss of production.

Installation of new railroad loading pockets on north side of headframe was completed in February.

The throats of the 12' cast steel skip head sheaves were ground for the first time since installation. This was necessary because wear had occurred to the extent that a new 1-7/8" dia. skip rope would no longer bottom in the sheave throat.

The Wisconsin Bridge and Iron Company completed the erection of No. 3 ore stock trestle and same is in service. At the end of the year two of the three new style Larry Cars had been received but had not been placed in service.

The largest underground project this year concerned the design and procurement of equipment for the 2500 ft. long belt conveying system on the 7th level. Excavation of discharge raises and conveyor drifts got under way and some of the equipment started to arrive before the end of the year.

A semi-permanent centrifugal pump station was erected on the 7th level to relay water to the main pump station on the 6th level. The connecting drift between "A" and "B" shafts on 6th level was completed and the 6th level pump station at "A" started to take some of the "B" mine water.

The installation of a 6" victaulic coupled pipeline from surface to 7th level was begun. This line is to be used to "shoot" concrete from surface in conjunction with Press-Weld pneumatic concrete placing machine.

Trial installations of arched steel sets in heavy ground show economies over standard steel supports and orders have been processed for a considerable tonnage of 5x5-16# and 6x6-15.5# arched steel sets.

Considerable experimental work has been done with rotary blast hole drilling equipment and it is indicated that there are many types of ground that can be drilled more economically with rotary drills utilizing tungsten carbide tipped auger steel than with the conventional type of percussion tool.

MATHER MINE "B" SHAFT:

The year 1950 brought the culmination of many long range projects at this new property. On January 25th the Nordberg cage hoist was turned over for the first time and on February 8th the 20,500# counterweight was installed and balanced cage hoisting was employed. The main M-G set with 87 ton flywheel was

MECHANICAL DEPARTMENT
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MATHER MINE "B" SHAFT: (Continued)

operated for the first time on February 28th. Many adjustments had to be made to the Westinghouse rototrol equipment and it was not until March 20th that the Nordberg skip hoist erection was complete, skips and skip ropes installed and balanced hoisting begun. A 222.6 cu. ft. Kimberley type skip was installed in the west skip compartment and a 211 cu. ft. experimental bottom dump skip was placed in the east skip road. Both skips were equipped with rubber tired guide rollers. The temporary engine house was abandoned in February shortly after No. 1 compressor and the cage hoist were placed in service. No. 2 compressor was also erected.

In the crusher house the erection of the rock feeders, shakeout screen and jaw crusher was completed after temporary heating facilities had been installed. The contractor completed the crusher house building and that was followed by completion of the Galbestos enclosure about the headframe.

A. H. Proksch & Son had sufficiently completed the miners' dry by June 16th so that the move could be made from the overcrowded temporary dry. The new boiler installation was the first to be completed and No. 1 was on the line in early February. The move into permanent new offices and shops was made in December and shortly afterwards the temporary quarters were torn down. At the end of the year many equipment installations in the new shops were temporary but permanent erection was proceeding satisfactorily.

In November the Bethlehem Steel Company started the erection of the main north run of the belt stocking conveyor trestle. Walker Jamar Company completed the installation of the shaft air heating system which is housed on surface just north of the shaft collar.

Underground, the installation of fir guides in skip and cage roads proceeded as scheduled so as to be ready in advance of skip and cage placement. A pumping station was cut on the 4th level and two 125 GPM 8-stage Ingersoll-Rand centrifugal pumps were installed to handle the clear water on automatic start and stop from flooded suction.

The permanent high pressure water column was installed from 10th level to surface prior to removal of sinking hoist facilities. This 10" column was completely installed by the end of September.

NEGAUNEE SHAFT:

Dismantling of the double drum, double clutched second-hand Allis-Chalmers hoist was begun at Jackson, California, on February 9th. The last carload of equipment left the west on March 6th and most of the revolving parts were shipped direct to Lake Shore Engineering Company's plant at Marquette, Michigan, for reconditioning. Close inspection after disassembly showed this hoist to be badly abused and rehabilitation took approximately six months. The decision to convert this A.C. motor driven hoist to D.C. drive was made in early March and the necessary electrical equipment ordered. Also, as it was decided to raise the hoisting speed from 1500 to 2000 fpm a new gear set was ordered.

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NEGAUNEE SHAFT: (Continued)

In September work was started on the dismantling of No. 2 M-G set to clear the wing of the engine house so foundations for Allis-Chalmers hoist could be placed. The old east wing of the engine house was torn down and hoist erection began December 21st. It was necessary to erect a temporary frame enclosure over the hoist so that erection could proceed without major delays caused by heavy snows and cold weather.

Prior to the end of the year the design of the lower portion of the new headframe had been completed, column footings poured and plans made to tear down the old headframe.

Design of repair steel sets for circular portion of shaft as well as new steel sets for shaft extension of 2000 ft. were completed and at the end of the year the bulk of the circular portion of the shaft had been repaired.

Shaft sinking equipment has been ordered and plans made to get under way just as soon as possible.

SPIES MINE:

The greatest single problem at this property this past year has been the handling of acid mine water. At the beginning of the year the acidity of the water on 4th level started to increase and it was combatted by increasing the amount of lime being fed to neutralize same. It was soon realized that lime treatment was not only too expensive but was also inadequate and so orders were placed for acid resistant pumping equipment. First, a 4" Carlon plastic drain line was installed between the 4th and 6th levels in February. In July the first all stainless steel two-stage centrifugal pump was received. This was placed in service on the 4th level and the entire piping system was made acid-proof by utilizing stainless steel valves and rubber lined pipe. This unit worked very nicely, pumping to surface and then we started to get highly acid water in quantity on the 6th level. By the time an acid-proof pumping system could be obtained, severe damage had been sustained by the regular mine pumping system. At times it was touch and go to keep the mine from being flooded. At the year's end the acid water was being handled from 4th and 6th levels to surface through completely acid-proof pumping system utilizing centrifugal pumps. The main line plunger pumps on 4th and 8th levels have been completely overhauled and are being used to handle water that has not been sufficiently contaminated by the acid water so as to corrode away their non-acid resistant parts.

On surface a settling sump was excavated so as to settle out most of the iron ore mud from the mine water. Water entering the sump carries about 30# per 1000 gallons and leaving the sump averages about 2# per 1000 gallons.

A 22' x 20' frame addition to office and warehouse was completed by mine labor to provide additional space for master mechanic, surface foreman and mine captain.

TILDEN MINE:

Only the usual maintenance problems were incurred at this property during the year. All equipment operated successfully during the summer loading season. A new dipper was fabricated and installed on #46 shovel.

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HARD ORE SHOP AREA:

The 30 x 99' addition to the east side of the Blacksmith Shop was completed during late spring and equipment installed to form a steel set production line. This steel set fabricating department has done a very nice job and in spite of rising labor costs, the cost per completed set has not risen over last year's prices.

A 40 x 60' addition to the north end of the Electric and Hoist Repair Shop was started in late September. Foundation troubles developed when excavation ran into black muck and the footings had to be carried down 8' deeper than anticipated. This set the job back and at the end of the year we were still a month away from being ready to erect the structural steel. Foundation contract was awarded to Kielinen & Son of Ishpeming. In the basement of this new addition we will install a new 150 HP boiler which will handle the heating load of all of the shops as well as the oil storage building.

Effective October 1st, A. E. Lillstrom was appointed General Shop Foreman and effective November 1st, Wm. J. Tamblyn, Jr. assumed leadership of the Hard Ore Plumbing Crew on part time basis as Master Plumber.

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COMPARATIVE TABLES

CLIFFS SHAFT MINE: YEAR	TONS ORE AND ROCK HOISTED	CU. FT. AIR USED	CUBIC FT. AIR PER TON HOISTED	GALLONS OF WATER PUMPED	G.P.M.
1941	677,249	1,218,780,000	1,799	343,850,964	655
1942	733 970	1 223 325 000	1 666	339 185 356	643
1943	669 300	1 368 045 000	2 044	376 325 326	718
1944	614 214	1 459 890 000	2 376	448 361 410	851
1945	567 691	1 194 570 000	2 104	444 687 684	848
1946	415 426	968 670 000	2 331	397 294 033	751
1947	562 650	1 527 345 000	2 715	424 721 789	809
1948	603 745	1 607 625 000	2 663	382 905 017	726
1949	504 513	1 124 105 000	2 228	433 229 875	821
1950	679 751	1 619 055 000	2 381	407 263 395	776
ATHENS MINE:					
1941	638,178	1,305,945,000	2,116	185,835,174	354
1942	699 590	1 351 440 000	1 931	204 533 558	387
1943	532 590	1 013 220 000	1 902	195 041 792	372
1944	443 576	900 765 000	2 030	162 835 951	308
1945	429 136	873 710 000	2 035	174 073 654	331
1946	376 417	745 605 000	1 990	168 139 933	317
1947	533 366	1 191 510 000	2 234	178 537 561	340
1948	527 876	1 183 970 000	2 243	169 128 786	320
1949	550 977	992 700 000	1 801	176 437 598	334
1950	611 162	1 161 045 000	1 899	199 518 654	380
MAAS MINE:					
1941	849,963	1,646,145,000	1,936	595,239,587	1,135
1942	894 963	1 703 655 000	1 905	553 194 582	1 049
1943	782 074	1 916 100 000	2 450	575 868 620	1 098
1944	614 836	1 542 835 000	2 509	578 257 239	1 097
1945	572 652	1 205 145 000	2 104	555 380 166	1 058
1946	487 523	965 880 000	1 981	607 511 502	1 148
1947	721 051	1 506 960 000	2 090	571 767 866	1 090
1948	683 074	1 389 825 000	2 035	569 972 839	1 081
1949	621 946	1 233 540 000	1 983	550 080 422	1 043
1950	659 467	1 374 300 000	2 083	602 179 256	1 148
NEGAUNEE MINE:					
1941	1,077,854	1,500,165,000	1,391	338,385,511	644
1942	1 128 737	1 432 260 000	1 268	345 945 101	656
1943	978 130	1 137 375 000	1 162	401 169 615	765
1944	760 871	1 165 140 000	1 531	375 706 897	713
1945	671 220	873 270 000	1 301	357 175 559	681
1946	418 232	542 025 000	1 295	360 778 626	682
1947	531 492	717 300 000	1 350	390 741 304	744
1948	386 215	743 625 000	1 925	402 657 133	757
1949	79 699	233 415 000	2 928	464 467 219	880
1950	0	82 755 000	-	635 580 650	1 212

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COMPARATIVE TABLES

CAMBRIA-JACKSON MINE: YEAR	TONS ORE AND ROCK HOISTED	CU. FT. AIR USED	CUBIC FT. AIR PER TON HOISTED	GALLONS OF WATER PUMPED	G.P.M.
*1943	155,513	216,657,000	1,393	123,714,000	431
1944	286 761	410 875 000	1 432	196 252 831	372
1945	319 222	386 626 500	1 211	190 159 826	362
1946	303 881	374 013 000	1 230	159 192 131	300
1947	548 027	628 515 000	1 147	190 950 934	363
1948	496 083	548 896 500	1 106	171 964 375	325
1949	438 064	508 050 000	1 159	173 342 402	328
1950	452 035	545 206 500	1 206	197 474 896	376

(*Mine operated by The Cleveland-Cliffs Iron Co. since June 1, 1943 and the above figures are for the last 7 months of the year only.)

LLOYD MINE:

1941	572,778	534,456,000	933	40,031,200	91 (10 Mos.)
1942	588 749	588 451 000	999	39 486 100	74
1943	531 260	525 280 500	988	65 024 800	124
1944	391 057	436 293 000	1 115	51 625 550	97
1945	334 117	419 088 500	1 254	59 943 400	114
1946	243 836	264 838 500	1 086	51 014 600	84
1947	262 395	254 470 500	970	69 182 000	131
1948	128 672	285 111 000	2 216	48 334 500	91
1949	209 161	231 241 500	1 105	50 828 500	96
1950	234 748	354 888 000	1 511	100 272 000	191

MATHER MINE "A" SHAFT:

1943	29,517	(First hoisting in September)			
1944	127 438	425,700,000	3,340	74,006,311	140
1945	258 028	378 600 000	1 467	134 384 517	256
1946	417 677	542 250 000	1 298	97 460 579	184
1947	817 145	1 144 800 000	1 401	133 005 294	253
1948	1 100 225	1 901 700 000	1 728	103 059 168	195
1949	1 154 538	1 207 350 000	1 045	91 876 158	174
1950	1 405 738	1 612 800 000	1 147	215 904 871	411

MATHER MINE "B" SHAFT:

1950	99,832	(First hoisting in August)

TILDEN MINE:

1941	302,943
1942	235 207
1943	139 991
1944	214 824
1945	197 476
1946	101 968
1947	168 669
1948	140 692
1949	88 503
1950	107 465