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CAT LOGGING IN THE DOUGLAS FIR AREA

by

PHILIP WORKMAN

A THESIS

presented to the faculty

of the

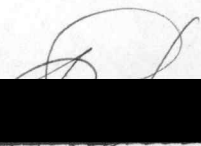
School of Forestry

OREGON STATE COLLEGE

in partial fulfillment of
the requirements for the
degree of

BACHELOR OF SCIENCE

May 1940

Approved 


Professor of Forestry

TO MY FATHER

who helped me with sound advice
and gave me the opportunity to
gather at first hand most of the
material presented here.

SCHOOL OF FORESTRY
OREGON STATE COLLEGE
CORVALLIS, OREGON

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CAT LOGGING IN THE DOUGLAS FIR AREA

The purpose of this paper is to present some of the facts that tend to increase the efficiency of the Caterpillar tractors now used in logging operations. It is not to compare Cat logging with steam or gas.

The only way that many companies learn how to operate their Cats efficiently is by the hard road of experience and by trial and error. This is impossible to get away from altogether due to the fact that no two logging shows are exactly the same. Some of the general rules put forth in this paper however will apply to nearly all the operations and are set forth in the hope that they may benefit some one in the future.

The various ideas incorporated here have been gathered from articles, talks with representatives of the different tractor companies, my own observations and some of my personal experiences.

The first indication of the present trend to the use of machinery for power in the woods was about the year 1893. Then Best and Holt, rival machinery companies, began to produce large steam wheel tractors for use as prime movers. They were better than the horses and oxen but were limited to fairly smooth roads, were quite top heavy, and their wheels did not give very good traction.

In 1904, however, came one of the greatest single machinery advancements in the logging woods - the development of the first track type tractors by Benjamin Holt. The machine was powered by a forty horsepower steam engine and because of its track type construction it was able to pull about a third more than the previous sixty horsepower wheel model.

Soon afterwards a gasoline engine was substituted for power. These machines were still far behind the ideal as they were cumbersome and were steered by a tiller wheel in front. This wheel made short turns impossible. Therefore they were used only on the longer and heavier hauls while the horses and oxen were used to yard and bunch the logs.

Just before the World War the tractor was made into a truly flexible machine by removing the tiller wheel and installing steering clutches. The tractor could now turn within its own length. Steep side hills and rough going

were now easy for these machines and they quickly began to take their place as the key prime mover of the logger.

The next step was to improve the companion equipment. With the new hydraulic wheel unit which soon made its appearance it was possible to profitably handle up to eight thousand board feet of logs in a turn and to yard them a distance of a mile.

About 1920 the Best Company developed the first single drum winch which made it unnecessary to bunch the logs for the hydraulic wheels. It soon followed that a fairlead unit was placed on top of the wheels and thus was developed the first fairlead arch.

In 1931 the first diesel type tractor was put on the market and trial runs were made against a sixty horsepower gasoline machine. The results of the test show that the Diesel tractor was 34% faster; got 61% more footage per hour; made 41% more trips per day; brought in 55% more logs and to top this off the fuel cost was 80% lower than the gas machine. It developed that in about ten thousand hours of operation the Diesel would show a fuel saving of about eight thousand dollars.

With this short history up to the development of the tractor in the lumber industry, it is apparent that the Cat and its allied equipment will give the logger chances of reclaiming timber and of logging tough shows that before were considered impossible because of high costs.

IV GROUND TYPES WITH REFERENCE TO TRACTOR OPERATION

The present day tractor equipped with a bull dozer and a winch is able to operate on practically any type of terrain, but the maximum slope of the ground should not be over thirty percent for the most efficient operation.

There are really only three types of ground that the tractor will not operate in efficiently.

The first is in swamps, and in low creek bottoms where there is no hard sub-stratum to bear the weight of the tractor. The only recommendations that can be given are to ascertain if possible the depth of the muck. If it is not over three and a half feet to reasonably hard ground the tractors will be able to operate successfully although their output will be reduced. In a situation such as this it is advisable to use an arch which will not cut up the ground so much and will be able to haul much larger loads with less drawbar pull.

The second bad type of ground for Cats is on terrain that is covered with boulders. Here there is always danger of getting the machine high centered or of breaking a track. Traction is poor in this type of ground, and because operations must be at low speed in order to protect the machine, the costs of logging rise considerably. It is generally found that it is much more economical to cord deck areas such as this when there is equipment available.

The third type of ground is land that has a slope of

V

thirty-five to forty percent and over. Here it is impossible to arch log the ground due to the inability of the Cat to negotiate the grades, and the difficulty of maneuvering the arch on these slopes. Grades of forty percent and over should be cold decked to the top or bottoms of the slopes and then arched in to the landing.

Many times on short hauls and steep slopes close to the landing it is much faster to drop the arch and "Bob tail" the logs to the landing. The time saved in maneuvering for the turns will be a saving over any factor of larger loads which could be taken by the arches.

A good deal of time will be saved on steep ground by the use of a well constructed go-back road to gain the elevation without loss of time and put the driver in a position to approach the next turn from the uphill side. This will obviate turning on a steep side hill and will speed up the operation considerably.

GENERAL RULES FOR LAYING OUT CAT ROADS

In planning the layout of the Cat operation there are several important main items to consider, namely - whether the operation is for summer or winter, and the amount of timber that will be coming into any one landing and over any one road.

First there is the summer logging operation to consider. The main Cat yarding roads as well as the go-back roads should all be laid out by the engineer with an abney so that the grade may be regular and not over the maximum. These roads should be constructed before the timber is felled and the fallers instructed to keep all the possible trees out of them.

The arch roads should be steep as are required for the shortest distance to the landing. It is not general practice to make them much over forty percent because of the wear and tear on the Cats and the damage to the motors due to running on compression.

A careful study of soil conditions, ground topography and the placement of the largest volume of the timber will bear an important part in determining the location of these roads.

The winter logging period is the supposed nemesis of Cat operators. Many of them think that when the first rains of winter set in the Cats are done for the year and should be put in the sheds. This supposition is not true

and can be proven by the many companies who are today operating the year round with Cats.

One of the important factors to be considered in wet weather is the type of soil that one has to contend with. There are places where the going is better in wet weather than dry and other places where the mud starts to flow like syrup covering the tracks and driver. (See picture.) The latter condition is not to be recommended and is avoidable since there is a middle ground.

To locate the best sites for winter logging will necessitate a careful study of the soil and the contour of the country. Roads must be planned to take advantage of all of the natural roading conditions, such as ridges, gravelly creek bottoms and areas where the drainage is good.

Following the contour of the slopes should be avoided as much as possible. In this way it is easier to keep the natural water drainage out of the road which would otherwise settle there and result in a continuous muddy condition.

The go-back roads should be held to about fifteen percent and the logging road up to thirty percent down-grade when possible. With this system it is possible to keep the tractor going back light over the contour roads and coming down loaded over the steeper roads which should be so planned as to provide adequate drainage in the boggy spots.

These winter roads should never be built until they are ready to be used. In this way roads built just after a storm are assured of a firm and dry road bed while the roads that were constructed before the storm are wet and soggy.



"Mud"

Picture missing

In order to keep up the production in winter it is necessary to lighten the turns considerably by taking only from two-thirds to a half the normal turn; this will enable the Cat to move right along without excessive wear on the road. To facilitate picking the most advantageous turn it is the custom in some camps to mark the scale of each log on the end, in this way the hooker is able to pick turns that will be much better balanced and that the Cat will have no trouble getting to the landing.

In wet especially as well as damp weather the tracks of the Cat should never be allowed to spin on the main arch roads. When this does take place one or more logs should be dropped at once and picked up on a succeeding turn.

Some operators outfit their Cats with special mud grousers in the winter. These are built by electric welding and cost about fifty cents a piece or approximately thirty dollars per Cat.

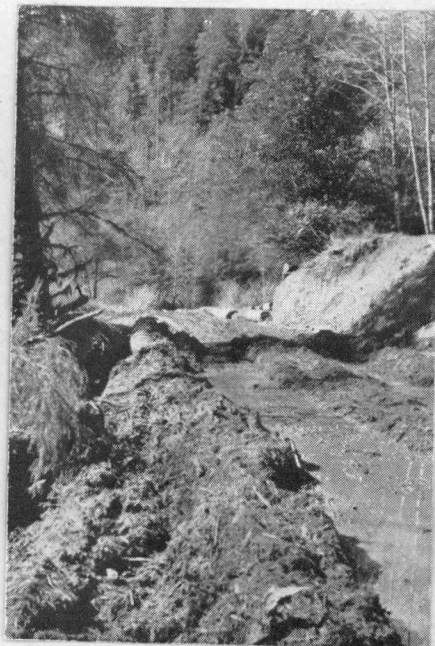
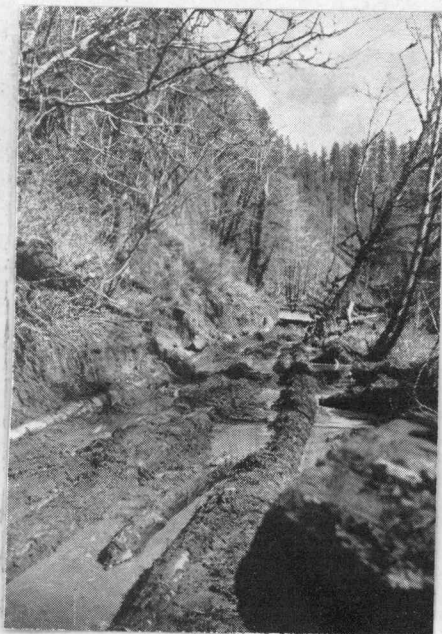
During the winter the roads should be shortened considerably and changed as often as is possible.

Another system of keeping the Cats logging in the winter is to combine them with a steam outfit. A skyline is run down over the area to be logged and the Cats operate out to the sides of this line. They yard the logs up to the swing road where they are swung on up to the landing.

The merit of this system is that the Cat yarding is held down to a minimum and the Cats are not yarding over any one road for any period of time. This method may also be adopted to advantage where there is good Cat ground below the landing but too much adverse grade between.

The system of pole roads is sometimes used when the ground conditions are very bad and there is a good deal of timber to come over the single road. The poles eighteen to thirty inches in diameter are laid lengthwise and the full width of the road. This type of road was built by the Anderson and Willard Logging Company, Marshfield. They constructed 2200 feet of it at a cost of \$1,250 including the material. There was no maintenance cost for the four million feet taken out over it.

Many times it is necessary to employ the use of a tow cat when there is some boggy ground or adverse grade. This of course will run up the cost of the yarding, but may pay on a larger operation when there is no other equipment immediately available for use.



-Pole Roads -
Marshfield



2200 ft. cost \$1250

60 M. in 4 hrs.

MAINTENANCE OF CAT ROADS AND LANDINGS

The bull-dozer on the yarding Cats in the summer is all that is required to keep the roads in shape. Large rocks and chunks should be kept out of the road at all times and small humps and gullies should be cut or filled by the driver as he returns to the woods. This should not all be done at once but each trip as he goes back a swipe here and there with the blade will keep the road in good shape.

The winter maintenance of roads presents a different picture and is one which should be given careful consideration. As was mentioned before the roads should be chosen to best advantage for winter logging as far as topography and soil are concerned.

The roads should be kept well drained and no water should be allowed to stand on them. Traction should be kept on the machine at all times and the minute the tracks begin to slip the load should be lightened.

Many operators when they intend to log a good deal of timber out over a single road use corduroy in the tracks.

The material is of cull timber found along the roads, cut into four foot lengths and split to approximately the size of cordwood. This material is laid in the tracks of the Cat at an angle on a kind of herring-bone pattern. This keeps the pieces from rolling out on a severe pull and insures the road a longer life! (Picture.)

Small saplings may also be used for corduroy in this manner when cut into four foot lengths. The upkeep on this type of corduroy road is in the neighborhood of twenty-five cents per thousand.

The landings for the Cats should be relatively level and from one hundred and fifty to two hundred feet square. This will allow plenty of room to store the logs when the loading is held up for some reason or another. Landings should always be bull-dozed off clean and should be kept that way. It is quite a simple matter for the Cat man to lower his blade with a turn as he comes into the landing and take the debris out when he goes.

In the winter the landings present rather difficult problems and probably the most successful method of solving it is to change landings frequently. Some operators figure on from ten to fifteen landings per mile and during the wet weather never use a landing more than a week.

Another way of solving this is to use puncheon on the landings, this is made from old wind-falls and is laid the full width of the landing. These pieces must be laid at right angles to the Cat roads coming into the landings or there will be trouble getting traction once the Cats are on the logs.



Diagonal Corduroy Road
Clackamas Timber Co.
Beavercreek Oregon.



The preparation of the settings should be very carefully considered and felled according to plan. If there are no large fir thickets the trees should be felled parallel with the landing as is shown in figures four and eight. If trying to save the reproduction, the trees should be felled towards the landing. This will enable the cats to yard them out without turning the logs, thus saving much of the young growth. This is illustrated in figures five and six.

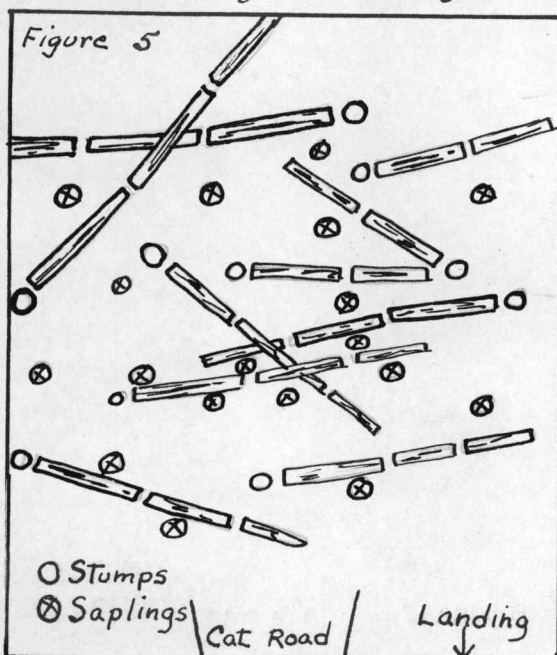
Cold or hot decks are sometimes necessary to remove timber from gulches or where heavy adverse grades make yarding impossible. Hot decks are generally preferable but where cold decks are used they should be built as straight as possible and a road cleared round them so that they may be more easily broken down.



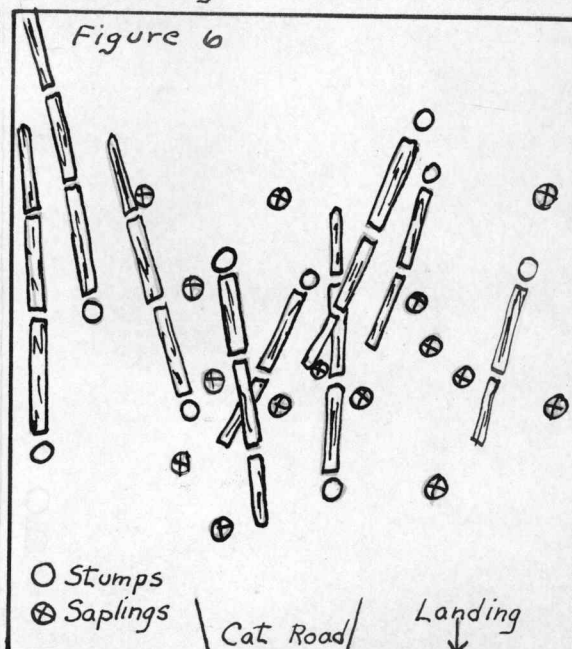
CROOKED PILE: Can't get full turn in one pull. Useless To try and set chokers ahead. Hard pulls shorten life of rigging. Have to reach high for loose logs.



STRAIGHT PILE: Full turn hooked up at one time. Full turn choked ahead. Easy on rigging. Logs roll down within easy reach.



Trees fell in haphazard fashion making it hard to yard logs around saplings.



Trees fell according to a pattern making it easier to get logs out.

THE RESPONSIBILITIES OF THE HOOKERS

The practice of looking ahead of the actual Cat logging by the Cat hooker is of prime importance, and proper application of this foresight will result in faster turns, less hang-ups and faster spotting time. These points are clearly illustrated in figures seven and eight. Figure seven shows the result of picking each turn as it comes. Taking what appears at first glance to be the proper turn results in a double spot for the third turn.

It is sometimes the practice for hookers to choke long holds on the logs and then rechoke the logs after they have been pulled up, instead of digging or blowing a hole near the end of the log. This method results in a considerable loss of time as rechoking the logs wastes time and often results in unforeseen trouble. This is a doubtful practice even when taking into consideration the powder saved.

Many times the log may be raised or rolled with the bull-dozer or the tracks, thus saving time when the log is in an especially bad position.

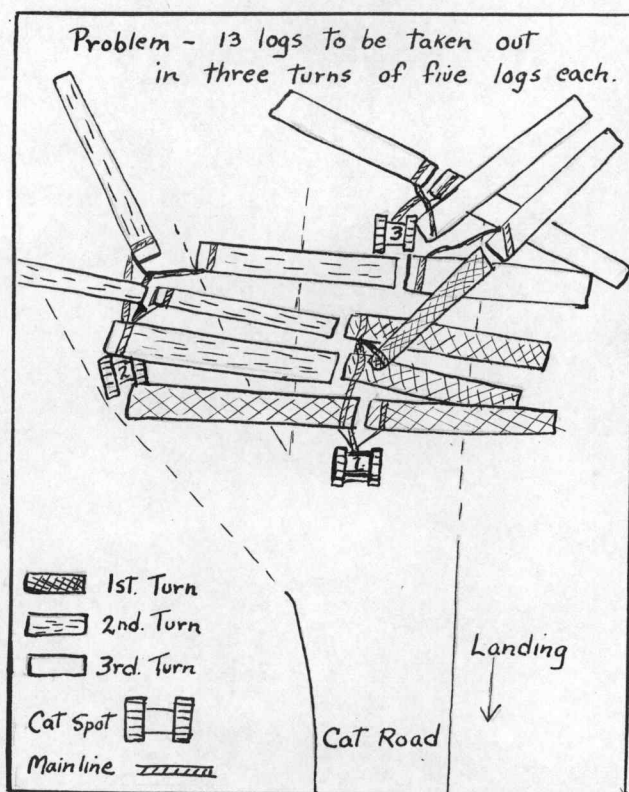


Fig. 7-Importance of picking Turns
Correct Method

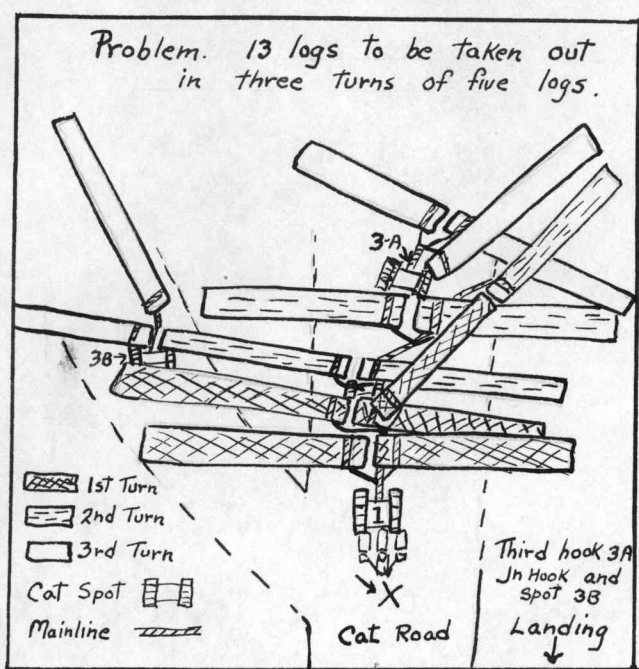


Fig. 8 - Incorrect Method

LONG HOLDS AND CHUNKS

The speed of the ingoing Cat is of course governed by the grade from the woods to the landing. The condition of the turn may also play an important part especially on level or adverse grades. Under all circumstances short ends are necessary for efficient Cat yarding. Long holds are dangerous on down hill grades and on level or adverse grades. The ends protruding up under the arch prevent the turn from being hoisted to its best traveling height, thus causing reduced speeds. On sharp turns the logs if they are not watched carefully, may also foul the arch and either break the ends or spring the arch supports.

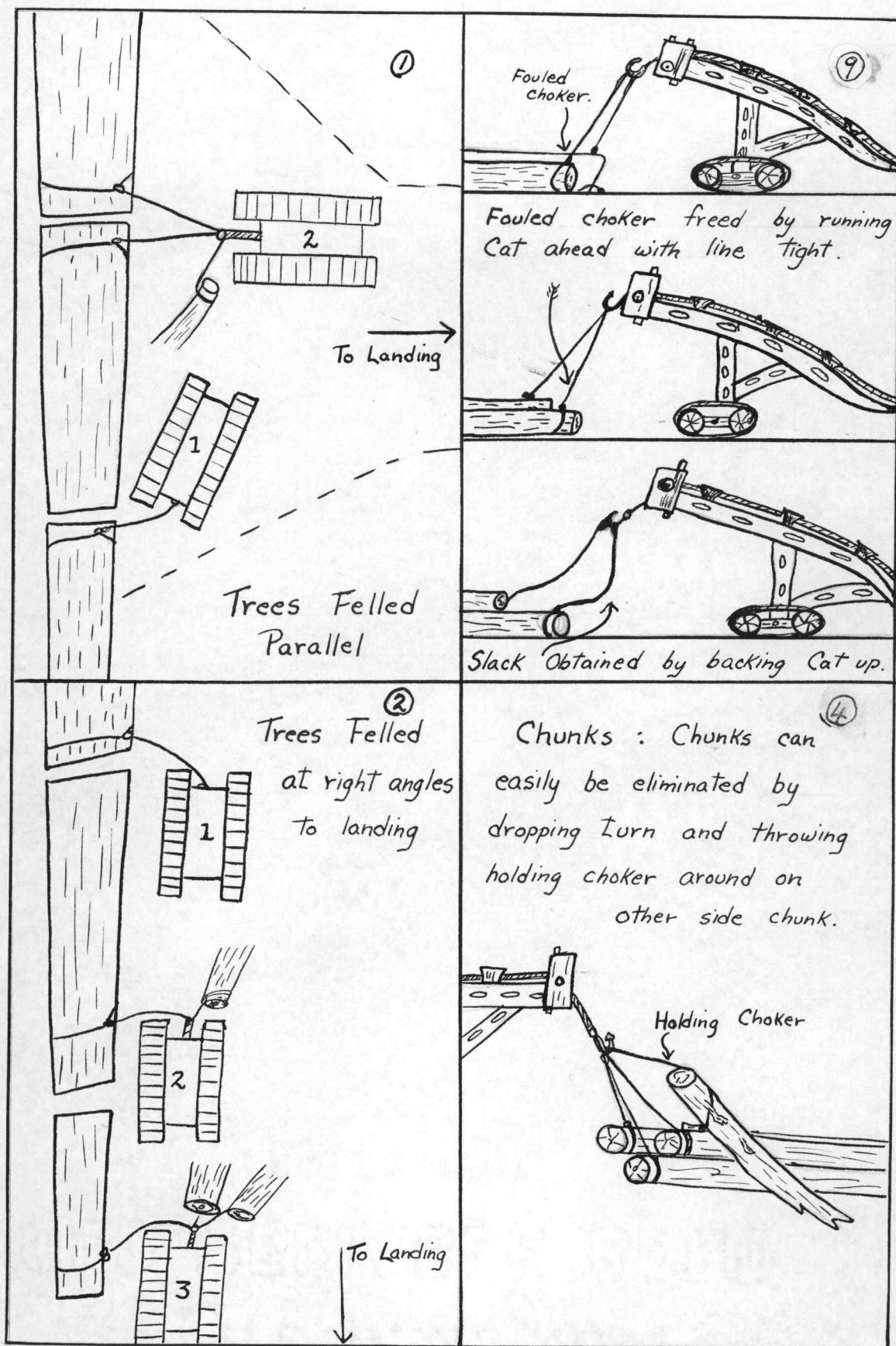
When chunks are allowed to ride on the turn they cause unnecessary drag, and when the end of the chunk protrudes too far in front of the turn, it prevents it being raised to its best traveling height. This is illustrated in figure nine. These chunks can best be disposed of out in the woods by just dropping the turn, throwing the choker under the end and again picking up the turn.

FREEING CHOKERS AT THE LANDING

In the average turn there will generally be one or more fouled chokers. There are two systems of freeing chokers; one is to pull the log ahead by spooling the line on the drum. The other and most efficient method is to set the brake, go ahead on the Cat until the choker is free and then back the Cat to give the chaser slack for unhooking. Coming into the landings, logs should be given six inches slack to clear tracks. This is easily accomplished by the use of the second and high reverse gears which are located directly opposite each other.

Under the first named method it was necessary to pull slack, and the but hook frequently fouls in the fairlead and causes additional loss of time.

In the second method the weight of the log is used to pull the slack which can be automatically given by just backing up the tractor. The illustration of number ten will show the second of these methods.



THE NECESSITY OF SIGNALING

A standard set of Cat signals is absolutely necessary for efficient Cat operation. The use of several different systems for the same operation is sure to cause confusion and to decrease the efficiency of the Cat sides.

Hookers and chasers should signal their wants at all times even though it is clearly apparent to the Cat driver what is expected of him. This practice will result in a situation that will be under control at all times as the driver will expect a signal from the hooker or chaser and will watch for it. If the driver is compelled to drive without adequate signaling there will be confusion resulting in an unnecessary waste of time.

For example it is the practice of some hookers to stand on the place that they want the Cat spotted without giving any signals. This is fine when everything is running smoothly, but if on a certain turn the hooker wants something out of the ordinary done, example a chunk pushed out, or a sapling knocked over, he is likely to have difficulty in signaling the driver. For the driver if he is not used to signals will give his entire attention to spotting the Cat as soon as he has seen where the hooker is standing.

This will undoubtedly result in extra work and perhaps ill feeling between the hooker and Cat driver.

Signaling at all times is advisable.

AUXILIARY USES OF THE CAT

Cold and hot decking with double drums mounted on Cats is gradually coming into much favor among the more up-to-date loggers. These machines are capable of yarding from seventy-five to one hundred and twenty-five thousand per eight hour day depending upon the ground and the timber.

The Hyster Company is now putting out a drum unit that is capable of carrying one thousand feet of 1 1/8 in. main-line.

The yarding distance on these machines should, however be kept down to from six hundred to eight hundred feet for the most efficient production. On longer hauls they are too slow and the lack of snap tends toward more hang-ups.

The chief value of these types of machines for cold decking lies in the small crew required and the time that they are able to save in rigging up. These factors should be emphasized and more weight put on short yarding and small cold decks for which they are ideally fitted.

The average time required for a cold deck crew to tear down a tree, load all of its equipment, move down half a mile and rig up should be in the neighborhood of seven to eight hours. This will give a rigging cost to the tree of about sixty dollars complete and ready to go. This cost cannot be compared to the cost of moving a steam machine, The equipment needed is a good set of drums, bull-dozer, a

sled for carrying oil and diesel, and of course the various blocks and straps for rigging.

When moving, all of the blocks and straps should be threaded on the haulback, run up snug against the drum and locked with the brake. The guy lines should be threaded on a strap and attached to the mainline. The sled should be coupled to the drawbar.

In starting out, about seventy-five feet of mainline should be run out, then the brake set. In this way the line can be passed back and forth over the sled on sharp turns, if this is not done the sled will be crowded. This often causes an upset and much loss of time.

In moving a double drum Cat, grades that would completely stop another Cat which is not so equipped can be negotiated in a short time. This is done by the simple expedient of turning the Cat around, running out the lines, and with a block to a block and a half on the mainline, moving right up any grade that might be encountered.

When the new tree is rigged it is very necessary to find a good setting for the Cat. This should be picked so that it is directly behind a convenient stump which will enable the machine to be tied to the ground. If this is not done the first hard pull will jerk the Cat from the setting, causing the drums to get out of lead. This will cause lost time as well as avoidable wear on the lines.

After the stump is picked, a hole should be dug under

it and a long strap fastened to one ear on the drum, passed under the stump, over the other ear, and back under the stump where it can be spiked. This is perhaps the most efficient method due to the solid support it gives. However it is sometimes hard to apply because of the nature of the ground and other factors.

Another method is to pick a fairly large stump, cut it off so that it just clears the drums; and just where the drawbar comes cut a deep notch somewhat on the order of a spring board hole. Back the Cat in, lock the brakes and start logging. The only drawback is that when a hard pull comes on one side of the drum the Cat is apt to tip and get slightly out of line.

One other method is to take a short piece of line and spike it between two convenient stumps that are at right angles to the way the Cat will be sitting when in place. Some slack should be left in the line and when spiked the Cat can back into it with the line holding on top of the main drum.

These last two methods are especially applicable when the Cat is apt to be required for some other job on short notice.

The real economy of the Cats comes not from the fuel saving or low operating costs so much as the versatility of the machines themselves. When not logging or cold decking the machine may be used in bridge building. The

double drum is especially useful in this work.

The road building usefulness of the Cat has been proven before so no more will be said on that phase.

In many places Cats are used extensively in rigging ahead, such as yarding poles, landings and cold deck. These can be rigged much more cheaply by a Cat with a small crew than otherwise.

Another place where the Cat and bull-dozer are invaluable is in fire prevention and suppression. The Cat roads themselves make the finest fire breaks and in making fire trails through old cuttings or green timber, each Cat will take the place of from two hundred to three hundred men with shovels.

Perhaps the most important part of the Cat operation is the maintenance system employed to keep the Cats running. Too many operators neglect this angle of the business and make no provisions at all for the upkeep of the Cats until some major breakdown forces them to do so.

If an efficient operation is expected there should be a Cat doctor who is directly responsible for the continued operation of the Cats. He should be a skilled mechanic with accurate knowledge of all of the intricate details of his particular job. The driver should never be allowed to make any but the most minor repairs on the machines. At the end of the day or whenever it is necessary he should report all adjustments to the Cat doctor who will service the Cat after work or during the night.

The Cats must be inspected thoroughly at least once a day and adequate greasing and cleaning facilities provided right on the job. Many operators have a movable Cat shed and repair shop that they maintain out in the woods. Each night the Cats are driven to this shed where there is light and equipment for checking and repairing the machines.

In winter logging it is advisable to have some sort of a cleaning system whereby the mud can be washed from the machines. This may be provided by rigging up an old donkey boiler and attaching a pressure pump and a fire hose. It will also provide heat to warm the motors for more

efficient starting on cold mornings.

The cats should always be started by the Cat doctor or assistant fifteen to ~~within~~ twenty minutes before actual work begins. In this way production will start on schedule and the rigging men will not be idle during the company's time.

CONCLUSION

Cat loggers should not merely learn their business by experience, they should profit by the systems which have been worked out by other operations. In this thesis some of the most successful methods of Cat logging have been presented with this end in view.

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COST OF OWNING AND OPERATING A D-8 CAT
WITH SINGLE WINCH AND ARCH

Cat @ \$8100; Winch @ \$1650; Arch @ \$1850

Total investment: \$11,600. Life 5 yrs (250 - 8 hr.days)

Charge/season Per day-

A. Fixed Charges:.....

(1) Interest @ 6%		
(2) Taxes @ 2% 10% of average		
(3) Insurance @ 1% annual investment..\$	696.00	\$2.784
(4) Misc. @ 1%		

B. Depreciation:.....	2320.00	9.28
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C. Operating Charges.....

(1) Repair parts and replacements..... (Manufacturer's estimate)	1600.00	6.40
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(2) Supplies:

(a) Diesel oil 5 gals per hour @ 8¢ gal.....	\$0.40	
(b) Gas (starting)-15 gal hour @ 18¢gal.....	.027	
(c) Lub. Oil .2 gals per hour @ 65¢gal.....	.13	
(d) Grease .9# 12¢.....	.108	
	.665	1330.00 5.32
(e) Wire Rope & Rigging... <i>(Est.)</i>	550.00	2.20
(f) Misc. (Manuf. estimate).....	200.00	.80

(3) Labor:

Operator @ \$1.12½ per hour.....	2250.00	9.00
	\$ 8946.00	\$35.784

Charge per hour...\$ 4.473

April 2, 1940

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COST OF OWNING AND OPERATING A DOUBLE DRUM CAT

Cat ~~\$1800~~ ^{\$8100}; Bull Dozer \$1935; Double Drum \$3245

Total Investment \$13,280

Per season Per day

A. Fixed Charges:

(1) Interest @ 6%		
(2) Taxes @ 2%	10% of average	
(3) Insurance @ 1%	annual investment...	\$ 796.80 3.18
(4) Misc. @ 1%		

B. Depreciation..... 2656.00 10.62

C. Operating Charges:

(1) Repairs and replacements..... 1600.00 6.40

(2) Supplies:

(a) Diesel Oil 5 gals per hour @ 8¢ gal.....	\$0.40
(b) Gas (starting) 15 gal hour @ 18¢ gal.....	.027
(c) Grease .9# @ 12¢.....	.108
(d) Lub. Oil .2 gals per hour @ 65¢ gal.....	.13
	<u>.665</u>

1300.00 5.32

D. Labor:

One engineer, per day....	\$7.00
One hooker, per day.....	8.00
Two Chokermen @ \$6.....	12.00
One whistlepunk, per day..	5.00
	<u>32.00</u>

8000.00 32.00

14382.80 57.52

Wire Rope:

1" Mainline, 840' @ 43¢.....	\$361.20
9/16" Haulback, 2090' @ 19¢.....	\$397.10

(30 million) Mainline.....	.012 deprec. per M.
(50 million) Haulback.....	.007 deprec. per M.
	<u>.019</u>

*To find the log cost per M. divide daily cost by days logging and add .019 line cost. x per M

(Per M.)

YARDING COSTS FOR A DOUBLE DRUM CAT

	Per M.
50 M. per day.....	\$ 1.166
60 M. per day.....	.974
70 M. per day.....	.836
80 M. per day.....	.734
90 M. per day.....	.654
100 M. per day.....	.591
110 M. per day.....	.538
120 M. per day.....	.495

*In yarding here the Labor runs about 55% Total Cost

YARDING COSTS FOR A CAT WITH ARCH

Cost per day..... \$ 47.00

	Per M.
50 M. per day.....	\$.94
60 M. per day.....	.78
70 M. per day.....	.67
80 M. per day.....	.58
90 M. per day.....	.52
100 M. per day.....	.47
110 M. per day.....	.42
120 M. per day.....	.39

*In yarding here the Labor runs about 43% Total Cost

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CO OP BOOKSTORE NEWS

KODAK EDITION

For years the Co op has anticipated
the needs of the Students at Oregon State.

Now! We have for your convenience
the "Co op Camera Shop".

CAMERAS

USED---Exceptional Values---

Argus Model C		f. 3.5	\$16.75
Kodak Jr.	620	f. 6.3	12.00
Kodak Vigilant	620	f. 4.5	18.00

NEW---

Kodak Monitor	620	f. 4.5	30.00
Kodak Vigilant	620	f. 4.5	25.00
Kodak Vigilant	620	f. 6.3	17.50
Kodak Recomar # 18		f. 4.5	54.00
Zeiss Nettar	120	f. 6.3	20.00
Zeiss Nettar A 1/2 620		f. 4.5	30.00
Zeiss Super Ikonta C		f. 4.5	99.00
Contax II Tessar Lens		f. 2.8	204.00

MOVIE EQUIPMENT

Movie Cameras and Projectors.....

Bell & Howell (exclusive dealer)
Eastman
Keystone

We rent 16mm, 8mm and 2x2 slide projectors

Trade in your old camera on a new KODAK.

We give liberal trade-in allowances.

EXPOSURE METERS

Imperial.....1.50	Weston Jr. ...15.50
Leudi.....2.15	Weston 650....19.95
Phaotron5.00	G. E.19.50
Weston Master..24.00	

DARKROOM SUPPLIES

Kodak Film Clips.....	.10
Squeegee Rollers.....	.40 - .60
Ferrottype Tins.....	.40
Safe Lights.....	.50 - 1.25 - 1.75
Trays, Enameled or Hard Rubber 4X6 -- 11X14	
Viceroy all metal printer.....4X6--	4.95
5x7 all metal printer.....	8.00
Developing Tanks.....	1.75 -- 2.50
Cut Film Developing Tanks.....	2.50
Paper Cutters	
6".....	2.50
8".....	3.00

CONTACT AND ENLARGING PAPERS VARIOUS SIZES
AND SURFACES.....

ENLARGING SUPPLIES

Kodak Advance Enlarger with Lens.....	27.50
Metal Paper Holder adj. 11x14.....	3.95
Master Dodger.....	1.00
MCM Photometer	4.85

FILMS

WE DO DEVELOPING AND PRINTING.

.25 cents per eight exposure roll.

.03 cents each additional print.

The stock of Films at The Co op is complete
and you are sure of getting fresh films at
all times.....