Development and Use of Power Saws In Felling and Bucking on the Pacific Coast

by

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Introduction

For the past twenty-five years, a great number of various devices for falling and bucking timer mechanically have been suggested and designed. Most of them have proven impractical for general forest conditions.

There are four main classes of these mechanical fallers and buckers: the circular saw, the rope saw, the drag saw, and the chain saw. Other ideas which have been tried include a wire rope feller which was supposed to burn through a tree by heat of friction when a wire rope was drawn back and forth rapidly in contact with the wood; a series of augers to cut through the stump below the level of the ground, thus leaving no stump to obstruct skiding; a mechanical chiseling apparatus to perform much the same as an axe; and a cutter mounted on the end of a horizontal shaft swinging rapidly in a horizontal arc. Felling trees by pulling them over with a donkey engine has been tried on a very small scale.

Various devices employing a circular saw have been designed but cannot be used in large timber because of the large saw needed.

The only rope saw to come on the market consisted of a steel cutting rope which was attached to cables from a double winch traction and was run rapidly from one winch to the other, cutting the tree in the operation.

Not much interest was shown for power falling in the Douglas-fir region until 1936 when the Pacific Logging Congress at Eureka, California, gave some demonstrations with power machines, which resulted in a committee to assist in their further development. The Pacific North West Forest Experiment Station volunteered to collect all of the available data. Their findings in brief are as follows:

1. The saw speed must be high. If this is not true, a power saw's only justification is in the saving resulting from lower cutting, saving more of the bole of the tree.

2. The saw must be easily portable regardless of dense brush and steep slopes; this is governed chiefly by weight. If weight could be disregarded, it would not be difficult to design a saw; but as weight is decreased, many complications arise.

3. Setting up to cut must not take a great deal of time, although as the size of the timber increases, the allowable time for setting up may increase proportionally. Numerous set ups in small timber may render a saw impractical if it does not meet this requirement.

4. The outfit must be durable and rugged. If this is not so, the depreciation and repair costs may be such that they will offset any advantages gained from the saw.

5. The motor must be simple, powerful, and reliable so that no time will be lost in starting, overheating, or other operating weaknesses resulting in mechanical delays.

6. Fuel must be readily obtainable and of low cost. This requirement is usually easy to satisfy; but when

aviation or similar fuel is required, this is sometimes not true.

Drag saws, which have been used in the redwoods several years prior to the above findings, do not meet with several of the listed requirements; but under the conditions they are used, they have proved a big saving in cost per M of falling and bucking. This, of course, is due to the large size of the timber, which in the case of the larger trees may take as long as eight hours to fell, and in some cases longer.

The Dow Chain Saw

The Dow Saw, built by the Dow Pump and Diesel Engine Company, of Alameda, California, has proved to be practical in the pine regions of the West but cannot be expected to be successful in the Douglas-fir belt, due to its extreme weight of 450 pounds.

This machine is mounted on pneumatic-tired wheels. In a demonstration of one of the early models in 1934 at a camp of the Diamond Match Company, of California, it bucked 118,712 board feet in 32 minutes! This company bucks its logs at a landing. On another occasion it felled 56,300 board feet on a steep hillside on a donkey "show" in five hours. A 50 percent saving was estimated over the hand system on a contract basis. These operations were under ideal conditions which are seldom found in the Pacific Northwest Douglas-fir region.

Development of Portable Chain Saw

Late in 1936, the British Columbia Loggers Association imported from Germany, a chain saw, similar to the type now seen in the Pacific Northwest. This was not the first saw of this type; however, it was supposed to be better than the inadequate saw which was coming on the market at the time. This saw was designed and developed for the German Army, for use, particularly, in cases of retreat through wooded country where trees could be felled to retard the advance of the enemy. This particular machine showed a big advantage over American machines in its simple construction and light weight (120 pounds). It was powered by a high speed, single-cylinder, two-cycle motor and cost $300.

Bloedel, Stewart, and Welch, Ltd., of British Columbia obtained this saw from the Loggers Association to make a study and trial of it. This company has been one of the main exponents in developing the chain saw to what it is today. By working it under their woods conditions, they gave it the most exacting tests, correcting weaknesses as they appeared.

They put this saw to work under the worst possible weather conditions, in frozen timber, with from one to three feet of snow on the ground. The ground was broken and brushy. The timber consisted of a mixture of fir, cedar, and hemlock averaging about three feet in diameter on the stump. The machine was operated from January 7 until February 4, when the camp was shut down because of snow. Six hundred M feet of timber was felled and bucked with the saw. The crew varied between two and four men; the average cut per man per day was 7,685 FBM. Costs were:

	Amount	Per M
Felling and Bucking, plus Operator's repair, Labor..........	$418.00	$.697
Fuel and Grease....................	11.91	.019
Depreciation (12 mos. $300 val.)..	17.98	.030
Repairs (Materials)...............	5.99	.010
Scaling and Supervising...........	32.97	.055
Filing............................	32.98	.035
	$507.83	$.846

These figures include time lost through break-downs. Handsets on the same "show" would have had a higher average cut per man at a lower cost per M.

During this trial period a good many defects were noted and corrected. A new chain was designed similar to the Dow chain. This first new chain was not satisfactory, so another was made immediately. This chain had the desired cutting speed but could not be controlled in the cut. Further changes were necessary. In the meantime, word was received from Germany that new improved saw chains had been developed and were being sent. Rather than spend more time and money, the company awaited the arrival of these. They proved to be a vast improvement over the originals, provided they could stand up long enough.

In May of 1937 the company took a time study on the saw to aid in stepping up its efficiency. These later proved to be a decided value. The form they used is as follows:

Time Study--Falling

Stihl Power Saw--Two-Man Crew--11 hours operation--May 13, 14

Tree	Scale	Gas & Oil	Repairs	Start Saw	Move Saw	Swamp & Spring Board	Undercut Saw	Undercut Chop	Saw		Remarks
76	2282		36	1.	2.00	7.45	1.30	5.30	3.45	2.00	Chain broke on back cut
77	731			.30	1.30	7.00		8.00	2.15	1.45	
78	457			.30	1.30	8.00	.30	1.30	1.30	1.	
79	1324			.30	1.30	7.00	.45	5.00	1.45		
80	2630			.30	2.45	16.30	.45	7.00	2.15	3.15	
81	4608			.30	2.45	26.00	1.30	6.15	1.15	39.30	
82	457			3.36	.45	6.30	.30	1.45	.45		
83	1823			1.15	4.39	7.00	1.00	2.00	4.15	.30	
84	1340			1.30	1.30	8.30	.30	2.00	1.00		
88	4100		4	2.30	1.15	10.45	3.00	5.45	9.45	2.00	Adjustments
89	964			.30	1.15	9.30	1.00	1.45	3.00	4.30	
90	2654		5.15	2.45	3.00	13.00	2.15	21.00	26.00		Adjustments
	23368	21	45.15	15.36	24.24	127.30	13.15	67.30	47.30		

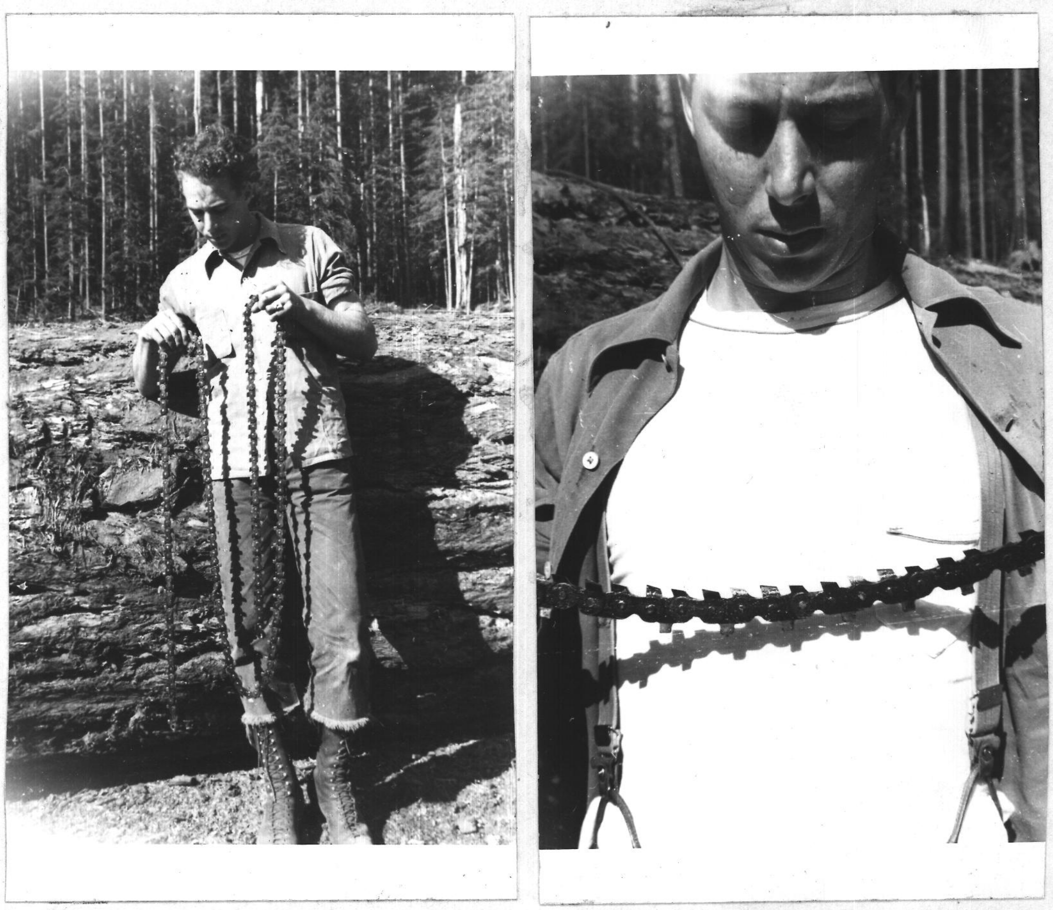
Figures shown are minutes and seconds

Time Study--Bucking

Stihl Power Saw--Two-Man Crew--11 hours operation--May 13, 14

Tree	Meas.	Move Saw	Start Saw	Sawing Time	Delay Wedge etc.	Repairs	Remarks	Misc. Delay	Remarks
76	3.45		.30	4.30					Spar Tree
77	1.30	4.30	.30	1.45				2.15	Removing saw from cut
78	2.00	4.00	.30	3.00	4.15				
79	2.00	2.00	1.00	4.45	9.00				
80	4.00	2.30	7.15	8.00	5.30	29.00	Clutch	6.00	Side Notch
81	5.30	7.45	8.15			8.00	Strap	29.45	Removing Saw from cut
82		3.15		3.30	5.30		broke		Snag
83	4.00		1.43	2.00	3.45				
84	3.30	.45		6.00				21.00	Removing saw from cut
88	3.45	3.45	1.30						Snag
	30.00	28.30	21.12	33.30	28.00	37.00		59.00	

Total time: 10 hrs. 48 mins.
Figures shown are minutes and seconds



REED PRENTICE SAW CHAIN

By March, 1938, Bloedel, Stewart, and Welch, Ltd., were using five power saws manufactured by the Stihl Company of Hamburg, Germany. These saws, however, were principally the same as the original one purchased by the British Columbia Loggers Association in 1936; but many new improvements had been incorporated into these machines, both by Bloedel, Stewart, and Welch, Ltd., and by the German company to make them adapted to the Douglas-fir region. The improved model was known as the "Vancouver," and cost $865.00. The new faster-cutting chain had an expected life of four million feet. Other improvements were: a more portable clutch, a removable handle to facilitate bucking, and many small improvements. A smaller machine of 65 pounds with a forty-inch blade was developed in Germany to fell smaller timber with a DBH of 18 to 20 inches.

At this time, Bloedel, Stewart, and Welch were getting five more saws ready to start on a different operation on Franklin River.

When the war broke out in 1939, it was necessary for the Company to find a different source from which to obtain its machines. It was then it turned to the Reed Prentice Company of British Columbia. This company, along with the D. J. Smith Equipment Company and Spear and Jackson, Ltd. of British Columbia, had been helping Bloedel, Stewart, and Welch make improvements. This machine was principally the same as the German make.

REED PRENTICE CHAIN SAW

By Fall of 1940 this company was falling 80 percent of their timber with power paws. One-hundred million feet had been felled up to September, 1940. By Fall of 1942, after five years of power sawing, Bloedel, Stewart, and Welch were 90 percent mechanized in their felling operation. Their cut over the period of years is as follows:

1937..........	6,000,000 feet
1938..........	28,000,000 "
1939..........	109,000,000 "
1940..........	277,000,000 "
1941..........	242,000,000 "
°1942..........	156,000,000 "

°First six months of 1942

Many of their machines are three to four years old, but by systematic overhaul and worn parts replacement these machines are kept in near-new condition. By this method, loss of crew time through repairs is kept at a minimum. The machines were all standardized on one basic pattern to make parts interchangeable. Up until 1938, the most expensive single replacement item was connecting-rod bearings failures, which was one to every million feet felled. This has since been cut to one for every three and a half million feet.

Over a period of five years, the saw chain costs have been cut to one-third the original cost. There is still room for improvement of saw chains; but as mass production of saws is increased, many of the faults will be worked out and chain costs likewise will be lower.

Gasoline Power Chain Saw Bucking

For power bucking a much lighter machine is needed than those used for falling. Bloedel, Stewart, and Welch, Ltd. set out to find or bring out a lighter machine. After two years of work and research by one firm, a machine of 97 pounds was developed, which was about 40 pounds overweight and entirely unsuitable. They searched elsewhere; and after four months, a machine weighing 64 pounds total weight was produced. This was built around a revolutionary English (Villiers motor.) motor developing between four and six horsepower and at a weight of only 25 pounds for the complete motor unit.

This unit was subjected to two months of experimentation and some general rough treatment to develop the best methods of handling it. The motor came through the period without any mechanical defects appearing. The rest of the machine showed need for a few minor changes, although the machine, as a whole, was quite satisfactory. Chains, however, offered a considerable problem until the correct combination of tooth shapes, set, and clearances was obtained.

This saw offered a rather radical departure from the conventional type of bucking in that undercutting is done by mortising the saw chain through the log. After the saw has mortised its way through the log, sawing action is done either up or down as the operator desires or the lay and bind of the log requires. The average cut by hand buckers for this company is slightly under 18 M feet per day. Indications are with this new machine that 7 M feet per hour is possible, giving 56 M per man day, under average ground and timber conditions. This same machine is being developed to fell timber of a DBH up to 48 inches.

Chain Saws versus Drag Saws

Chain saws have been made much lighter and more complex than drag saws. They cut more rapidly than drag saws because the chain saw does not require a reversal of direction as does the drag saw. Therefore, more feet per minute of travel are obtained by the chain saw. These two points have tended in the past to make the chain saw more successful than the drag saw. However, the drag saw has several factors which should not be overlooked:

1. Drag saws are more simple and more rugged in operation.

2. Drag saws have a small initial investment, hence a lower charge against total production in machine life.

3. When a small log or tree is encountered while cutting in large timber with a drag saw, a shorted blade may be substituted while in chain saws it is necessary to use an outfit which will cut the largest tree or log encountered.

4. Once a drag saw is started in a cut, it can be operated by one man, leaving the other one to do other duties; but in the case of the chain saw, both men are needed at all times.

5. Engine vibrations do not bother draw saw operators, whereas in the case of the chain saw, it tires them rather rapidly.

6. Electric power will eliminate this factor, but here again many complications arise.

Drag Saws As Used in the Redwoods

The drag saw, as used for felling today, requires very little change over from the conventional type used for bucking. One change is to exchange the place of the water tank and gas tank on the drag saw rigging. When the saw is working in vertical position, alongside of a tree, this arrangement prevents the engine from heating when the water gets low in the tank. Another change is placing a small eye made of 3/8-inch round iron in and near the rear end of the frame. From this is fastened an extension arm to fasten to the side of the tree. The extension arm is ahalf inch pipe, five feet long, in which a 3/8-inch rod will slide. This rod has a dog welded to the outer end for driving into a tree. Through the rod and pipe are drilled quarter-inch holes, through which a bolt may be fastened to hold the extension rod to the proper length.

In setting up the saw after direction of fall is determined, the next step is to place a spring board to hold the outer end of the saw frame. This, of course, is done after proper staging and spring boards are placed for the operators. The saw frame is then placed across the springboard and turned to a vertical position against the tree. With the saw held against the trees in this position, the side gear is swung toward the center of the tree where, if the saw was fastened to it, the points on the tree to which the operators have previously decided will be the maximum cut. When the side gear is in this position, a sight across the saw bolt parallel to its long axis should fall upon a line which is parallel to and within a foot or two of the predetermined layout for the tree. During this operation, the springboard supporting the pointed end of the saw frame may be adjusted until the lineup is correct and the saw frame is in the proper position to give the correct depth of cut on each side of the tree. This operation usually takes about five minutes and is important because as well as regulating the depth of the cut, it also influences the direction of fall.

After this has been accomplished, the wide end of the frame is raised or lowered to a point where it will make the saw cut level or sloping, which ever is needed for the particular tree. The dogs on the wide end of the frame are then driven securely into the tree. The shortest saw which will cut the tree is then selected and fastened to the side gear by means of a saw bolt. Then a pair of double blocks is fastened. Into these blocks a quarter-inch rope is driven to which weights are hung. Usually two wedges are used for weights. The loose end of the rope is fastened to the side gear at the point where the saw bolt holds the saw. This forms the feed works for sawing and completes the setup.

The sawing is started by one man holding the saw at the proper level while the other man starts the engine and engages the clutch. While the motor is driving the saw through the tree, the operators prepare the tree for the backcut. When the first cut is finished, the saw is moved to the backcut. After the saw has started on the back, the operators chop out the undercut. Often, however, two parallel cuts are made on the undercut side of the tree, varying from six to eight inches apart and then are chiseled out with an axe.

Electric Power Chain Saws

Until recently, electric power chain saws have taken a back seat to gasoline power chain saws. The reason for this is twofold: electric power chain saws take a considerably high initial investment; electric power chain saws require a generator as well as a power unit as a source of power to drive the cutting chain.

THE UNDERCUT

Recently some of the companies manufacturing electric power chain saws conceived the idea of mounting a generator on a small tractor, supplying power from a power take-off on the tractor for the generator. This proved to be quite successful and was readily adopted by loggers in the "Pine" country; but due to topographic conditions, it was not considered, by most loggers, a feasible unit to use in the Douglas-fir region.

A comparison of merits between electric and gasoline power chain saws will show the electric power unit to be more desirable. A complete unit of a gasoline saw with an 84-inch cutter bar weighs 135 pounds; a saw unit on an electric outfit with an 84-inch cutter bar weighs but 85 pounds, which is an enviable point from the side of the operator. Vibrations on an electric power saw are considerably less than on the gasoline unit--a big factor when fatigue of operators is taken into consideration. Noise and fumes are at a minimum on the electric saw--another fatigue and a bigger safety factor. Production on electric saws averages around 100 M per day against 75 M per day on gasoline units. Starting time on electric saws is a negligible item; while on gasoline saws, it is often a time consuming element. Fire hazard on an electric saw practically does not exist, while quite serious fires have been started from back-firing and sparks from gasoline engines. Depreciation on electric units which have an initial investment of $10,500 (including three saws) is to some extent less than a gasoline power saw that costs $865.

Against these merits there are two main faults with electric power saws. A heavy rubber-covered electric conduit is required to transmit power from the generator to the saw unit. These are often fouled by trees falling on them and breakage from innumerable sources. These conduits are long enough to allow the fallers to work in a thousand-foot radius around the tractor and generator. The other fault is the close proximity of the workers around each generator unit. Each generator unit has three saw units working from it. Another fault, if it may be considered a fault, is the danger of falling a tree on the tractor and generator. This is a rare accident among experienced personnel, but is a possibility.

Since the priority on gasoline power chain saws has been granted to the Armed Forces, and since there is a shortage of manpower in the woods, many logging operators have turned, or will turn, to electric power saws. It is believed that after this war emergency, many operators will continue to use this type of unit.

(Note: It is interesting to note the physical size of the men wanted for power saw operation. Requirements for future power saw operators are: he must be young, fairly husky, over 5' 10" tall, weigh over 175 pounds, have the average young man's gas engine knowledge, and have previously done a little hard work. These young men are to be worked for a period of a week or ten days helping and working with an experienced crew. At the end of this period, if he has proved satisfactory, he is turned out with a head faller.)

The following charts and tables show a comparison of cost of production for different methods of falling and bucking timber on the Pacific Coast. Daily production ranges of each under average conditions are:

Falling	
Gasoline Chain Saw	65-85 M
Electric Chain Saw	80-110 M
Dow Chain Saw	120-160 M
Drag Saw	50-80 M
Hand Set	30-45 M
Falling and Bucking	
Dow Chain Saw	50-80 M
Bucking	
Electric Power Chain Saw	120-150 M
Drag Saw	50-70 M
Hand	20-30 M

COST OF POWER FALLING AND BUCKING WITH ELECTRIC POWER CHAIN SAW IN PINE WITH CREW PAID ON HOURLY BASIS, COMPARED WITH COST OF CONTRACT FALLING AND BUCKING (Hand Work)

Note: Limbing on this operation is done on hourly basis under either power or hand falling and bucking method.

<u>Cost as it would be under hand method on contract:</u>

Contract for falling and bucking would be	.830 per M	
Plus 10% a/c loss of scale between full scale in woods and net landing scale	.083	
	.913	
Tools	.025	
Bull-buck wages	.055	
		.993 per M
Present hand limbing cost		.450 per M
Total Cost, hand method		1.443
		1.443

<u>Machine Falling and Bucking, with hand limbing:</u>

Cost of Operating One Power Unit: (No Labor):

	Per Day
D2 Tractor & Saw Unit Repair & Operating Supplies	1.00
Fuel and Grease	.75
Saw Chain & Blade Repairs	.85
Chain & Blade Replacements	.75
Miscl. Cable, fittings, tools	.65
Cost per Unit per Day	4.00

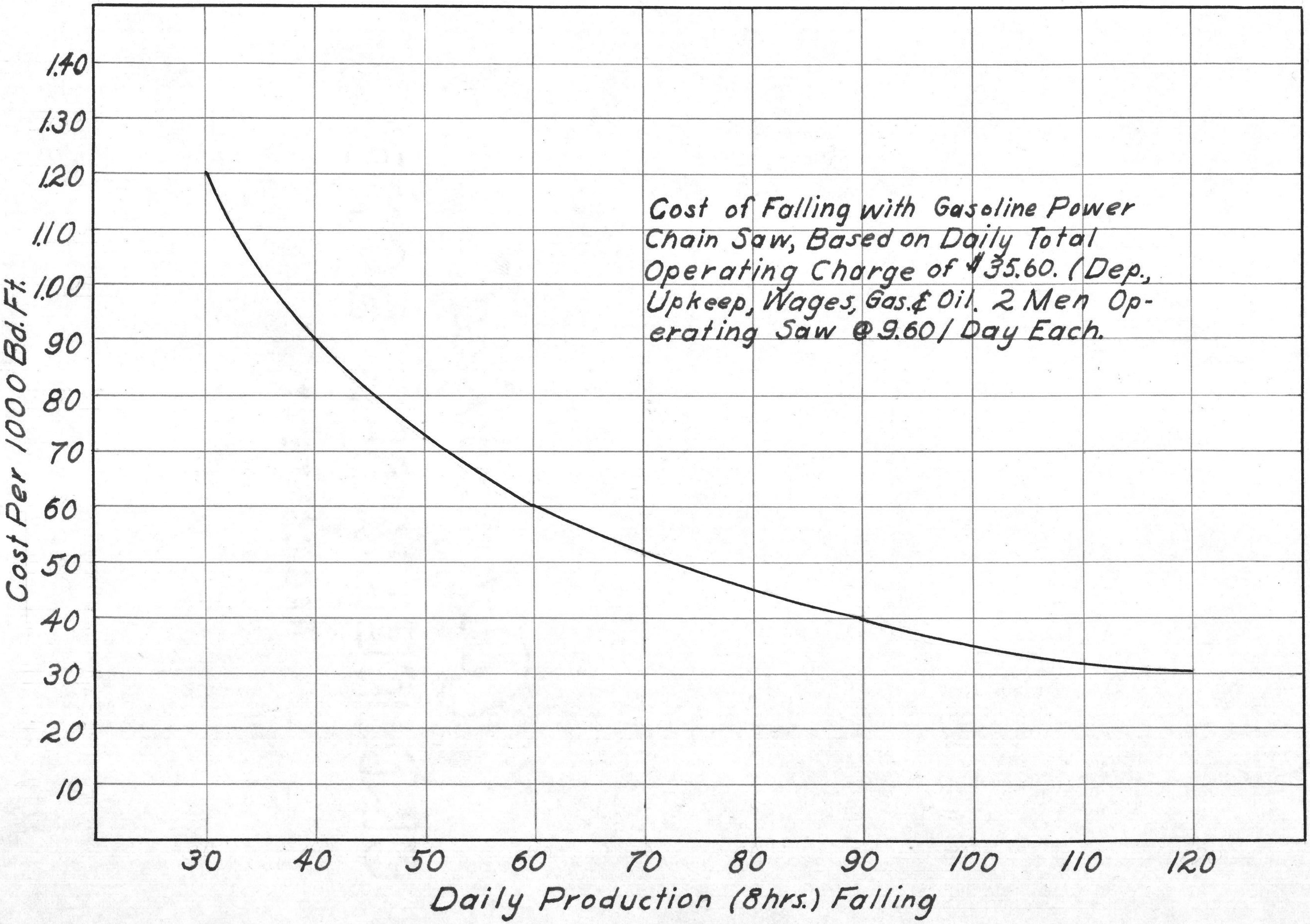
Daily Cost--2 Falling and 1 Bucking Unit	x 3		
		12.00	
Labor: 4 Men Falling @ 8.20		32.80	
2 Men Bucking @ 8.20		16.40	
1 Helper " @ 7.40		7.40	
1 Hole Digger @ 7.00		7.00	
Supervision Charge		7.10	
Total Cost, Labor & Supplies: 3 Units:		82.70	
Cost per M on average of 160M per Day:		.517	
Plus Limbing Cost (hand work)		.450	
Plus Topping Cost " "		.100	
Total Cost, Machine Falling & Bucking, with Hand Limbing & Topping			1.067
Difference of Contract Hand Work & Mach. Work			.376
On basis of annual in-put of 37 Million Feet margin for depreciation and profit will be:			$13,912.00
Investment in three units			$10,500.00
Net Profits on one year's operation			$ 3,412.00

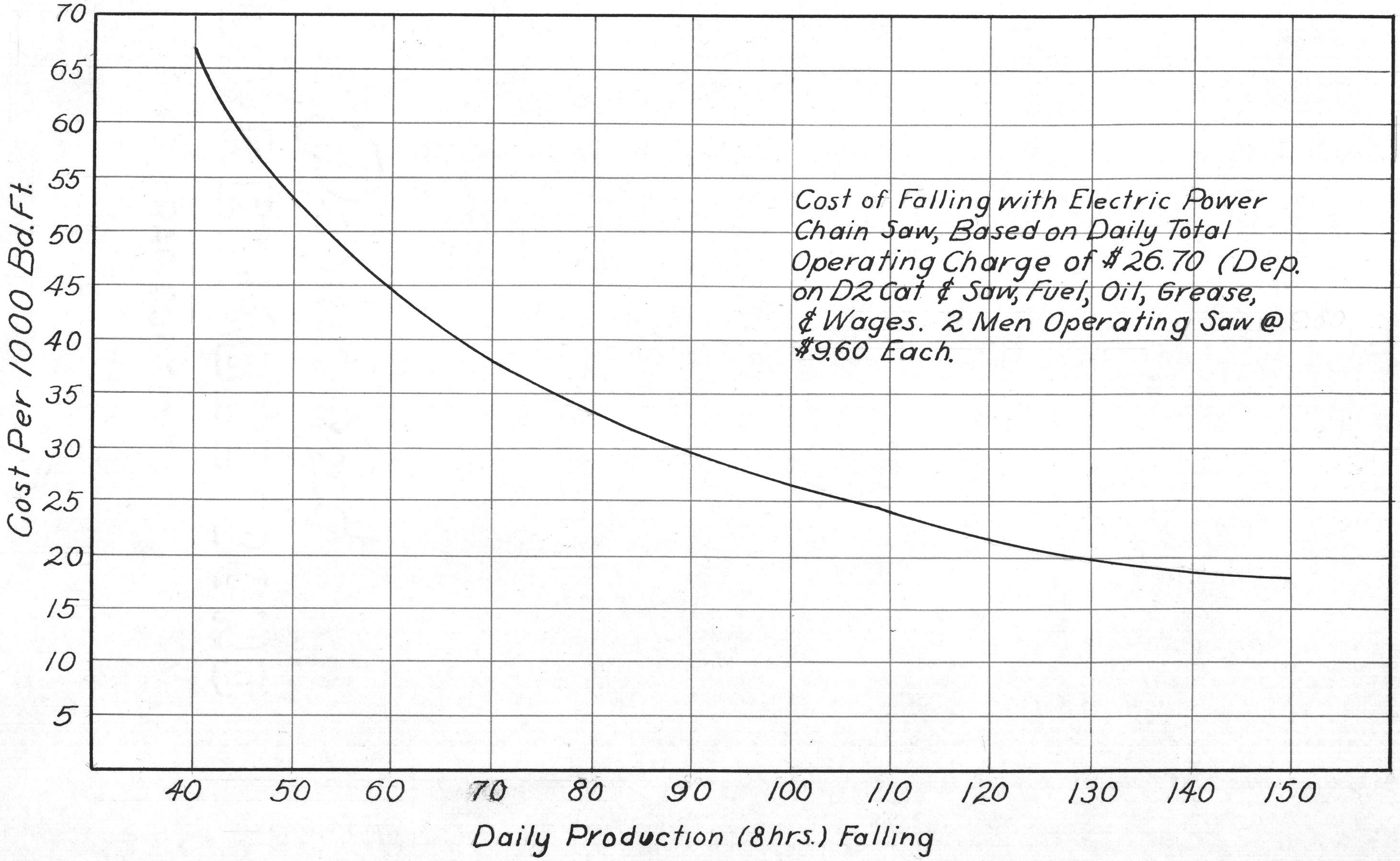
Note: Other savings, such as labor taxes, greater utilization of timber, etc., can be added to above figures as desired.

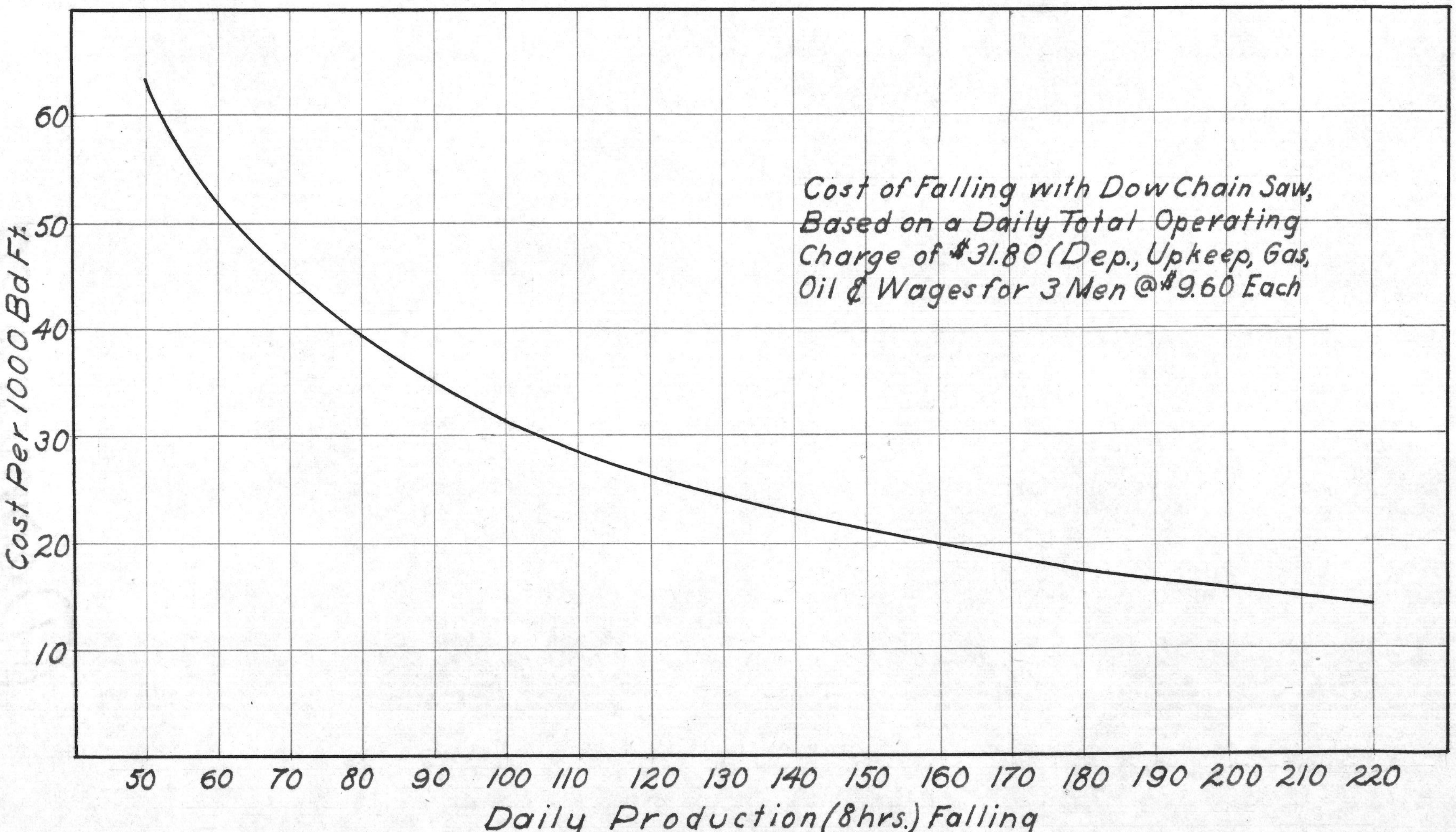
COST OF FALLING WITH GASOLINE POWER CHAIN SAW

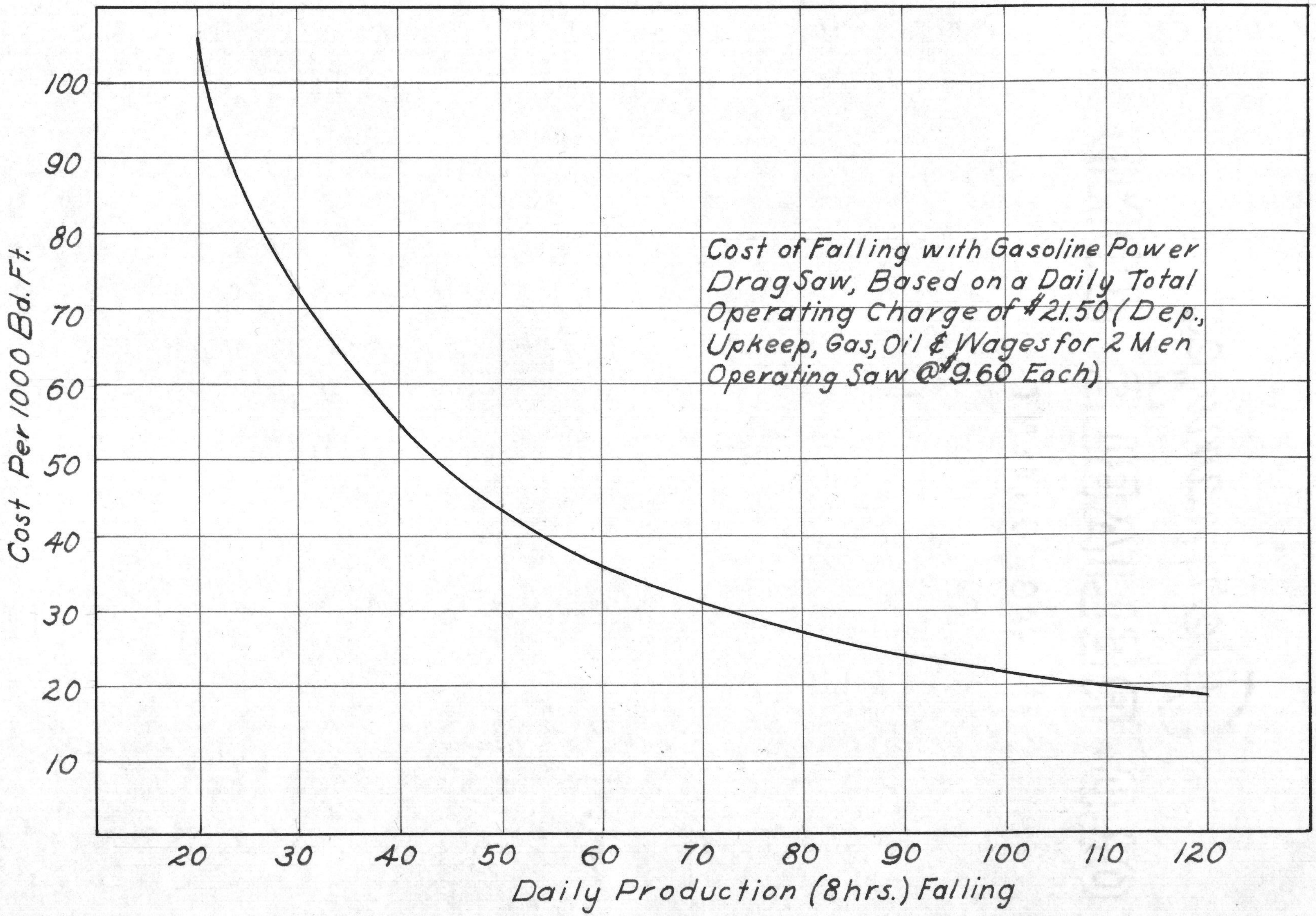
Includes Extra Blade and Chain
Total Investment $865.00 Assumed at 2½ Years
One Year @ $250.00 8-hr. Days

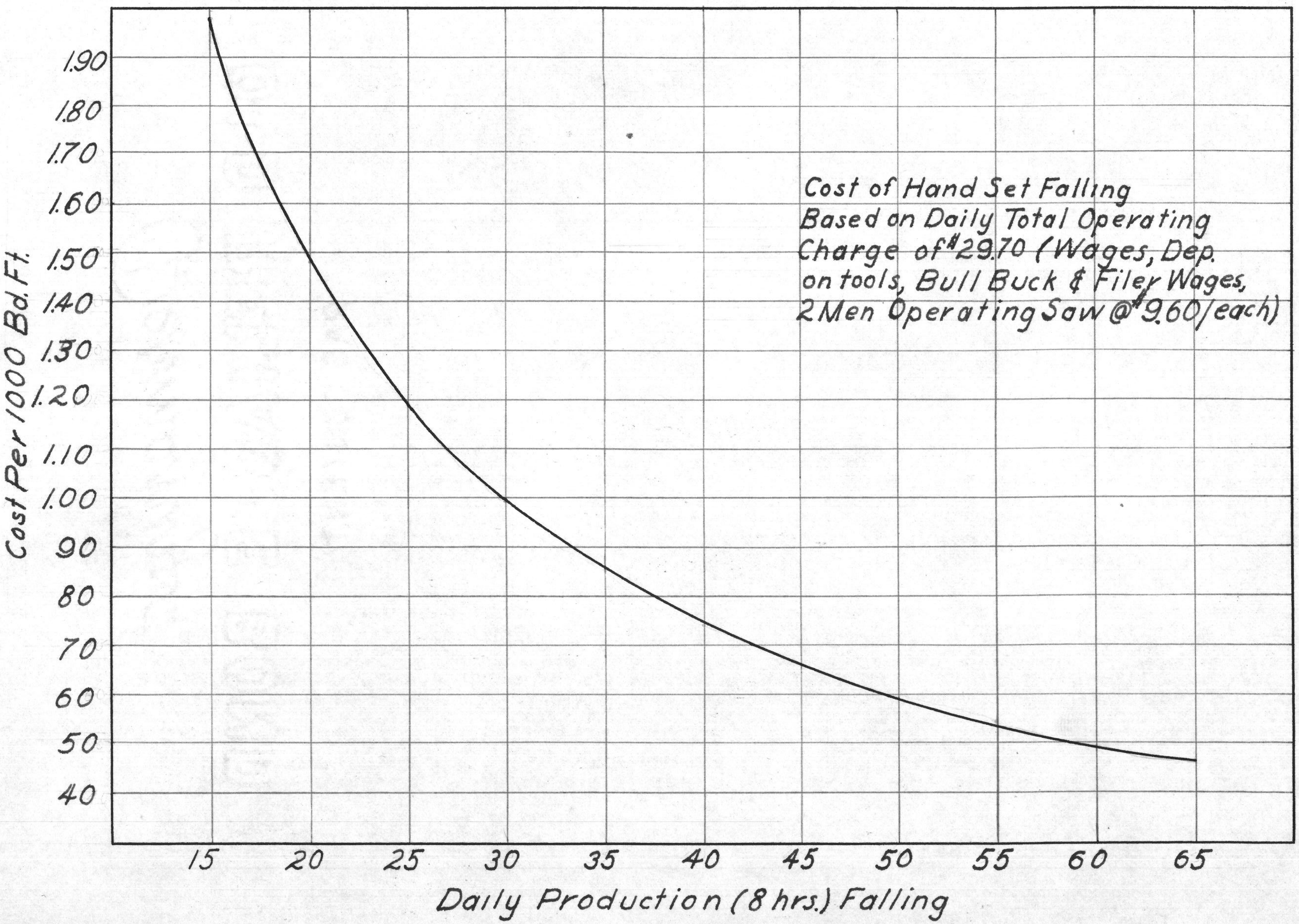
			Charge per Day
A. Fixed Charges			
1. Interest	@ 6%	10% of Average Annual Invest.	
2. Taxes	@ 2%		
3. Insurance	@ 1%		
4. Miscl.	@ 1%		$ .24
B. Depreciation			1.38
C. Operating Charges			
1. Repair parts and replacement including Labor Power Saw mechanic	@ $1.70/hr.		3.00
2. Supplies			
2. Supplies			
a. Gas	@ .18/gal.		
b. Lube. oil	@ .65/gal.		
c. Grease	@ .12/lb.		1.14
3. Filing chain	@ 1.70/hr.		1.70
4. Labor			
a. Head Faller	@ 1.20/hr.		
b. 2nd Faller	@ 1.19½/hr.		
c. Helper	@ 1.10/hr.		27.80
5. Overhead--Bull Back & Scaler			4.60
6. Industrial & Social Insurance 14% of labor			4.54
			$44.80

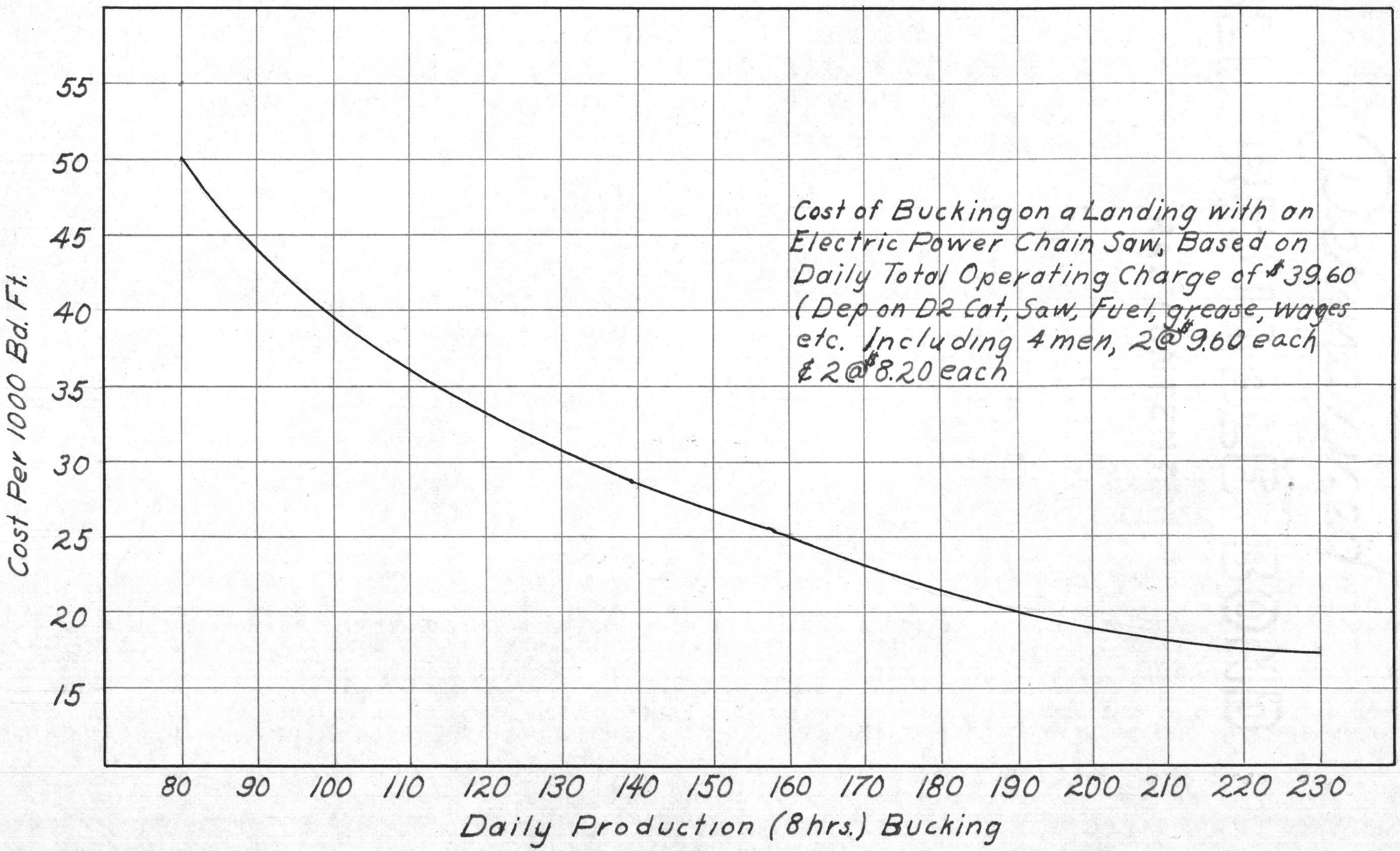

Cost of Falling with Gasoline Power Chain Saw, Based on Daily Total Operating Charge of $35.60. (Dep., Upkeep, Wages, Gas.& Oil. 2 Men Operating Saw @ 9.60/Day Each.
Cost Per 1000 Bd. Ft.
1.40
1.30
1.20
1.10
1.00
90
80
70
60
50
40
30
20
10
30
40
50
60
70
80
90
100
110
120
Daily Production (8hrs.) Falling

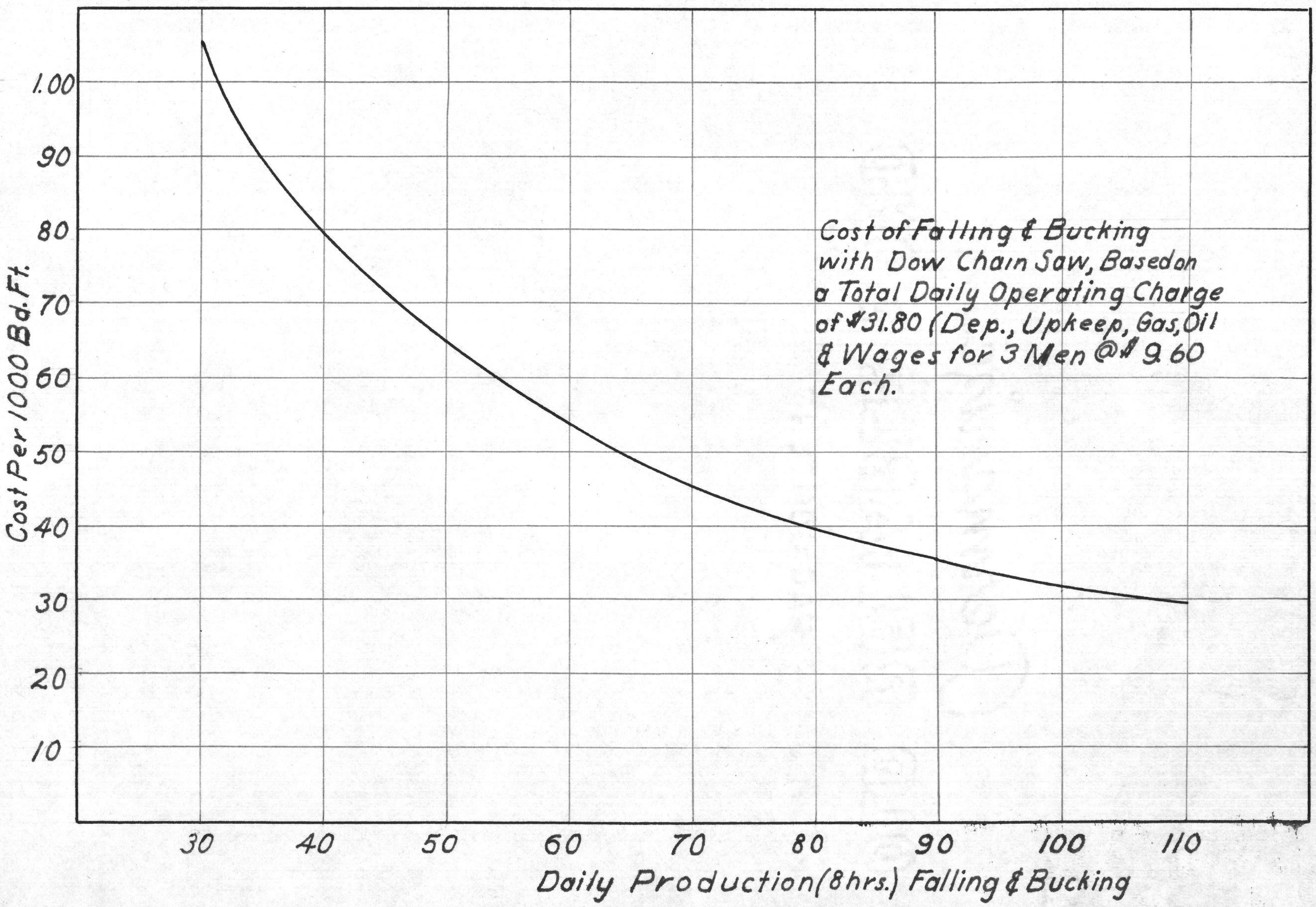

Cost of Falling with Electric Power Chain Saw, Based on Daily Total Operating Charge of $26.70 (Dep. on D2 Cat & Saw, Fuel, Oil, Grease, & Wages. 2 Men Operating Saw @ $9.60 Each.
Cost Per 1000 Bd.Ft.
70
65
60
55
50
45
40
35
30
25
20
15
10
5
40
50
60
70
80
90
100
110
120
130
140
150
Daily Production (8hrs.) Falling


Cost of Falling with Dow Chain Saw, Based on a Daily Total Operating Charge of $31.80 (Dep., Upkeep, Gas, Oil & Wages for 3 Men @ $9.60 Each
Cost Per 1000 Bd Ft
60
50
40
30
20
10
50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220
Daily Production (8 hrs.) Falling

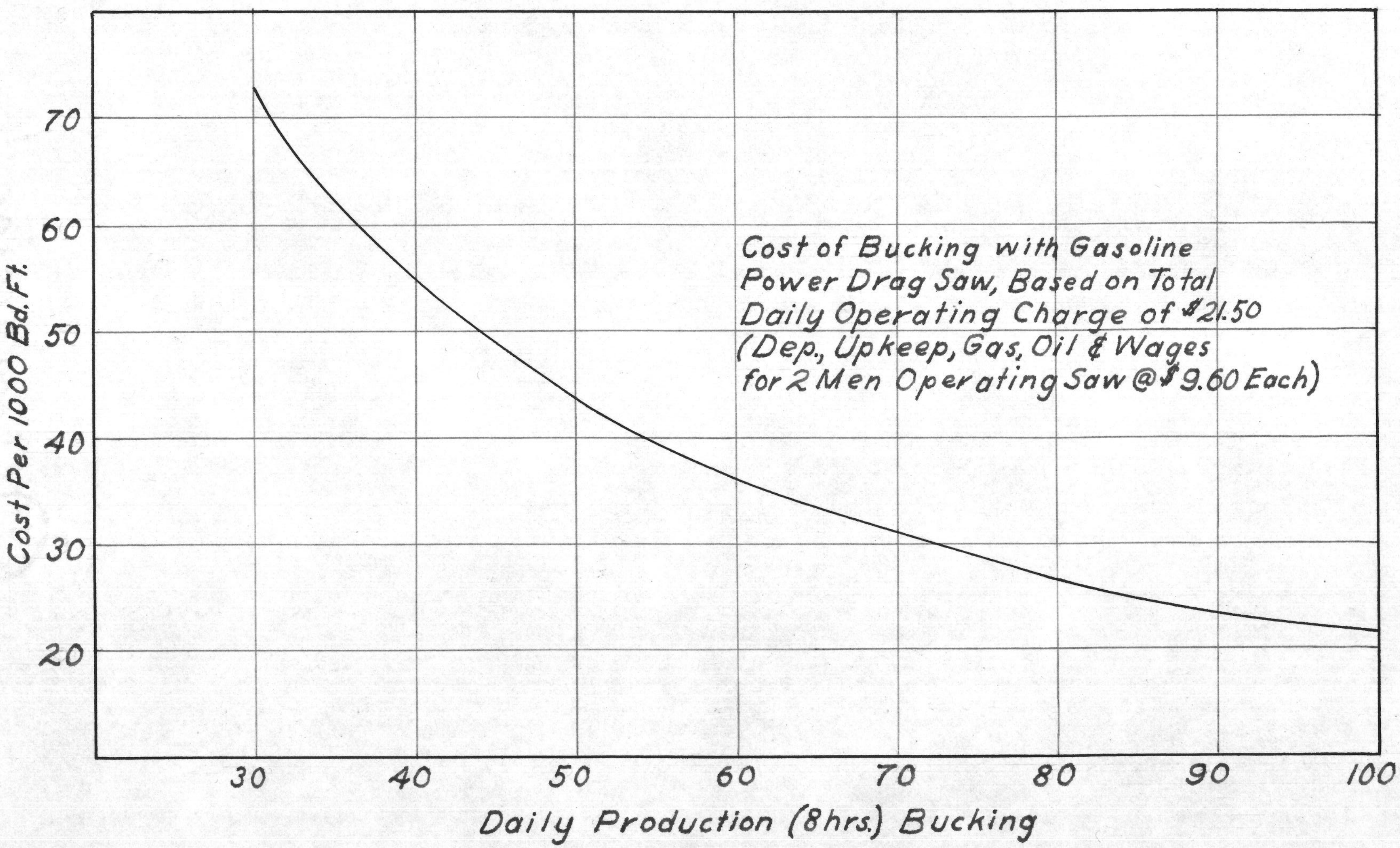

Cost Per 1000 Bd. Ft.
100
90
80
70
60
50
40
30
20
10
Cost of Falling with Gasoline Power Drag Saw, Based on a Daily Total Operating Charge of $21.50 (Dep., Upkeep, Gas, Oil & Wages for 2 Men Operating Saw @ $9.60 Each)
20
30
40
50
60
70
80
90
100
110
120
Daily Production (8 hrs.) Falling

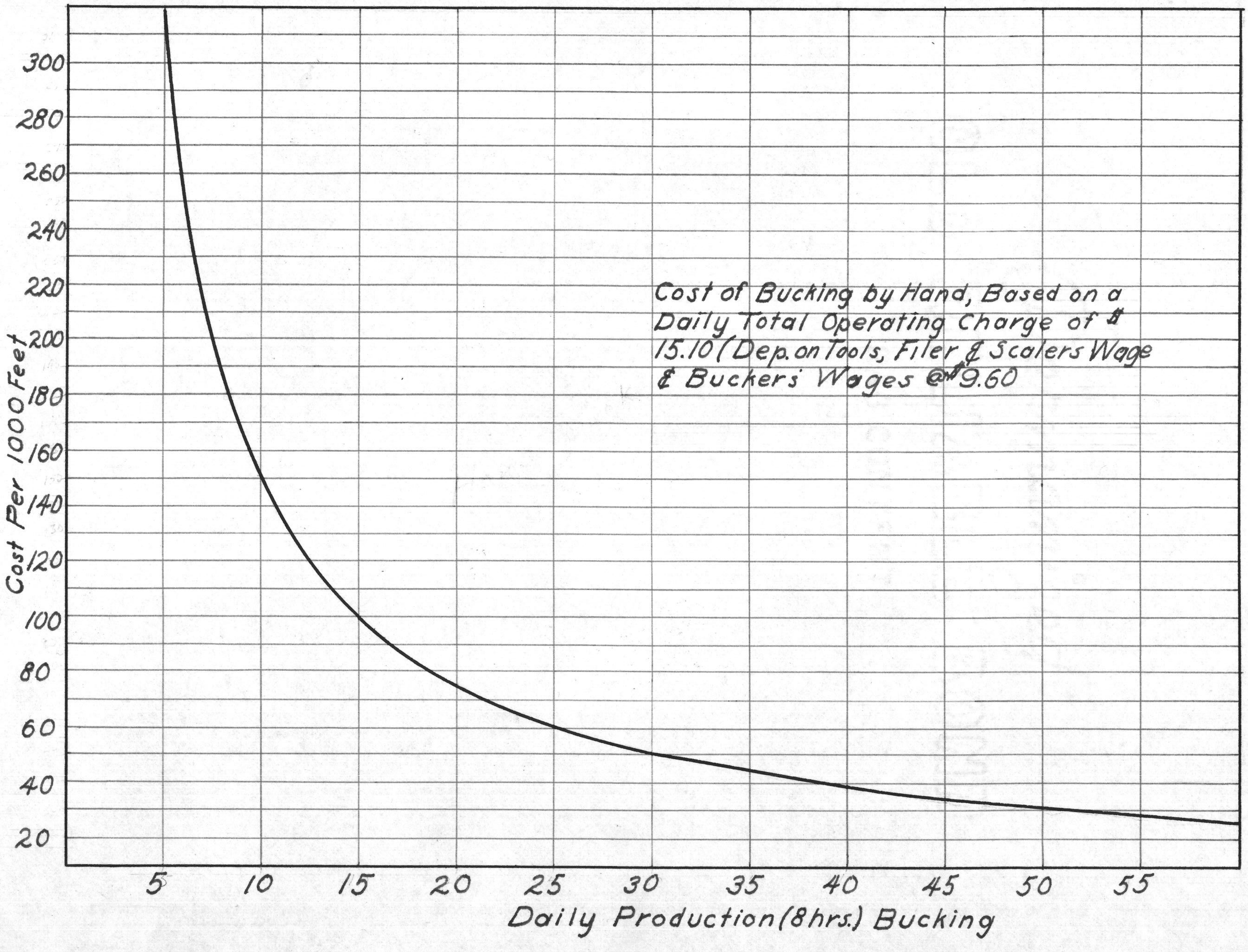

Cost of Hand Set Falling
Based on Daily Total Operating
Charge of #29.70 (Wages, Dep. on tools, Bull Buck & Filer Wages,
2 Men Operating Saw @ #9.60/each)
Cost Per 1000 Bd. Ft.
1.90
1.80
1.70
1.60
1.50
1.40
1.30
1.20
1.10
1.00
90
80
70
60
50
40
15
20
25
30
35
40
45
50
55
60
65
Daily Production (8 hrs.) Falling


Cost of Bucking on a Landing with an Electric Power Chain Saw, Based on Daily Total Operating Charge of $39.60 (Dep on D2 Cat, Saw, Fuel, grease, wages etc. Including 4 men, 2@$9.60 each & 2@$8.20 each
Cost Per 1000 Bd. Ft.
55
50
45
40
35
30
25
20
15
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220
230
Daily Production (8 hrs.) Bucking



Cost of Falling & Bucking
with Dow Chain Saw, Basedon
a Total Daily Operating Charge
of $31.80 (Dep., Upkeep, Gas, Oil
& Wages for 3 Men @ $9.60
Each.
1.00
90
80
70
60
50
40
30
20
10
Cost Per 1000 Bd. Ft.
30
40
50
60
70
80
90
100
110
Daily Production (8 hrs.) Falling & Bucking


70
60
50
40
30
20
Cost Per 1000 Bd. Ft.
30
40
50
60
70
80
90
100
Daily Production (8hrs.) Bucking
Cost of Bucking with Gasoline
Power Drag Saw, Based on Total
Daily Operating Charge of $21.50
(Dep., Upkeep, Gas, Oil & Wages
for 2 Men Operating Saw @ $9.60 Each)


Cost of Bucking by Hand, Based on a Daily Total Operating Charge of $15.10 (Dep. on Tools, Filer & Scalers Wage & Buckers' Wages @ $9.60
Cost Per 1000 Feet
300
280
260
240
220
200
180
160
140
120
100
80
60
40
20
5
10
15
20
25
30
35
40
45
50
55
Daily Production (8hrs.) Bucking

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