SECOND EDITION

COST FINDING

FOR

TEXTILE MILLS

COTTON
WOOLEN
WORSTED
HOSIERY
UNDERWEAR

PUBLISHED BY

TEXTILES

A MONTHLY TECHNICAL JOURNAL FOR MILL MEN

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No. 47

ESTIMATE OF COST

Date May 17, 1916

STYLE 3704

Length Dressed 40 yds. Weight Woven, Width Woven 75.3 in.
Woven, 37 " Finished, 28 oz. Finished, 55 in.
Finished, 32.3 "

STOCK.

USE	SIZE	KIND	No.	Yarn per lb.	Yarn per Cut	PRICE	Cost per Cut	Per Yd Finished	MIXTURE OF STOCK
Face Wft	5/4	2560		5.1 oz	2 7/8	.67	8 54	.256	Face Wft. & Fill
Back Wft.	14/5	1280		1.7	4 1/4	.21 1/2	91	.027	50 lbs. Cape .70 $35.
									50 " Peruv. .58 25.
Face Fill	5/4		40	5.4	12 1/2	.67	8 38	.252	60.
Back Fill	7/8		20	7.2	3.97	.164	6 25	.185	10 lbs. Waste .10 1.
									59.
			60	29.4			24 09	.723	12% Loss Yarn .67 per lb.

MANUFACTURING.

PROCESS, ETC.	Weight per yd.	AVERAGE Labor	AVERAGE Supplies	TOTAL PER CUT Labor	TOTAL PER CUT Supplies	
Dorting	82 lbs.	.004		328		
Scouring	28 "	1.67	1.25	102.		035
Picking	76 "	.0032	.0020	243		22
Carding	182 Runs	.0046	.0005	837		145
Spinning	182 "	.008	.0002	1456		037
Spool. & Twist	6 Deg	.0576	.0007	341		023
Weav. Day	37 yds.	.023	.0031	925		114
" Piece	37 "	.096		3 55		
Piece Dyeing	37 "	.007	.024	259		888
Finishing	32.3 "	.0587	.016	1895		532
Tent & Mend	37 "	.0187	.0044	692		163
Steel	37 "	.008	.0292	296		108
Ins. Tax.	37 "		.0132			488
Freight	37 "		.0096			355
Federal	37 "	.0329	.0102	1 20		377
			Total	12 217	4 457	

Back Fill.
40 lbs. Cotton .10 4.
20 " Noils .17 3.40
20 " Noils .21 4.20
20 " Waste .05 1.
12.60
20 lbs Loss
Yarn .15 1/2 per lb.

COST PER FINISHED YARD.

Stock,	.723
Labor.	.367
Supplies,	.134
Total	1.224

COST FINDING IN TEXTILE MILLS

FINDING THE COST OF WOOL GOODS.

A reliable system of cost finding must be based on accurate statistics of production and cost in the different departments of the mill. These statistics should be compiled monthly and for at least a year in order to include all the charges, some of which, such as taxes, cannot be conveniently calculated monthly. Take a woolen mill for illustration. The monthly record should give the aggregate cost of day labor of piece work and of supplies for each department and the production of the respective department as shown below:

Sorting: Grease weight.

Scouring: Scoured weight.

Dyeing: Weight of raw stock. Length and weight of cloth.

Picking: Weight.

Carding: Runs spun. Runs per set.

Spinning: Runs spun. Runs per spindle. Average size of yarn.

Dressing and Spooling: Pieces beamed. Average sections. Section pieces.

Weaving Yards: Weight. Average ounces per yard. Average picks. Percentage of efficiency.

Finishing: Yards. Weight. Average ounces per yard. Allowances. Remnants. Seconds.

The general charge should be classified under the following heads: Fuel, Freight, Iron and Wood Work.

At the end of the year the reports for that year should be combined and the items, such as taxes, insurance, etc., included so as to cover the total cost.

The production of the weave room, as shown by each monthly or annual report, is reduced to the equivalent on the basis of say 50 picks per inch. Thus if 1,000 yards of 40-pick cloth is woven the equivalent would be 800 yards of 50-pick cloth.

The report shows the average cost of day labor, of piece-work and of supplies for each department per unit of production for that department; thus: scouring, per 100 pounds; carding and spinning, per 100 runs; weaving, per yard woven.

In addition the average cost of each item, day labor, piece-work and expense, for each department and for each division of the general expense, is calculated per woven yard of 50 picks per inch.

Having compiled these statistics, the manufacturer is in a position to calculate the cost of each style of goods, either before, during or after the process of manufacture, as shown by the accompanying illustration.

The quantities of material per cut are calculated for each department and extended at the averages as shown by the mill statistics.

The cost averages for iron and wood work, fuel, insurance and taxes, freight and general expense are calculated from the average cost per yard of cloth having 50 picks per inch. Thus in the accompanying estimate of cost for Style 3704, the cost of freight for 50-pick cloth is $.008 per yard. As there are 60 picks per inch in Style 3704, this item is increased in proportion:

$(.008 \times 60) \div 50 = \$.0096$ per yard.

If the fabric should have less than 50 picks per inch, the average cost would be reduced in proportion.

The cost of raw material is calculated from the amount of material required and the purchase price. The calculation is shown in the accompanying illustration under the headings, "Mixture of Stock" and "Stock."

This application of the method to a woolen fabric illustrates the principle as applied to worsteds.

MAIN 19.

COST FINDING FOR COTTON MILLS

By W. A. Merrill

The method described in these articles is in use in a number of New England mills. It is not offered as the "only way of salvation," but in the main it is a practical and accurate method. It requires a good many figures, but no more than are necessary.

Some may say that the system to be described is complicated. Admitted, but it is a complicated situation which we have to deal with.

Carding Room

Cost per pound for One WEEKS, or 54 hours ending, May 5 1917

Hank Roving	2.00	Cost per lb.		Cost per lb.	3.00	Cost per lb.		Cost per lb.	4.00	Cost per lb.		Cost per lb.		Cost per lb.		Cost per lb.	TOTALS
lbs.	14352				29022				35368								59,742
WAGES																	
Picking																	
Carding																	
Drawing	99 46	.693			133 74	.693			176 14	.693							414.36
Slubbing																	
Intermediate	22 84	.159			81 44	.157			43 20	.174							97.48
Fine	28 06	.195			54 36	.272			92 10	.363							174.52
TOTAL WAGES	150 36				224 56				311 44								686.36
COST PER LB.		.1047				.1122				.1226							
GEN. EXP.	29 32				43 78				60 84								133.94
COST PER LB.		.2014				.219				.1240							
COST PER LB.																	
TOTAL MFG'G & EXP.	179 68				268 34				372 28								820.30
TOTAL COST PER LB.		.1251				.1341				.1446							

Av. Hank 3.18 Av Cost per lb .1373 John Doe Overseer.

The system will not run itself but it will pay to run it.

There are a great many interesting and helpful facts about a mill which are disclosed by a system of cost finding, and which in themselves are alone worth the labor and expense involved.

In a large mill each department is supposed to make out its own cost sheets. In a small mill this might not be possible.

There must, however, be some one person, a cost clerk, whose duty it is to gather all these figures and facts and weld them together.

It is not possible to devise a system that will fit exactly the condition and needs of every mill. The method offered is capable of being readily adjusted to the requirements of any mill, for the reason that the underlying principles are always the same.

About all that would be necessary in order to adapt this system to any plant would be the addition of sections covering such processes as are peculiar to the mill.

It would be an ideal condition if mills making similar grades of goods would estimate and keep their costs by the same method.

Not only should a mill be able to estimate its costs, but it should also have a system whereby it could prove up its estimates. All of these features will be shown as we progress.

Any system of cost is better than none. For example, a mill might use an erroneous method which would not accurately show the cost of any given piece of goods or count of yarn, and which, nevertheless, would be valuable by showing which of several styles of goods were the more profitable, all being figured in the same manner and on the same basis.

Too much dependence, however, should not be placed on an estimate of cost known to be faulty. The writer knows of a Southern mill which showed a good profit on the "sounding sheet" and yet failed for a large amount within a year.

Filling Spinning Room

Cost per pound for One WEEKS, or 54 hours ending Sept. 23 191

	13s	Cost per lb.	16s	Cost per lb.	19s	Cost per lb.		Cost per lb.		Cost per lb.		Cost per lb.		Cost per lb.		TOTALS
Spindles	832		832		832											2496
Pounds	2624		2028		1668											6320
WAGES																
Spinning	13 32		13 32		13 32											39.96
Doffing	8 50		6 50		5 24											20.24
TOTAL WAGES	21 82		19 82		18 56											60.20
COST PER LB.		.831		.977		1.112										
GEN. EXP.	6 48		6 48		6 48											19.44
COST PER LB.		.247		.319		.388										
COST PER LB.																
TOTAL WAGES & EXP.	28 30		26 30		25 04											79.64
TOTAL COST PER LB.		1.078		1.296		1.500										

Av No 15 55

Av. Cost per lb 1.260

Warp Spinning Room

Cost per pound for One WEEKS, or 54 hours ending Sept 23 191

Yarn No.	7s	Cost per lb.	8s	Cost per lb.	10s	Cost per lb.	12s	Cost per lb.	14s	Cost per lb.	16s	Cost per lb.	18s	Cost per lb.	20s	Cost per lb.	TOTALS
Spindles	416		2080		484		2778		504		920		3952		7144		18278
Pounds	2216		10556		1830		10776		1620		2510		9106		14966		53580
WAGES																	
Spinning	6 66		33 28		7 74		36 40		6 04		12 70		63 24		88 08		254.14
Doffing	8 76		20 20		3 52		16 76		2 36		4 16		17 60		22 20		95.56
TOTAL WAGES	15 42		53 48		11 26		53 16		8 40		16 86		80 84		110 28		349.70
COST PER LB.		.664		.507		.615		.493		.518		.672		.888		.737	
GEN. EXP.	3 24		16 30		3 80		21 78		3 94		7 20		30 98		56 24		143.46
COST PER LB.		.140		.154		.207		.202		.243		.287		.340		.376	
COST PER LB.																	
TOTAL WAGES & EXP.	18 66		69 78		15 06		74 94		12 34		24 06		111 82		166 52		493.18
TOTAL COST PER LB.		.806		.661		.822		.695		.761		.959		1.228		1.113	

Av. No. 14 44

Av. Cost per lb. .902

A sounding sheet is a statement designed to show the rate of profit or loss of a mill at any given date. It shows the estimated cost and the net yield from the selling price for each style, the difference between the two being the estimated profit or loss. The sounding sheet also shows the number of spindles or looms running on each grade of yarn or style of goods, and the corresponding profit or loss per day,

week or month. The production of each grade or style is extended at the respective profit or loss. The difference between the total of the profit items and the total of the loss items gives the rate of profit or loss of the mill for the given period. The report is called a sounding

Spooling Room

Cost per pound for One WEEKS, or 54 hours ending Sept. 23 191

Yarn No.	8s W. P.	Cost per lb.	8s	Cost per lb.	10s	Cost per lb.	12s	Cost per lb.	14s	Cost per lb.	16s	Cost per lb.	18s	Cost per lb.	20s	Cost per lb.	TOTALS
Pounds	2544		4272		3408		7440		720		960		7344		13968		40656
WAGES																	
Spooling	18 54		17 80		15 62		34 10		3 46		4 60		36 72		69 84		200.68
TOTAL WAGES																	
COST PER LB.																	
GEN. EXP.	2 42		2 32		2 04		4 44		46		60		4 80		9 12		26.20
COST PER LB.																	
COST PER LB.																	
TOTAL WAGES & EXP.	20 96		20 12		17 66		38 54		3 92		5 20		41 52		78 96		226.88
TOTAL COST PER LB.		824		471		516		517		544		542		556		566	

Av. No. 15 12

Av Cost per lb. .558

Warping Room

Cost per pound for One WEEKS, or 54 hours ending Sept. 23 191

Yarn No.	8s	Cost per lb.	10s	Cost per lb.	12s	Cost per lb.	15s	Cost per lb.	18s	Cost per lb.	20s	Cost per lb.		Cost per lb.		Cost per lb.	TOTALS
Yards	1247		124		470		434		240		500						189244
Pounds	5236		5406		10086		14700		5538		16012						56928
WAGES																	
Warping	6 17		6 17		23 38		21 59		11 94		24 87						94.12
TOTAL WAGES																	
COST PER LB.																	
GEN. EXP.	66		66		2 48		2 29		1 27		2 64						10.00
COST PER LB.																	
COST PER LB.																	
TOTAL WAGES & EXP.	6 83		6 83		25 86		23 88		13 21		27 51						104.12
TOTAL COST PER LB.		130		126		257		162		238		218					

Av No. 15 05

Av Cost per lb .183

sheet because it is intended to show how near the mill is to the breakers.

A mill is usually obliged to sell its product at the market price, irrespective of cost, but with an accurate knowledge of costs a mill can select the more profitable styles.

Sometimes for the sake of running full it is a good plan to manu-

facture a style showing a small margin of profit, or none at all, but the mill manager should know which style is yielding the small return.

The cost of the same count of yarn or style of goods will vary in different mills, even where labor and materials cost the same. A mill might be laid out to make certain numbers of yarn, say 10s to 20s, another to make 40s to 80s, and yet another to make all of these counts. It is obvious that if the same system of cost finding is em-

Dressing Room

Cost per pound for One WEEKS, or 54 hours ending Sept 23 19

Yarn No.	10s	Cost per lb.	14s	Cost per lb.	15s	Cost per lb.	16s	Cost per lb.	18s	Cost per lb.	20s	Cost per lb.		Cost per lb.		Cost per lb.	TOTALS
Yards	20M		24		26		5		30		94						199M
Pounds	2968		1192		9622		1112		3446		10374						28714
WAGES																	
Dressing	6	14	7	37	7	98	1	54	9	21	28	86					61.10
TOTAL WAGES																	
COST PER LB.																	
GEN. EXP.		75		90		98		19		113		355					2.50
COST PER LB.																	
COST PER LB.																	
TOTAL WAGES & EXP.	6	89	8	27	8	96	1	73	10	34	32	41					63.60
TOTAL COST PER LB.		232		694		994		156		300		313					

Av No. 16.65

Av Cost per lb .239

Web Drawing Room

Cost per pound for One WEEKS, or 54 hours ending Sept 23 191

Kind of Goods		Warps	Pounds	Wages				General Expense		Total Wages and Gen. Ex.		Total Cost Per Pound	
4567		10	2013	10	20			1	00	11	20		556
4570		9	1620	9	03				90	9	93		613
4734		12	2520	11	20			1	20	12	40		492
4962		16	3100	17	36			1	60	18	96		612
4963		22	4532	14	37			2	20	16	57		366
		69	13785	62	16			6	90	69	06		501
												Average Cos	
												.501	

ployed in these three mills, assuming that they are of about the same size, the cost will vary on any given number of yarn.

In mills having a wide range of yarn counts, it would be necessary, in order to arrive accurately at the cost of a given count of yarn, to apportion the general labor expense of a department according to its relation to the labor cost and not according to the spindles, yarns or

looms. For example, it takes more oversight to care for the frames spinning coarse numbers than for frames on fine yarn. There is more roving to be carried and more yarn to take away. There being more help on coarse work, more attention is required from the overseers and others.

Even though a mill were running on one style of goods only, it would be well to know the cost of each kind of yarn entering into the cloth, and not the average cost only, so that in the event of its being necessary to change the mill over to another style, the cost of the new fabric could be accurately estimated.

Weaving Room

Cost per pound for One WEEKS, or 54 hours ending Sept 23 191

Kind of Goods	Loom Days		Pieces	Pounds	Wages	Cost per Pound	General Expense	Total Wages and Gen. Ex.	Total Cost Per Pound			
4567	140			1490	46 19	3100	21 36	67 55	4534	Cost per		
4568	97			540	33 60	4000	14 80	48 40	5762	Loom per Day		
4570	306			3960	90	2500	46 70	145 70	3679	Hand		
4632	210			1944	58 32	3000	32 04	90 36	4648	Ex.		
4734	96			1117	31 27	2800	14 64	45 91	4111	11.2 cts		
4834	410			7310	146 20	2000	62 72	208 92	2860			
4872	351			8940	160 92	1800	53 56	214 48	2399			
4962	114			1216	31 61	2600	17 39	49	4030			
4963	208			3015	72 36	2400	31 79	104 15	3456			
										Average Cost per lb. for 9,267		
	1932			29832	679 47	2277	295	974 47	3267			

Finishing Room

Cost per pound for One WEEKS, or 54 hours ending Sept 23 191

Kind of Goods	Pieces	Pounds		Overseer	Napping	Starching Calendar	Tentering	Total Wages	Total Wages Per Pound
1	350	3500		7 00		3 50	7 00	17 50	.500
2	200	1200		4 00		2 00	4 00	10 00	.833
3	600	4800		12 00		6 00	12 00	30 00	.625
4	300	3600		6 00	18 00			24 00	.666
5	400	2800		8 00		4 00	8 00	20 00	.714
6	600	3600		12 00		6 00	12 00	30 00	.833
7	80	720		1 60		80	1 60	4 00	.555
8	90	810		1 80		90	1 80	4 50	.555
9	200	2400		4 00	12 00			16 00	.666
10	300	3300		6 00		3 00	6 00	15 00	.455
	3120	26730		62 40	30 00	26 20	52 40	171 00	

The figures inserted in the sheets which follow do not represent the actual results in any particular mill, but have been selected solely for illustrating the method of cost-finding.

In all of the cost sheets the decimal point is placed at the right of the cents. For example, instead of expressing one cent .01000, it is written 1.000.

All the cost sheets should be kept in loose leaf form so that as they come in from the mill they may be filed in a suitable binder.

Cost of Carding

The product of this department is that which is sent to the spinning room and not that which is sent from coarse to fine speeders.

According to this sheet the mill is making 2.00, 3.00 and 4.00 hank roving.

As all the stock for these rovings has the same treatment through all the processes up to and including the slubbing, we may bunch the cost of these processes together. When we come to the intermediates the 2.00 hank is made from a coarser intermediate roving than the 4.00 hank and consequently from this point we must separate the cost of the different rovings.

The various processes should be brought together on the payroll sheets, also the general expense, overseers, etc., in order to facilitate getting the total cost of labor for each process.

As most mills pay piece work prices it will be easy to ascertain the product and labor cost totals for each process.

The general expense in the carding room is distributed according to the labor cost on each hank roving or by the percentage which the general expense bears to the labor cost. It can be spread in proportion to the spindles run on each roving, but, as already stated, this

Waste Account for 3 Months ending Sept. 30

Cotton Used 1000 bales		500,000 lbs.	$100,000
Stock in Process Sept. 30	140,000 lbs.		
June 30	130,000 "		
Gain	10,000.		
Received for Waste Sold $4000, equal in value to cotton	20,000.		
Production of Cloth	400,000 "		
Total Product		430,000.	
Net Waste 14%		70,000 "	
Gross Waste 18%		90,000 "	

would be incorrect as the general oversight for the finer roving is not as expensive as for the coarse roving.

Having found the labor cost to be $686.36 and the general expense to be $133.94, the proportion of general expense is found as follows:

$133.94 (gen. exp.) ÷ $686.36 (labor) = 19.5 per ct.

The general expense is therefore equal to 19.5 per cent. of the total labor.

The general expense is then divided proportionately among the different sizes of roving as follows:

2.00 hank roving:
- Labor $150.36
- Gen. Ex., 19.5% $29.32
- Total $179.68

3.00 hank roving:
- Labor $224.56
- Gen. Ex., 19% 43.78
- Total $268.34

4.00 hank roving:
- Labor $311.44
- Gen. Ex., 19.5% 60.84
- Total $372.28

The costs per pound are found by dividing these totals by the number of pounds of the respective sizes:

$179.68 ÷ 14,352 (lbs.) = 1.251, cost per lb. for 2.00 hank roving
$268.34 ÷ 20,022 (lbs.) = 1.341, cost per lb. for 3.00 hank roving.
$372.28 ÷ 25,368 (lbs.) = 1.466, cost per lb. for 4.00 hank roving.
$820.30 ÷ 59,742 (lbs.) = 1.373, average cost per lb. for entire production.

These results show plainly the importance of calculating the proportionate cost for each number instead of taking the average cost of the entire production as the cost of each number. In the above exhibit, the average cost is 12 points higher than the proportionate cost for 2.00 hank roving, and 9 points lower than the proportionate cost for 4.00 hank roving. Thus an estimate based on the average cost per pound, involving such great discrepancies in the cost of five or six processes, would be a long way from the actual cost of a given yarn.

The wider the range of rovings made the greater will be the variation of the cost of the fine and coarse numbers from the average.

Filling Spinning Room

It is best to separate the filling spinning from the warp spinning even though they may both be in the same room. If this is not done there is danger of mixing the filling up with the warp of the same numbers.

The product can be measured either by hank clocks or by the number of doffs. It simplifies the work of cost finding to make up a sheet showing the standard price paid per spindle for spinning and per hank for doffing. If a record is kept of the number of doffs of each yarn size, that will serve in place of the hanks for determining the labor cost of doffing.

The basis for spreading the general expense in the spinning department is the number of spindles run. Note the difference between the cost of 13s filling and of 19s.

The cost system for warp spinning is the same as for filling.

Cost of Spooling

The method adopted for finding the cost of spooling will be evident from the accompanying form. The weight of each size of yarn is given and the general expense is apportioned by the percentage that the total amount bears to the total amount paid for labor. For example, the total general expense is equal to 13.1 per cent. of the labor cost. The cost of labor on 2,544 pounds of 8s yarn is $18.54, the proportion of the general expense charged to this yarn being (18.54 × .131) $2.42. The ends of the 8s yarn marked W. K. are tied with weaver's knots.

Cost of Warping

The help in the warping room being paid by the hour, the labor cost and general expense are each apportioned according to the weight of each count, as shown by the following example, taken from the accompanying form:

Cost of labor:

$94.10 ÷ 1.892 = .04974 per thousand yards.
1.24 × .04974 = $6.17, cost of labor on 8s yarn.

Slashing or Dressing

The cost in the slashing or dressing department is found by the same method as that given for warping. The sets with a large number of ends will cost less than those having a small number. It is more expensive to slash a set with 1,400 ends than one with 4,000, although the 1,400-end set may be run through at a higher speed, which will reduce the cost somewhat.

The 15s yarn shown on the sheet was used in a set with a large number of ends. This accounts for the proportionately greater weight, as compared with the yardage.

Web Drawing

On this sheet we begin to separate one style of goods from another. The general expense is spread at so much per warp.

To find the expense per warp divide the amount paid for general expense by the number of warps drawn in.

Where one overseer has charge of several processes, his pay, as well as the pay of those who assist him, should be split up in such proportions as seem right.

Cost of Weaving

The report shows the cost of weaving in a mill in which the weavers were paid by the pound. When they are paid by the piece it will be necessary to keep a record of the pieces woven, as well as the weight. The general expenses, including wages of overseer, fixers, etc., are charged to the respective styles of goods in proportion to the looms run on each style.

For example, the number of looms run on Style 4567 during the week was equal to one loom for 140 days, or 7¼ per cent. of 1932 loom days, the total for the room. Accordingly 7¼ per cent. ($21.36) of the total general expense ($295) is charged to this style of goods.

There are 322 looms in the room, making 1932 loom days per week when running full time. The production (29,832 lbs.), wages ($679.47) and general expense ($295) are given for the week. The general expense (15.26 cents) per loom per day is found by dividing the total for the week ($295) by the total number of loom days (1932). This cost per loom per day is the basis on which the cost of a given style is estimated.

Some mills make both plain and fancy goods in the same room, a fixer running a smaller number of the looms on fancy goods than on plain weaves. In order to arrive at the cost of each style in such mills it is necessary to have a set price per loom for the general expense on the plain goods and the balance of the overhead expense spread on the fancies. It is wrong to charge a plain loom with as much expense for oversight as is charged to a fancy loom. The plain loom does not call for the skill nor attention that the fancy loom requires. This is also true where wide and narrow goods are made in the same room. An accurate cost cannot be reached by charging to a loom making 40-inch goods as much for oversight as is charged to a 72-inch loom.

Cost of Finishing

The accompanying sheet illustrates the method of showing the cost of finishing. The cost of style 1, is ½ cent per lb. All of the processes, including folding, ticketing, etc., are in charge of the overseer. Certain styles pass through certain processes and should bear only the proportionate share of the cost. Those styles which have less work done on them should bear a proportionately smaller share of the cost. The average cost should not be used. The overhead charges, as well as the labor cost, are spread by the piece. The number of pieces and weight of each style are given, after which follow the proportionate costs of the overseer, napping, starching and calendering and tentering. The total cost for each style is then entered and from it is calculated the cost per pound, which is entered in the last column.

Waste Account

The waste report should be based on the drill or woven weight of the product and not on the finished weight.

Most goods, no matter what the finish is to be, will make practically the same waste as they come from the loom. Very coarse yarns will, of course, make more waste than fine yarns, but for all practical purposes goods made from the same stock may be figured with same percentage of waste, unless made from combed stock or some special process involving a larger amount of waste.

The gain or loss in the amount of stock in process must be allowed for, the gain added to the product from spindles or looms, and the loss deducted.

It is assumed that the money received from sales of waste is used to buy cotton at the average cost of cotton used for the period, this cutton being added to the product.

Efficiency Sheet

One of the most important factors in accurately estimating the cost of a fabric is the efficiency of the looms, which is indicated by the proportion of 100 per cent. production actually turned out. Experience shows which weaves will run well, but it sometimes happens that styles that can be run in the designing room will not run well in the weave room. The efficiency sheet shows exactly how they run.

The efficiency sheet shows the number of looms run on each style per day, the total for the week, also the number of pieces woven and the gross and net weight of the cloth woven.

The net weight is given, as some goods gain and some lose weight in finishing.

Efficiency Report Weave Room

One WEEKS, of 54 hours ending Sept 23 19

Style	LOOMS RUN							No. Pieces Woven	Gross Pounds Woven	Net Pounds Woven	Ends per loom	Picks per inch	Pieces per Loom per Day	Net Pounds per Loom per Day	100 per cent. of Weaving	Per cent. Woven of Possible Production	Yards off Looms per Loom per Day	Finished Yards per Loom per Day
	Mon.	Tues.	Wed.	Thu.	Fri.	Sat.	TOTAL											
473	19	20	18	16	18	18	109	167½	1018	1047	36	180	1.54	9.60	75	71.4	53.58	57.44
476	181	177	186	186	181	181	1092	1824	9395	9255	50	180	.81	8.46	54	77.2	41.27	74.27
497	38	37	38	36	36	35	220	1749½	1443	1422	54	180	.68	6.46	50	71.8	35.90	97.18
	238	234	242	238	236	235	1423	11993½	11856	11724	49.17	180	.84	8.24	59.67	76.4	42.58	76.63

The 100 per cent. production is the number of yards which would be woven in one day ($\frac{1}{6}$ week) if the loom were kept running without a stop. Dividing the actual yards woven by this 100 per cent. yardage gives the efficiency of the looms as indicated by the actual proportion of the 100 per cent. production obtained.

The number of finished yards per loom per day is calculated from the woven yards and the gain or loss in length in finishing. The finished yards and the net pounds are not essential except where there is a considerable gain or loss in finishing.

Assuming that the cost system has been in operation for a sufficient period, we now have the facts and figures required for estimating the cost of a given fabric.

The number of looms run on each style, number of pieces woven, weight of cloth woven, picks per inch and yards woven per day per loom are taken from the mill records. The number of pieces and the weight of cloth per loom per day are calculated from the production and the number of loom days. Thus for style 473:

167.5 ÷ 109 = 1.54 pieces per loom per day.
1047 ÷ 109 = 9.60 lbs. per loom per day.

The percentage of efficiency is calculated from the speed of the loom, picks per inch and yards per loom-day. Thus for style 473:

180 ÷ 36 = 500 yds. per 60 hrs., 100 per cent.
500 × .90 = 450 yds. per 54 hrs., 100 per cent.
450 ÷ 6 = 75 yds., per loom-day, 100 per cent.
53.58 ÷ 75 = 71.4 per cent., efficiency.

The finished length is obtained by increasing or decreasing the woven length to correspond with the estimated gain or shrinkage.

COST FINDING IN HOSIERY MILLS.

The methods of cost finding are in some respects the same for hosiery as for underwear. The yarn is considered the raw material, even when it is spun and knit in the same mill. In the latter case a separate cost system is used for the yarn department and the yarn is charged to the hosiery department at cost or with a profit added. The production of the knitting machines is taken as a basis for calculating the cost of fixed charges per dozen. Unlike underwear, however, the proportions of the different kinds of yarn cannot be calculated from the number of ends and sizes of the yarns, but must be determined by an analysis of a finished stocking.

Cost of Material.

The first step in cost finding for hosiery is to calculate the cost of material, and to do this the stocking must be analyzed to determine the proportions of the different yarns. To illustrate the process, we will assume that the cost is to be estimated for three grades of half-hose, A, B and C, which are made as follows:

	A	B	C
Needles in Cylinder	200	220	240
Rip Top	2/26	2/36	2/36
Leg	2/26	2/60	2/70
Heel and toe	2/26 and 2/60	2/40 and 2/60	2/50 and 2/70
High splice		1/50	2/100
Advanced toe		1/50 and 2/60	2/100 and 2/70
Weight per doz.	20 oz.	15 oz.	13½ oz.
	1.25 lb.	.937 lb.	.844 lb.

The weight is given in decimal parts of a pound in order to facilitate the calculation of the cost of yarn per dozen from the proportions and prices of the different yarns. The calculation of yarn cost for styles A, B and C is as follows, allowing 12 per cent. for waste:

Style A.

.067 lb.	2/60s	.55	$.037
1.183 lbs.	2/26s	.70	.82
1.25 lbs.			.857

$.857 ÷ .88 = $.974, cost of yarn per dozen.

Style B.

.10 lb.	1/50s	1.00	.10
.10 lb.	2/40s	.88	.088
.463 lb.	2/60s	1.10	.509
.275 lb.	2/36s	.80	.22
.938 lb			.917

$.917 ÷ .88 = $1.042, cost of yarn per doz.

Style C.

.125 lb.	2/100s	1.75	.219
.09 lb.	2/50s	1.05	0.94
.29 lb.	2/36s	.80	.232
.339 lb.	2/70s	1.20	.406
.884 lb.			.951

$.951 ÷ .88 = 1.081, cost of yarn per dozen.

Cost of Manufacturing.

Having found the cost of the yarn per dozen pairs of stockings, the next step in the process is to determine the cost of manufacturing, which for the purpose of cost finding is divided into two principal items, fixed charges and wages paid for piece work.

The classification of fixed charges is somewhat arbitrary, as under this head are included many items that strictly speaking are not fixed, but which vary more or less with the production of the mill. The amount of these charges per dozen can, however, be most easily determined by classing them with the charges that are actually fixed.

We will assume that such a record has been kept in a mill operating 200 machines on the three grades of hosiery, A, B and C. already described, and that the annual charges classed as "fixed" are found to be as follows:

Labor:		
Treasurer		$3,500.00
Superintendent		2,250.00
Bookkeeper		1,200.00
Overseer of knitting	$28.00	1,456.00
6 fixers	21.00	6,552.00
6 spare boys	8.00	2,496.00
Fireman	15.00	780.00
Engineer	21.00	1,092.00
Watchman	17.50	910.00
Shipping clerk	18.00	936.00
Packing clerk	18.00	936.00
Laborer	11.00	572.00
Machinist	20.00	1,040.00
6 inspectors	9.00	2,808.00
Overseer of mending	12.00	624.00
Extra man	16.00	832.00
Total labor		$27,984.00

$27,984 ÷ 52 = $538.15 per week
$538.15 ÷ 200 = $2.69, fixed labor cost per machine per week.

Expense:	
Depreciation	$5,000.00
Interest	5,000.00
Taxes	1,600.00
Insurance	300.00
Advertising	2,000.00
Fuel	3,750.00
Freight	1,500.00
Supplies	750.00
Repairs	1,500.00
Needles	800.00
Total expense	$22,200.00

$22.200 ÷ 52 = $426.15 per week
$426.15 ÷ 200 = $2.13, fixed expense per machine per week.

The amount of the fixed charges per dozen depends on the total charges and the production of the mill. We have just found the total charges and it now remains to find the production.

Production of Knitting Machine.

The production of a hosiery knitting machine, which measures the production of the mill cannot be calculated, as in the case of underwear, from the number of ends, counts and speeds of the yarn entering the machine, but must be found by an actual test of one or more machines running on the style in question. We will assume that a test has shown the production on Styles A, B and C to be as follows:

Style A, 30 dozen per machine per week.
Style B, 26 dozen per machine per week.
Style C, 22 dozen per machine per week.

The fixed charges per dozen are now calculated from the production and the charges per machine. Taking Style A for illustration:

$2.69 ÷ 30 (doz.) = $.089, fixed labor cost per dozen.
2.13 ÷ 30 (doz.) = .071, fixed expense cost per dozen.

Cost of Piece-Work.

The remaining items of cost consist of the prices paid for piece work. These vary with the different mills and kinds of goods, but for illustrating the method of cost finding we will assume these charges per dozen to be as follows for Style A:

Knitting rib top	$.005	Boarding	.02	
Cutting rib top	.005	Pressing	.01	
Topping rib top	.07	Mating	.02	
Transferring	.045	Stamping	.005	
Looping	.06	Ticketing	.005	
Turning	.005	Folding	.01	$.305
Mending	.03	Box and boxing	.05	
Turning 2d time	.005	Dyeing	.06	.11
Turning 3d time	.01	Piece work, dyeing and boxing		.415

Total Cost per Dozen.

A summary of the various items of cost gives the total cost per dozen of Style A:

Style A.

Yarn	$.974
Fixed labor	.089
Fixed expense	.071
Piece work, etc.	.415
Total cost per doz.	$1.549

We find that the piece-work on Style A is $.305 per dozen. As Styles B and C are made on 220 and 240 needle machines, the production will be less and a higher price will have to be paid for topping, transferring, looping and mending, making the piece-work cost 34 cents for Style B and 38 cents for Style C. With the cost of dyeing and boxing added these items amount to $.45 for Style B, and $.49 for Style C.

The total cost of Styles B and C are then summarized as follows:

Style B.

$2.69 ÷ 26 (doz.) =	$.104, fixed labor per doz.
2.13 ÷ 26 (doz.) =	.082, fixed expense per doz.
Yarn	$1.042
Fixed labor	.104
Fixed expense	.082
Piece work, etc.	.450
Total cost per doz.	$1.678

Style C.

$2.69 ÷ 22 (doz.) =	$.122, fixed labor per doz.
2.13 ÷ 22 (doz.) =	.097, fixed expense per doz.
Yarn	$1.081
Fixed labor	.122
Fixed expense	.097
Piece work, etc.	.49
Total cost per doz.	$1.79

If this method is carefully applied to a mill the result will be the cost of each style if the mill has been operated under the conditions on which the cost estimate is based. If, however, the cost is estimated on the basis of a full production and the actual production has been much less, due to any cause whatever, such as shortage of yarn, needles or help, the actual cost will be higher than the estimated. In order to find the mill cost of goods in advance of their manufacture it is necessary to have some reasonably stable basis of production. Selling prices of goods are based on the production of the industry and not on that of a particular mill among many. Buyers will not pay the prices based on costs in a mill turning out but part of its normal production. That being the case, the manufacturer must calculate the cost of the product on the basis on which selling prices are fixed, that of normal production.

Allowance for Seconds

The result as obtained by the above method is the average cost for the entire product of the mill, including "seconds," as well as "firsts." In order to eliminate the loss on seconds from the selling account, it is a common practice to allow for this loss by adding it to the calculated cost of the goods. One method of making this allowance is illustrated as follows:

On a style of hosiery a mill is making 1 dozen seconds selling at $1.10 per dozen for every 10 dozen of "first" selling at $1.60 per dozen.

$.50 (loss on 1 doz. seconds) ÷ 10 (doz. firsts) = $.05 per dozen.

This amount, $.05 per dozen, is added to the average mill cost as an allowance for the loss on "seconds." MAIN 19.

"STRAIGHT LINE" COST FINDING FOR KNIT UNDERWEAR.

The mill cost of knit goods is made up of two principal items, raw material and manufacturing. So far as cost is concerned the spun yarn is considered the raw material even when the yarn is made in the same mill in which the goods are knit. This method simplifies the accounts, particularly when a knitting mill is spinning part of the yarn it uses and buying the remainder. When a spinning plant is operated in connection with a knitting mill, a separate cost system is adopted for the yarn department, and the yarn is charged to the knitting department. A reasonable profit may or may not be added to the mill cost of the yarn, this depending on the judgment of the manufacturer. Adding a profit to the cost of the yarn is the best practice, as it places all kinds of yarn, whether bought or spun in the mill, on the same basis of value.

Cost of Yarn.

If a knitting mill is using but one kind of yarn, the cost of the yarn per pound, after making a fair allowance for waste, represents the cost of the yarn in a pound of knit cloth. There are, however, few, if any, knitting mills in which finding the cost of the material presents so simple a problem. In many mills every fabric is made of two or more kinds of yarn, differing in both size and cost per pound. The same mill may be making a large number of fabrics at the same time, no two of which are of the same construction or cost. While in such cases the cost finding problem is more complicated, the calculation is by no means difficult.

Take, for illustration, a cloth, A, knit on a circular machine from 4 ends of 50s merino costing 90 cents per pound, 4 ends of 48s worsted at $1.20 per pound, and 4 ends of 24s cotton at 40 cents per pound. The problem is to find the cost of the yarn in a pound of the knit cloth.

As equal lengths of the three kinds of yarn are used in making the cloth it follows that the respective weights of the three kinds of yarn in any given length delivered to the knitting machine will be the proportionate weights of these three yarns in the knit cloth. It makes no difference on what length this calculation is based, whether 1 inch, 1 yard, 1,000 yards, or what not, the proportionate weights will be the same. That being the case, a length convenient for calculation may be selected. The length most convenient for this purpose is that number of hanks which is easily divisible by each of the yarn counts after all have been reduced to the same basis. When the yarn counts are based on different systems of numbering, it is necessary to reduce all to the same basis, preferable the cotton count.

In the above case the 48s worsted is equal to 32s cotton, so that we have on the cotton basis of numbering:

4 ends merinos 50s
4 ends worsted 32s
4 ends cotton 24s.

As there are the same number of ends of each kind of yarn and as 2400 is a common multiple of the three counts, 60s, 32s and 24s, the calculation is based on 2400 cotton hanks of each kind of yarn fed to the knitting machine. The proportionate weight of each is then found as follows:

2400 ÷ 50 = 48 lbs. 50s merino
2400 ÷ 32 = 75 lbs. 48s worsted
2400 ÷ 24 = 100 lbs. 24s cotton
233 lbs.

The average cost per pound could be calculated directly from these quantities, but it is a good plan at this stage of the operation to reduce the proportions to percentages, which is accomplished by dividing the number of pounds of each kind of yarn by the total, 223, which gives the proportions, from which the average cost is readily calculated, on a basis of 100 pounds:

48 ÷ 223 = 21.5 per cent.	21.5 lbs.	.90	$19.35
75 ÷ 223 = 33.7 per cent.	33.7 lbs.	1.20	40.44
100 ÷ 223 = 44.8 per cent.	44.8 lbs.	.40	17.92
100 per cent.	100		$77.71

Allowing 2 per cent. for waste of yarn before knitting:

$77.71 ÷ 98 = $.792 average cost of yarn per lb.

The calculation of another fabric, B, made with an unequal number of ends of three kinds of yarn will illustrate a somewhat more complicated form of the problem. This cloth is knit from four ends of 50s merino at 60 ends per pound, 2 ends of 48s worsted at $1.20 per pound, and 2 ends of 24s cotton at 40 cents a pound. For every 1200 yards of each end fed to the knitting machine, there are the following lengths of each kind of yarn:

1200 × 4 = 4800 yards, 50s merino
1200 × 2 = 2400 yards, 48s worsted
1200 × 2 = 2400 yards, 24s cotton

The proportionate weights are then found, the 48s worsted being reduced to 32s, the cotton equivalent:

4800 ÷ 50 = 96 lbs. 50s merino 35.4 per cent.
2400 ÷ 32 = 75 lbs. 48s worsted 27.7 per cent.
2400 ÷ 24 = 100 lbs. 24s cotton 36.9 per cent.

The average cost per pound is then found:

35.4 lbs.	.90	$31.86
27.7 lbs.	1.20	33.24
36.9 lbs.	.40	14.76
100 lbs.		79.86

Allowing 2 per cent. for waste:

$79.86 ÷ .98 = $81.49
$81.49 ÷ 100 = $ .815, average cost of yarn per lb.

In calculating the production of the knitting machine on a particular style of knit cloth for the purpose of finding the cost of manufacturing, it is necessary, as will be shown later, to determine the weight in grains of each kind of yarn for 120 yards of a single end fed to the needles. The percentages of the various yarns can, if desired, be obtained from these grain weights for calculating the average cost per pound. Take for illustration the preceding example:

	Cotton No.	Cotton Equivalent.	Grains per 120 yds.	Per cent.
4E 50s merino	50	12½	80	35.4
2E 48s worsted	32	16	62.5	27.7
2E 24s cotton	24	12	83.3	36.9
Total			225.8	100.

Cost of Manufacturing.

The cost of manufacturing knit goods per unit of production depends on two factors, the total expense and the total production. Dividing the expense by the number of units in the production gives the average manufacturing cost per unit. The first step in cost finding is to determine the production of the mill. If all the machinery is running on one class of goods the problem is so simple as to call for no explanation, the production being found by counting or weighing the goods.

We are not studying the question of cost finding in that simple form, but are devising a system for finding the cost of knit goods when a number of widely different kinds of goods are being made in the same mill. The production and the total expense are still the determining factors, but it is necessary to adopt some method by which the expense of manufacturing will be apportioned fairly between the different kinds of goods, so as to determine what each particular style actually costs. This is accomplished by finding the production of each kind of goods from one knitting machine and then basing the unit cost for each style on the respective product.

Factors in Production.

The production of a knitting machine in pounds depends on:

(a) the number of ends;

(b) the speed of the yarn entering the machines;

(c) the size of the yarn;

(d) the amount of time lost during working hours.

The speed of the yarn as it is fed to the machine is readily determined by counting the revolutions per minute and measuring the length of one thread delivered at each revolution. This length may be found by any convenient and accurate method. Measure say 2½ yards (90 inches) of yarn from the needles, marking the two yard point with a spot of black grease or in any other way. Then turn the machine slowly by hand for one revolution and measure the distance still remaining between the needles and the spot, which we will assume is 12 inches. The difference, 78 in. or 2 1/6 yards, between the two lengths is the length of yarn knit at each revolution. The length per minute is then found by multiplying the length per revolution by the revolutions per minute. If the machine is running say 44 r. p. m., the speed of the yarn per minute will be:

$(78 \times 44) \div 36 = 95\ 1/3$ yards per minute.

Calculating the Daily Production.

Having found the speed of the yarn [yards per minute] the calculation of the production per day in pounds can be best explained by a concrete example:

Ex. A circular knitting machine is running 44 r. p. m., with 4 ends of 50s merino, 4 ends of 30s worsted and 4 ends of 25s cotton, each end entering at the rate of 78 inches (2 1/6 yards) per revolution of the cylinder. Find the production in 10 hours, assuming that the machine is idle for 5 per cent. of the time.

The speed of a single end is:

$(78 \times 44) \div 36 = 95\ 1/3$ yards per minute.

Weight of Yarn Entering Machine.

The next step is to find the weight of the 12 ends entering the machine. To do this the (12) ends are treated as if they were only one end. The calculation is simplified by the fact that the number of grains per 120 yards is equal to 1,000 divided by the cotton number. The weight of the yarn delivered to the machine in 10 hours is then readily calculated from the grains per 120 yards and the speed of the yarn. The operations are as follows:

(a) The yarn sizes are first reduced to the cotton basis.

(b) The ends of each size are reduced to the cotton equivalent.

(c) The cotton equivalents are converted to grains per 120 yards.

(d) The grains per 120 yards for the different yarns are added together, the total being the total weight of yarn delivered to the machine for every 120 yards of a single end.

These results (a, b, c, and d) are as follows:

	Cotton No.	Cotton Equivalent.	Grains per 120 yds.
4 E 50s merino	50	12½	80
4 E 30s worsted	20	5	200
4 E 25s cotton	25	6¼	160
		Total	440

We have already found that each end is fed into the machine at the rate of 95 1/3 yards per minute. As the 12 ends treated as one end weigh 440 grains per 120 yards, the productions in pounds per 10 hours (600 minutes) is easily found as follows:

$95\ 1/3 \times 600 = 57{,}200$ yards per 10 hours.

$(57{,}200 \times 440) \div (7{,}000 \times 120) = 29.9$ lbs. cloth per 10 hours.

Less 5 per cent. for lost time 1.5

Net production 28.4 lbs. per 10 hours.

The operations are given in detail in order to make them understood. In practice, however, the calculation can be shortened by reducing the formula to the following:

(Yds. per min. × grains per 120 yds.) ÷ 1400 = lbs. per 10 hours. Thus:
(95 1/3 × 440) ÷ 1400 = 29.9 lbs. per 10 hours.
Less 5 per cent ..... 1.5 lbs.
Net production.....28.4 lbs. per 10 hours.

We will now take for illustration a knitting room in which the pay-roll amounts to $24 per day for 60 machines running on eight different styles as follows:

Style.		Each End per Rev.	R.P.M.
1	4 E 50s merino.... 78 in.	44	
	4 E 30s worsted....		
	4 E 25s cotton.....		
2	8 E 15s cotton..... 86	54	
3	4 E 18s merino....145	48	
	4 E 20s cotton.....		
	4 E 100s cotton....		
4	4 E 40s merino.... 94	57	
	4 E 36s cotton.....		
	4 E 20s cotton.....		
5	4 E 75s worsted,... 79	55	
	4 E 30s cotton.....		
6	4 E 30s merino....111	48	
	4 E 30s worsted....		
	4 E 20s cotton.....		
7	4 E 30s worsted.... 80	55	
	4 E 18s cotton.....		
8	4 E 40s cotton.....112	57	
	4 E 30s worsted....		
	4 E 60s cotton.....		

The production per 10 hours is then calculated for each style of cloth as follows:

No. 1: Already calculated at 28.4 lbs. per 10 hours.

No. 2: (86 × 54) ÷ 36 = 129 yds. per min.
15 ÷ 8 = 1⅞ cotton No.
1000 ÷ 1⅞ = 533 1/3 grains per 120 yds.
(129 × 533 1/3) ÷ 1400 = 49.1 lbs.
Less 5 per cent.. 2.5 lbs.
Net production ..46.6 lbs. per 10 hours.

No. 3 (145 × 48) ÷ 36 = 193 1/3 yards. per min.
4 E 18s 4½ 222 grains
4 E 20s 5 200 grains
4 E 100s 25 40 grains
Total .....462 grains
(193 1/3 × 462) ÷ 1400 = 63.8 lbs.
Less 5 per cent..... 3.2 lbs.
Net production ..60.6 lbs. per 10 hours.

No. 4: (94 × 57) ÷ 36 = 149 yds. per min.
4 E 40s 10 100 grains
4 E 36s 9 111 grains
4 E 20s 5 200 grains
Total 411
(149 × 411) ÷ 1400 = 43.8 lbs.
Less 5 per cent.. 2.2 lbs.
Net production ..41.6 lbs. per 10 hours.

No. 5: (79 × 55) ÷ 36 = 120.7 yds. per min.
4 E 75s worsted 50s 12½ 80 grains
4 E 30s cotton 30s 7½ 133 1/3 grains
Total.....213 1/3 grains
(120.7 × 213 1/3) ÷ 1400 = 18.4 lbs.
Less 5 per cent..... .9 lbs.
Net production .....17.5 lbs. per 10 hours.

No. 6: (111 × 48) ÷ 36 = 148 yds. per min.
4 E 30s cotton 30s 7½ 133 1/3 grains
4 E 30s worsted 20s 5 200 grains
4 E 20s cotton 20s 5 200 grains
Total.....533 1/3 grains
(148 × 533 1/3) ÷ 1400 = 56.4 lbs.
Less 5 per cent..... 2.8 lbs.
Net production ....53.6 lbs. per 10 hours.

No. 7: $(89 \times 55) \div 36 = 136$ yds. per min.

4 E 30s worsted	20s	5	200 grains
4 E 18s cotton	18s	4½	222 grains
Total			422 grains

$(136 \times 422) \div 1400 = 41$ lbs.
Less 5 per cent.. 2 lbs.
Net production 39 lbs. per 10 hours.

No. 8: $(112 \times 57) \div 36 = 177$ yds. per min.

4 E 40s cotton	40s	10s	100 grains
4 E 50s worsted	20s	5s	200 grains
4 E 60s cotton	60s	15s	66 2/3 grains
Total			366 2/3 grains

$(177 \times 366\ 2/3) \div 1400 = 46.3$ lbs.
Less 5 per cent..... 2.3 lbs.
Net production....44 lbs. per 10 hours.

The payroll for the knitting room amounts to $24 per day or an average of $.40 for each of the 60 knitting machines. The average cost of labor per unit of production in the knitting department for each style is then readily found by dividing $.40 by the respective daily production. Thus for Style No. 1:

$.40 ÷ 28.4 = $.0141, knitting room payroll per pound.

Production and Cost of Manufacturing.

The following table gives the daily production and the average cost of labor in the knitting department for each style:

	Lbs. per day.	Pay roll per lb.		Lbs. per day.	Pay roll per lb.
No. 1	28.4	$.0141	No. 5	17.5	$.0228
2	46.6	.0086	6	55.6	.0074
3	60.6	.0066	7	39	.0102
4	41.6	.0096	8	44	.0091

The cost decreases as the production increases, the cost being highest, $.0228 per pound, for Style 5, which yields the smallest production, 17½ lbs. per day, and lowest, $.0066 for Style 3, which yields the largest production, 60.6 lbs. per day.

This calculation shows what the knitting labor cost of each style would be if the 60 machines were all running on the one style. For example, if the 60 machines were running on Style 1, the total production would be (28.4 × 60) 1704 lbs. per day, and the average knitting labor cost would be ($24 ÷ 1704) $.0141 per pound.

It will be readily understood that if all the machines were running on one style the total knitting room payroll would probably vary from the amount for the mixed room, being greater on some classes of goods and less on others. This fact, however, does not affect the soundness of the above method of apportioning the cost when two or more styles are made in the same room.

It should also be borne in mind that the cost thus found is based upon a full production from each machine. If the machines are idle for any cause, such as waiting for help, yarn or repairs, the manufacturing cost per pound will be higher by reason of the decrease in production. In such a case the manufacturer should not blame the method of cost-finding but should either keep the machines running or base his estimate of cost on less than a full production.

Calculating the Fixed Charges.

Calculating the fixed charges per unit of production is based on the same principle as that adopted for finding the cost of knitting per unit, which has already been explained. The production of the knitting machines is accepted as the production of the mill, it being assumed that the preparatory processes will keep the knitting machines supplied with yarn and that the

finishing departments will handle all of the knit cloth turned off by the knitting machines.

Having adopted this principle of cost-finding the next step is to classify all the remaining items of cost into three groups:

1. Work which is done by the piece.

2. Labor and supplies which should be separately calculated per unit of production because they are not involved in the production of all kinds of goods. For example, bleaching comes under this head, because some styles of underwear may require bleaching, while other styles are finished unbleached.

3. Fixed charges. Under this head are included all charges that are substantially permanent and which must be borne by the business regardless of what particular kind of goods are being manufactured. For example, taxes must be paid no matter what goods are manufactured in the mill, and accordingly taxes are a fixed charge. For the same reason, the costs of insurance, power, heating, lighting, repairs, watchman, office and superintending are included in the fixed charge of the mill. Under this head are also included the wages of overseers and other employees paid by the day in departments where the work is nearly all paid for by the piece.

No unvarying rules can be laid down for classifying fixed charges. Where there is doubt as to whether an item should be considered a fixed charge or placed under a head for separate calculation per unit of production, the question must be settled more or less arbitrarily in accordance with the judgment of the manufacturer.

Mill Statistics of Cost and Production.

Having classified the expenses of manufacturing under these three heads, it is necessary to determine what the charges classified as "fixed" amount to. This is done by keeping a systematic record of such charges and basing the cost estimate on the average.

The best way to keep this record is in the form of monthly statements, which serve a double purpose. They show the total fixed expenses for any desired period and they keep the manager of the mill informd as to the amount of these expenses from month to month. To obtain a reliable average for cost-finding purposes it is necessary to take the charges for a period long enough to include every kind of expense, say one year, as some of the charges, such as taxes and insurance, are entered only once a year.

Let us assume that these reports of fixed charges have been made for a year or more in the underwear mill and that a summary of them for the twelve months gives the following results:

Labor:		Expense:	
Drying Room	$780.00	Depreciation	$5,479.00
Watchman	730.00	Carting	520.00
Boiler House	936.00	Fuel	1,248.00
Superintendent	2,000.00	Power	1,560.00
Office	2,482.00	Taxes	1,092.00
Forewoman	780.00	Water Tax	312.00
Shipping Room	1,810.00	Insurance	364.00
Yard Man	624.00	Freight	764.00
Miscellaneous	528.00	Needles	364.00
	$10,680.00	Miscellaneous	1,311.00
			$13,014.00
Total Fixed Charges			$23,694.00

Fixed Charges Per Unit.

From the total thus obtained the fixed charges per pound of knit cloth, which is the unit of production, are determined by the same method used for calculating the cost of knitting per pound. The fixed charges per day for each knitting machine are first calculated:

Labor:

$10,680 ÷ 300 (days in one year) = $35.60 per day for 60 machines.

$35.60 ÷ 60 = $.593 per day for each machine.

Expense:

$13,014 ÷ 300 (days in one year) = $43.38 per day for 60 machines.

$43.38 ÷ 60 = $.723 per days for each machine.

Fixed charges per day for each knitting machine:

Labor	$.593
Expense	.723
Total	$1.316

Having found the amount of the fixed charges per day for each machine the rate per unit of production on any particular cloth is found by dividing the charges per day for one machine by the number of pounds of the respective style knit by one machine per day.

Take for illustration Style 1, on which the daily production per machine is 28.4 lbs.:

Style 1. Fixed Charges:

Labor	$.593 ÷ 28.4 =	$.0209 per lb.
Expense	.723 ÷ 28.4 =	.0254 per lb.
Total fixed charges		.0463 per lb.

In like manner the fixed charges per unit of production are calculated for each style, following being the results for the eight fabrics:

Style	Lbs. per day	Labor per lb.	Expense per lb.	Total per lb.
No. 1	28.4	.0209	.0254	.0463
2	46.6	.0127	.0155	.0282
3	60.6	.0098	.0119	.0217
4	41.6	.0142	.0174	.0316
5	17.5	.0339	.0413	.0752
6	55.6	.0106	.013	.0236
7	39	.0152	.0185	.0337
8	44	.0135	.0164	.0927

It having been assumed that these charges are "fixed," that is, of the same amount per year regardless of variations in the production of the mill, it follows that the rate per unit of production will be in inverse proportion to the production itself, increasing as the production decreases, and decreasing as the production increases.

This result is illustrated by the production and cost of the eight styles, 1 to 8, given above. Style No. 3, on which a machine gives the largest production, 60.6 lbs. per day, shows the lowest cost per pound for fixed charges, $.0098 for labor and $.0119 for expense, a total of $.0217, while Style No. 5, on which there is the smallest production, 17.5 lbs. per day, shows the highest cost per pound for fixed charges, $.0339 for labor and $.0413 for expense, a total of $.0752.

The fixed charges thus found for each style represent what the charges per pound would be if the entire mill were running on the respective style with the annual "fixed" charges unchanged. As this important feature of the system should be clearly understood, we will give a somewhat detailed illustration of it.

Let us assume that during the year there were 20 machines running steadily on Style 1, and 40 machines on Style 3. The production would then be as follows:

Style 1. 28.4 × 20 = 568 lbs. per day.
568 × 300 = 170,400 lbs. per year.

Style 3. 60.6 × 40 = 2424 lbs. per day.
2424 × 300 = 727,200 lbs. per year.

It has already been found that the fixed charges amounted to $.0463 per lb. for No. 1, and $.0217 per lb. for No. 3. Calculating the annual fixed charges at these rates on the production of the two styles, we have:

Style 1.	170,400 lbs.	.0463	$7,889.52
Style 3.	727,200 lbs.	.0217	15,780.24
			$23,669.76

The annual fixed charges of the mill amounted to $23,694. Thus the actual production of the two styles when extended at the calculated rates per pound give an amount equal to the actual fixed charges for the year, demonstrating the accuracy of the rate per pound for each of the two styles.

An equally exact agreement between the calculated fixed charges per pound for the different styles and the actual fixed charges of the mill will be obtained by this "straight line" system of calculating cost, regardless of the number of styles made in one mill or the number of machines run on each style from day to day.

One point should be borne in mind in connection with this system of cost finding. It is necessarily based on the assumption that the machines are operated at full capacity, and that the amounts taken for the annual fixed charges are correct.

If for any reason the mill is forced to incur extraordinary expenses in the nature of general charges in any one year, or if such charges are materially less than the amount on which the calculated averages per pound are based, the actual averages per pound will be more or less than the calculated amounts.

Moreover, if the mill is not run to full capacity or if the actual production is larger than the amount on which the calculated averages are based, then the actual averages per pound will necessarily be more or less than the calculated amounts

Such variations, however, do not affect the accuracy or value of the "straight line" system of cost finding.

Cost per Dozen.

Having explained the method of finding the cost of material, the production for each style of goods and the fixed charges per pound of knit cloth, we come now to the calculation of the total cost of underwear per dozen suits. Some mills may carry on one or more processes, such as bleaching or dyeing, for which the cost must be calculated separately. This is done by keeping a monthly record of the production and the cost of labor and supplies, for example, in a bleaching room, for, say six months or a year. From this record the average cost per unit of production is found, and this average is used in calculating the cost per dozen, as will be explained later.

In most knitting mills, however, the goods are bleached and dyed in outside establishments at a fixed price. In such cases the cost of bleaching or dyeing is known for each style without the necessity of keeping a monthly statistical record.

We will assume that in the mill taken for illustration the goods are bleached by contract at a fixed price per pound. It is also assumed that the goods are made in the 60-machine mill used for illustrating the previous articles and with the fixed charges as already given.

Fixed charges per day for each knitting machine:

Labor	$.593
Expense	.723
Total fixed charges	1.316

We now have to calculate the total cost of each style per dozen, and will explain the method by an estimate of Style 329, a ladies' two-piece suit, weighing 7 pounds per dozen suits and made of knit fabric No. 3, as follows:

4 Ends 18s 32 cents per lb.
4 Ends 20s 41 cents per lb.
4 Ends 100s 85 cents per lb.

Machine, 48 revolutions per minute, 145 inches of each end of yarn per revolution.

To shorten the operation we will calculate the average cost of the yarn from the grain weights per 120 yards of the different kinds of yarn in the cloth.

The average cost of the yarn per pound can be calculated directly from the grain weights, treating the grains as pounds, but the reduction to percentages is the better practice, as it shows the percentages of each kind of yarn in each fabric, enabling a comparison to be made between different fabrics. Then the average cost is found from the percentages and yarn prices per pound. Thus for Style 329:

4 E	18s	4½s	222 gr.	48	per cent.
4 E	20s	5 s	200 gr.	43.3	per cent.
4 E	100s	25 s	40 gr.	8.7	per cent.
Total per 120 yards			462 gr.	100	per cent.

48	lbs. .32	$15.36
43.3	lbs. .41	17.75
8.7	lbs. .85	7.39
100	lbs.	40.50

$40.50 ÷ 100 = .405, cost of yarn per pound.

The cost of yarn per dozen suits of Style 329 is now found as follows:

Two piece suits, finished,	7 lbs. per doz.
Waste (found by actual test)	1.1 lbs.
Yarn per doz. suits	8.1 lbs.

8.1 lbs. $.405 $3.28, cost of yarn per doz. suits.

The next step is to find the production of the knitting machines when running on this particular style. This is done by the method already explained, and which it may be well to explain briefly again. First, the speed of the yarn in yards per minute is found.

(145 × 48) ÷ 36 = 193 1/3 yards per minute.

Next, the production in pounds per 10 hours is calculated:

(193 1/3 × 462) ÷ 1400 =	63.8 lbs.
Less 5% for lost time	3.2 lbs.
Net production per 10 hours,	60.6 lbs.

The fixed charges per pound for Style 329 are then found:

Labor	$.593 ÷ 60.6 = .0098	per lb.
Expense	.723 ÷ 60.6 = .0119	per lb.
Total fixed charges,	.0217	

We now come to the calculation of the piece work and trimmings. These values are taken from the prices paid in the mill in which the goods are made. The prices given in the following statement are not to be taken as the actual costs in any mill. They are used here simply to illustrate the "straight line" system of cost finding.

Piece work costs per dozen suits:

Cutting	.015
Seaming	.02
Gussets	.015
Cover seaming	.01
Button stay	.02
Cuttings necks	.015
Sewing lace	.015
Button holes	.007
Button sewing	.01
Cutting sides	.015
Crochet	.01
Merrow shell	.015
Finishing	.02
Steaming	.015
Inspection	.005
Boxing and Folding	.01
Bleaching	.01
Piece work per doz. suits	.227

Trimmings:

Buttons	.01
Lace	.015
Silk	.005
Facing	.01
Thread	.005
Trimmings per doz. suits	.045

A summary of the results of the calculations gives the mill cost per dozen suits.

Yarn	$3.28
Fixed charges	.022
Piece work	.227
Trimmings	.045
Cost per doz. suits	$3.574

The result of the calculations represents the cost of this particular style, 329, when manufactured under the assumed conditions. The cost for other styles is found by the same process, the difference in the result being due to the variation in construction and production, cost of yarn, production of knitting machines and in the finish and weight of the garment MAIN 19.

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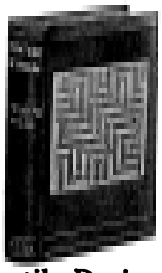

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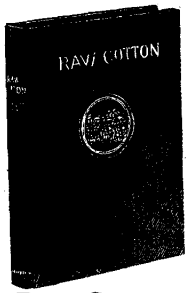

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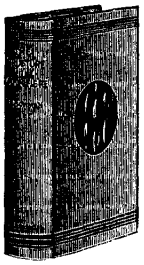

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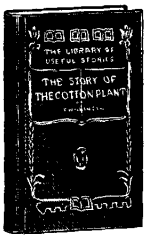

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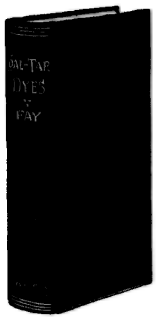

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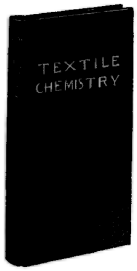

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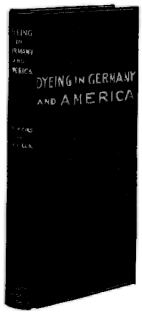

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