A STUDY OF THE ECONOMIES OF SIZE IN NEW ZEALAND DAIRY FARMING

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the requirements for the degree of
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VOLUME II

APPENDIX A

FARM SURVEY DATA

Table A.1 Types of Labour Units Employed on the Group I Survey Farms

Farm No.	Season 1968/69	Season 1969/70
1	Owner Operator	Owner Operator
2	Partner (family)	Partner (family)
3	Owner Operator	Owner Operator
4	Owner Operator	Owner Operator
5	Sharemilker	Sharemilker
6	Sharemilker	Sharemilker
7	Sharemilker	Sharemilker
8	Owner Operator	Owner Operator
9	Owner Operator	Owner Operator
10	Sharemilker	Sharemilker
11	Manager (e)	Manager (e)
12	3 Managers (e)	Manager (e)

NOTES: i) The term 'Manager' is used to describe those labour units who are concerned with the managerial function:

On those farms where the organisation is described as a company;

On those farms where the organisation is described as a trust;

On those farms where the organisation is described as a combination;

ii) The abbreviation (e) denotes that the labour unit is also concerned with the entrepreneurial function.

Table A.2 Types of Labour Units Employed on the Group II Survey Farms

Farm No.	Season 1968/69	Season 1969/70
13	Partner (family) Single man	Partner (family) Single man
14	Owner Operator Married man	Owner Operator Married man
15	Sharemilker Single man	Sharemilker Single man
16	Owner Operator Married man	Owner Operator Married man
17	Owner Operator Single man	Owner Operator Single man
18	2 Managers (e)	2 Managers (e)
19	Manager (e) Single man	Manager (e) Single man
20	Manager (e) Married man	Manager (e) Married man
21	2 Managers (e)	2 Managers (e)

NOTE: The abbreviations used are as for Table A.1.

Table A.3 Types of Labour Units Employed on the Group III Survey Farms

Farm No.	Season 1968/69	Season 1969/70
22	Manager (e) Married man	Manager (e) Married man
23	Sharemilker 2 single men	Sharemilker 2 single men
24	Partner Married man Single man	Partner Married man
25	Manager (e) Married man Single man	Manager (e) Married man Single man
26	2 Managers (e) Married man	2 Managers (e)
27	Manager (e) Married man Single man	Manager (e) Married man Single man
28	Owner Operator 2 Married men	Owner Operator 2 Married men
29	2 Partners Single man	2 Partners Single man
30	Sharemilker Married man Single man	Sharemilker Married man Single man

NOTE: The abbreviations used are as for Table A.1.

Table A.4 Types of Labour Units Employed on the Group IV Survey Farms

Farm No.	Season 1968/69	Season 1969/70
31	Manager Married man Single man	Manager (e) Married man 2 Single men
32	Partner (family) 2 Married men Single man	Partner (family) 2 Married men Single man
33	Manager (e) 3 Married men Single man	Manager (e) 3 Married men Single man
34	Partner (family) Married man 2 Single men	Partner (family) Married man 2 Single men
35	Owner Operator 2 Married men Single man	Owner Operator 2 Married men Single man
36	Manager (e) Married man Single man	Manager (e) Married man 2 Single men
37	Manager Married man 3 Single men	Manager Married man 3 Single men
38	Manager (e) 2 Married men Single man	Manager (e) 2 Married men Single man
39	Manager 2 Married men 2 Single men	Manager 3 Married men Single man
40	2 Partners 3 Single men	2 Partners 4 Single men
41	Manager 4 Married men	Manager 4 Married men

NOTE: The abbreviations used are as in Table A.1.

Table A.5 Types of Milking Units Employed on the Group I Survey Farms

Farm No.	Season 1968/69	Season 1969/70
1	Owner Operator	Owner Operator
2	Partner (family)	Partner (family)
3	Owner Operator Wife	Owner Operator Wife
4	Owner Operator Wife	Owner Operator Wife
5	Sharemilker	Sharemilker
6	Sharemilker	Sharemilker
7	Sharemilker Father	Sharemilker
8	Owner Operator Wife	Owner Operator Wife
9	Owner Operator	Owner Operator Wife
10	Sharemilker Wife	Sharemilker Wife
11	Manager (e)	Manager (e)
12	3 Managers (e) Wife	Manager (e) Wife

NOTE: The abbreviations used are as in Table A.1.

Table A.6 Types of Milking Units Employed on the Group II Survey Farms

Farm No.	Season 1968/69	Season 1969/70
13	Partner (family) Single man	Partner (family) Single man
14	Owner Operator Married man	Owner Operator Married man
15	Sharemilker Single man	Sharemilker Single man
16	Owner Operator Married man	Owner Operator Married man
17	Owner Operator Single man	Owner Operator Single man
18	2 Managers (e)	2 Managers (e)
19	Manager (e) Single man	Manager (e) Single man
20	Manager (e) Married man	Manager (e) Married man
21	2 Managers (e)	2 Managers (e)

NOTE: The abbreviations used are as in Table A.1.

Table A.7 Types of Milking Units Employed on the Group III Survey Farms

Farm No.	Season 1968/69	Season 1969/70
22	Manager (e) Married couple	Manager (e) Married couple
23	Sharemilker 2 Single men	Sharemilker 2 Single men
24	Partner Married man Single man	Partner Married couple
25	Manager (e) Married man Single man	Manager (e) Married man Single man
26	2 Managers (e) Married man	2 Managers (e)
27	Manager (e) Married man Single man	Manager (e) Married man Single man
28	Owner Operator 2 Married men	Owner Operator 2 Married men
29	2 Partners Single man	2 Partners Single man
30	Sharemilker Married man Single man	Sharemilker Married man Single man

NOTE: The abbreviations used are as in Table A.1.

Table A.8 Types of Milking Units Employed on the Group IV Survey Farms

Farm No.	Season 1968/69	Season 1969/70
31	Manager Married man Single man	Manager (e) Married man 2 Single men
32	Partner (family) 2 Married men Single man	Partner (family) 2 Married men Single man
33	3 Married men Single man	3 Married men Single man
34	Married man 2 Single men	Married man 2 Single men
35	2 Married men Single man	2 Married men Single man
36	Manager (e) Married man Single man	Married man 2 Single men
37	Married man 3 Single men	Married man 3 Single men
38	Manager (e) 2 Married men Single man	Manager (e) 2 Married men Single man
39	2 Married men 2 Single men	3 Married men Single man
40	2 Partners 3 Single men	2 Partners 4 Single men
41	4 Married men	4 Married men

NOTE: The abbreviations used are as in Table A.1.

Table A.9 Dependence of the Survey Farms on Family and Casual Labour and Contractors (1969/70 Season).

Farm No.	Family Labour (1)	Casual Labour (2)	Contractors (3)	Comments (4)
1	Calf rearing (f) Cleaning milking shed/yards (f)		Hay baling Hay loading Some topdressing Hedge cutting Draincleaning	Hay Summer Crop
2	Milking Spr. (w) Calf rearing (w) Stock work (f) Suppl. Fdng. (f) Hay Raking (f) Hay loading (f)		Hay baling Silage making Hedge cutting	Hay Silage
3	Milking (w)	Casual Labour for silage making	Hay baling Hay loading Silage making Topdressing Draincleaning Hedge cutting Some weed/pest c.	Hay Silage
4	Milking (w) Calf rearing (w) Hay Raking (f) Hay Loading (f)	Hay loading (N)		Hay
5		Hay loading (N)	Hay baling Hedge cutting Hay cutting (N)	Hay
6	Milking Spr (w)	Relief milkers	Hay baling Some hay loading Some topdressing Hedge cutting	Hay Winter crop
7	Relief Milking (F) Calf rearing (M)		Hay baling Some hay loading	Hay
8	Milking (w) Calf rearing (w)	Rep. and Maint.	Hay baling Hay loading Some topdressing Drain cleaning Development Cultivation	Hay Farmer is developing gorse country
9	Milking (w)	Relief milkers	All haymaking Some cultivation Some topdressing	Hay Summer crop Herd off in winter

Table A.9 (continued)

Farm No.	Family Labour (1)	Casual Labour (2)	Contractors (3)	Comments (4)
10	Milking (w) Rep. and Maint. (F) Weed/Pest c. (F) Hay cutting (F)		Hay baling Hay loading Topdressing Draincleaning	Hay
11	Calf rearing (f)	Rep. and Maint.	Hay cutting Hay baling Hay loading Topdressing Silage making Draincleaning	Hay Silage Herd off in winter
12	Milking (w) Stock work (f) Suppl. Fdng (f)	Silage making Some Rep. and Maint.	Hay baling Hay loading Silage making Topdressing	Hay Silage Farmer is developing gorse country
13	Calf rearing (w)	Relief milkers	Hay baling Hay loading Some topdressing Hedge cutting Cultivation Draincleaning	Hay An area of the farm is levelled and regrassed each year
14	Relief milking (f) Stock work (f)		Hay baling Hay loading Topdressing	Hay
15	Relief milking (w) Farm Cash Book (w)	Hay loading	Hay baling Silage making Topdressing Weed spraying	Hay Silage
16	M.M. (w) milks from Oct/Feb.	Some rep. and maint.	Topdressing Hedge cutting	Silage
17		Relief milker	Hay baling Hay loading Topdressing Hedge cutting	Hay An area is levelled and regrassed each year
18	Relief milking (Both wives)	Silage making (N) Hay loading (N)	Hay baling Topdressing Hedge cutting Cultivation	Hay Silage Developing peat
19	Hay raking (w) Hay loading (w)	Relief milker Hay loading Silage making	Hay baling Silage making Topdressing Hedge cutting	Hay Silage

Table A.9 (continued)

Farm No.	Family Labour (1)	Casual Labour (2)	Contractors (3)	Comments (4)
20	Calf rearing (w) Relief Milker (w)		Hay loading Topdressing Hedge cutting	Hay
21		Hay cutting Rep. and Maint. Weed/pest c. Some topdressing	Hay raking Hay baling Some hay loading Some topdressing	Hay
22	Relief Milking (w) Calf rearing (w) A.B. work (w) Record keeping (w) Stock work (w)	Relief milkers Hay loading	Topdressing	Hay An area is levelled and regrassed each year
23		Relief milkers	Hay baling Hay loading Silage making Topdressing	Hay Silage
24			Hay baling Hay loading Topdressing Draincleaning	Hay
25			Some topdressing	Silage Summer crop Farmer is developing scrub country
26		Relief milker from other farm	Hay baling Some topdressing	Hay
27			Some topdressing Hedge cutting Draincleaning	Hay Silage Some levelling and regrassing
28		Neighbour to drive baler (N)	Topdressing Draincleaning Dip spraying Rotary hoeing	Hay Some regrassing
29	Calf rearing (w) Relief milking (F) Rep. and Maint (F) Hay loading (F)		Rotary hoeing Hedge cutting Draincleaning	Hay Some levelling and regrassing

Farm No.	Family Labour (1)	Casual Labour (2)	Contractors (3)	Comments (4)
30			Some Hay loading Topdressing Hedge cutting Hay Baling	Hay Silage
31	Some calf rearing (both wives) Relief milking (both wives)		Hay raking Hay baling Hay loading Hedge cutting	Hay Silage
32		Hay loading	Hedge cutting	Hay Silage
33				Hay Silage
34		Hay loading Silage making	Hay baling Silage making Topdressing Hedgecutting	Hay Silage
35		Hay loading (from other farms)	Draincleaning Hedge cutting	Hay Silage
36	Relief milking (both wives) Record keeping (w)		Undersowing	Hay
37		Hay baling (from other farms)	Topdressing	Hay Silage
38	Relief milking (both wives)	Some Rep. and maint.	Topdressing Draincleaning	Hay Silage
39			Hay baling Draincleaning Hedge cutting	Hay Silage Summer crop
40			Hay raking Hay baling Hay loading Topdressing Draincleaning	Hay
41		Hay loading	Hay baling Draincleaning Hedge cutting	Hay Silage

Table A.9 (continued)

NOTES: i) Column (1) shows the various farm operations for which family labour was utilised. The following abbreviations are used:

(w)	- Wife	-	of the farm operator;
(f)	- Family	-	of the farm operator;
(F)	- Father or Father in law	-	of the farm operator;
(M)	- Mother	-	of the farm operator;

The term operator in this context denotes the labour unit concerned with the entrepreneurial function. In the case of Farm Nos. 16 and 20, the abbreviation (w) refers to the wife of an employed labour unit. On Farm Nos. 18, 31, 36 and 38, the term "both wives" indicates that either the wives of both farm operators were employed for the operation in question or the wives of the farm operator and an employed labour unit were employed for the operation in question.

ii) Abbreviations used for various operations include:

Milking Spr	:	Milking during the spring months;
Suppl Fdng	:	Supplementary feeding;
Rep. and Maint.	:	Repairs and maintenance;
Weed/pest c.	:	Weed and pest control;
A.B. work	:	Artificial Breeding work (i.e. detecting in-season cows);

iii) Column (2) shows the various farm operations which were performed by casual labour; Column (3) shows the various farm operations which were performed by contractors. Where only part of a particular operation was performed by casual labour or contractors, the operation in question is preceeded by the word "some". Where neighbours were involved, this is indicated by the abbreviation (N).

iv) Hay loading has been shown in Column (2) if machinery belonging to the farm in question was used. Where contractors' machinery (and labour) was used, the entry has been made in Column (3). In the case of Farm No.8 hay baling and hay loading are shown as operations for which contractors were employed. It should be noted however that such machinery was jointly owned with two other farmers.

v) Column (4) lists a number of farming practices, which are helpful to an understanding of the use made of the various sources of labour on the survey farms.

Table A.10 Working Time, Milking Time, Time Off and Holidays (1969/70 Season)

Farm No.	Hours Worked (1)	Milking Times (Minutes) (2)	Time-off (3)	Holidays (4)
1	64/39	90/90 70/70	None normally	Very little
2	76/32	90/90 90/90	" "	2 weeks
3	75/39	80/70 70/60	" "	10 days
4	84/45	150/150 120/120	" "	Very little
5	86/44	150/150 120/120	" "	2 weeks
6	81/40	150/140 140/130	Some weekends	1 week
7	76/50	150/150 105/105	Some time off	2 weeks
8	77/44	135/120 120/120	None normally	1 week
9	71/15	105/100 90/80	Some milkings off	2 weeks
10	100/52	150/150 115/115	None Normally	Very little
11	92½/0	240/220 170/160	" "	4 weeks
12	87/54	135/135 110/110	" "	1 week
13	70/37	155/145 140/130	Some weekends off	Both 2 weeks
14	75/45	110/100 100/100	Some days off	Own/op 2½ weeks MM 2 weeks
15	N.A.	N.A.	S.B. 2 weeks every 3rd weekend	Both 2 weeks
16	68/44	90/80 70/70	None normally	Own/op 10 days MM 2 weeks
17	74½/28	120/120 100/100	" "	Both 2 weeks
18	83½/48	150/135 105/105	Some weekends off	Both 2 weeks

Table A.10 (continued)

Farm No.	Hours Worked (1)	Milking Times (Minutes) (2)	Time-Off (3)	Holidays (4)
19	62½/48	135/120 130/110	Both some time off	Both 2 weeks
20	72½/44	160/160 120/120	Both some milkings off	3 weeks MM 2 weeks
21	77/32	165/156 120/120	None normally	Both 1-2 weeks
22	60/42¼	120/110 110/105	Some weekends off	All 3 weeks
23	61/45	140/140 110/110	S.B.1 weekend per 4 weeks	S/M little S.B. 2 weeks
24	70½/41½	140/130 130/130	None normally	All 3 weeks
25	56/40½	100/90 100/90	All 1 weekend per 6 weeks	All 3 weeks
26	95/49	150/140 120/120	Both 1 weekend per 5-6 weeks	All 2 weeks
27	57/44	120/120 105/105	All 3 weekends per season	All 3 weeks
28	71/46	150/135 120/105	All 1 weekend per 4 weeks	All 3 weeks
29	67/34	140/130 105/100	All some week-ends off	All 2 weeks
30	70/45	125/110 105/90	All 1 weekend per 4 weeks	All 3 weeks
31	66¼/46	120/120 120/120	All 1 weekend per 8 weeks	All 2 weeks
32	56½/34½	120/120 120/120	All 2 milkings per month	All 2½ weeks
33	66/44	120/120 120/120	All some time off	All 3 weeks
34	72/46	135/120 120/105	All regular time off	All 2 weeks
35	60½/44	140/140 110/110	All some time off	All 2 weeks
36	60/51½	120/110 120/110	All 1 weekend per month	All 2 weeks
37	68/45	135/130 105/105	All 1 weekend per month	All 2 weeks

Table A.10 (continued)

Farm No.	Hours Worked (1)	Milking Times (Minutes) (2)	Time-Off (3)	Holidays (4)
38	69/44	120/120 120/105	All 1 weekend per month	All 2 weeks
39	72½/42	150/150 135/135	All 1 weekend per month	All 2 weeks
40	51/45	120/120 90/90	All 1 day every 6 days	All 4 weeks
41	56/56	120/105 90/75	All 1 weekend per month	All 2 weeks

NOTES: i) Column (1) presents estimates made by the farmers of the numbers of hours they and each member of their labour force would work during a normal working week at two periods of the year. The two periods of the year are, first, during the early spring when the spring workload is considered to be at its maximum, and second, during the winter months when the herd is dry. These two periods are taken as the periods of maximum and minimum labour input. (Labour input expressed in terms of man hours.) The figures for the spring are shown on the left, while those of the winter are shown on the right. Although such estimates have been corrected for any regular weekly time-off, they have not been adjusted for any regular time-off which is given or taken by the labour units on a longer basis, (i.e. fortnightly, three-weekly, etc.). Consequently, the figures shown for those farms where such time-off is available may be over estimates.

ii) Column (2) shows two estimates of the morning and evening milking times at two times in the dairying season. The two times are, first, at the flush (i.e. when the production of milk is highest) and second, in the summer (i.e. late January - early February). The figures for the morning milking are shown on the left, while those of the evening milkings are shown on the right. The upper figures refer to the spring milkings; the lower to the summer milkings. The time refers to the cups-on cups-off time.

iii) Column (3) shows the time-off during the milking season the milking units on the various farms took or were given.

iv) Column (4) indicates the regular holidays the labour units took or were given.

v) The following abbreviations are used in Columns (3) and (4):

Own/Op - Owner operator;
S/M - Sharemilker;
MM - Married man;
S.B. - Single man;
N.A. - Not available;

It should be noted that on seven farms, it was indicated that the hours worked by the various labour units differed. Details of the hours worked by the various labour units on such farms are shown in Table A.10'.

Table A.10' Hours of Work by Various Labour Units on the Survey Farms where the Hours of work differed between Labour Units.

Farm No.	Labour Unit	Hours (Spring)	Hours (Winter)
16	Owner operator	75	44
	Married man	68	44
24	Partner	73½	41½
	Married man	70½	41½
33	Manager (e)	Very little	Very little
	Remainder	66	44
35	Owner operator	Very little	Very little
	Remainder	60½	44
38	Manager (e)	60	44
	Remainder	69	44
39	Manager	50	50
	Remainder	72½	42
41	Manager	60	60
	Remainder	56	56

NOTE: The abbreviations used are as in Table A.1.

Further, although all labour units of Farm No. 34 worked similar hours in both the spring and winter, management (i.e. the labour unit concerned with the managerial function) was also concerned with another property.

Table A.11 Data Concerning the Stocking Rates of the Survey Farms.

Farm No.	Acres (1)	Effective Area (2)	Run-off (3)	Stocking Rate (4)	Feed (5)	Grazing (6)	Comments (7)
1	60	57	12	1.05/1.11	Meal	Hfrs 12M R/O	
2	69	69		1.30/1.39	Meal	Hfrs 12M O.G.	
3	90	90		0.88/0.97			
4	103	95		1.06/1.13	Meal		
5	112	110		1.05/1.09			
6	160	130		1.00/1.10	Hay		
7	215	200		0.69/0.65			Heifer Sales Beef
8	279	270		0.53/0.56			Beef
9	230	226		0.97/0.98	Hay	Herd 5 wks O.G. Hfrs 3M O.G.	
10	223	200		0.92/1.33	Hay		
11	200	198	65	1.12/1.05		Hfrs 12M R/O Herd 6 wks R/O	
12	429	350	500	1.05/0.95			Beef
13	107	105		1.43/1.54		Hfrs 12M O.G.	
14	125	120	80	1.15/1.17		Yst 18M R.O.	Heifer sales
15	151	141		1.14/1.19		Hfrs 12M O.G.	Beef weaners
16	127	124		1.24/1.27		Hfrs 12M O.G.	
17	173	168		1.24/1.26	Meal		
18	272	260		0.87/0.87			
19	180	176	Other farm	1.37/1.33		Yst 18M R/O	
20	147	143		1.43/1.48	Hay/ Mother Liquor	Hfrs 12M O.G.	
21	278	258		1.28/1.31	Hay	Yst 18M O.G.	Beef weaners

Table A.11 (continued)

Farm No.	Acres (1)	Effective Area (2)	Run-off (3)	Stocking Rate (4)	Feed (5)	Grazing (6)	Comments (7)
22	187 238	184 [1] 234		1.22/1.13		Hfrs 12M O.G.	
23	209	205	Other farm	1.13/1.28		Hfrs 12M R/O	
24	284	280		0.89/1.00			Hay
25	350	340		0.99/0.79			Heifer sales Beef weaners
26	335	320	Other farm	1.26/1.08		Other farm used for some grazing	
27	246	243		1.27/1.25		Hfrs 12M O.G.	
28	240	238	11	1.30/1.32		Yst 18M R/O	
29	258	248	40	1.16/1.18		Yst 18M R/O	
30	320	310	90	1.23/1.12	Mother Liquor	Yst 18M R/O	Beef (1969/70 only)
31	372	368	Other farms	0.94/1.00		Yst 18M R/O	Beef Hay Heifer sales
32	247	237		1.15/1.17	Hay	Hfrs 12M O.G	
33	310	290		1.10/1.17		Hfrs 12M O.G.	
34	225	220	80	1.38/1.30	Hay	Hfrs 12M R/O Herd 5 wk R/O	Beef Heifer sales
35	253	245	66	1.14/1.14		Yst 15M R/O	Beef
36	300	275	40	1.08/1.18		Some use made of R/O	
37	300	290		1.20/1.20	Hay	Yst 18M Other farm	Pigs
38	347	345		1.12/1.15			Weaner heifers
39	325	320	110	1.43/1.44		Hfrs 9M R/O	
40	747	732	138	0.89/1.01		Hfrs 12M R/O	Lambs Hay sales
41	330	325	60	1.55/1.45	Hay	Calves 2M Hfrs 6M	

1. It should be noted that the surveyed (and effective) area of farm 22 was increased in the winter of 1969.

Table A.11 (continued)

NOTES: i) Column (1) is reproduced from Table 5.1 and shows the surveyed acreages of the survey farms.

ii) Column (2) presents an estimate of the effective area of the farm (i.e. the area in any form of pasture, crops, races and buildings).

iii) Column (3) is also reproduced from Table 5.1 and shows the surveyed acreage of any run-offs (where applicable) and cases where other farms are farmed in conjunction with the survey farm.

iv) Column (4) shows the stocking rate in terms of milking cows per effective acre. (This has been derived by dividing the number of cows in milk in December by the number of acres shown in Column (2).) The figures on the left relate to the 1968/69 season while those on the right to the 1969/70 season.

v) Column (5) indicates the additional type of feedstuffs used in the 1968/69 and 1969/70 seasons on the farm in question. Reference to such feedstuffs is made only if the feedstuffs come from beyond the farm in question and its associated run-offs and other farms.

vi) Column (6) refers to additional feedstuffs obtained by the survey farms in the form of grazing in the 1968/69 and 1969/70 dairy seasons. Reference is made to the class of stock grazed, the period of grazing, and the location of grazing. Abbreviations used are:

Hfrs	-	Heifers;
Yst	-	Young stock (i.e. both calves and heifers)
O.G.	-	Outside grazing;
R/O	-	Run-off;
M	-	Months

vii) Column (7) shows any additional activities undertaken which are relevant when considering the actual stocking rates of the farms.

Table A.12 Procedures adopted on the Survey Farms in order to select in-season Cows for Artificial Breeding.

Farm No.	1	2	3	4	5	6	7	8	9	10
1	✓	✓						2 1(bt) 1(mt)		Yes
2		✓						1 1(bt)		Yes
3		✓						2 1(mt) 1(bt)	✓	Yes
4	✓	✓						1 1(bt)		Yes
5		✓								
6	✓	✓						3 (2(mt) 1(bt)		Yes
7		✓							✓	Yes
8		✓								
9		✓	✓				✓			
10		✓	✓					1 1(mt)		Yes
11		✓	✓							Yes
12		✓		✓				2 1(mt) 1(bt)		
13	✓	✓	✓		✓			2 2(mt)		
14	✓	✓	✓					1 1(mt)		Yes
15										Yes
16	✓	✓	✓							
17	✓	✓						2 2(bt)		Yes
18		✓						1 1(mt)		
19			NATURAL MATING							
20	✓	✓			✓		✓			
21		✓	✓					2 2(mt)		

NOTES: i) The columns marked 1 to 9 represent the procedures designated a) to i) as discussed in section 5.13. A tick indicates that a particular procedure was used on a given farm. In Column 8 (which refers to the number of special visits made to the paddock, the first figure indicates the number of visits normally made per day, while the second and third show how many visits were specifically for bloat, and how many specifically to observe in-season cows. (The abbreviations used are (bt.) bloat, mt (mating).

ii) The word 'Yes' in Column 10 indicates that the farmer in question knew every individual cow of his herd.

Table A.12 (continued)

Farm No.	1	2	3	4	5	6	7	8	9	10
22	✓	✓		✓				1 1(mt)		
23	✓	✓								Yes
24	✓	✓	✓			✓				
25	✓	✓	✓	✓	✓					
26		✓	✓	✓						
27	✓	✓	✓	✓				1 1(bt)		
28		✓		✓		✓				
29	✓	✓	✓	✓				1 1(mt)	✓	
30	✓	✓		✓	✓				✓	
31		✓						2 2(mt)		
32		✓	✓						✓	
33		✓	✓					1 1(bt)		Yes
34	✓	✓						3 3(mt)		Yes
35	✓	✓						2 2(mt)		
36	✓	✓	✓		✓			1 1(bt)		Yes
37		✓	✓							
38		✓		✓				3 3(mt)		
39	✓	✓		✓				3 3(bt)		
40		✓						2 2(mt)		
41		✓						3 3(bt)		Yes

APPENDIX B

BASIC ASSUMPTIONS OF THE STUDY AND COST DATA

APPENDIX B

BASIC ASSUMPTIONS OF THE STUDY AND COST DATA

B.1 INTRODUCTION

In this appendix, details of the assumptions made and cost data used in the analysis are presented. The author consulted a number of people for data concerning certain assumptions - these people are acknowledged. The author, however, accepts full responsibility for all assumptions made. The cost data were collected from various Manawatu merchants and pertain to August 1970.

B.2 STOCK PERFORMANCE: PRODUCT PRICES: STOCK VALUES: STOCKING RATE

1) Milkfat production per cow is defined as the total milkfat supplied to the factory, divided by the total number of cows wintered.

Constant Milkfat Production per Cow

The level of milkfat production per cow is taken as 300 pounds, both between and within plant sizes.

Variable Milkfat Production per Cow

Milkfat production per cow within each of the five plant sizes is described by the following five linear functions:

Plant size one	:	y	=	444.47	-	0.9078 x
Plant size two	:	y	=	431.70	-	0.5141 x
Plant size three	:	y	=	408.12	-	0.3016 x
Plant size four	:	y	=	387.29	-	0.1984 x
Plant size five	:	y	=	369.38	-	0.1386 x

where y is the pounds of milkfat production per cow,
x is the herd size.

The five linear functions have been derived from the data shown in Table B.1. Table B.1 is based upon the hypothesis that the level of milkfat production per cow is a function of both the number of cows per milker, and the absolute herd size. The data of Table B.1 were obtained by adjusting the data from the farm survey (i.e. Tables 5.10, 5.12 and 5.13) to comply with the above hypothesis.

Table B.1 Production per cow, according to plant size

Plant size	Start point, subclass (a), (b) and (c) (Pounds of Milkfat)	Cut-off point, subclass (c), (Pounds of Milkfat)
Plant size one	390.00	320.00
Plant size two	370.52	308.80
Plant size three	353.63	299.54
Plant size four	339.68	292.06
Plant size five	327.80	286.22

2) Stock Statistics

General Statistics

It is assumed that the following statistics remain constant both between and within the five plant sizes. The statistics are based upon the data of the farm survey.

Culling per cent	(cows)	:	20 per cent
Deaths	(cows)	:	3 per cent
Herd Wastage		:	23 per cent
Empty Heifers		:	4 per cent
Deaths	(heifers)	:	1.6 per cent
Deaths	(calves)	:	3 per cent
Calving per cent		:	93 per cent

Number of Bulls Required

The maximum ratio of yearling heifers to yearling bulls is 25 : 1.[1/] Therefore, one bull calf must be reared for every 25 yearling heifers. That is from:

1 - 25 yearling heifers, 1 bull is required;
26 - 50 yearling heifers, 2 bulls are required;

3) Cull Stock Price

The assumptions made in determining the prices received for cull stock are shown in Table B.2.

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1. The information was obtained from Dr. K. L. McMillan, Research Officer, New Zealand Dairy Board, Awahuri.

Table B.2 Cull Stock Prices

Class of Stock	Dead Weight (lbs)	Price/100lb Dead weight $	Transport costs (per head) $	Net Price per head $
Cull cows	300	20.00	2.35	57.65
Empty heifers	276	20.00	2.35	52.85
Cull bulls	437	24.00	2.49	102.39
Bobby calves				8.79

Data relating to carcass weights were obtained from the records of the Massey University Dairy Farms. In the case of cull cows, the dead weights were estimated from the live weight records of cows on the University farms in the autumn of 1969. The figures for empty heifers and cull bulls are the averages of the actual dead weights of these two classes of stock, sold by the University farms in the 1968/69 season. (Hence the precise figures.) Similarly the price of bobby calves is the average price received by the University farms in the 1970/71 season. (In all cases the data pertains to Jersey stock.)

Although milkfat price is treated as a variable, and L.R.A.C. curves produced for a series of milkfat prices, cull stock prices are not varied. The assumption is therefore made that there is no relationship between milkfat price and cull stock prices.

4) Stock Values

The stock values used are shown below:

Mature cows	$90.00
Rising 2 year old heifers	$70.00
Yearling heifers	$40.00
Rising 2 year old bulls	$70.00
Yearling bulls	$40.00

(A charge of 30 cents per herd has also been included for stock identification eartags for all mature cows.)

5) Stocking Rate

Stocking rate is defined as the number of cows wintered divided by the surveyed acreage of the farm. Both between and within plant sizes,

the stocking rate is assumed to be 1.1 cows per acre. [2] Replacement heifers and replacement bulls are grazed away from the farms for a period of 12 months but calves, however, are retained on the farms.

B.3 FARM SHAPE AND LAYOUT

All farms are of the shape and layout as shown in Figure B.1. Initially the author was led to believe that the farm race could be used as a tanker track. Such an impression was later found to be contrary to the Dairy Division Regulations. Consequently in order to comply with the Dairy Division Regulations, the total investment costs should include an allowance for a tanker track.

Legend for Figure B.1

(1) Farm Dairy
(2) Barn
(3) Implement Shed
(4) Pump Shed
(5) House (a)
(6) House (b)
(7) House (c)
(8) House (d)
(9) House (e)
(10) Tanker Track
(11) Farm Race
(12) Cattle Stop
(13) Race to Farm Dairy

---- Service power lines and drop-offs.

O Position of troughs on farms of herd size 60 - 399 cows.

Position of additional troughs on farms of herd size 400 - 599 cows.

Position of additional troughs on farms of herd size of 600 cows.

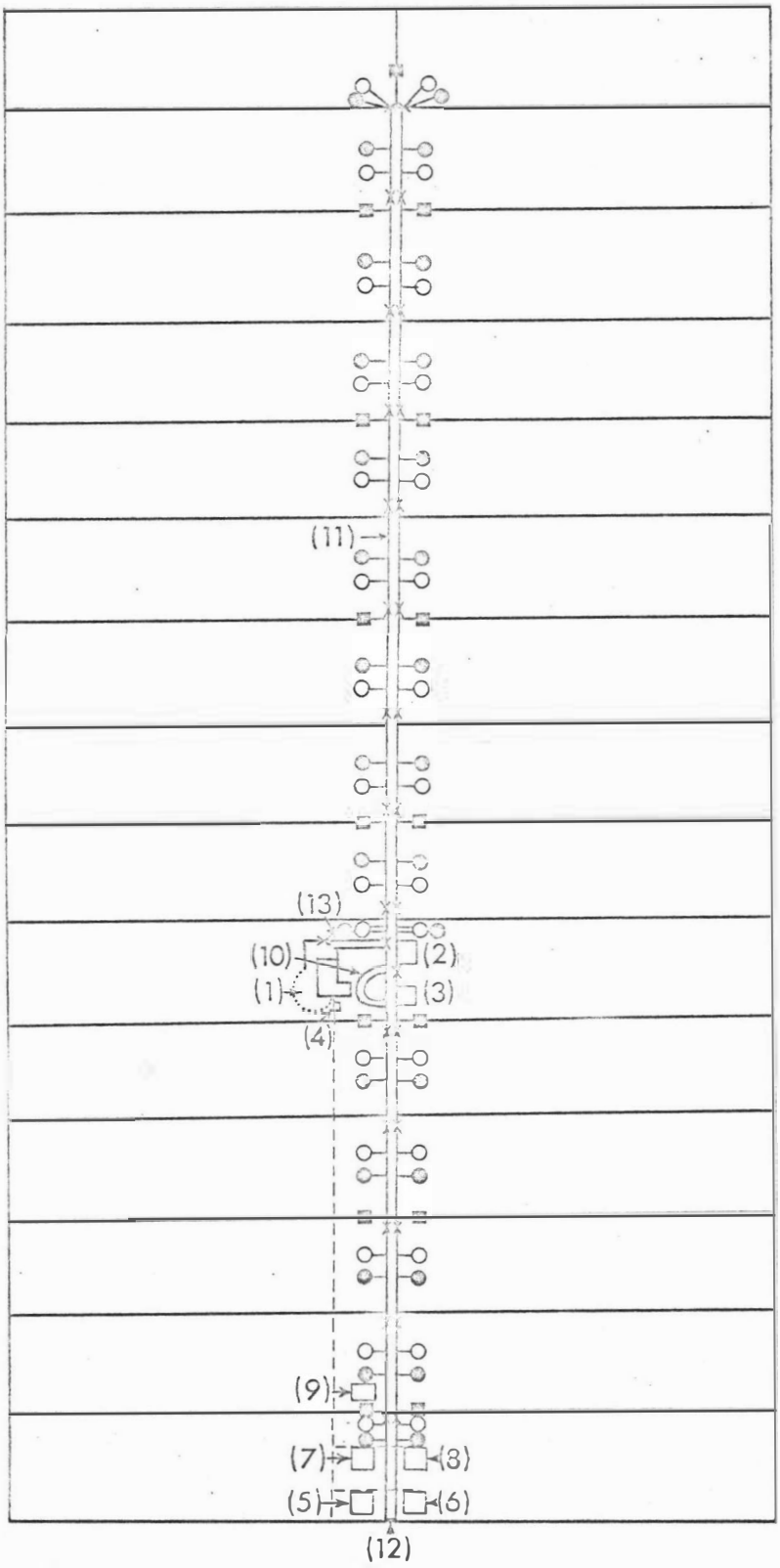
——— Fence lines.

X Gates.

---

2. The stocking rate of 1.1 cows per acre was decided upon by the author, after discussions with Manawatu Extension Officers.

FIG. B.1 FARM SHAPE AND LAYOUT



B.4 INVESTMENT COSTS OF CAPITAL RESOURCES

1) Land Prices

The purchase price of land is described by the following two functions:

25 - 100 acres : $y = 708.0 - 3.33\,x$

More than 100 acres : $y = 395.0 - 0.20\,x$

where y is the price of land (per acre) in dollars

x is the number of acres.

The two functions have been derived from the data [3] shown in Table B.3.

Table B.3 Price of Land per Acre, according to the Number of Acres

Acres (1)	Price per Acre (dollars) (2)
25	625
100	375
600	275

The purchase price of land, as shown in Column (2) refers to the price of the "bare" land. All improvements, except pasture, are excluded. The pastures, however, are considered to be high producing and of good quality.

2) Fencing Costs

Boundary Fences

The boundary fences consist of [4] 4 posts per chain, 7 wires (2 barbed and 5 plain) and 4 battens between posts.

Cost per chain of Boundary Fence

Laying	$ 1.75
Erection cost	$ 5.75
Materials (and freight)	$ 8.89
	$16.39

3. Data obtained from Mr. A. K. Ford, Valuation Department, Palmerston North.
4. Data concerning fence construction were obtained from discussions with Manawatu Extension Officers.

On all boundary fences, except those bordering the road, the cost is assumed to be shared with a neighbour.

Internal Fences

The internal fencing consists of 3 posts per chain, 3 plain wires and no battens.

Cost per chain of internal fencing

Laying	$ 1.00
Erection	$ 2.00
Materials (and freight)	$ 4.09
	$ 7.09

Gates

The following cost for gates applies to all farms:

31	12 foot gates at $13.49	=	$418.19
31	sets of hinges at $1.82	=	$ 56.42
			$474.61

The following costs for gates (including hinges) apply to specific ranges of herd sizes:

60 - 199 cows	1,	10 foot gate	$10.07
200 - 399 cows	1,	15 foot gate	$17.82
400 + cows	1,	20 foot gate	$20.32

The total costs for gates applying to the ranges of herd sizes noted above are therefore:

60 - 199 cows	$485.68
200 - 399 cows	$492.43
400 + cows	$494.93

3) Race Costs

Main Race

The widths of races on the representative farms are taken as:

60 - 199 cows	:	15 feet
200 - 399 cows	:	20 feet
400 + cows	:	25 feet

The data shown above are based upon information obtained from the farm survey. Cost and further physical data of the farm races are shown in Table B.4.

Table B.4 Physical and Cost Data of Three Widths of Farm Race

Race Width	15 feet	20 feet	25 feet
Width of metal	15'	18'	23'
Depth of metal	4"	4"	4"
Grading cost per chain	$2.40	$3.00	$4.00
Metal cost per chain	$8.40	$11.57	$15.12
Cartage cost per chain (metal)	$17.64	$24.30	$31.75
Total cost per chain	$28.44	$38.87	$50.87

Cost of Race to Farm Dairy

The width of the race from the main race to the farm dairy varies according to herd size, (see Figure B.1). Physical and cost data relating to such races is shown in Table B.5.

Table B.5 Physical and Cost Data of the Races to the Farm Dairy

Race Width	10 feet	15 feet	20 feet
Range of herd sizes	60 - 199	200 - 399	400 +
Width of metal	9'	14'	19'
Depth of metal	4"	4"	4"
Grading cost	$2.47	$3.70	$4.63
Metal	$9.42	$14.52	$19.59
Cartage	$19.78	$30.48	$41.15
Total	$31.67	$48.70	$65.37

Sundry Items

Three cost items apply to all representative farms. The tanker track is 12 feet wide and the turning circle is 66 feet in diameter The farm race contributes to part of the turning circle. Details of the cost are:

Grading cost	:	$ 7.02
Metal	:	$60.13
Cartage (metal)	:	$28.63
		$95.78

Details of the cost of materials for gate fillings are:

Metal	:	$36.15
Cartage	:	$75.80
		$111.95

The cost of a cattle stop erected is 120.00 dollars.

4) Farm Dairy Costs [5]

Milk Room and Vat Stand

As the introduction of bulk milk vats of 1,000 gallons or more necessitates a change in the dimensions of the vat stand, two sizes of milk room and vat stand have been costed. (A bulk milk vat of 1,000 gallons is introduced when herd sizes exceed 265 cows.)

For herd sizes up to and including 265 cows, 18' x 10' :
$2,285.00 (including electrical fittings);

For herd sizes of 266 cows and above, 21' x 12' :
$3,030.00 (including electrical fittings);

Herringbone (shed)

The cost per linear foot of the herringbone is $93.00. The lengths of the various herringbones are shown in Table B.6.

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5. The cost information relating to the farm dairies was prepared by Mr. D. G. Hogg, of Hogg and Cardiff, Quantity Surveyors, Palmerston North. Mr. Hogg has prepared these costings on a quantity measurement basis and states that the data will provide an estimate of the costs of various sizes of farm dairies, and further that the data must be used only for budget purposes.

Table B.6 Lengths of Herringbone Farm Dairies

Farm Dairy Size No. of sets of cups	Herringbone Length (feet)	Farm Dairy Size No. of sets of cups	Herringbone Length (feet)
6 aside	24	21 aside	69
8 aside	30	24 aside	78
10 aside	36	28 aside	90
12 aside	42	30 aside	96
14 aside	48	32 aside	102
16 aside	54	35 aside	111
18 aside	60	40 aside	126

Circular yard cost

Cost per square foot of the concrete	:	$ 0.52
Cost of plumbing for shed wash down units	:	$ 40.00

Backing Gate cost

Cost per linear foot of backing gate	:	$ 3.75
Cost of power unit to backing gate	:	$110.00
Cost of power outlet to backing gate	:	$100.00

Circular yard railing and kerbing

Cost per linear foot	:	$ 2.95

Drenching Race

Cost per square foot of concrete	:	$ 0.52
Cost per linear foot of railing	:	$ 1.25
3' 0" x 3' 6" gate to drench race	:	$ 12.50
3' 0" x 3' 6" gate with head crush	:	$ 20.00

Curved gate (entry to round yard)

60 - 199 cows	:	10' gate	:	$ 28.60
200 - 399 cows	:	15' gate	:	$ 37.00
400 + cows	:	20' gate	:	$ 46.50

Entry/Exit/Draughting Area

For herd sizes of:

60 - 199 cows	:	$572.00
200 - 399 cows	:	$639.00
400 + cows	:	$747.00

Entry Area

Cost per square foot of concrete	:	$ 0.52
Cost of railing and kerbing per linear foot	:	$ 2.95

5) Barn Costs

The annual requirement for hay is taken as 12 bales per cow. [6] The 12 bales per cow also provides for the associated replacement stock. The costs of the various sizes of barns required are shown in Table B.7.

Table B.7 Costs of Barns according to Herd Sizes

Range of Herd Size (cows)	Cost of Barn (dollars)	Range of Herd Size (cows)	Cost of Barn (dollars)
60 - 66	367.00	201 - 266	1,226.00
67 - 100	506.00	267 - 333	1,504.00
101 - 133	635.00	334 - 400	1,777.00
134 - 166	777.00	401 - 533	2,032.00
167 - 200	973.00	534 +	2,399.00

6) Implement Shed Costs

The implement shed costs were determined by summing the areas required to house the various items of machinery and multiplying the total area by the appropriate cost factor. The areas [7] required to house various implements are shown in Table B.8.

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6. The author decided upon 12 bales per cow after discussion with Mr. K.W. Pheasant, Dairy Board Consulting Officer, Palmerston North.
7. The author obtained the data of Table B.8 by measuring the implements at the Massey University Dairy Farm and from data supplied by a Palmerston North machinery dealer. The areas are the product of the length of the implement, plus one foot, and the width of the implement, plus one foot. In the case of Tractor (a), 225 square feet has been allowed to provide an area for a workshop.

Table B.8 Areas Required to House Farm Implements

Implement	Area (sq. ft.)	Implement	Area (sq. ft.)
Tractor (a)	225	Hay mower	59
Tractor (b)	66	Hay rake	68
Tractor (c)	66	Spray equipment	25
Transport tray (small)	28	Baler	140
Transport tray (large)	35	Fertiliser Distributor	30
Trailer (a)	56	Front End Loader	68
Trailer (b)	74	Bale Loader	124
Trailer (c)	88	Grader blade	52

The cost per square foot of implement sheds is 1.50 dollars.

7) Pump Shed Cost

Cost of pump shed	:	$85.00
Cost of electrical installations	:	$60.00

8) Dwelling Costs

The investment costs of all dwellings on the representative farms are similar. The investment cost is based upon a 1,000 square foot Modal house and is $8,000.00 per dwelling. A charge of $20.00 per dwelling is also allowed for telephone installation.

9) Electric Power Installation

The service lines extend to the farm dairy which in the case of:

a) 6 - 30 aside herringbones, is a distance of one third the farm length plus 21 yards.

b) 32 - 40 aside herringbones, is a distance of one third the farm length plus 42 yards.

The authorities make no charge for the first 60 feet of service line from the farm boundary. The cost of the remaining service line is $1.33 per yard.

The lengths of drop-offs from the main service line to the various buildings are shown overleaf.

Milking shed	:	10 feet
Pump shed	:	10 feet
Dwelling (a), (c), (e)	:	30 feet
Dwelling (b), (d)	:	105 feet

The cost of drop-offs per yard is $1.50.

10) Water Reticulation Costs [8]

The reticulation systems have been designed to provide a total daily requirement of 30 gallons per cow and for a maximum pressure of 43 p.s.i. The pump selected is a dual purpose reticulation and farm dairy washdown pump. For herd sizes of 60 - 399 cows, the number of troughs provided is 30. For herds of 400 - 599 cows, the number of troughs provided is 45. When a herd size of 600 cows is reached, the number of troughs is increased to 60.

Over the range of herd sizes considered, three pump sizes are used. The costs of the pumps are shown in Table B.9.

Table B.9 Pump Costs according to Herd Size

Herd Size (cows)	Cost (dollars)
60 - 199	280.00
200 - 299	290.00
300 +	308.00

Water reticulation investment is described by the following two regression equations:

60 - 399 cows : $y = 3.928x + 1,696$

400 or more cows : $y = 5.292x + 1,326$

where y is the reticulation investment in dollars

x is the herd size

The above equations have been obtained by fitting linear regressions to the data shown in Table B.10.

---

8. The data relating to water reticulation systems was supplied by Mr. W. E. Sloane, Farm Advisory Officer, (Machinery), Department of Agriculture, Palmerston North.

Table B.10 Water Reticulation Costs According to Herd Size

Herd Size (cows)	Reticulation cost (dollars)	Herd Size (cows)	Reticulation Cost (dollars)
60	1,902.62	300	2,829.14
90	2,039.40	400	3,525.45
120	2,168.84	500	3,809.49
150	2,299.48	600	4,582.35
200	2,551.39		

11) Effluent Disposal Systems [9]

The effluent disposal systems have been designed to give an application rate of effluents of $\frac{1}{2}$" per acre per 28 days and it is assumed the volume of wastes per cow per day is 10 gallons.

Three different disposal systems have been costed:

60 - 120 cows : Portable sprayline pivoted around the pump, and spraying 120° of a circle;

121 - 350 cows : Buried mainline to a single hydrant. Portable sprayline sprays over a complete circle;

351 cows or more: Two buried mainlines to two hydrants, two portable spray lines.

The investment in effluent disposal systems is described by the following three regression equations:

60 - 120 cows : $y = 1.7395\ x + 303.0$

121 - 350 cows : $y = 1.1301\ x + 448.0$

351 or more : $y = 1.1820\ x + 532.0$

where y is the effluent disposal system investment in dollars

x is the herd size

The above functions have been obtained by fitting linear regressions to the data shown in Table B.11.

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9. The data concerning effluent disposal systems was supplied by Mr. J. Luxton, Dairy Advisory Officer (Farms), Department of Agriculture, Palmerston North.

Table B.11 Effluent Disposal System Cost according to Herd Size

Herd Size (cows)	Effluent Disposal System Cost (dollars)	Herd Size (cows)	Effluent Disposal System Cost (dollars)
60	416.00	200	662.00
70	420.00	250	757.00
80	435.00	300	804.00
90	446.00	350	820.00
100	500.00	400	1,003.00
120	507.00	450	1,071.00
140	592.00	500	1,106.00
160	634.00	550	1,202.00
180	655.00	600	1,233.00

Over the range of herd sizes studied, six effluent pumps are used. The costs of such pumps are shown in Table B.12.

Table B.12 Costs of Effluent Disposal Pumps

Herd Size (cows)	Cost (dollars)
60 - 99	208.00
100 - 159	247.00
160 - 249	285.00
250 - 399	311.00
400 - 499	361.00
500 +	403.00

12) Milking Equipment Costs

Milking machine [10] costs for the various sizes of farm dairies are shown in Column (2) of Table B.13. Column (3) shows the costs of teat washers for the various sizes of farm dairies. The costs of herd testing brackets are shown in Column (4). (The cost is 80 cents per bracket plus a $3.00 fitting charge per farm dairy.) The cost of

Table B.13 Milking Equipment Costs

Farm Dairy Size, No. of sets of cups (1)	Milking Machine Costs (dollars) (2)	Teat Washer Costs (dollars) (3)	Herd Testing Brackets (dollars) (4)	Buckets (dollars) (5)
6	1,448.90	45.05	7.80	9.00
8	1,585.90	47.80	9.40	9.00
10	1,841.90	50.55	11.00	9.00
12	2,006.40	53.30	12.60	13.50
14	2,365.40	56.05	14.20	13.50
16	2,813.90	58.80	15.80	13.50
18	2,974.90	68.05	17.40	18.00
21	3,295.90	107.10	19.80	18.00
24	3,561.00	112.30	22.20	18.00/22.50
28	3,871.00	117.80	25.40	22.50
30	4,021.00	120.55	27.00	27.00
32	4,675.80	123.30	28.60	22.50
35	5,081.80	126.35	31.00	27.00
40	5,552.80	140.86	35.00	27.00

NOTE: i) The first value (i.e. £18.00) shown in Column (5) - 24 aside, refers to Plant size three farms while the second (i.e. £22.50) refers to plant size four farms.
ii) In the case of milking machines, teat washers and herd testing brackets, the costs shown in Table B.13 include the installation costs.

The size of the actual teat washer cylinders required are shown in Table B.14. The sizes of teat washer cylinders required were determined by estimating the volume of water each of the various teat washer cylinders could raise from 60° to 100°F per hour and comparing this volume with the quantity of warm water required per hour. The quantity of warm water required per hour is dependent on the output of cows per hour from the farm dairy and the volume of water required per cow per milking. It is assumed the volume of water required per cow is 1/10th gallon per milking. Output of cows per hour from the various sizes of farm dairies is discussed in section B.5.

Table B.14 Size of Teat Washer Cylinders according to Farm Dairy Size

Farm Dairy Size (No. of sets of cups)	Size of Teat Washer Cylinders (gallons)
6 - 16 aside	3
18	5
21 - 35	5 and 3
40	2 (5)

The sizes of hot water cylinders required for the various farm dairies are based upon the regulations of the Department of Agriculture. The regulations require that the hot water cylinder be capable of producing:

2 gallons of hot water per set of cups per milking;
2 gallons of hot water per milking for the milk pump;
10 gallons of hot water per milking for the milk room;
Either 10 gallons of hot water per day for the bulk milk vat; where the bulk milk vat is less than 1,000 gallons capacity,
Or 20 gallons of hot water per day for the bulk milk vat, where the capacity of the bulk milk vat is 1,000 gallons or above. [11]

The sizes and costs of hot water cylinders required for the various sizes of farm dairies are shown in Table B.15.

13) Machinery

The complements of machinery and machinery investment for each of the five plant sizes are shown in Table B.16.

14) Equipment

A summary of the complements of equipment and the equipment investment costs for each of the five plant sizes are shown in Table B.17. The length of electric fence wire required has been varied as farm area varies. The length of electric fence wire required has been assessed as equal to half the width of the farm, plus one fifth the length of the farm.[12] The cost of electric fence wire is 0.6 cents per yard.

11. Data supplied by Miss J. Bromley, Farm Advisory Officer, Department of Agriculture, Palmerston North.

12. Such a length of electric fence wire is sufficient to allow the herd to be grass wintered in two mobs.

Table B.15 Sizes and Costs of Hot Water Cylinders Required according to Herd Size and Plant Size

Farm Dairy Size, No. of sets of cups	No. of Milkers	Range of Herd Sizes (cows)	Size Water Cylinder Required (gallons)	Cost (Dollars)
6	1	60 - 105	40	141.78
8	1	60 - 120	40	141.78
10	1	60 - 136	45	161.28
12	2	120 - 210	55	176.28
14	2	120 - 226	55	176.28
16	2	120 - 240	55	176.28
18	3	180 - 265	60	196.28
21	3	180 - 265	60/25	306.31
24	3	180 - 265	60/25	306.31
18	3	266 - 315	60/25	306.31
21	3	266 - 339	60/25	306.31
24	3	266 - 360	60/25	306.31
24	4	240 - 265	60/25	306.31
28	4	240 - 265	60/25	306.31
32	4	240 - 265	60/33	323.06
24	4	266 - 420	60/25	306.31
28	4	266 - 452	60/33	323.06
32	4	266 - 480	60/40	338.06
30	5	300 - 525	60/33	323.06
35	5	300 - 565	60/45	357.56
40	5	300 - 600	60/55	372.56

NOTES: i) It is assumed that a 1,000 gallon bulk milk vat is introduced when herd sizes reach 265 cows.

ii) For all farm dairies greater than an 18 aside, two hot water cylinders are required to heat the necessary volume of water. The largest hot water cylinder manufactured has a capacity of 60 gallons. Hence for a 21 aside farm dairy, a 60 gallon and a 25 gallon hot water cylinder are required.

Table B.16 Machinery Complements and Investment according to Plant Size

Item	Plant Size One (dollars)	Plant Size Two (dollars)	Plant Size Three (dollars)	Plant Size Four (dollars)	Plant Size Five (dollars)
Tractor (a)	2,842.00	2,842.00	2,842.00	2,842.00	2,842.00
Tractor (b)			2,842.00	2,842.00	2,842.00
Tractor (c)				1,982.00	1,982.00
Hay mower	276.00	276.00	276.00	276.00	276.00
Hay Rake	529.00 *	529.00	529.00	529.00	529.00
Transport tray (small)	69.00	69.00	(2)138.00	69.00	69.00
Transport tray (large)				(2)154.80	(2)154.80
Trailer (a)	294.00	294.00		294.00	
Trailer (b)			304.00		304.00
Trailer (c)				529.00	529.00
Grader Blade	170.00	170.00	170.00	170.00	170.00
Spray Equipment	73.50	73.50	73.50	73.50	73.50
Fertiliser distributor		268.00 *	268.00 *	268.00	268.00
Front end Loader		434.00 *	434.00 *	434.00	434.00
Baler			2,079.00 *	2,079.00 *	2,079.00 *
Bale Loader				353.00	353.00

NOTE: i) The items of machinery marked by an asterisk may or may not be included in the complement of machinery for the relevant plant size. The rated horsepower capacities of the tractors are:

Tractor (a) 45 Bhp Tractor (b) 45 Bhp Tractor (c) 30 Bhp

Table B.17 Equipment Investment according to Plant Size

Item	Plant Size One (dollars)	Plant Size Two (dollars)	Plant Size Three (dollars)	Plant Size Four (dollars)	Plant Size Five (dollars)
General Farm Equipment	327.90	353.40	374.40	454.74	473.92
Carpentry Tools	40.19	50.07	52.87	76.23	79.03
Mechanics Toolkit	82.57	83.80	83.80	92.78	95.53
Total	450.66	487.27	510.90	623.75	648.48

NOTE: The term 'General Farm Equipment' refers to such items as handtools, snig chains, diesel tanks, loaders, drench guns, dehorners, eartag applicators, electric fence units and electric fence reels.

15) Working Capital

The requirements for working capital are assessed as 7.24 dollars per cow. This figure was obtained from a cash profile prepared by the author.

B.5 ANNUAL CASH COSTS

1) Animal Health Costs

The assumption is made that per unit animal health costs remain constant over the complete range of herd sizes studied. [13]

Detailed Costings for a 100 cow Herd

Calving Disorders

Assume 4% of the herd is affected		
4 cows at $5.00/visit	:	$20.00
Drugs at 50 cents/cow	:	$ 2.00
Total mileage for 4 visits:		
32 miles at 12 cents/mile [14]	:	$ 3.84

Metabolic Disorders

Assume 6% of the herd require the services of a veterinarian:		
6 cows at $3.00/visit	:	$18.00
Drugs at $2.00/cow	:	$12.00
Total mileage for 6 visits:		
48 miles at 12 cents/mile	:	$ 5.76

Visits for Sundry Disorders (e.g. Woody Tongue, Scours, Lameness, Salmonella, etc.)

Assume 4% of the herd is affected (i.e. 4 cows)		
Assume only one visit is required to treat all four animals:		
Visit fee [15]	:	$ 6.00
Drugs (Total)	:	$10.00
Mileage: 8 miles at 12 cents/mile	:	$ 0.96

Visits for Cleaning Disorders

Assume 2% of the herd to be affected (i.e. 2 cows)		
Assume only one visit to treat both cows.		
Visit fee [15]	:	$ 4,00
Drugs at $2.00 per cow	:	$ 4.00
Mileage: 8 miles at 12 cents/mile	:	$ 0.96

13. This series of costings are based upon data obtained from a Palmerston North veterinarian.

14. Travelling costs are based upon the distance one way (i.e. the return trip is not included). The farm is eight miles from Palmerston North.

15. i.e. $3.00 for the first cow, $1.00 per cow thereafter.

Visits for Mastitis

Assume only 1% of the herd requires the services of a veterinarian (i.e. one cow)		
Visit fee	:	$ 3.00
Drugs at $5.00 per cow	:	$ 5.00
Mileage: 8 miles at 12 cents/mile	:	$ 0.96

Visits for Reproductive Disorders (October/November)

Assume 8% of the herd to be affected (i.e. 8 cows)		
Assume only one visit required		
Visit fee [16]	:	$ 6.50
Drugs: 8 cows at 25 cents/cow	:	$ 0.96

Repeat Visit (January)

Assume 3% of the herd to be affected (i.e. 3 cows)		
Assume only one visit		
Visit fee [16]	:	$ 4.00
Drugs 3 cows at 50 cents/cow	:	$ 1.50

Mastitis

Assume 8% of the herd to be affected (i.e. 8 cows)		
Each cow requires 3 tubes/quarter		
Drugs: 2 dozen tubes of penicillin at $1.15/ dozen	:	$ 2.30

Pregnancy Testing

Assume 10% of the herd requires pregnancy testing (i.e. 10 cows).		
Visit fee [17]	:	$ 6.60
Mileage: 8 miles at 12 cents/mile	:	$ 0.96

Treatment for Ectoparasites (lice)

It is recommended that the mature cows be treated once during the season (during the winter) and the calves, twice.

Cost of material required to treat 100 cows and associated young stock according to the above recommendations	:	$11.97

16. i.e. $3.00 for the first cow; thereafter 50 cents per cow.
17. i.e. $3.00 for the first cow; thereafter 40 cents per cow.

Prevention of Metabolic Disorders

It is recommended that Calcined Magnesite be fed to the herd at a rate of 2 ounces per cow per day for a three weekly period in the spring.

Cost of material for 100 cows over the period	:	$26.25
Total Animal Health Costs for 100 cows	:	$161.51

Calf Vaccination Costs

Contagious abortion vaccination	:	25 cents/calf
Nasal catarrh vaccinations	:	25 cents/calf

Calf Rearing Disorders

Assume 20% of the calves being reared require sulphur drug treatment.
Cost per calf treated (80 cents)
Overal cost per calf : 16 cents/calf

Animal Health Costs per Calf

Heifer calves	:	66 cents/calf

Animal Health Costs per Calf

Bull calves	:	41 cents/calf

Drench Cost

It is recommended that calves be drenched six times in their first 12 months of life. The recommended months of drenching for August born calves are: October, November, December, February, April and May. Further, it is recommended that the rising two year old heifers (and bulls) be drenched in May.

The quantity of drench to be administered per animal is dependent on the live weights of the animals. Table B.18 shows the assumed live weights of the animals at the times of drenching [18] and the recommended drenching rates.

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18. Live weight data were obtained from the Massey University dairy farm records.

Table B.18 Live Weights and Drenching Rates according to Age

Month	Live Weight (lbs)	Drench Rate Drench A (fluid ounces)	Drench Rate Drench B (fluid ounces)
October	125	1⅓	
November	165	1⅓	
December	200	1½	
February	250		1¼
April	310		1½
May	325		1½
Total drench used per calf (fluid ounces)		4	4.25
Total cost per calf		$0.44	$1.09

NOTE: The drench costs are based upon the cost of a 1 gallon pack.

The live weight of the rising 2 year old heifers at May is taken to be 550 lbs.

Quantity of drench A required per animal : 3½ fl. oz.
Cost of drench per animal : $0.38

Bloat Prevention

It is assumed that bloat conditions exist from mid-September to the end of November and also for a further two weekly period in the autumn, making a total of 90 days. Pasture spraying is used as the sole means of bloat prevention for the whole 90 day period.

It is recommended that antifoaming agent be applied to pasture so that each cow obtains three fluid ounces of antifoaming agent per day. (37 ,p4).

Cost of antifoaming agent per cow for 90 days : $1.99

2) Breeding Costs

Number of Cows required to be Inseminated to produce sufficient A.B. replacements. (This discussion follows that in (38 , pp.102 - 104)

Calves born from first calving cows are excluded from selection as their dams have no production records. As it is assumed, both between

and within plant sizes, that twenty three per cent of the herd consists of rising 2 year old heifers, seventy-seven per cent of the herd is available to provide calves for selection.

The calving percentage is assumed to be 93%. [19] Therefore, from the seventy-seven cows from which calves can be selected, seventy two calves are produced. Of these, 48% are heifer calves. Therefore of the seventy-two calves available, 35 are heifer calves.

However, 15% of all calvings occur beyond six weeks of the district median calving date and the calves from such calvings are not normally selected as replacements. Therefore of the 35 heifer calves available, 30 are born within six weeks of the district median calving date.

In order to obtain 23 [19] rising 2 year old heifers, 26 heifer calves must be saved. Therefore the percentage of cows which must be artificially inseminated to produce 26 heifer calves is 67 per cent.

Artificial Breeding Costs

A seven week standard service period is assumed for all farms. Costs per cow are as follows:

1st cow	:	$4.85
2nd cow	:	$3.95
3rd cow	:	$3.25
4th cow	:	$2.45

Plus $1.61 for each additional cow up to 30, thereafter $1.41 per cow.

Herd Testing Costs

It is assumed that 97 per cent of the herd is herd tested using the monthly herd testing system. (Three per cent of the herd wintered abort.) The cost of herd testing is $1.53 per cow, plus a herd fee of $13.70.

3) Dairy Shed Expenses

Rubberware

It is suggested [20] that inflations be changed:

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19. See stock statistics Section B.2.
20. The suggestions were made by Mr. A.C.F. Langton, Extension Officer, Ruakura Agricultural Research Centre, Hamilton.

Twice per season, if the ratio of cows per set of cups is 15 or less.
Three times if the ratio is greater than 15 but less than 30.
Four times if the ratio is over 30.

The cost of inflations is $1.59 per dozen.

It is suggested [20] that claw rubbers be changed twice per season. The cost of claw rubbers is 96 cents per dozen.

It is suggested that [20] milk and air droppers be changed once per season. The combined cost of milk and air droppers is $1.56 per set.

Detergent

The quantities of detergent required are assessed according to recommendations of the Department of Agriculture. [21] It is recommended that:

14 cc of iodophor be used per set of cups per day;
14 grams of alkaline detergent be used per set of cups per day;
14 cc of iodophor and 14 grams of alkaline detergent be used per day for the milk pump;
35 grams of alkaline detergent be used per day for bulk milk vats of less than 1,000 gallons capacity;
70 grams of alkaline detergent be used per day for bulk milk vats of a capacity of 1,000 gallons or more.

The total quantity of alkaline detergent required by the milk pump and per set of cups over a season is therefore 9.18 lbs. (A milking season extends over 300 days and a total of 600 milkings are performed.)

Similarly, the total quantity of iodophor required by the milk pump and per set of cups over a season is 0.918 gallons.

The total quantity of detergent used per season for a bulk milk vat of a capacity of less than 1,000 gallons is 25.06 lbs.

For bulk milk vats with a capacity of 1,000 gallons or more, the total quantity of detergent used per season is 46.12 lbs.

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21. Data obtained from Miss J. Bromley, Farm Advisory Officer, Department of Agriculture, Palmerston North.

The costs [22] of the two materials are:

Iodophor	:	$4.60 per gallon
Alkaline detergent	:	$0.[illegible] per pound

Vacuum Pump Oil Consumption

The sizes [23] of vacuum pumps required for the various milking machines and the consumption of rotary pump oil are shown in Table B.19.

Table B.19 Size of Vacuum Pumps required and Oil Consumption of the Vacuum Pumps

Farm Dairy Size No. of sets of cups	Vacuum Pump	Oil Consumption Hours/Gallon
6 - 10 aside	Masport Major	144
12 - 30 aside	Masport Major 500	144
32 - 40 aside	(2) Masport Majors 500	72

The cost of vacuum pump oil is $1.85 per gallon.

Estimation of Total Milking Time (for the calculation of the oil consumption of the vacuum pump).

It is assumed that the average length of lactation for cows, herd tested in the Manawatu district is 251 days. (30 , p. 58) From a herd of 100 cows, after deducting cows which abort, the season can be viewed as a total of 24,347 cow days (i.e. 97 x 251) or 48,694 individual milkings.

Within a plant size, the rate of milking (cows per man per hour) is assumed to vary according to the number of sets of cups handled per milker. Between plant sizes, however, the rate of milking for a given number of sets of cups per milker, is assumed to remain constant. Table B.20 shows the assumed rates of milking. The output of cows per hour from the farm dairy is therefore the product of the rate of milking and the number of milkers.

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22. Costs are based on: Iodophor - 5 gallon container
Alkaline detergent - 40lb container

23. Data supplied by Mr. A. Hughes, Special Inspector, Department of Agriculture, Palmerston North.

Table B.20 Rate of Milking according to the Number of Sets of Cups per milker. [24]

Number of sets of cups per milker	Rate of Milking (Cows per man per hour
10	70
8	62
7	58
6	54

Further it is assumed that the milking machines are operated for an additional ten minutes each milking to allow the machines to be cleaned.

The total milking time (in hours for the season) is therefore the product of the herd size and 486.94 divided by the output of cows from the farm dairy per hour, plus 100.

Brushes for the Milking Shed

The annual cost of milking shed brushes for the five plant sizes is shown in Table B.21. [25]

Table B.21 Annual Requirements and Costs of Milking Shed Brushes (Costs in Dollars)

Plant Size	Plant Size One	Plant Size Two	Plant Size Three	Plant Size Four	Plant Size Five
Size of farm dairy, No. of sets of cups	6, 8, 10	12, 14 16	18, 21 24	24, 28 32	30, 35 40
Scrubbing Brush	0.82	(2) 1.64	(3) 2.46	(4) 3.28	(5) 4.10
Spout Brush	0.75	0.75	0.75	0.75	0.75
Dropper Brush	(2)1.50	(2) 1.50	(2) 1.50	(2) 1.50	(2) 1.50
Traveller Brush	0.49	0.49	0.49	0.49	0.49

24. The author decided upon the rates of milking shown in Table B.20 after discussions with Mr. H.J. Clifford, Assistant Director of Farm Production, New Zealand Dairy Board, Wellington.

25. The costs of the dairy shed brushes for each of the five plant sizes were decided upon by the author after discussions with the Farm Dairy Instructors of the Department of Agriculture, Palmerston North.

Eartags

The costs of eartags are taken as 40 cents per rising two year old heifer.

Annual Milking Machine Check

The charge for a milking machine check remains constant at 10.00 dollars per annum over the complete range of plant sizes and herd sizes studied.

4) Fertiliser Costs

The rate of application of fertiliser is four cwt per acre [26] per annum of superphosphate, both between and within plant sizes.

The cost of fertiliser per acre is as follows:

Cost of fertiliser (ex works)	:	$25.60 per ton
Cost of fertiliser minus fertiliser subsidy	:	$20.60 per ton
Plus railage from Wanganui	:	$23.60 per ton
Less Transport subsidy	:	$20.15 per ton
Fertiliser cost per acre	:	$ 4.03 per acre

5) Weed and Pest Control

The area requiring treatment for porina each year is taken to be 1/10 of the farm area. [27] The recommended treatment is to spray with Dipterex at an application rate of ¾lb of active ingredient per acre. The cost of materials for such treatment is 77 cents per acre.

The only weed requiring treatment is considered to be barley grass. The quantity of herbicide required is 0.6 gallons per 100 acres. [28] The cost of herbicide per gallon (paraquat) is $15.36.

6) Administration

Accountancy

Accountancy fee varies with herd size according to the linear function

$$y = 0.1852x + 88.8$$

where y is the accountancy fee

x is the herd size

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26. Data supplied by Mr. K. W. Pheasant, Dairy Board Consulting Officer, Palmerston North.
27. Data supplied by Mr. W. L. Osborne, Farm Advisory Officer, Department of Agriculture, Palmerston North.
28. Data supplied by Mr. A. Greig, Farmer, Awahuri

The linear function in question was obtained from the following data:

60 cows	:	Accountancy fee	$100
600 cows	:	Accountancy fee	$200 [29]

Sundry Items

Rural Delivery Fee	:	$ 2.00
Journal Subscriptions	:	$ 7.40
Telephone (Rental)	:	$44.00
Postages	:	$10.00
Tolls	:	$20.00
		$83.40

7) Feed

Feed costs include only grazing costs for the yearling heifers and associated bulls. The cost is $22.00 per head for 12 months grazing.

8) Freight

The cost of transporting the yearling heifers and associated bulls, a distance of 20 miles for grazing away from the farm is 84 cents per head. The cost of transporting the above cattle back to the "home farm" after 12 months grazing is $1.20 per head.

The cost of transporting farm requisites such as bloat oil and calcined magnesite is $1.73 per ton.

Freight on materials for repairs and maintenance is included in the cost of these items, and freight charges for cull stock have been deducted from the prices received.

Fertiliser freight can assume two values; on farms where contractors are used for fertiliser distribution : 0.22 dollars per acre; on farms where fertiliser is applied by the farm staff : 0.17 dollars per acre.

9) Electricity

Water Pumping Costs (During the Milking Season)

The number of electrical units (kwh) required per day is given by the function:

$$y = 0.0294x - 0.434$$

where y is the number of electrical units required per day

x is the herd size

29. The author decided upon these two values showing the relationship between herd size and accountancy fee after discussions with a number of Palmerston North accountants.

The function was derived by fitting a linear regression to the data shown in Table B.22.

Table B.22 Kilowatt hours (kwh) required per day (during the milking season) for Water Pumping according to Herd Size

Herd Size (cows)	kwh per day	Herd Size (cows)	kwh per day
60	1.5720	300	9.0660
90	2.0040	400	11.9688
120	2.8152	500	14.3832
150	3.4670	600	16.8140
200	5.5920		

NOTE: The data of Table B.22 is based upon the following assumptions:

i) The quantity of water to be pumped per day is 30 gallons per cow;

ii) The pump operates for 12 hours per day;

iii) The pump efficiency is 40 per cent;

The basis of charging is 4.3 cents per unit for the first 600 units used per period [30] and 2.7 cents per unit thereafter.

Water Pumping Costs (During the Remainder of the Season)

The number of units (kwh) required per day during this period is given by the function:

$$y = 0.00981x - 0.142$$

where y is the number of electrical units required per day

x is the herd size

The above function has been derived by fitting a linear regression to the data shown in Table B.23.

30. A period is in this context 2 months. The number of days in each of the 6 periods is as follows:
Period 1 : 61 days; Period 2 : 61 days; Period 3 : 62 days;
Period 4 : 59 days; Period 5 : 61 days; Period 6 : 61 days;

Table B.23 Kilowatt Hours (kwh) required per day (during the remainder of the season) for Water Pumping according to Herd Size

Herd Size (cows)	kwh per day	Herd Size (cows)	kwh per day
60	0.5240	300	3.0220
90	0.6680	400	3.9896
120	0.9364	500	4.7944
150	1.1556	600	5.5380
200	1.8640		

NOTE: The data of Table B.23 is based upon the following assumptions:

i) The quantity of water to be pumped per day is 10 gallons;

ii) The pump operates for 4 hours per day;

iii) The pump efficiency is 40 per cent;

Similarly, units are charged at 4.3 cents per unit for the first 600 units used per period and 2.7 cents per unit thereafter.

Milking Machine Electricity Costs

The number of electrical units required to power the various milking machines is shown in Table B.24. [31]

Table B.24 Electrical Units required per hour to power various sizes of Milking Machines

Size of Milking Machines (No. of sets of cups)	Electrical Units per hour	Size of Milking Machines (No. of sets of cups)	Electrical Units per hour
6	1.58	21	3.68
8	1.87	24	4.10
10	2.12	28	4.67
12	2.45	30	4.92
14	2.69	32	5.98
16	2.99	35	6.35
18	3.23	40	7.12

31. Data supplied by Mr. J. Luxton, Dairy Advisory Officer (Farms), Department of Agriculture, Palmerston North and Mr. L. Richardson, McEwans Machinery Ltd., Palmerston North.

The input of units required by the milking machines per period is determined by multiplying the required kilowatt hours (as shown in Table B.24) by the number of hours the milking machines operate per period. The number of hours the milking machines operate per period is obtained by multiplying the total number of individual milkings [32] per season by the following factors:

Period 1 : 0.1563 (or 76.14/486.94)
Period 2 : 0.2407 (or 117.20/486.94)
Period 3 : 0.2427 (or 118.20/486.94)
Period 4 : 0.2278 (or 110.92/486.94)
Period 5 : 0.1325 (or 64.48/486.94)

Then dividing the result of the multiplication by the output of cows from the farm dairy per hour and adding 10 minutes per milking for cleaning purposes.

The derivation of the above factors is as follows: (For a herd of 100 cows)

The total number of individual milkings per season) is assumed to be 48,684, and the assumed conception rates (from the previous mating season) are 60% for cows (30 , p.76) and 68% for the heifers. [33] Herd losses are assumed to be 3% (i.e. 3 cows) and occur at the following times after the beginning of the milking season: 101 days; 143 days and 185 days.

From the above data, a graph can be drawn showing the number of cows in milk at any given day during the season. From the graph, the average number of individual milkings per cow per month and hence per cow per period is obtained. The factors are obtained by dividing the average number of individual milkings per cow per period by the total number of individual milkings per cow per season.

Electric Lighting Costs (Farm Dairy)

The number of electric lights installed in the farm dairies is as follows:

Herringbone pit : 1 light per 2 sets of cups;
Milkroom and vat stand : 2 lights;
Circular yard : 1 light;
Entry/Exit area of milking shed : 1 light;

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32. The derivation of the total number of individual milkings (per season) is discussed in Section B.5, 3)

33. Data from Dr. K. L. McMillan, Research Officer, New Zealand Dairy Board, Awahuri.

The wattage of the electric lights is 100 watts.

In each of the five periods, the milking machines are in use during the season, the electric lights are assumed to operate for the following proportions of the total hours of milking machine operation:

Period 1	:	$\frac{1}{2}$	Period 2	:	$\frac{1}{3}$
Period 3	:	1/10	Period 4	:	$\frac{1}{4}$
Period 5	:	4/10			

Electrical Costs for In Place Cleaning Devices (Bulk Milk Vats)

In place cleaning devices are introduced when herd sizes exceed 176 cows. (i.e. For bulk milk vats of 720 gallons capacity or more) The daily electrical requirement, wherever relevant, is in all cases 0.0465 kwh. It is assumed that the in place cleaning device is powered by a $\frac{1}{4}$ h.p. electric motor and is operated for 15 minutes per day.

Electrical Costs of the Effluent Disposal Systems

The number of electrical units required per day to power the effluent disposal systems is given by the expression:

$$y = 0.1049x - 0.473$$

where y is the number of electrical units required per day

x is the herd size

The expression was obtained by fitting a linear regression to the data of Table B.25. [34]

It is assumed that the milking machines, farm dairy lights, in place vat cleaner, and the effluent disposal system are connected to the one switchboard. The number of electrical units used per period by these four devices is totalled and costed at the rate of 4.3 cents for the first 600 units per period and thereafter at 2.7 cents per unit.

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34. Data supplied by Mr. J. Luxton, Dairy Advisory Officer (Farms), Department of Agriculture, Palmerston North.

Table B.25 - Electrical Units required per day to power the Effluent Disposal Systems

Herd Size (cows)	kwh per day
60	0.3496
70	0.4118
80	0.4662
90	0.5283
100	0.5827
120	0.6093
140	0.7068
160	1.1835
180	1.3239
200	1.4844
250	1.9872
300	2.9411
350	3.4368
400	3.5023
450	3.9401
500	5.3967
550	5.1986
600	5.4712

Water Heating Costs

The number of units required for water heating for a 300 day milking season is shown in Table B.26. Table B.26 is based upon the recommendations discussed in section B.4, 14. The annual average increase in temperature is 152°F.

Table B.26 Electrical Units required per season for Water Heating

Farm Dairy Size No. of sets of cups	No. of Milkers	Range of Herd Sizes (cows)	Total kwh
6	1	60 - 105	7,753
8	1	60 - 120	8,822
10	1	60 - 136	9,894
12	2	120 - 210	10,961
14	2	120 - 226	12,010
16	2	120 - 240	13,097
18	3	180 - 265	14,165
18	3	266 - 315	15,514
21	3	180 - 265	15,779
21	3	266 - 339	17,111
24	3	180 - 265	17,378
24	3	266 - 360	18,713
24	4	240 - 265	17,378
24	4	266 - 420	18,713
28	4	240 - 265	19,508
28	4	266 - 452	20,852
32	4	240 - 265	21,650
32	4	266 - 480	22,901
30	5	300 - 525	21,918
35	5	300 - 565	24,592
40	5	300 - 600	27,262

Electrical units for water heating are costed at 0.75 cents per unit.

Electrical Costs of the Teat Washers

The number of units required to provide the necessary volume of warm water per cow per milking is 0.1171 kwh. (The volume of water required per cow is taken as 1/10th gallon per milking and the annual average increase in temperature is 40°F.) The total number of units required to provide warm water for a herd for a complete season is obtained by first, multiplying the total number of individual milkings per season by 0.1171. Further, due to the warm water which is drawn-off being immediately replaced by cold water, the total number of units used must

be increased by the number of units required to initially raise the contents of the teat washer cylinder from 60°F to 100°F at the commencement of each milking. The number of units required to initially raise the contents of the various teat washer cylinders from 60°F to 100°F is shown in Table B.27.

Table B.27 Electrical Units required to raise the contents of Teat Washer Cylinders 40°F

Farm Dairy Size (No. of Sets of cups)	Capacity of Teatwashers (gallons)	kwh (per milking)
6 - 16	3	0.351
18	5	0.586
21 - 35	8	0.937
40	10	1.171

The electrical units used for water heating by the teat washers are charged at 0.75 cents per kwh.

Electricity Costs of Refrigeration Units

Refrigeration units are introduced when herd sizes exceed 176 cows. The number of electrical units required for refrigeration purposes per day is given by the expression: [35]

$$y = \frac{1}{500} (G \times R) + \frac{1}{1000} (d \times h + \frac{d^2}{4})$$

where y is the number of units used per day;
G is the gallons of milk per milking;
R is the reduction in temperature (°F);
d is the vat diameter (inches);
h is the vat height (inches);

The average output of gallons of milk per cow per milking is taken as 1.044. The assumptions upon which this figure are based follow: The average production of milk per cow of herd tested cows in the Manawatu-Hawkes Bay Herd Improvement Association (30, p. 58) in the 1968/69 dairy season was 6,463 lbs. After allowing for cows which abort

35. The expression was derived by Mr. M. E. Dutton, Lecturer, Biotechnology Department, Massey University.

100 cows produce in total 626,911 pounds of milk per season, or 6,269.11 pounds per cow per season. There are 600 milkings per season. Therefore the average volume of milk per cow per milking is 6,269.11/600 or 10.44 pounds. Finally, the average reduction in temperature is assumed to be 17°F. [36] The dimensions of the various bulk milk vats used are shown in Table B.28. Table B.28 also shows the range of herd sizes associated with each size of bulk milk vat. [37]

Table B.28 Bulk Milk Vats required for various Herd Sizes, Dimensions of Bulk Milk Vats

Range of Herd Size (cows)	Capacity of Bulk Milk Vat (gallons)	Diameter (inches)	Height (inches)
177 - 212	720	65	62
213 - 235	800	75	53
236 - 265	900	75	59
266 - 294	1,000	93	48
295 - 353	1,200	93	57
354 - 441	1,500	93	71
442 +	2,000	93	94

Electrical units used for refrigeration are costed at 1.1 cents per kilowatt hour.

10) Contracting and Casual Labour

The costs of the various contract services are shown below:

Contract price for hay mowing	:	5 cents per bale;
Contract price for hay raking	:	2 cents per bale;
Contract price for hay baling	:	11 cents per bale;
Contract price for hay loading		
With 3 labour units	:	10 cents per bale;
With 2 labour units	:	8.67 cents per bale;
With 1 labour unit	:	7.34 cents per bale;
Cost of fertiliser application	:	68 cents per acre;

36. The author decided upon such a figure after discussions with Mr. Dutton and representatives of the Manawatu Co-operative Dairy Company.

37. The data shown in Table B.28 was derived by the author from information supplied by a manufacturer of bulk milk vats.

Casual labour is employed only on those plant size one farms where the herd size exceeds 120 cows. The total cost of casual labour varies discretely with the herd size as shown below.

121 - 130 cows : 90 hours at 92 cents per hour = $82.80
131 cows or more : 135 hours at 92 cents per hour = $124.20

11) Permanent Labour

The annual remuneration (i.e. wages) for all employed labour units on the representative farms is $3,000.

12) Rates

Three rates are levied. They are:

General Rate (Kairanga County Council) : 0.9130 cents per $ of unimproved value;
Manawatu Catchment Board Administration Rate : 0.0966 cents per $ of unimproved value;
Manawatu Drainage Board Rate (Class E) : 0.1300 cents per $ of unimproved value;

Total : 1.1396 cents per $ of unimproved value;

The total unimproved values are obtained by multiplying the total land investment by the following linear functions:

25 - 100 acres : $y = 0.517 - 0.00066x$
More than 100 acres : $y = 0.480 - 0.0003x$
where y is the ratio of unimproved value to the purchase price of the land
x is the number of acres

The two linear functions discussed above have been derived from the following data: 38/

25 acres : The unimproved value is 50 per cent of the purchase price of the "bare" land;
100 acres : The unimproved value is 45 per cent of the purchase price of the "bare" land;
600 acres : The unimproved value is 30 per cent of the purchase price of the "bare" land;

38. Data obtained from Mr. A. K. Ford, Valuation Department, Palmerston North.

13) Insurance Costs

Details of the annual insurance payments are as follows:

Dwelling(s)	: Rate :	37.5 cents per $100 value of initial investment cost;
Barn	: Rate :	37.5 cents per $100 value of initial investment cost;
Implement shed	: Rate :	37.5 cents per $100 value of initial investment cost;
Machinery (excluding tractor(s))	Rate :	50 cents per $100 value of initial investment cost;
Hand tools and general equipment	: Rate :	50 cents per $100 value of initial investment cost;
Milking equipment	: Rate :	50 cents per $100 value of initial investment cost;
Water pump	: Rate :	50 cents per $100 value of initial investment cost;
Effluent disposal pump	: Rate :	50 cents per $100 value of initial investment cost;
Farm Dairy	: Rate :	14 cents per $100 value of initial investment cost;
Pump shed	: Rate :	14 cents per $100 value of initial investment cost;
Hay	: Rate :	50 cents per $100 value
Workers' Compensation	: Rate :	$1.30 per $100 of wages paid
Personal Accident and Sickness	: Annual Premium :	$50.00 per year;
Tractor insurance	: Tractor (a) Annual Premium:	$20.61 per year;
	Tractor (b) Annual Premium:	$20.61 per year;
	Tractor (c) Annual Premium:	$16.38 per year;

Farmers' Public Liability:

Plant size one	: Annual Premium:	$6.00
Plant size two	: Annual Premium:	$6.50
Plant size three	: Annual Premium:	$6.75
Plant size four	: Annual Premium:	$7.00
Plant size five	: Annual Premium:	$7.00

14) Vehicle Expenses

The total tractor hours are obtained by summing the hours each implement (except trailers and transport trays) operate and then multiplying such a sum by 1.66. [39] The factor of 1.66 is based upon an English survey, which suggests that 40 per cent of the total tractor hours are concerned with transporting materials and "hacking". The operating hours for both the transport tray(s) and trailer(s) are then calculated as twenty per cent of the total tractor hours.

The rates of working of the various implements is shown in Table B.29.

Table B.29 Rates of Work of various Farm Implements

Implement	Rate of Work
Hay mower (mowing hay)	2.4 acres per hour
Hay mower (topping)	4.8 acres per hour
Hay rake	10 acres per hour
Hay baler	300 bales per hour
Hay loader	100 bales per hour
Fertiliser distributor	10 acres per hour
Spray equipment (bloat spraying)	3 acres per hour
Spray equipment (Pest control - Porina)	3 acres per hour
Spray equipment (Spot spraying weeds)	10 acres per hour
Spray equipment (Spraying animals for ectoparasites)	30 - 33 cows per hour
Grader blade (15 foot race)	11 chains per hour
Grader blade (20 foot race)	8.25 chains per hour
Grader blade (25 foot race)	6.60 chains per hour

NOTES: i) The rates of work of the implements have been derived according to the formula:

$$\text{Acres per hour} : \frac{\text{Rated width of implement (feet)} \times \text{speed (MPH)}}{10}$$

ii) A field efficiency of 82.5% has been assumed for all implements.

iii) The hours the front end loader operates are taken to be 17.5% of the hours of operation of the fertiliser distributor.

The average fuel consumption for all operations except hay baling is taken as 1.28 gallons of diesel per hour. The average fuel consumption for hay baling is taken as 1.61 gallons of diesel per hour. The oil

39. Data obtained from Mr. J. Baker, Senior Lecturer in Agricultural Mechanisation, Massey University.

consumption is taken to be 3 per cent of the volume of the fuel consumption. The cost of diesel is 0.185 dollars per gallon; the cost of oil is 1.38 dollars per gallon.

The cost of registering vehicles is 9.15 dollars per tractor and 0.45 dollars per trailer.

The cost of baling twine is assessed as 0.186 dollars per cow.

15) Repairs and Maintenance Costs

Buildings

Repairs and maintenance costs are assessed as a percentage of the initial investment cost. The rates are as follows:

Dwelling(s)	:	2 per cent;
Barn	:	1 per cent;
Implement shed	:	2 per cent;
Pump shed	:	0.5 per cent;
Farm Dairy	:	2 per cent;

Fences

The fencing repairs and maintenance cost is assessed as five per cent of the initial cost of materials (including freight). The repairs and maintenance cost per chain is therefore:

Boundary fencing	:	41.45 cents
Internal fencing	:	20.50 cents

It is assumed that the cost of repairs and maintenance on boundary fences (except the fence bordering the road) is shared with neighbours. The cost of repairs and maintenance on such fences is therefore 22.22 cents per chain. The repairs and maintenance cost for gates is also assessed as five per cent of the initial cost of materials (including freight).

Race Repairs and Maintenance

The initial cost factor for farms of minimum race stocking rate is set as five per cent of the original cost of materials including freight.

The repairs and maintenance cost of gateways has been similarly determined. Because the width of metal in the gateways is less than the width of the metal of the farm race, the initial rate (i.e. on the 60 cow farms) is set as 6.5 per cent. The rate is similarly increased as herd size (and hence race stocking rate) increases.

A similar procedure is adopted to calculate the repairs and maintenance costs of the entry race to the farm dairy. The initial rate, however, is set at 10 per cent for the 60 cow farm because the race to the milking shed carries traffic every day whereas only parts of the main race are used every day. An arbitrary decision has been made that the "traffic density" on the race is (on the 60 cow farm) twice that on the main race. The rate on the tanker track is assessed as five per cent of the material costs.

Milking Equipment, Water Supply, Effluent Disposal Unit, Equipment and Hand Tools

The annual repairs and maintenance costs for the above are assessed as a percentage of the initial investment cost. The assumed rates are:

Milking equipment [40]	:	3 per cent;
Water supply [41]	:	3 per cent;
Effluent disposal unit [42]	:	3 per cent;
Equipment and hand tools	:	5 per cent;

Machinery

The repairs and maintenance costs for machinery are expressed on an hourly basis. It is assumed the hourly repairs and maintenance costs remain constant throughout the life of the machines. The hourly repairs and maintenance costs for the various machines are shown in Table B.30. [43]

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40. Data obtained from Mr. L. Richardson, McEwans Machinery Ltd., Palmerston North.
41. Data obtained from Mr. W. E. Sloane, Farm Advisory Officer (Machinery) Department of Agriculture, Palmerston North.
42. Data obtained from Mr. J. Luxton, Dairy Advisory Officer (Farms). Department of Agriculture, Palmerston North.
43. The costs in Table B.30 have been derived by the author from information supplied by Mr. R. M. Collins, Lecturer in Agricultural Mechanisation, Massey University.

Table B.30 Repairs and Maintenance Costs per hour of Various Machines

Machine	Cost per Hour (dollars)	Machine	Cost per Hour (dollars)
Tractor (a)	0.3410	Hay loader	0.1420
Tractor (b)	0.3410	Fertiliser distributor	0.1340
Tractor (c)	0.2378	Front end loader	0.2170
Hay mower	0.2760	Transport tray (small)	0.0124
Hay rake	0.3703	Transport tray (large)	0.0139
Spray equipment	0.1102	Trailer (a)	0.0529
Grader blade	0.6800	Trailer (b)	0.5472
Baler	2.0790	Trailer (c)	0.9520

16) Sundry Expenses

No allowance has been made for sundry expenses because of the difficulties in assessing how such an item of expenditure might vary with the plant size and herd size.

B.6 DEPRECIATION DATA

The estimated economic lives of the resources which are to be depreciated are shown below: 44/

Group One	Dwelling(s)	:	60 years;
	Barn	:	30 years;
	Implement shed	:	30 years;
	Pump shed	:	100 years
	Farm dairy	:	25 years;
	Milking equipment	:	25 years; 40/
	Water pump	:	25 years; 41/
	Effluent disposal pump	:	25 years; 42/

44. The estimated economic lives for the various assets were decided by the author after discussions with Mr. J. N. Hodgson, Reader in Farm Management, Massey University.

Group Two [45]	Tractor (a)	:	10 years;
	Tractor (b)	:	10 years
	Tractor (c)	:	10 years
	Hay mower	:	10 years
	Hay rake	:	8 years;
	Transport tray(s)	:	20 years;
	Trailer(s)	:	15 years;
	Grader blade	:	25 years
	Spray equipment	:	10 years;
	Hay baler	:	10 years;
	Fertiliser distributor	:	10 years;
	Front end loader	:	10 years
	Bale loader	:	10 years

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45. Data concerning the estimated economic lives of the various items of machinery were based upon information obtained from Mr. C.J. Crosbie, Farm Advisory Officer (Machinery), Department of Agriculture, Christchurch.

APPENDIX C

PER UNIT COST AND INCOME CURVES

(The reader's attention is drawn to the fact that on some figures the lowest value shown on the abscissa and ordinate is not zero.)

FIG. 7.1 PER UNIT INVESTMENT COSTS OF LAND ACCORDING TO HERD SIZE

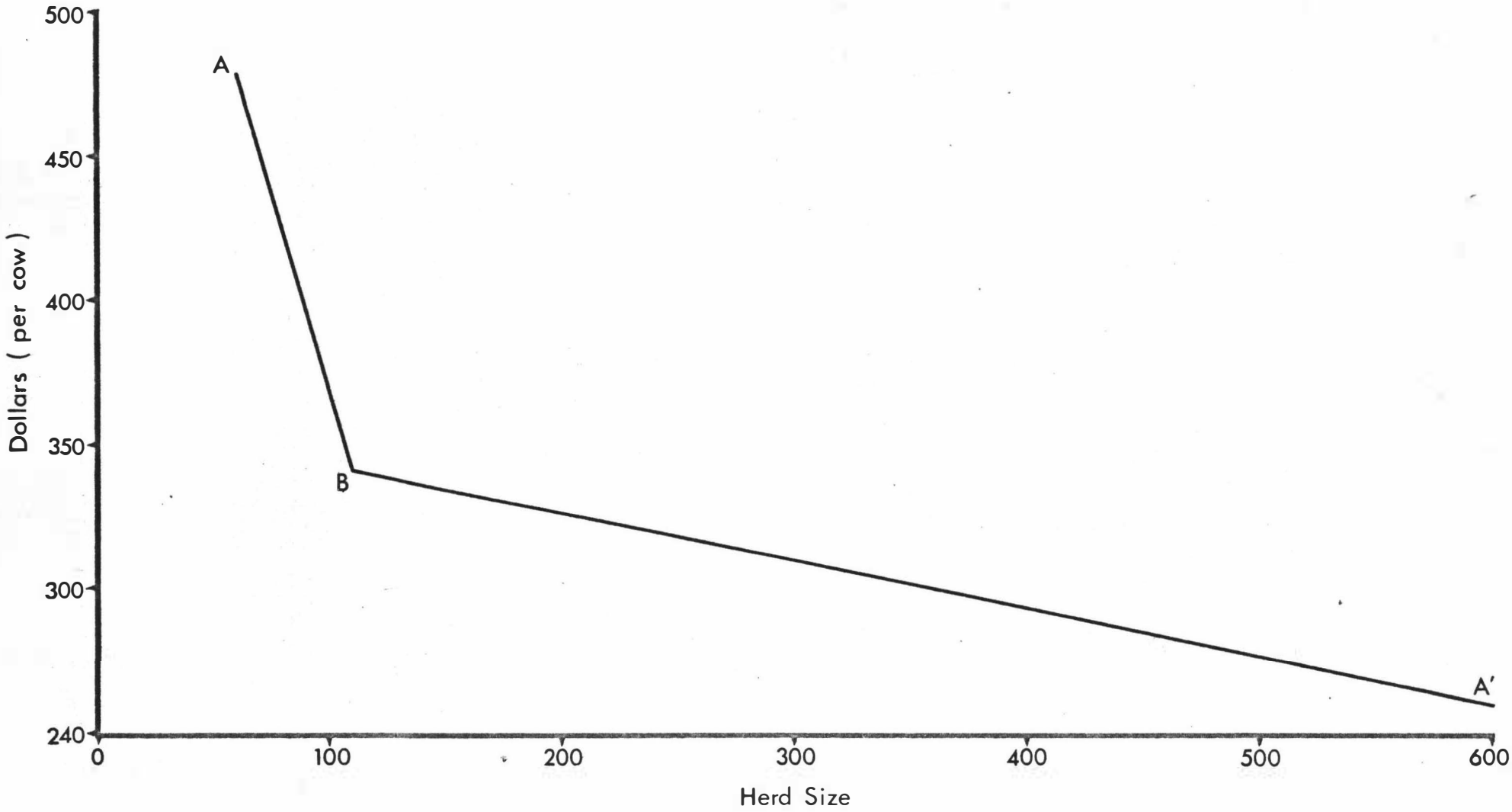


FIG. 7.2 PER UNIT FARM RACE INVESTMENT COSTS ACCORDING TO HERD SIZE

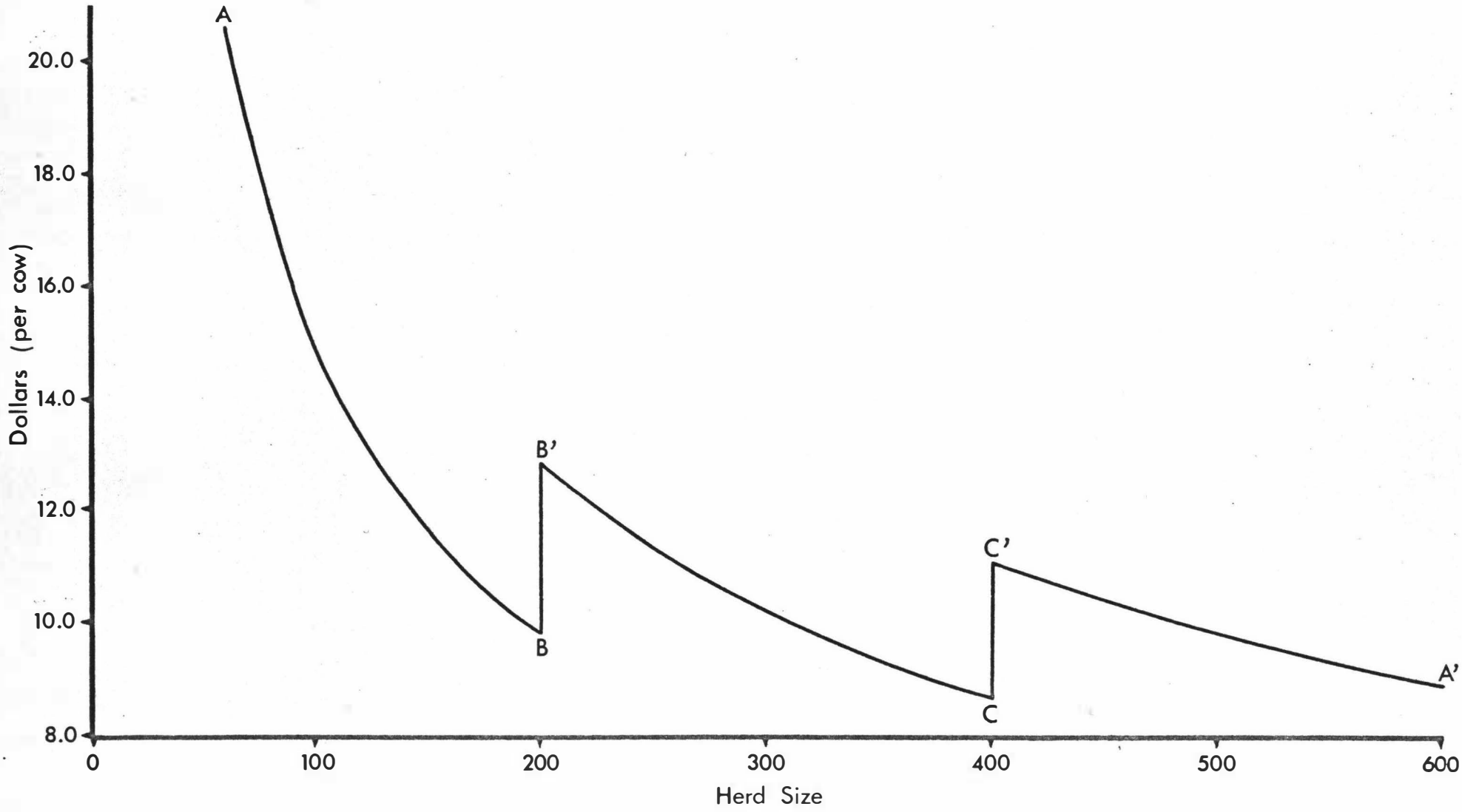


FIG. 7.3 PER UNIT FENCING INVESTMENT COSTS ACCORDING TO HERD SIZE

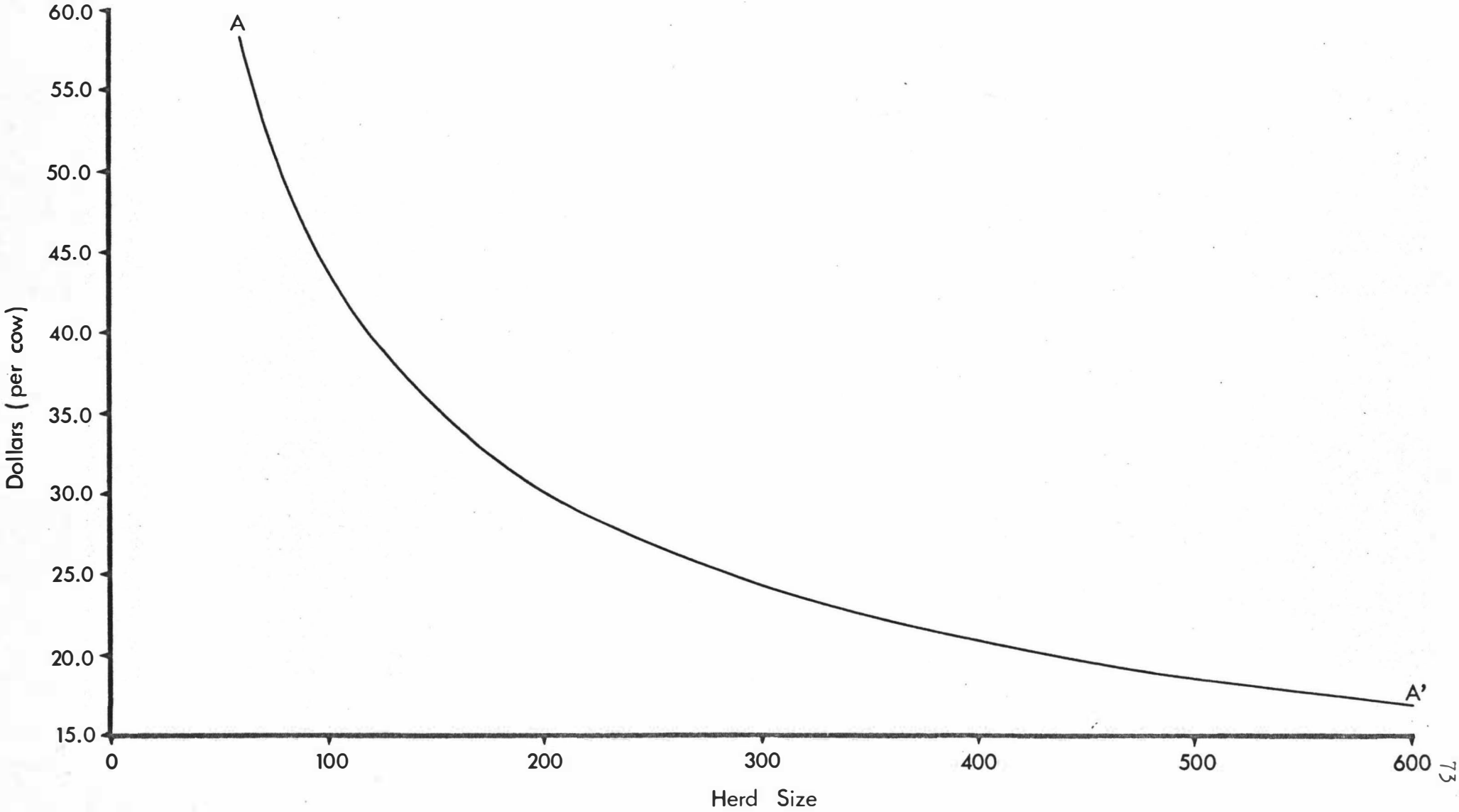


FIG. 7.4 PER UNIT WATER RETICULATION INVESTMENT COSTS ACCORDING TO HERD SIZE

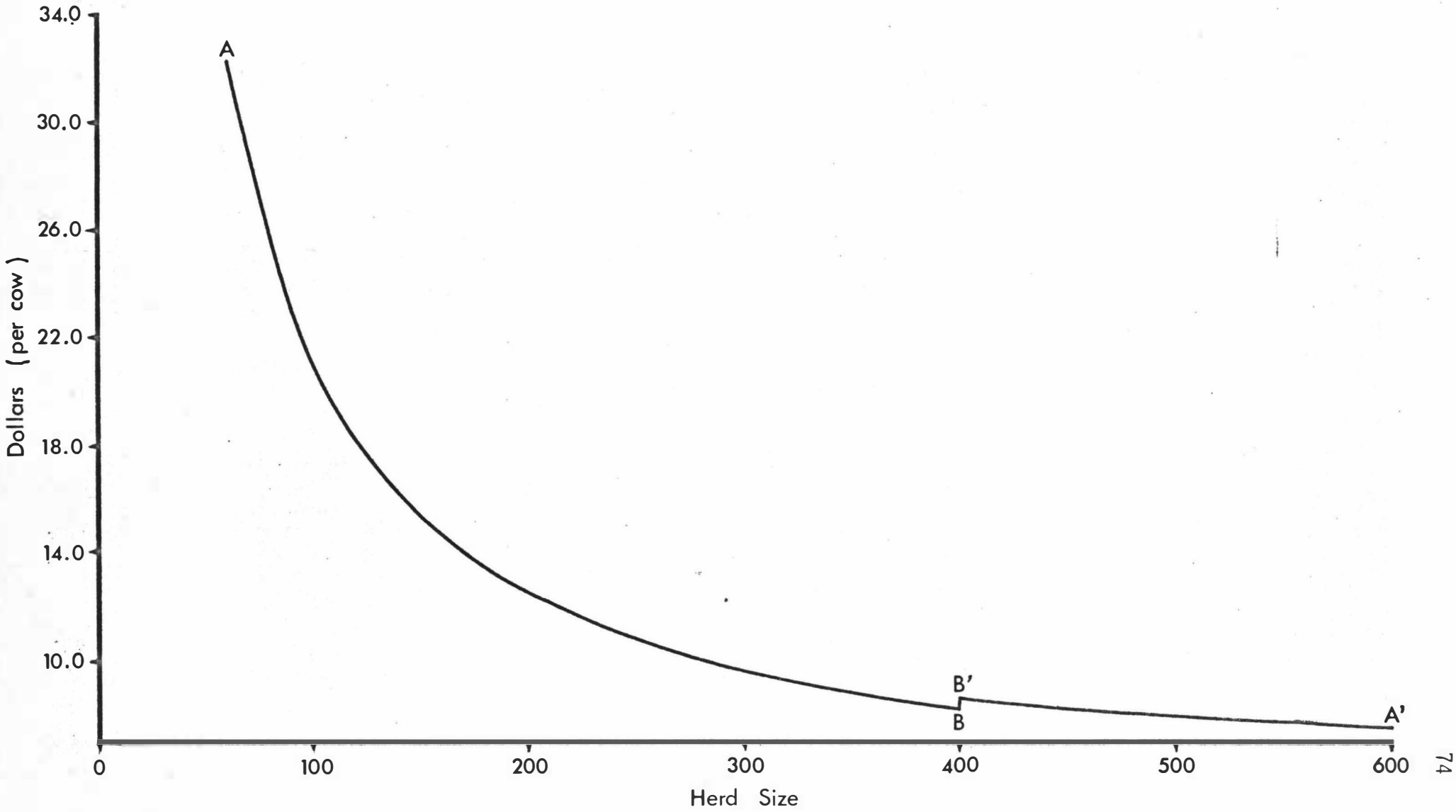


FIG. 7.5 PER UNIT COSTS OF ELECTRIC POWER INSTALLATION ACCORDING TO PLANT AND HERD SIZE

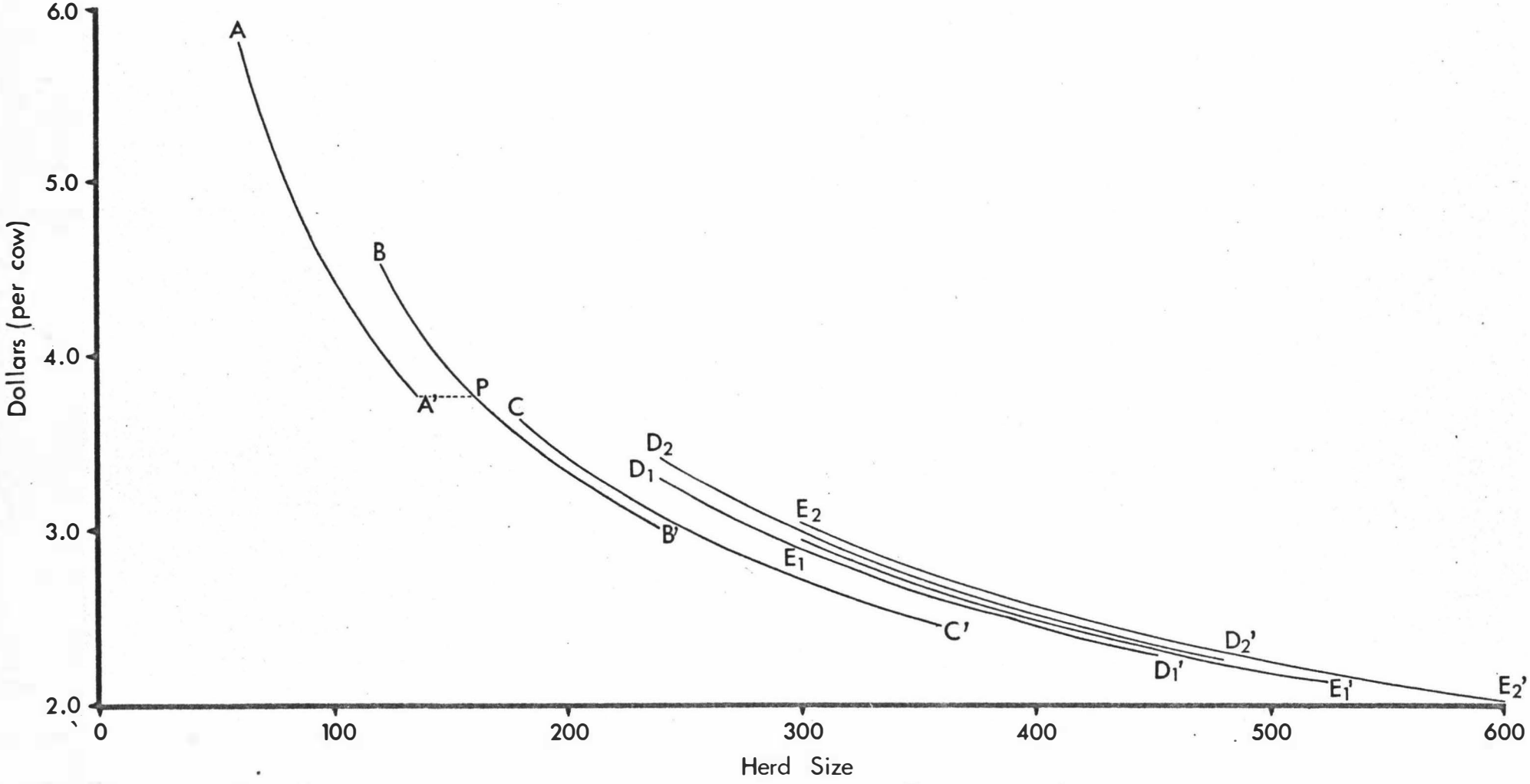


FIG. 7.6 PER UNIT FARM DAIRY INVESTMENT COSTS ACCORDING TO PLANT AND HERD SIZE

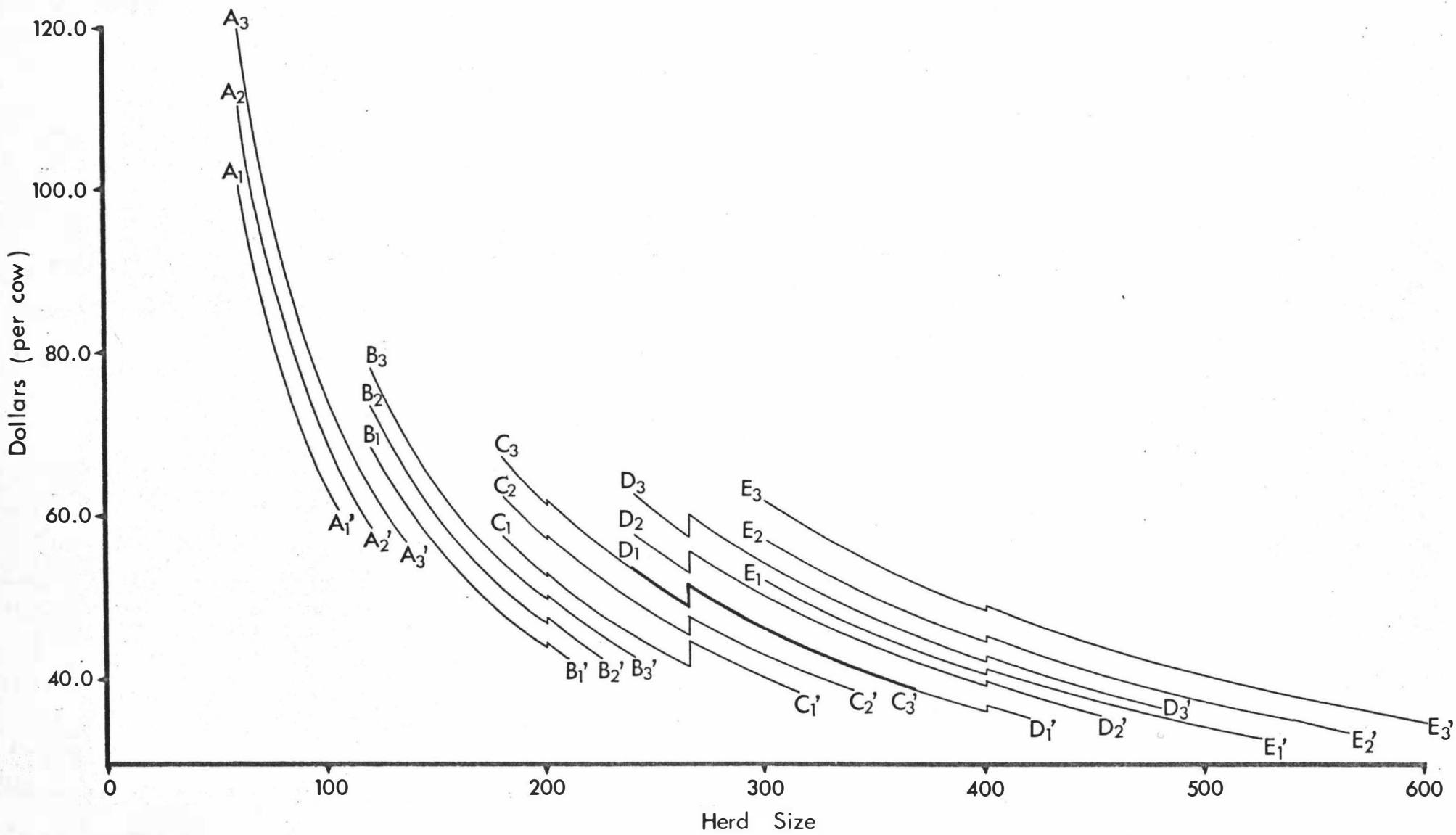


FIG. 7.7 PER UNIT BARN INVESTMENT COSTS ACCORDING TO HERD SIZE

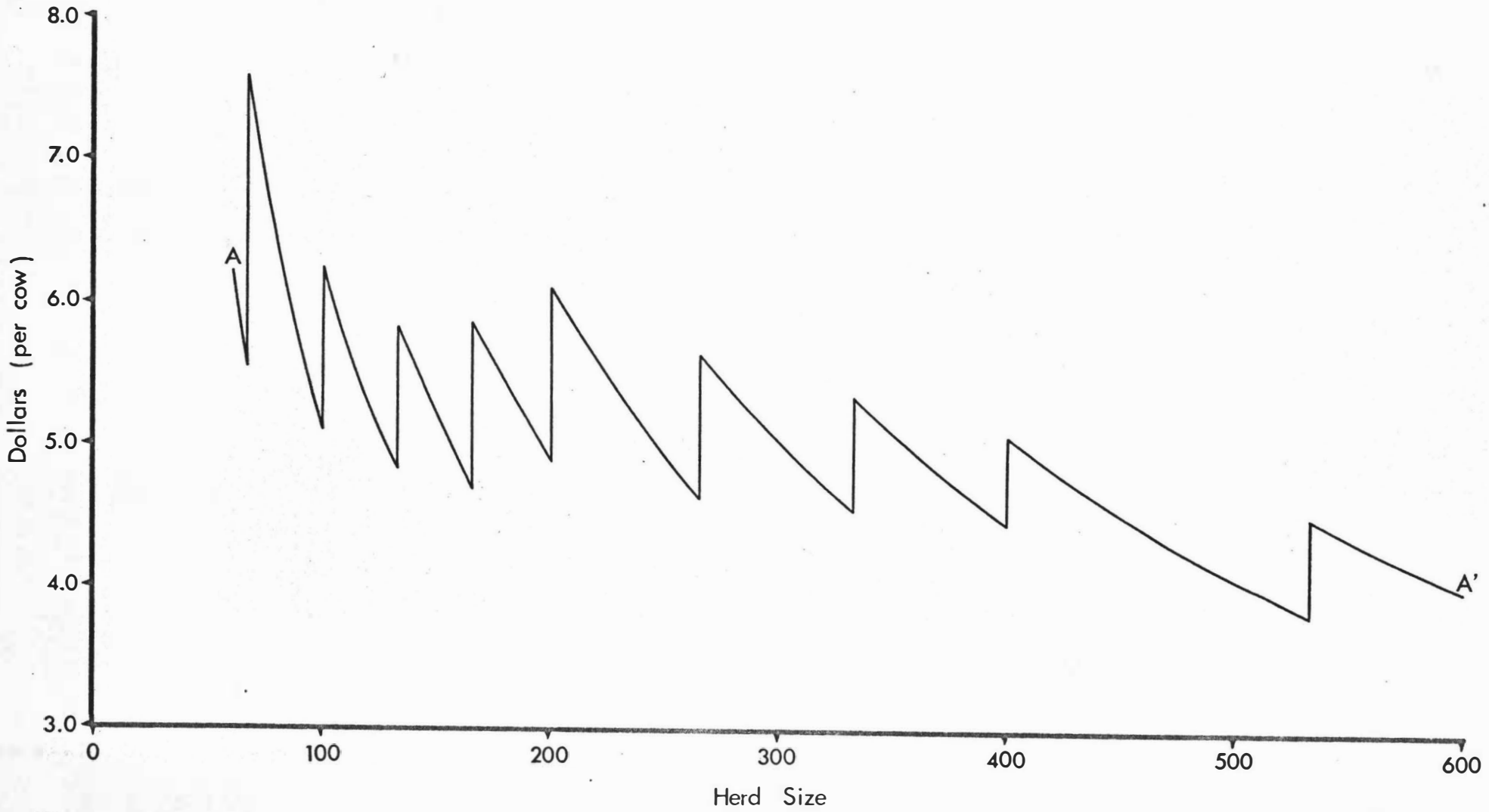


FIG. 7.8 PER UNIT COSTS OF IMPLEMENT SHEDS ACCORDING TO PLANT AND HERD SIZE

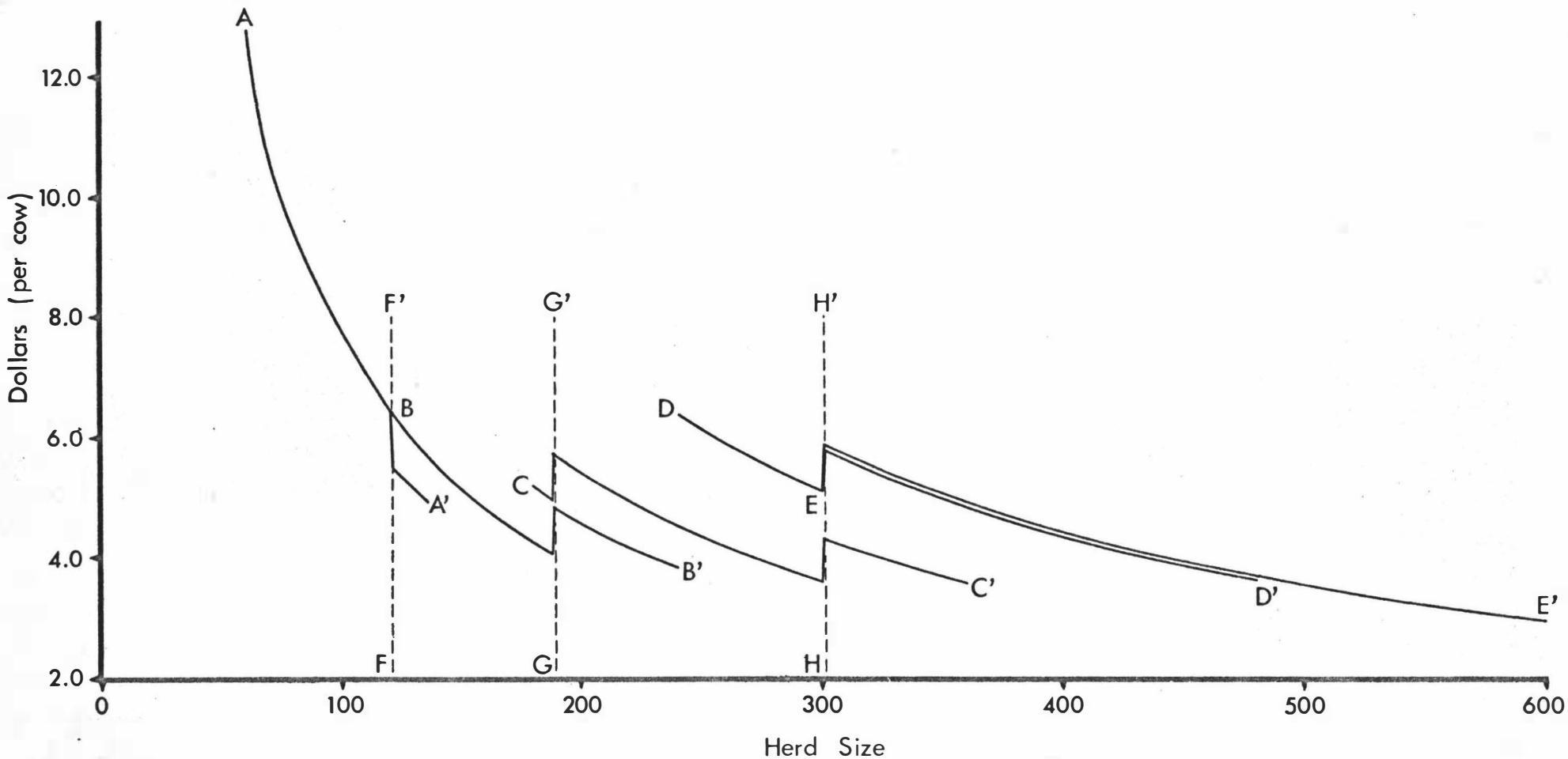


FIG. 7.9 PER UNIT COSTS OF MILKING EQUIPMENT ACCORDING TO PLANT AND HERD SIZE

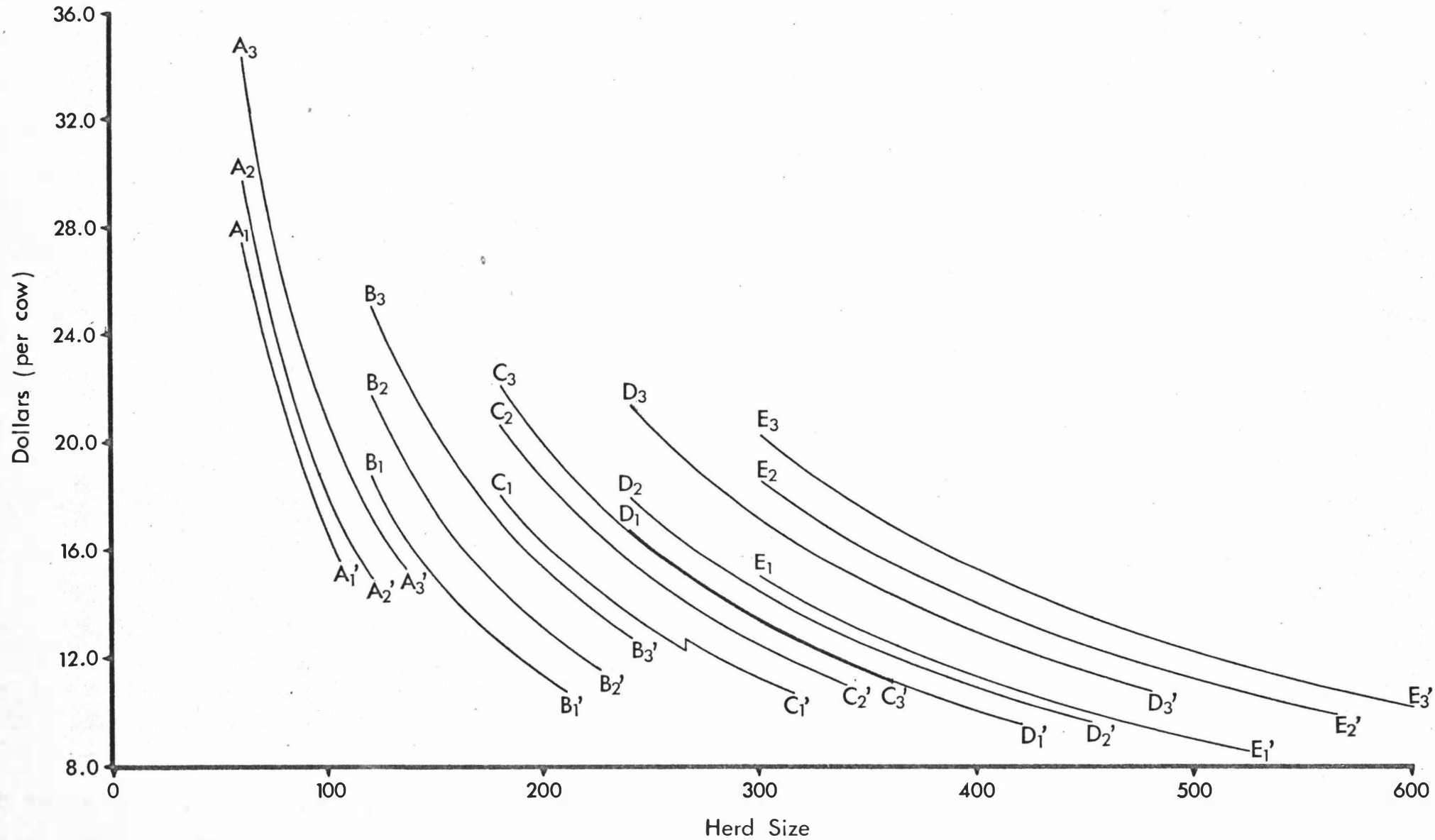


FIG. 7.10 PER UNIT INVESTMENT COSTS OF EFFLUENT DISPOSAL SYSTEMS ACCORDING TO HERD SIZE

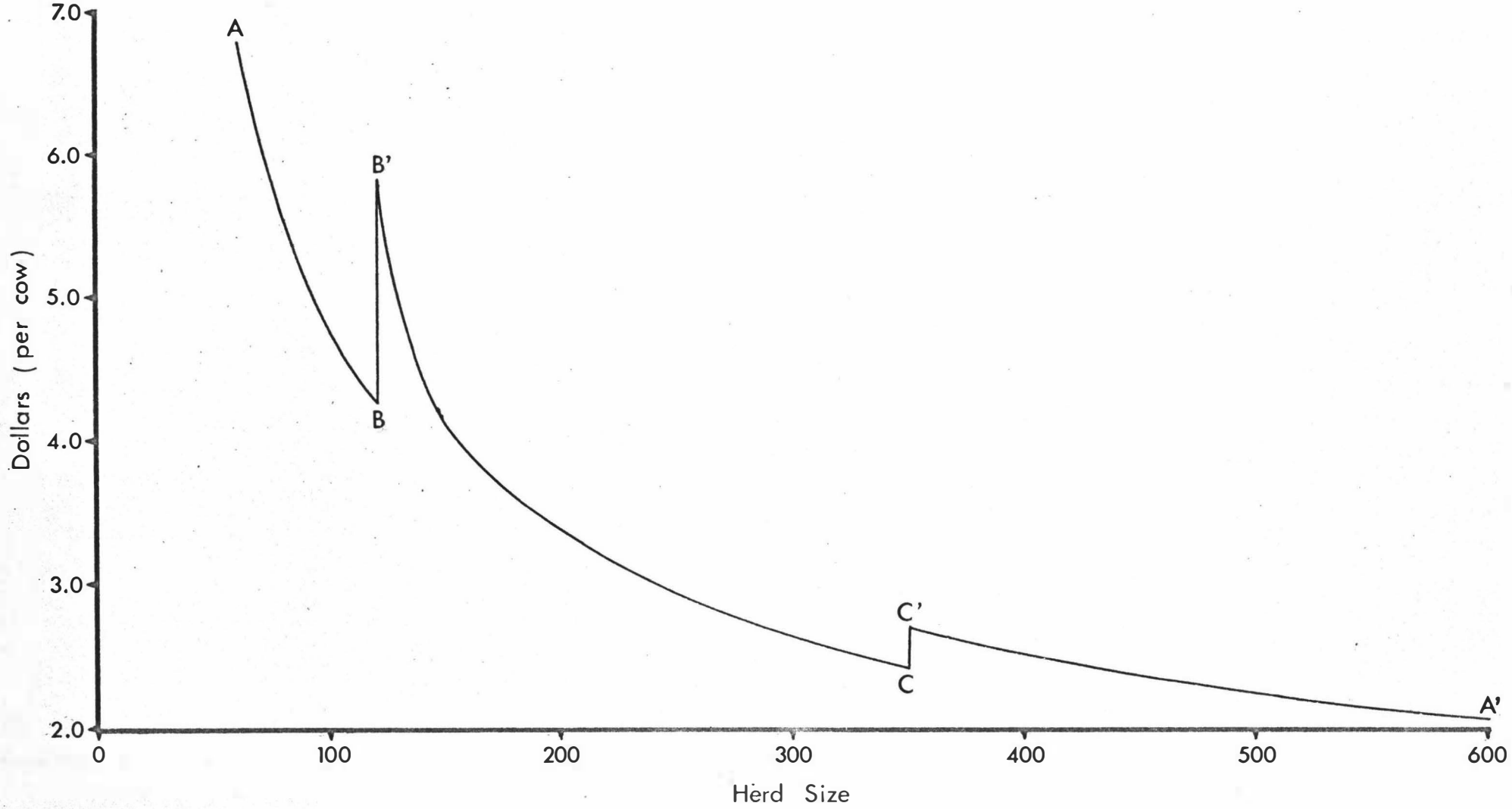


FIG. 7.11 PER UNIT INVESTMENT COSTS OF MACHINERY ACCORDING TO PLANT AND HERD SIZE

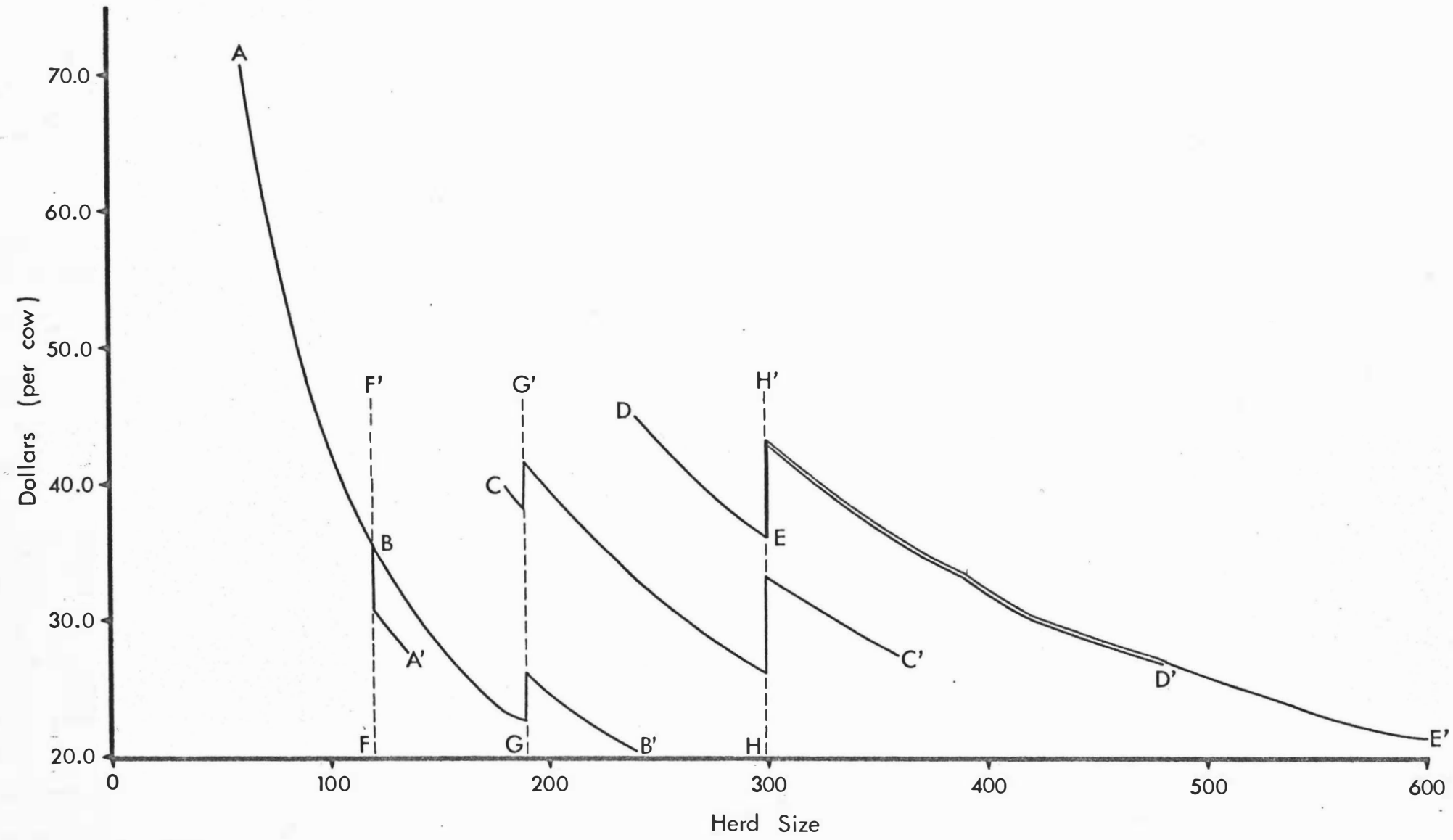


FIG. 7.12 PER UNIT INVESTMENT COSTS OF EQUIPMENT ACCORDING TO PLANT AND HERD SIZE

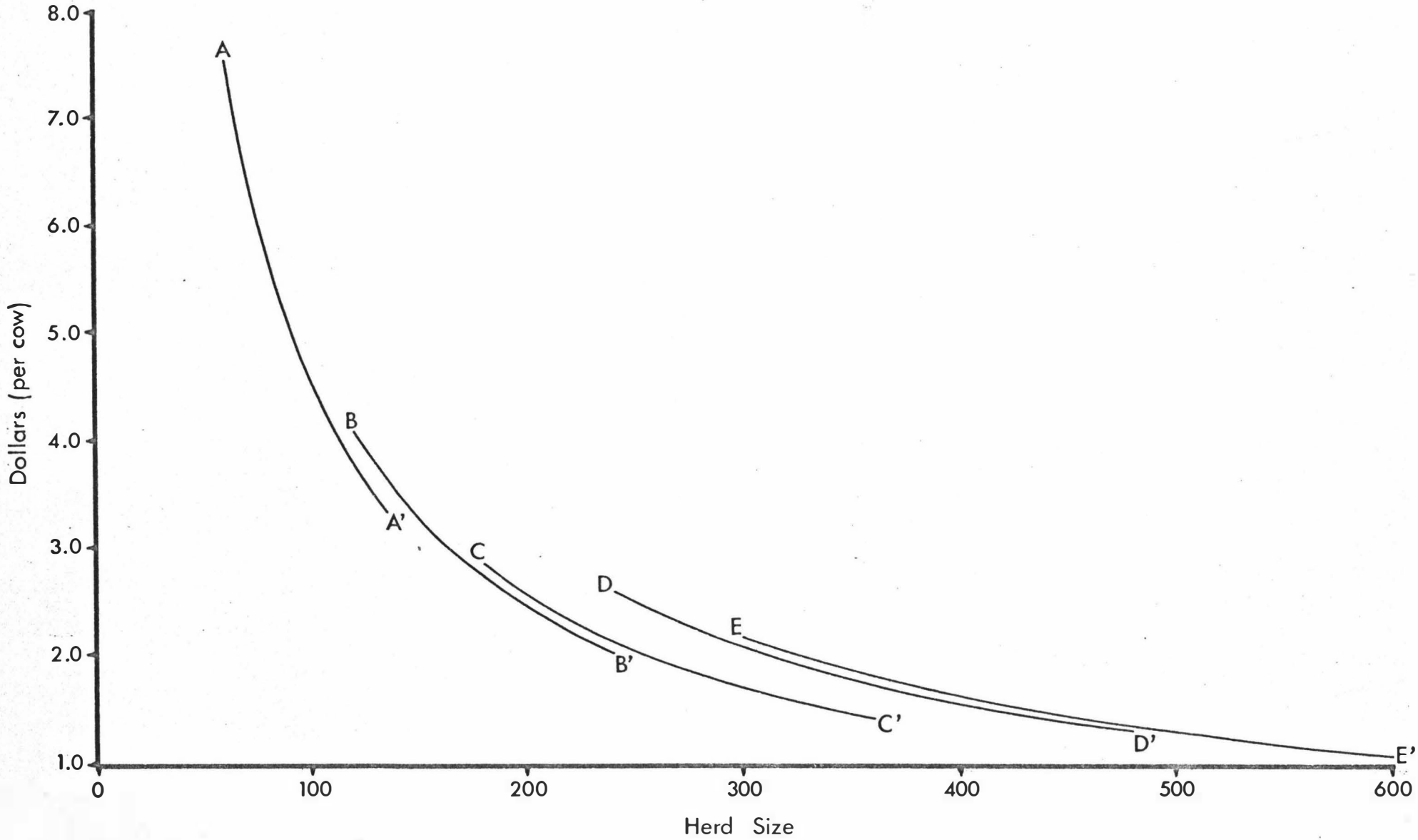


FIG. 7.13 PER UNIT TOTAL INVESTMENT COSTS ACCORDING TO PLANT AND HERD SIZE

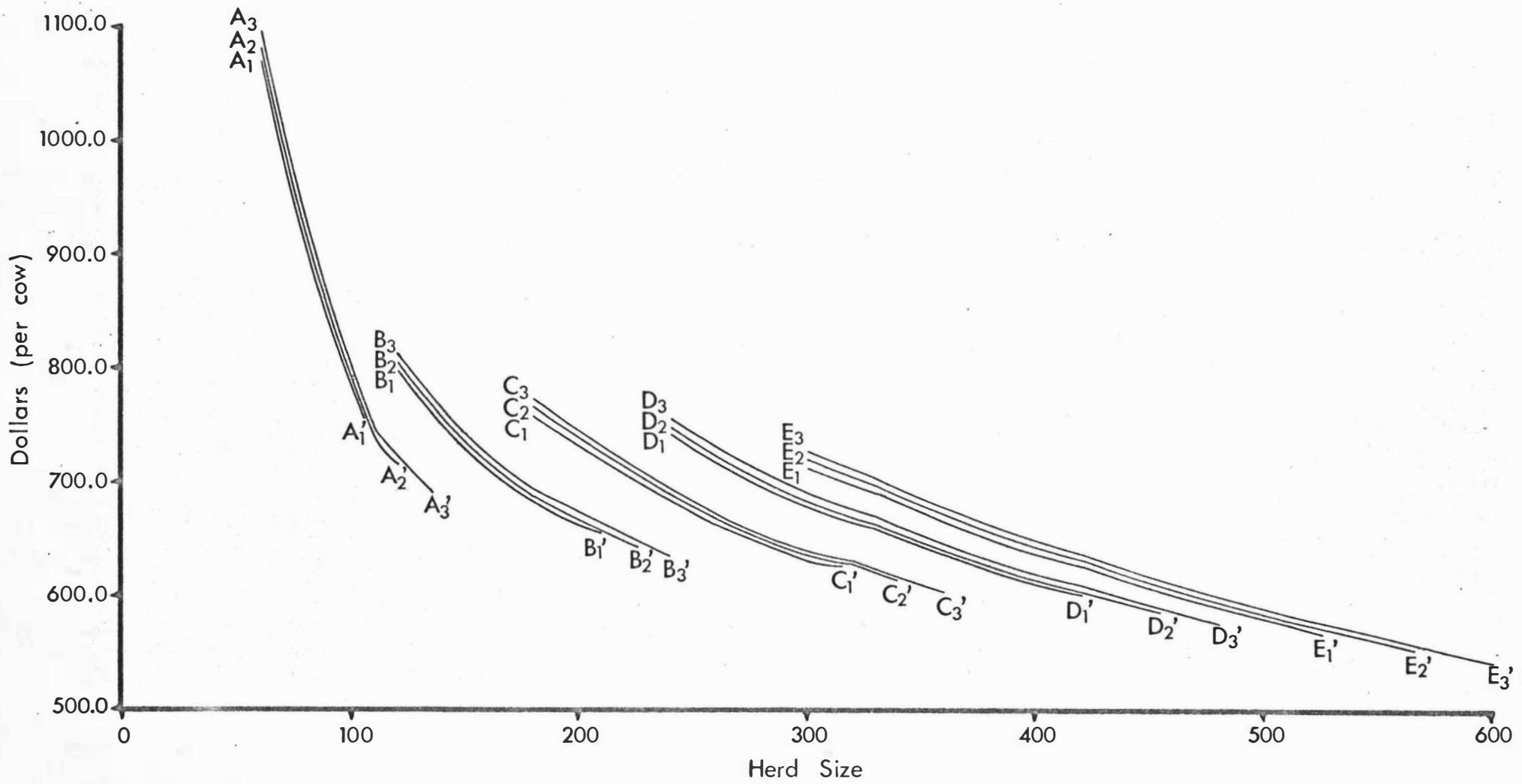


FIG. 7.14 PER UNIT MARKET VALUE (COSTS) ACCORDING TO PLANT AND HERD SIZE

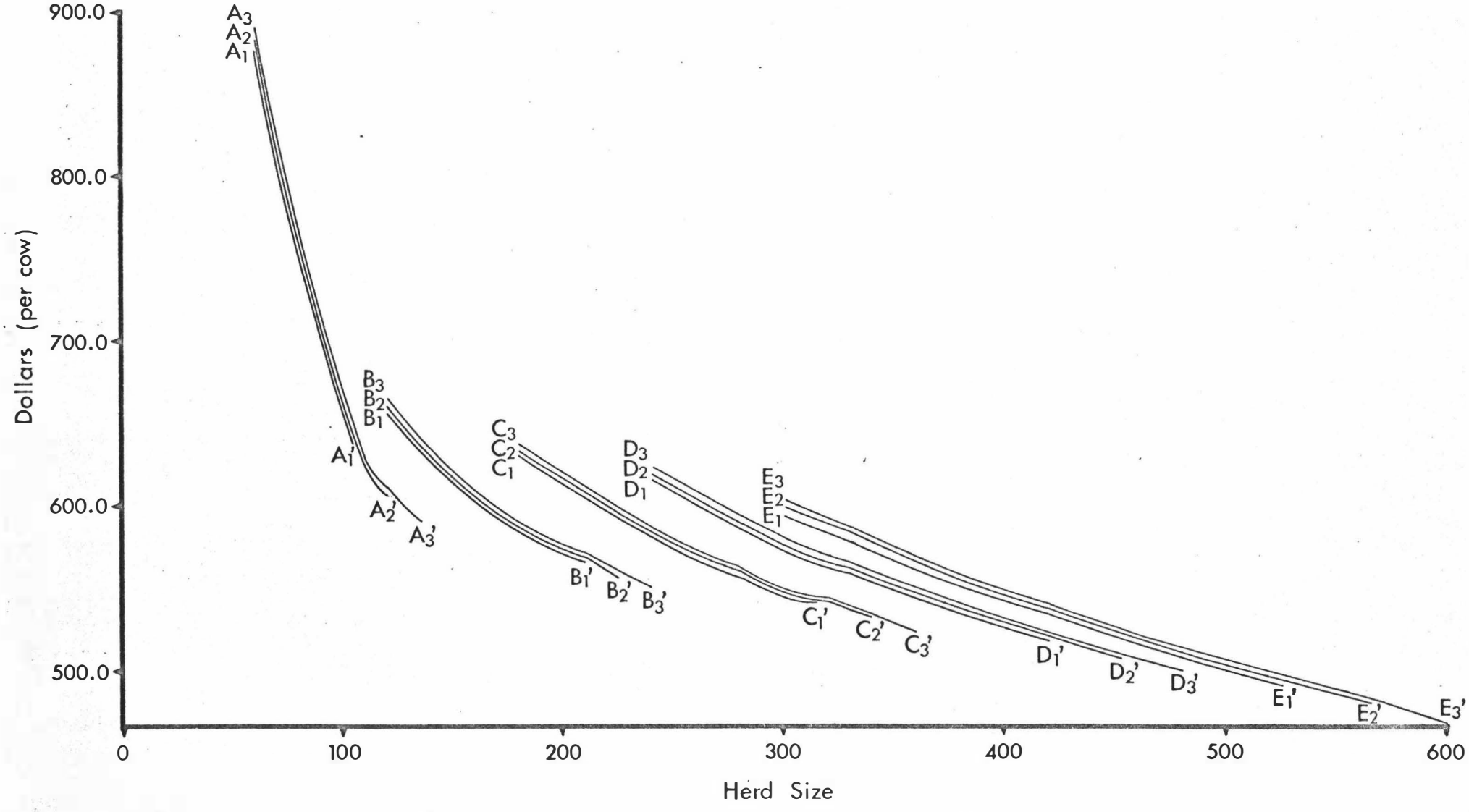


FIG. 7.15 PER UNIT COSTS OF ARTIFICIAL BREEDING AND HERD TESTING ACCORDING TO HERD SIZE

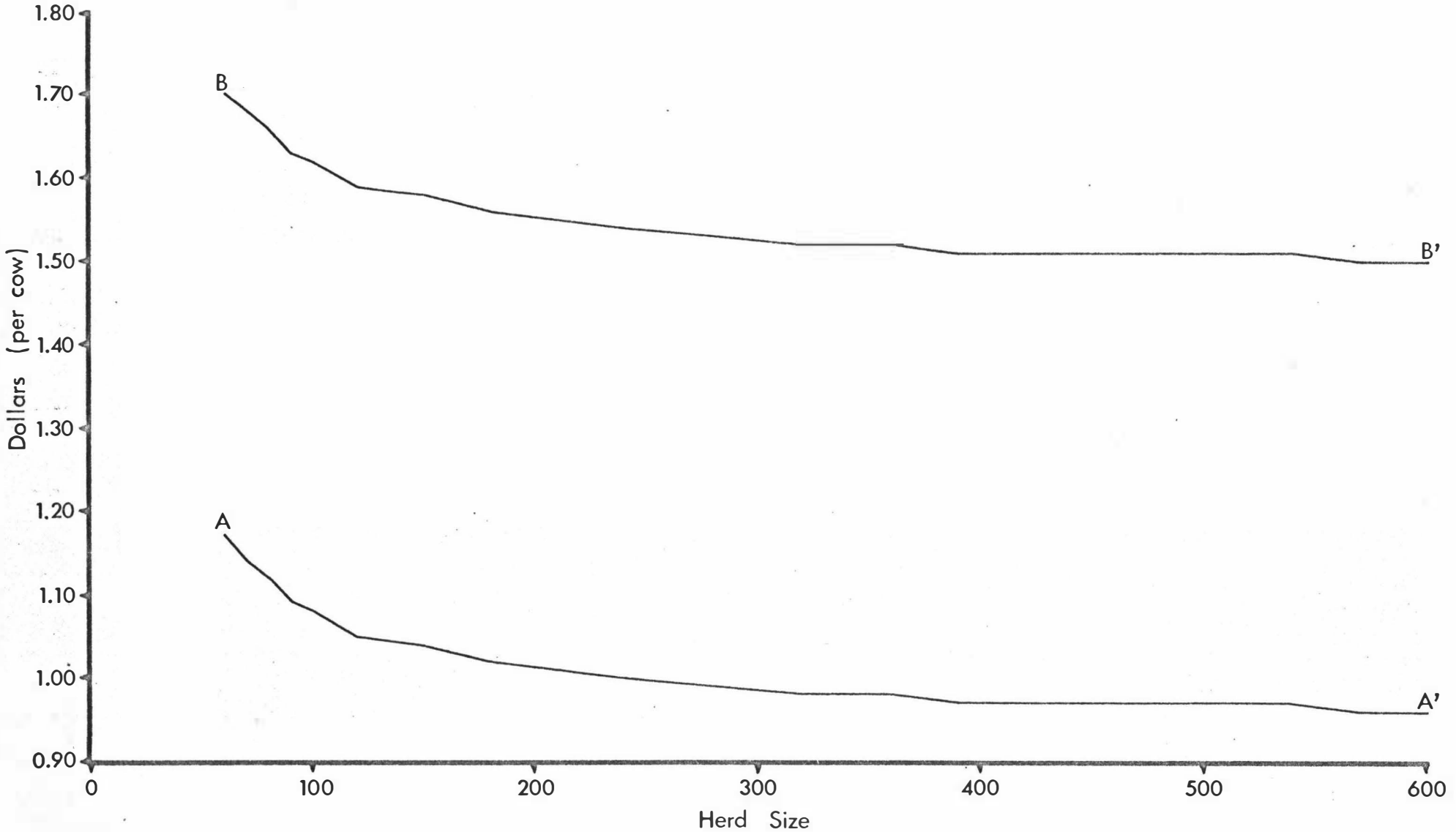


FIG. 7.16 PER UNIT COSTS OF ADMINISTRATION ACCORDING TO HERD SIZE

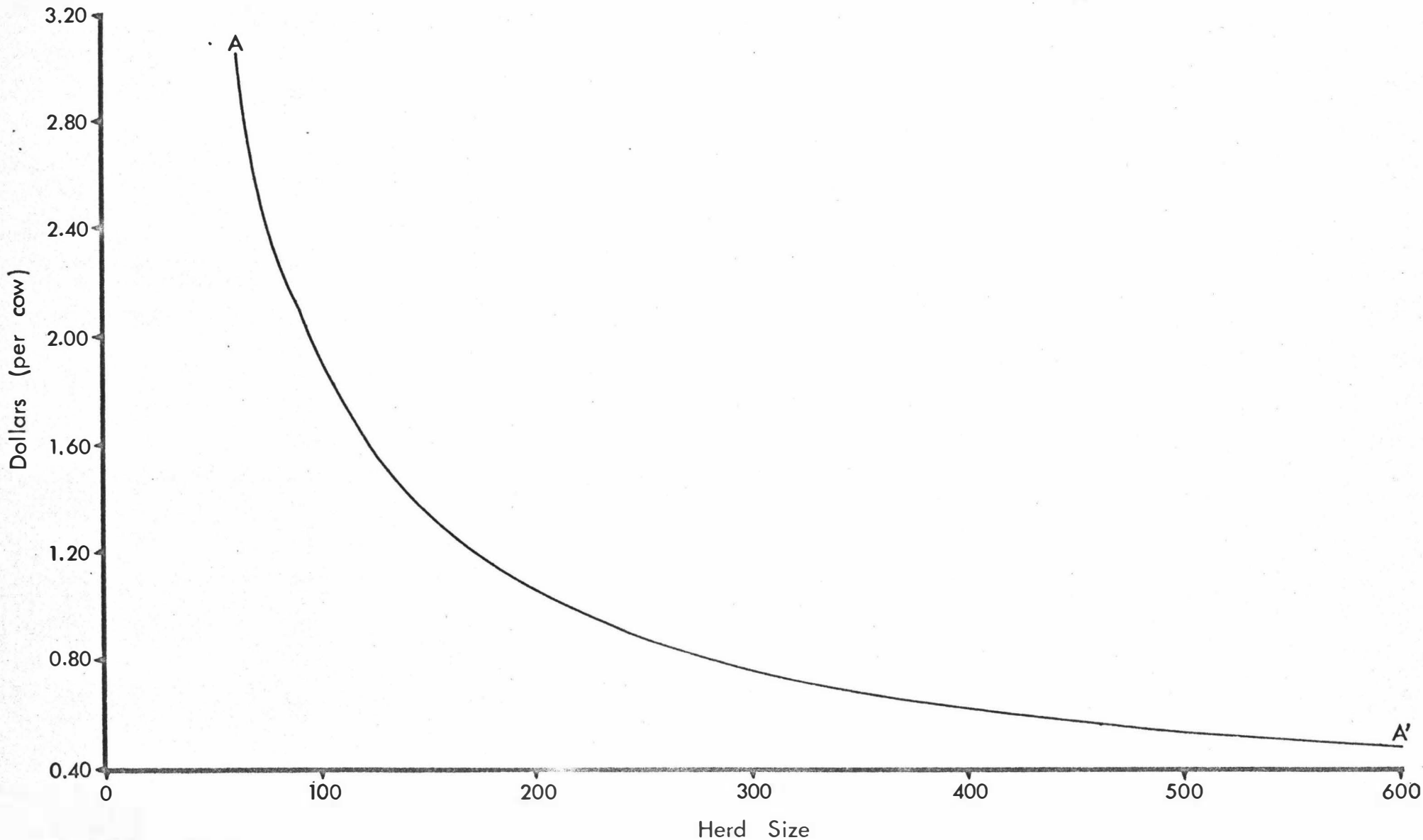


FIG. 7.17 PER UNIT COSTS OF RATES ACCORDING TO HERD SIZE

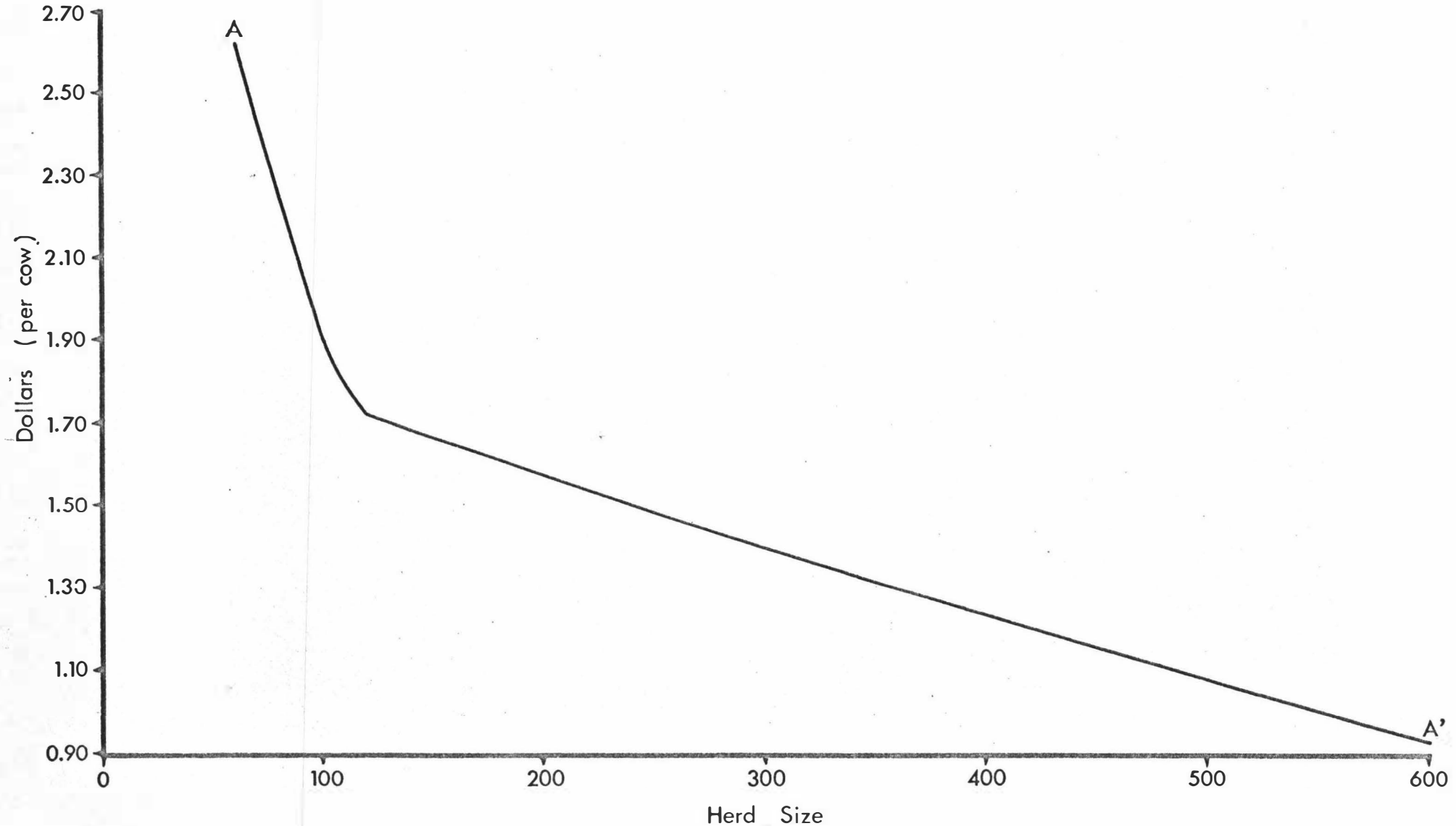


FIG. 7.18

PER UNIT COSTS OF CASUAL AND CONTRACT LABOUR
ACCORDING TO PLANT AND HERD SIZE

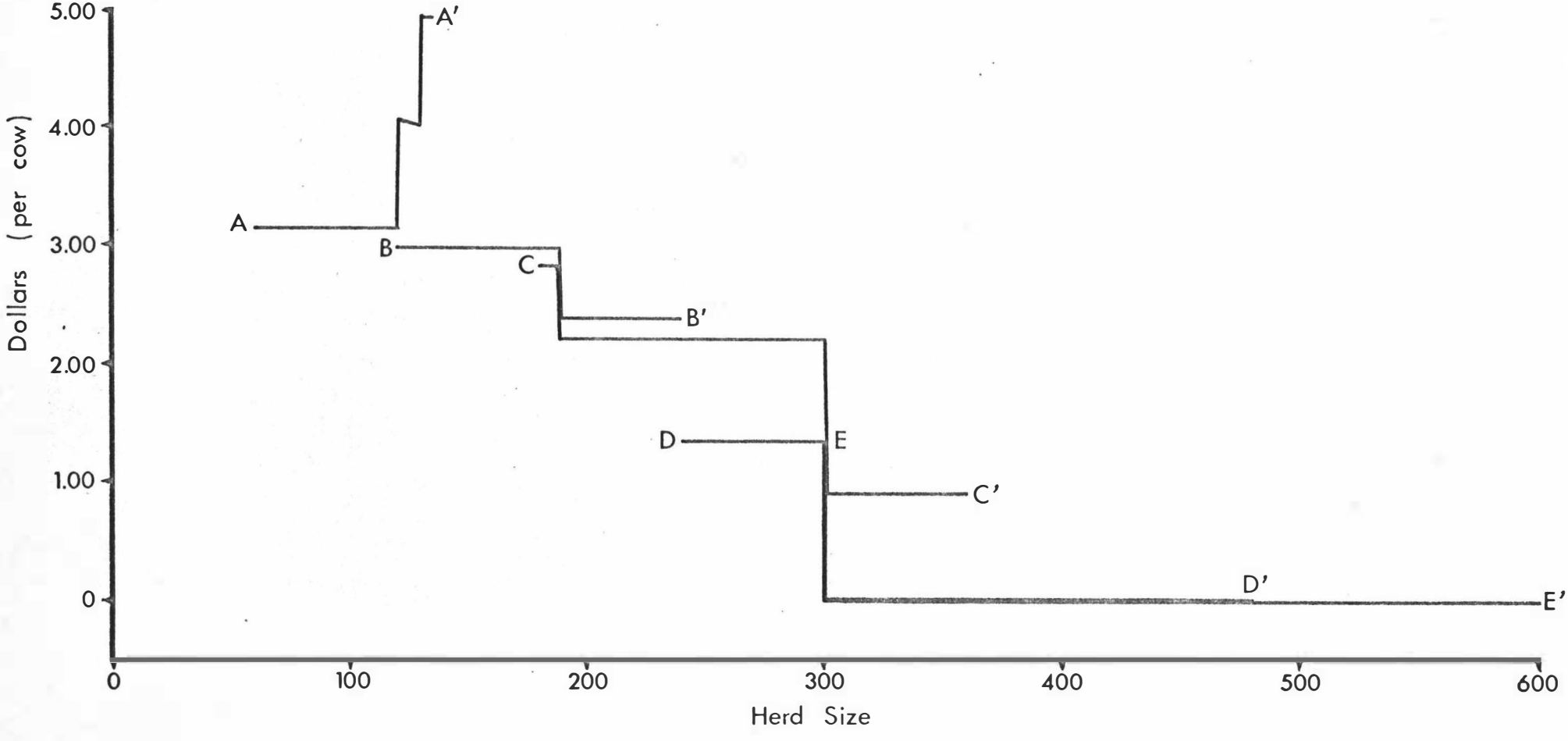


FIG. 7.19

PER UNIT COSTS OF PERMANENT LABOUR (WAGES)
ACCORDING TO PLANT AND HERD SIZE

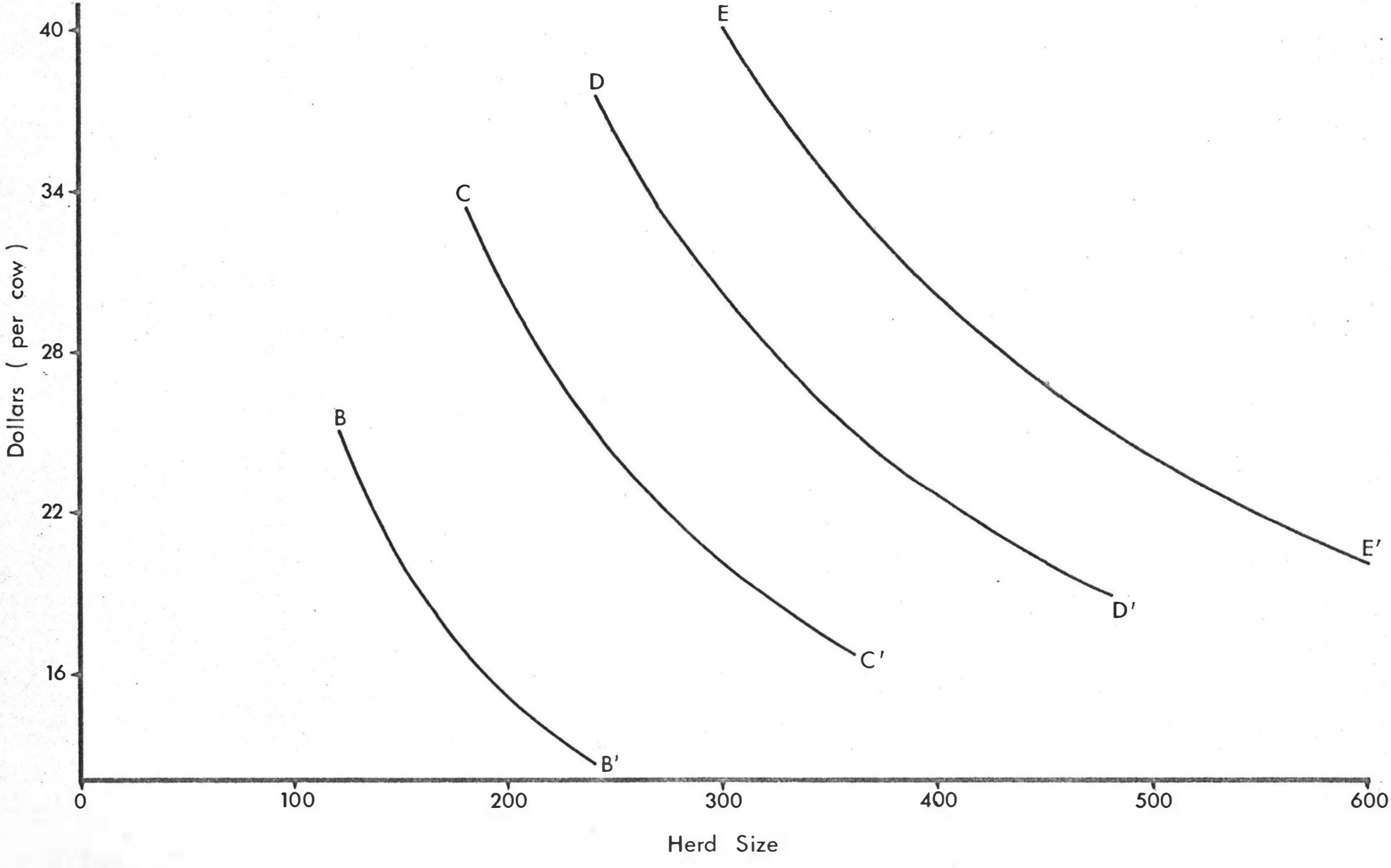


FIG. 7.20 PER UNIT COSTS OF VEHICLE EXPENSES ACCORDING TO PLANT AND HERD SIZE

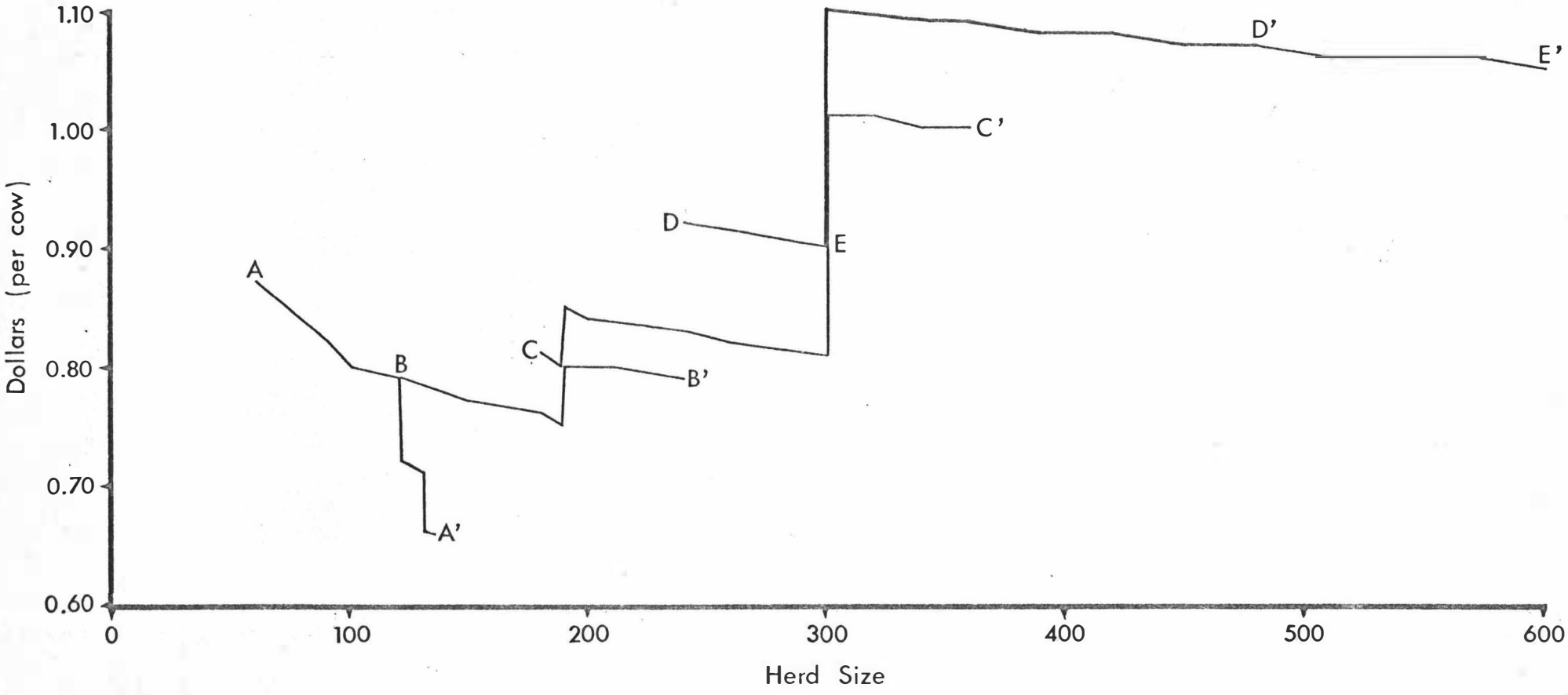


FIG. 7.21 PER UNIT COSTS OF INSURANCE ACCORDING TO PLANT AND HERD SIZE

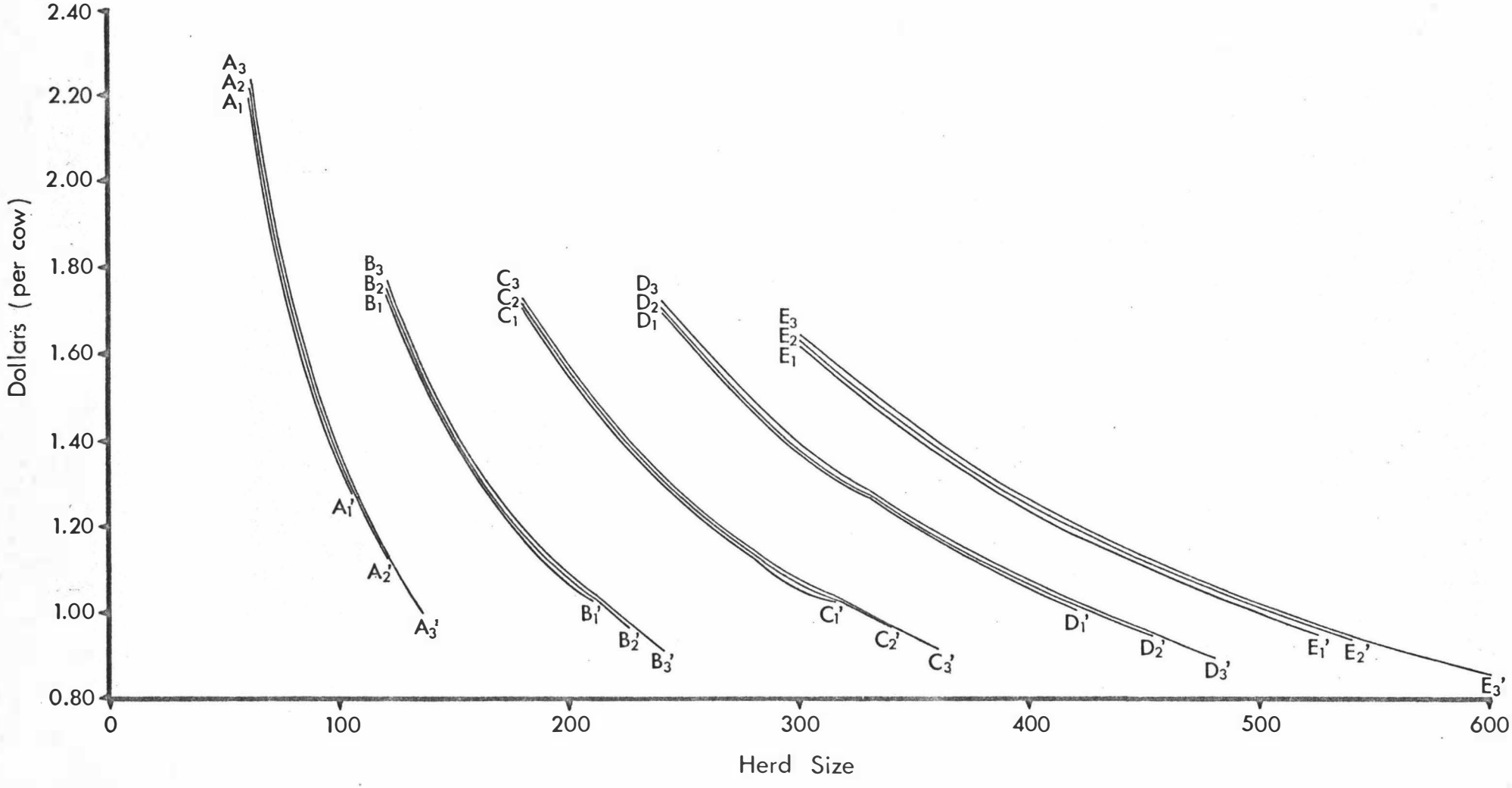


FIG. 7.22 PER UNIT COSTS OF DAIRY SHED EXPENSES ACCORDING TO PLANT AND HERD SIZE

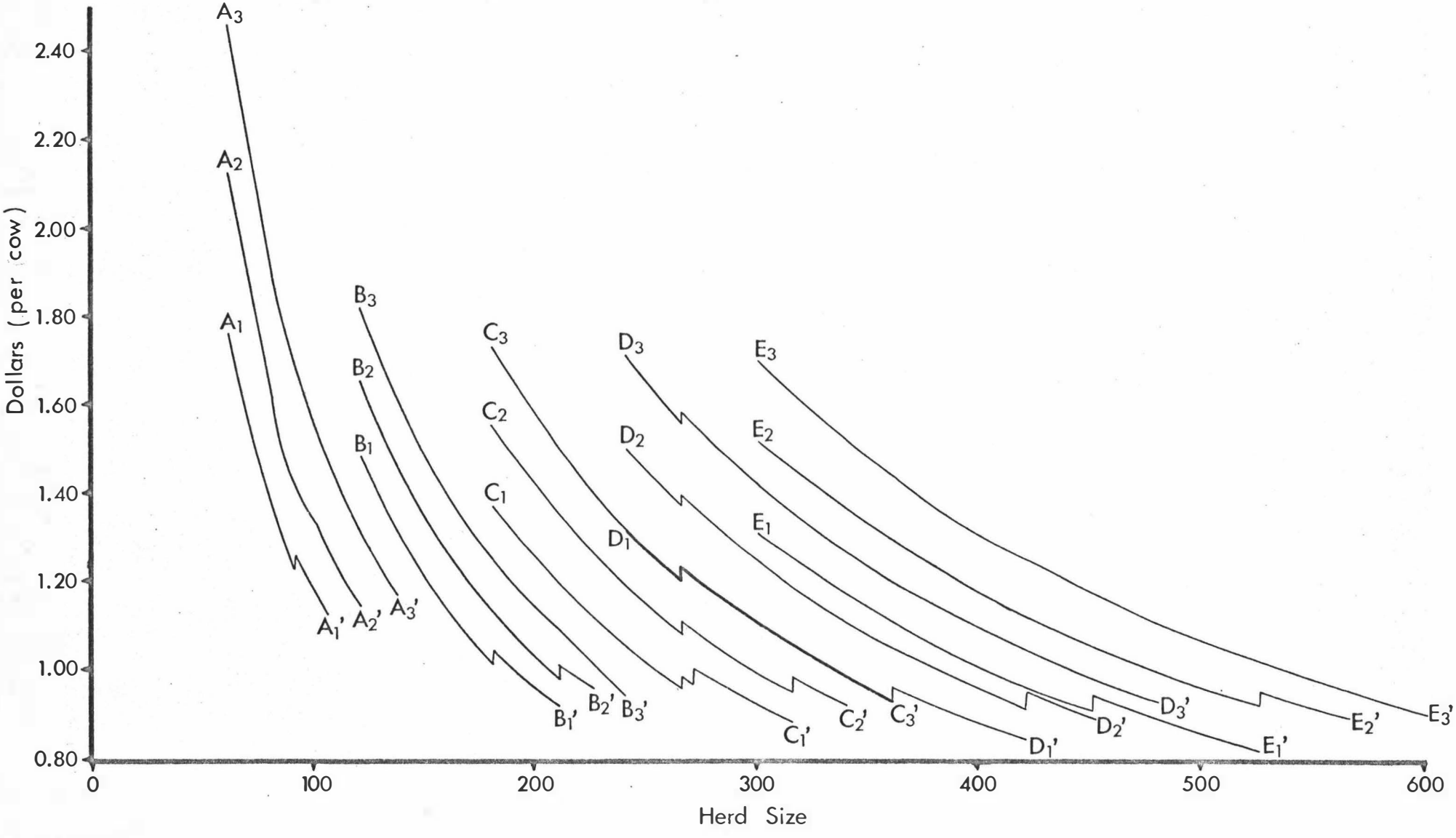


FIG. 7.23 PER UNIT COSTS OF ELECTRICITY ACCORDING TO PLANT AND HERD SIZE

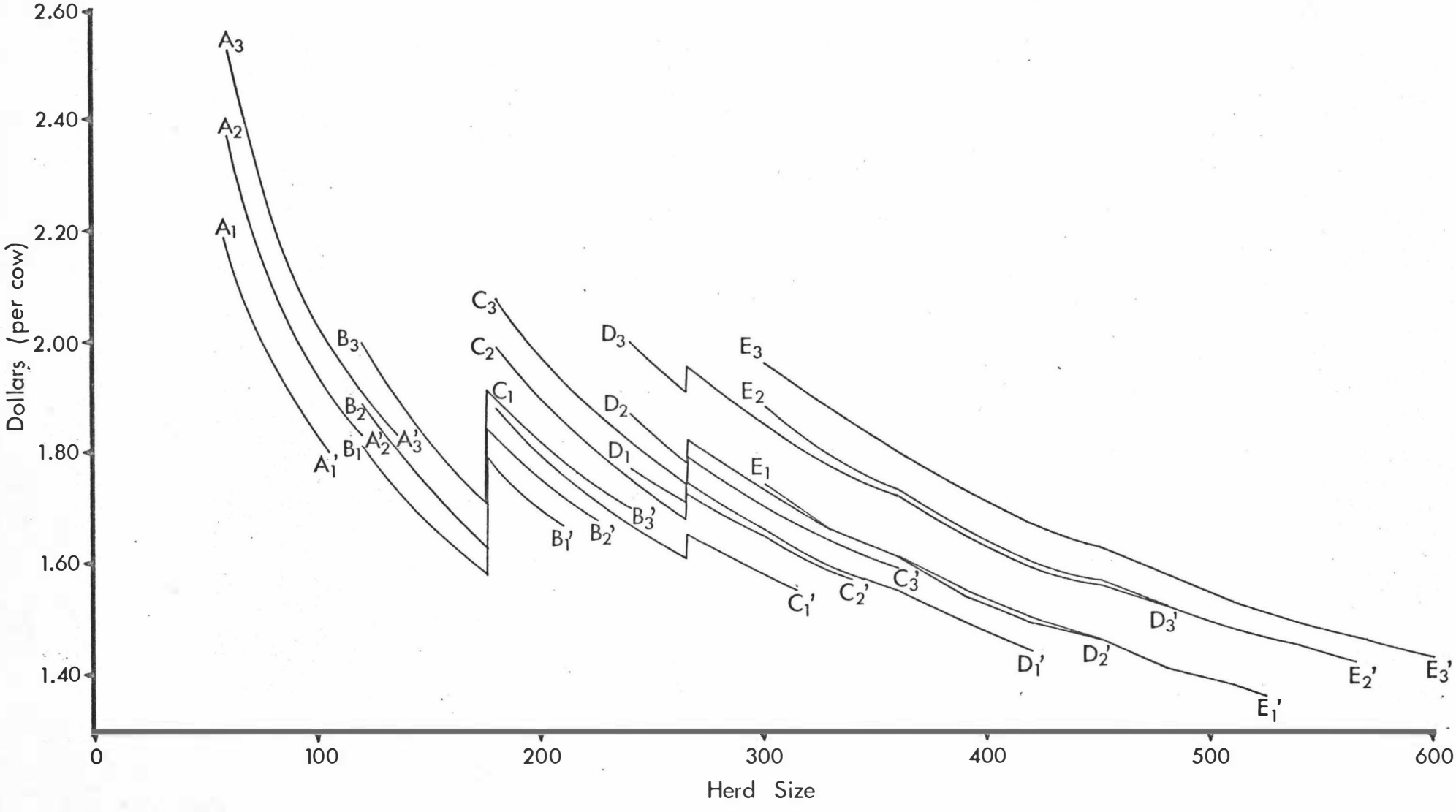


FIG. 7.24 PER UNIT COSTS OF REPAIRS AND MAINTENANCE ACCORDING TO PLANT AND HERD SIZE

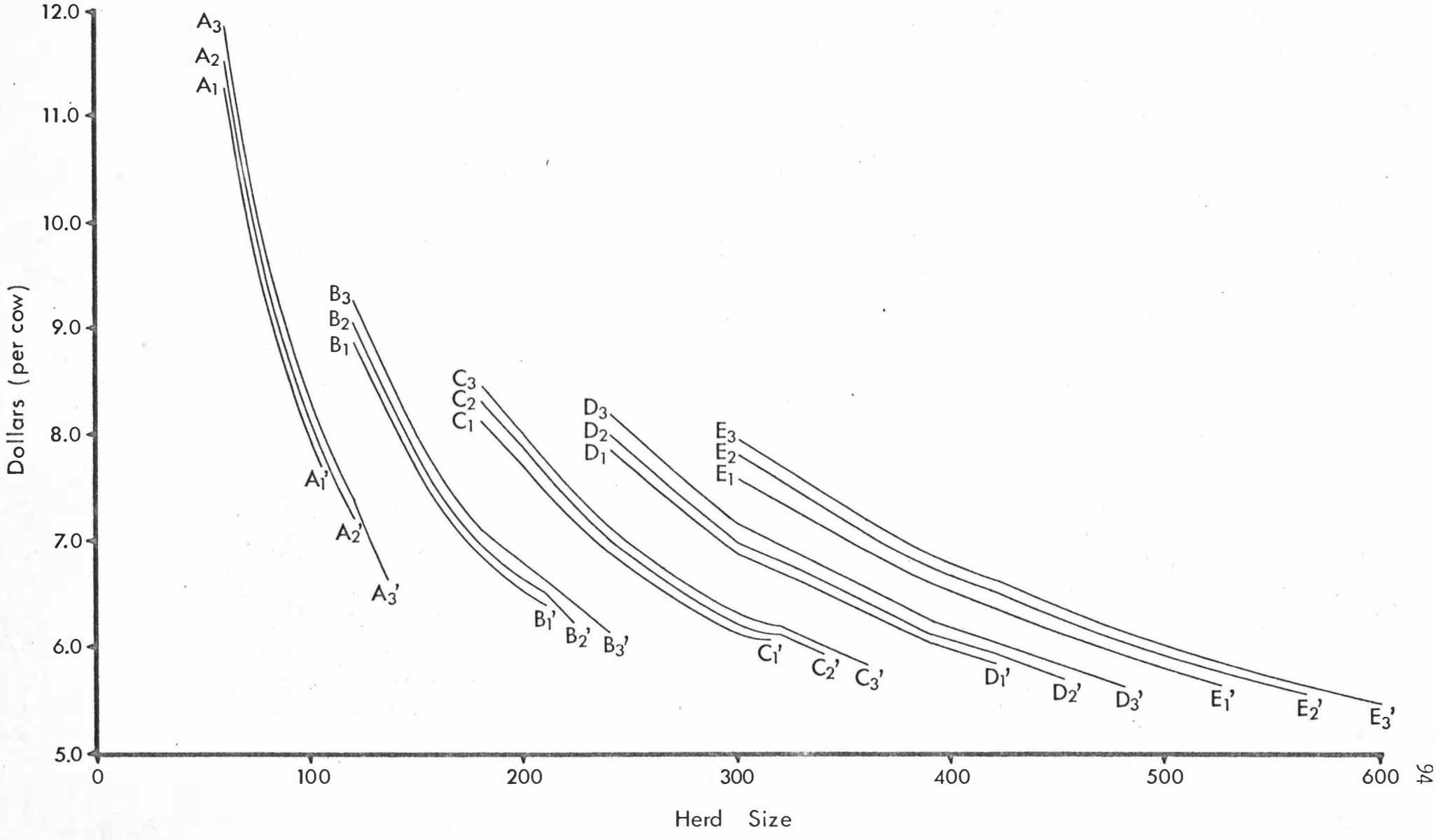


FIG. 7.25 PER UNIT DEPRECIATION COSTS ACCORDING TO PLANT AND HERD SIZE

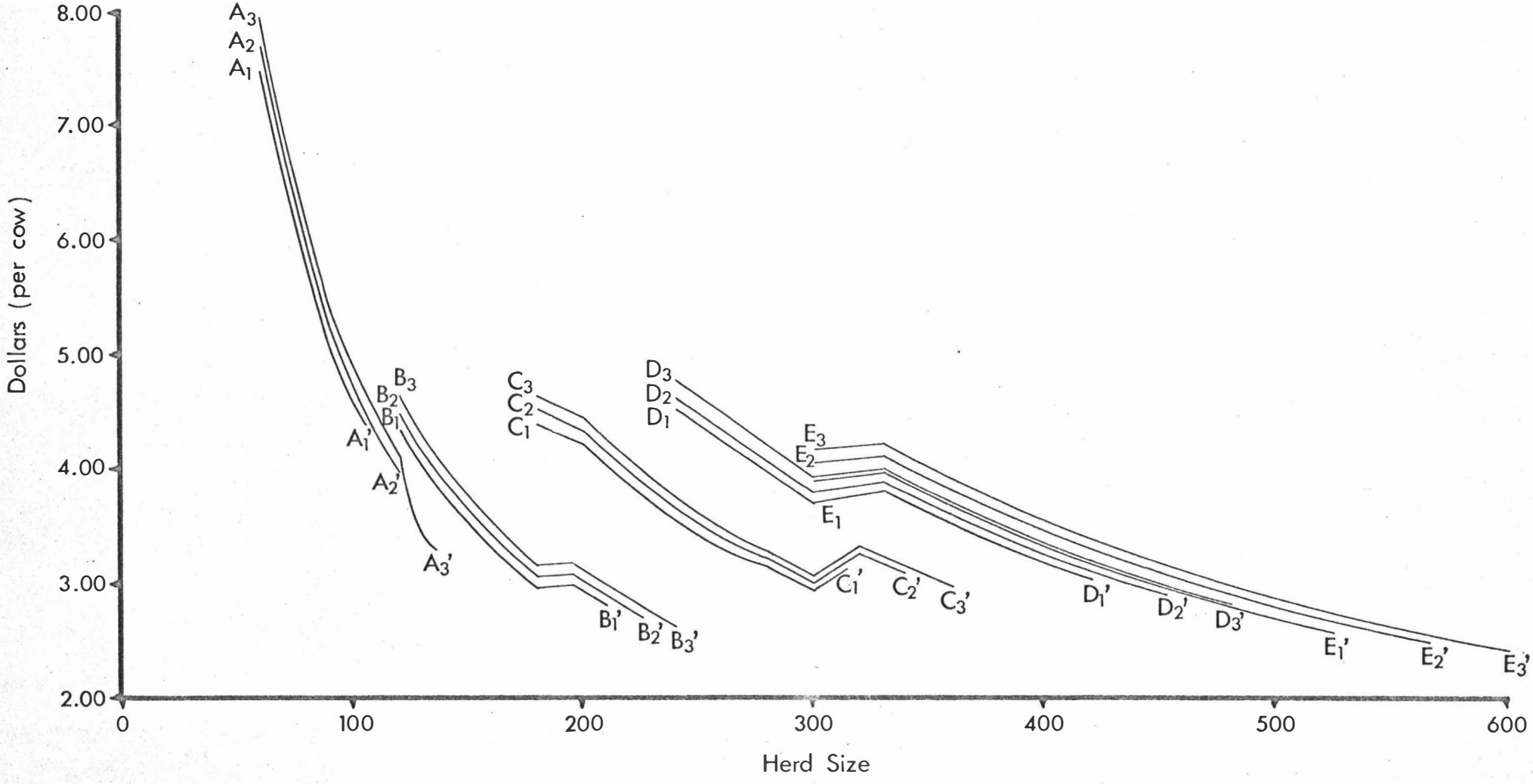


FIG. 7.26 PER UNIT INTEREST COSTS ACCORDING TO PLANT AND HERD SIZE

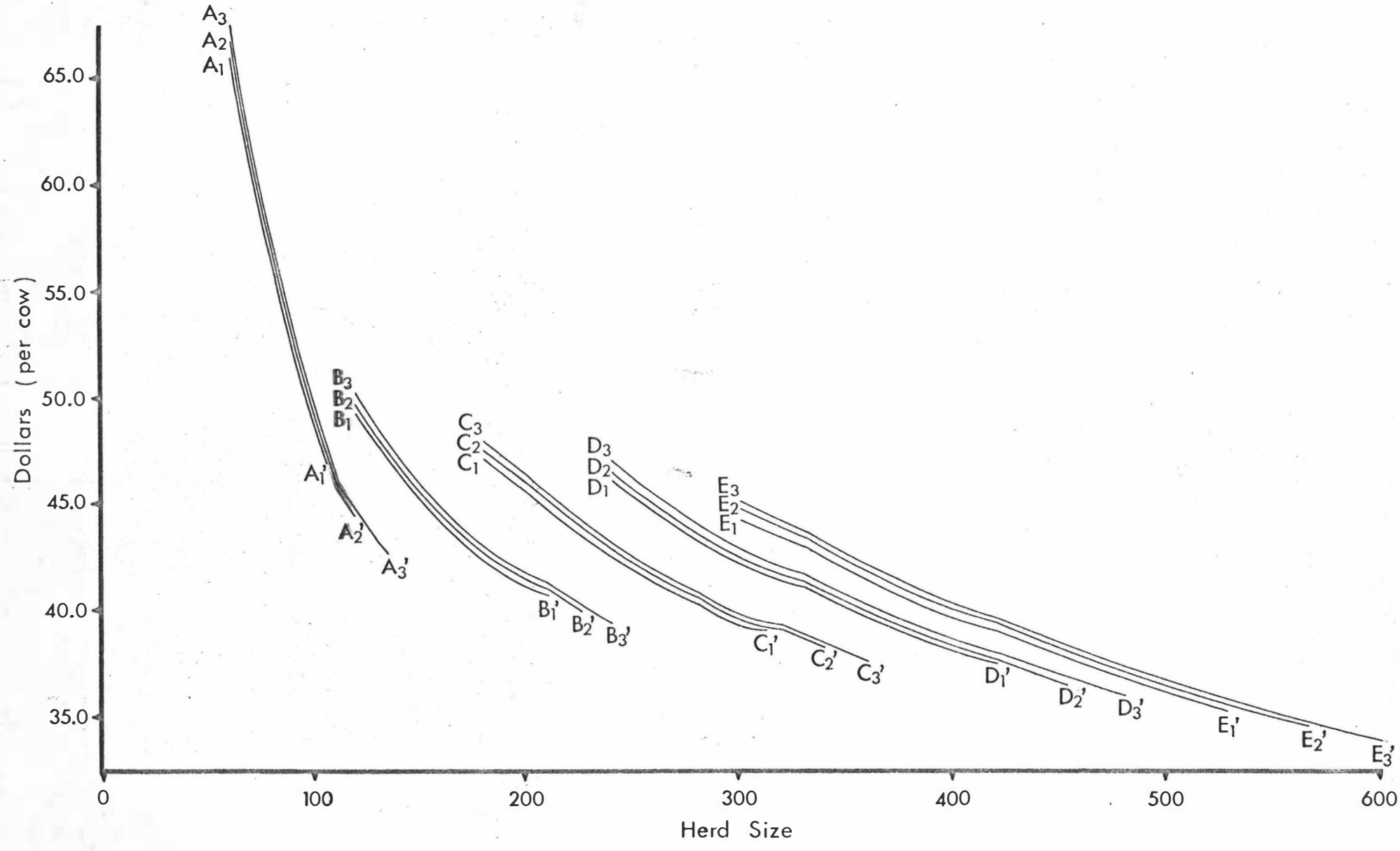


FIG. 7.27 MANAGERIAL RETURN ACCORDING TO PLANT AND HERD SIZE (CONSTANT MILKFAT PER COW)

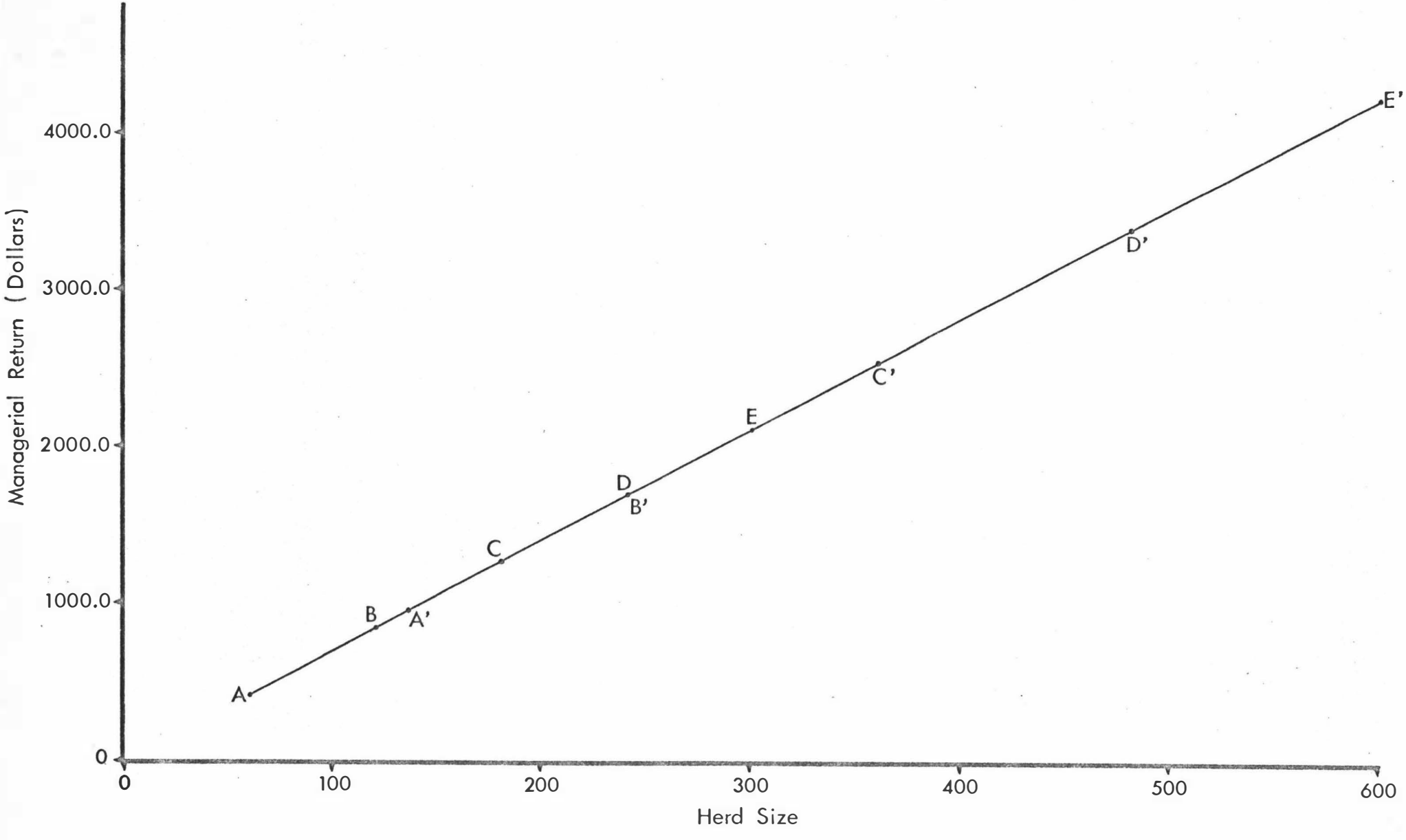


FIG. 7.28 MANAGERIAL RETURN ACCORDING TO PLANT AND HERD SIZE (VARIABLE MILKFAT PER COW)

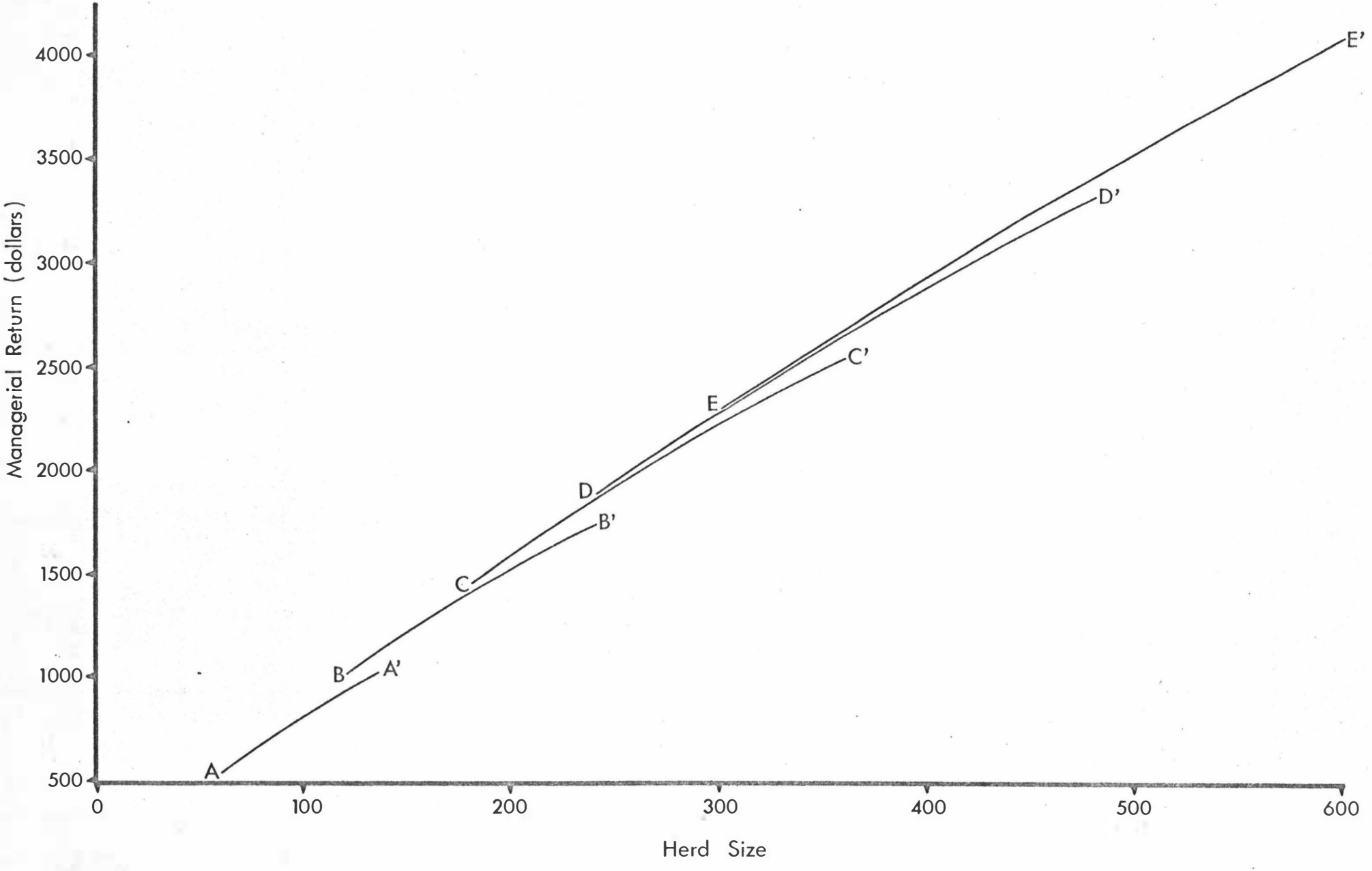


FIG. 7.29 PER UNIT COSTS OF TOTAL COST (A) ACCORDING TO PLANT AND HERD SIZE

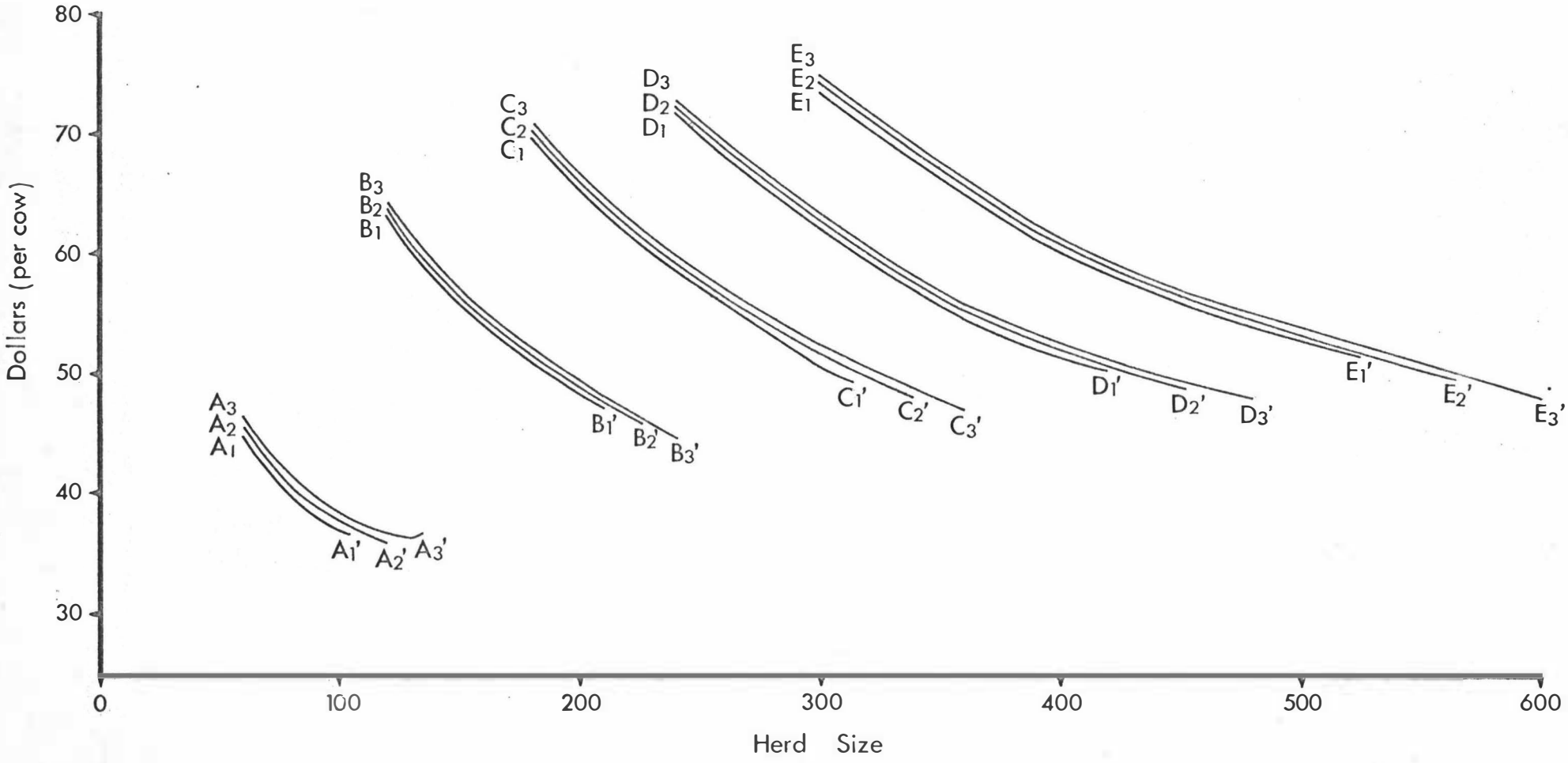


FIG. 7.30 PER UNIT COSTS OF TOTAL COST (B) ACCORDING TO PLANT AND HERD SIZE

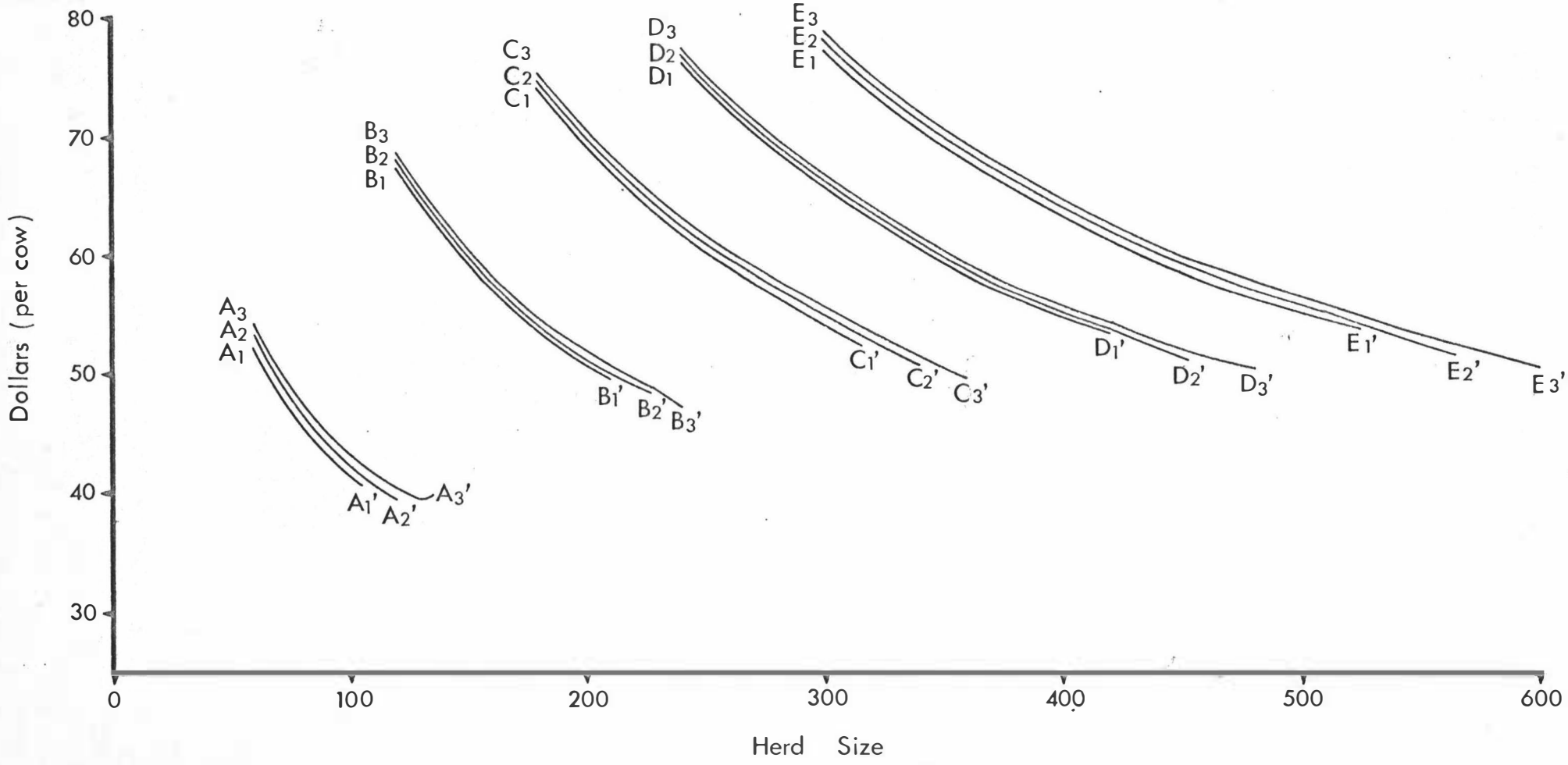


FIG. 7.31 PER UNIT COSTS OF TOTAL COST (C) ACCORDING TO PLANT AND HERD SIZE

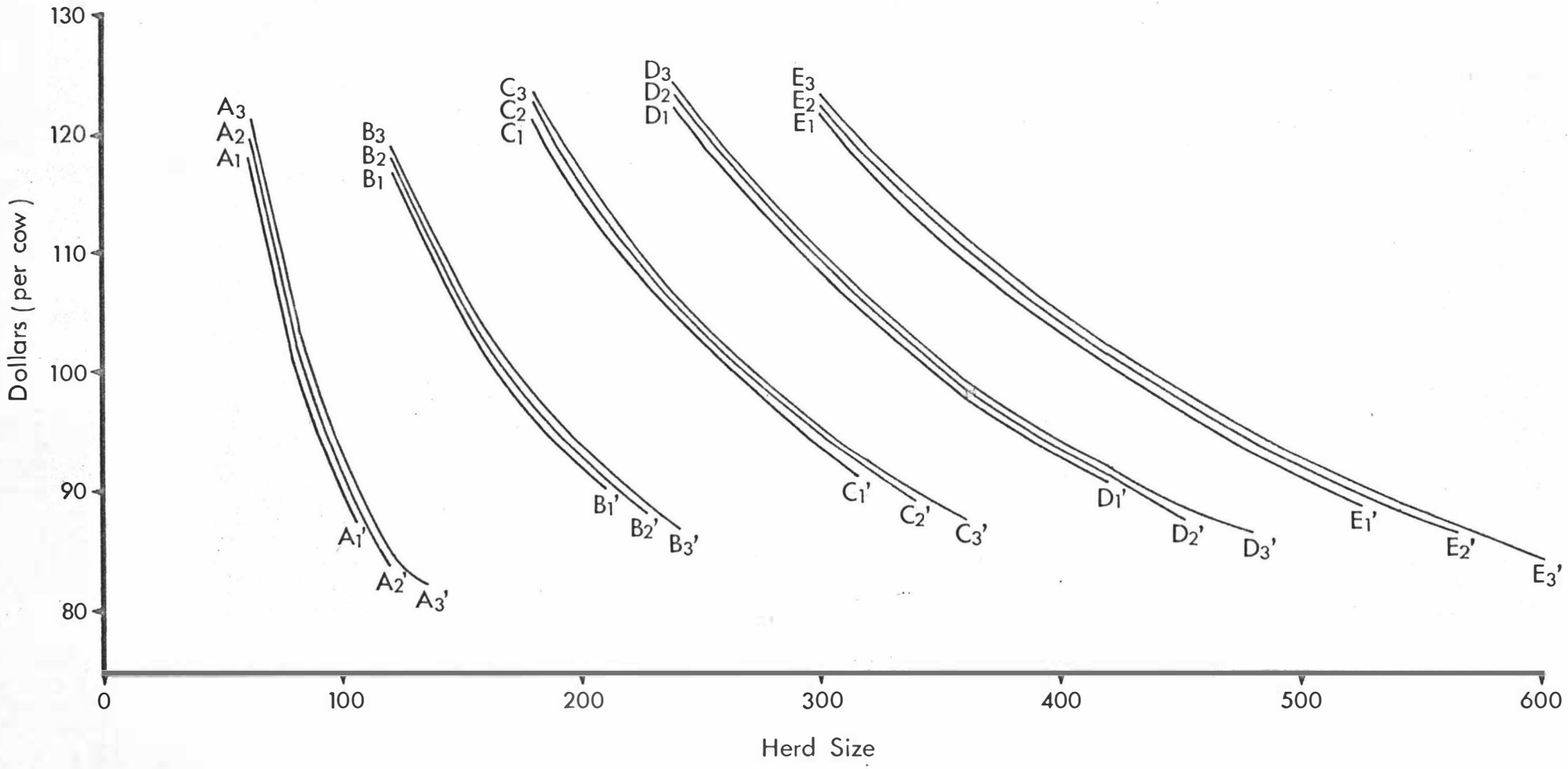


FIG. 7.32 PER UNIT COSTS OF TOTAL COST (D) ACCORDING TO PLANT AND HERD SIZE

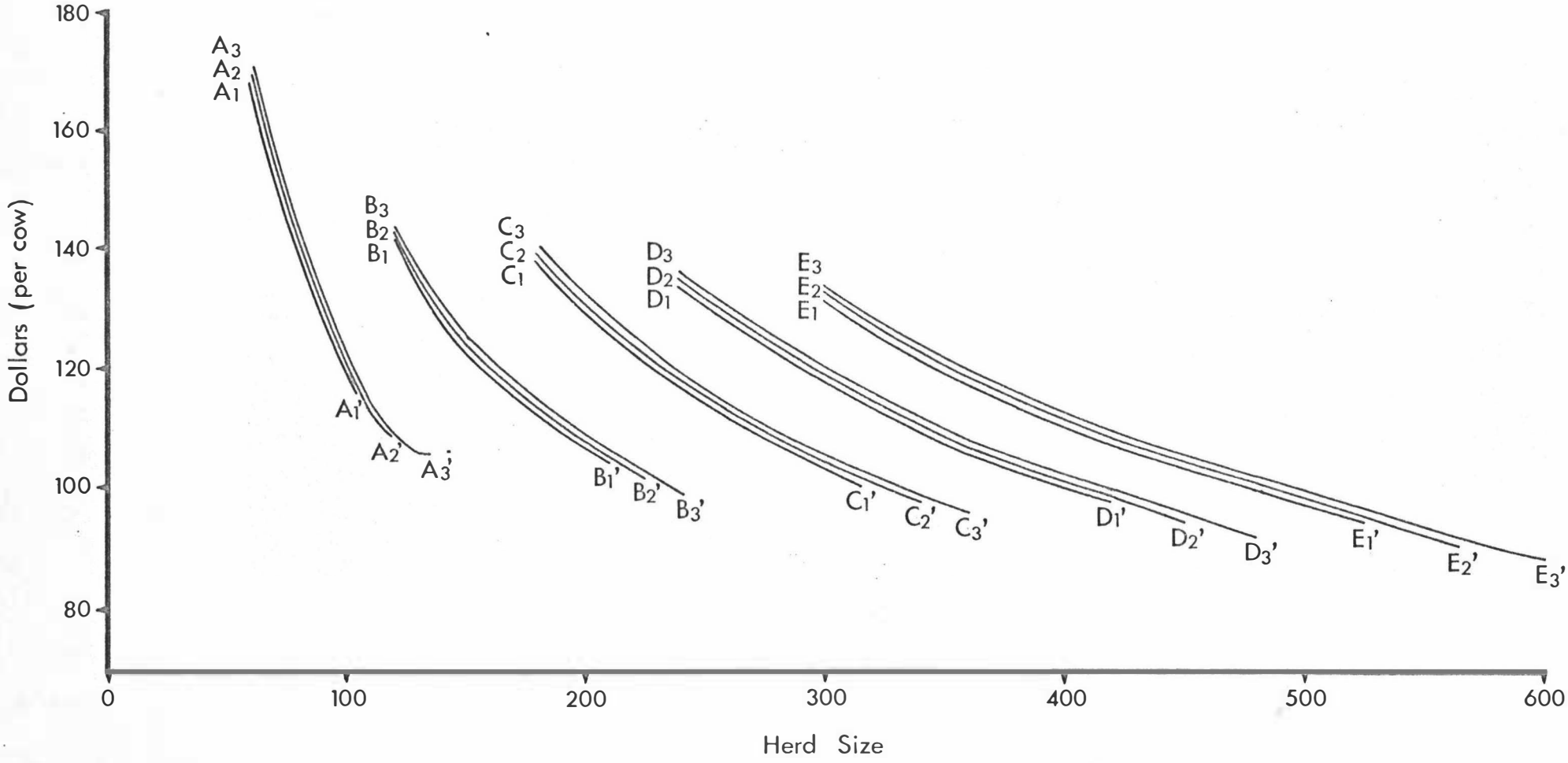


FIG. 7.33 PER UNIT COSTS OF TOTAL COST (E) ACCORDING TO PLANT AND HERD SIZE (CONSTANT MILKFAT PER COW)

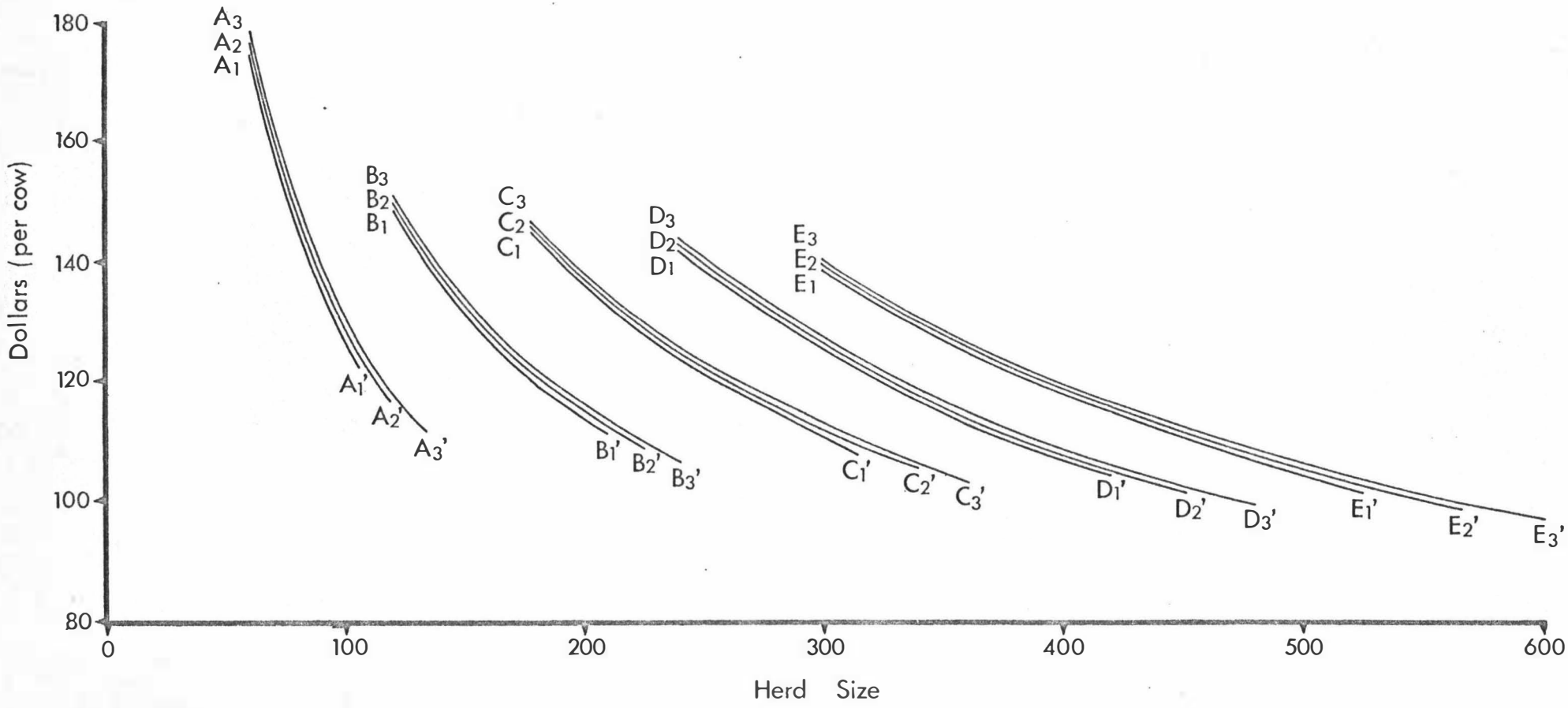


FIG. 7.34 PER UNIT COSTS OF TOTAL COST (E) ACCORDING TO PLANT AND HERD SIZE (VARIABLE MILKFAT PER COW)

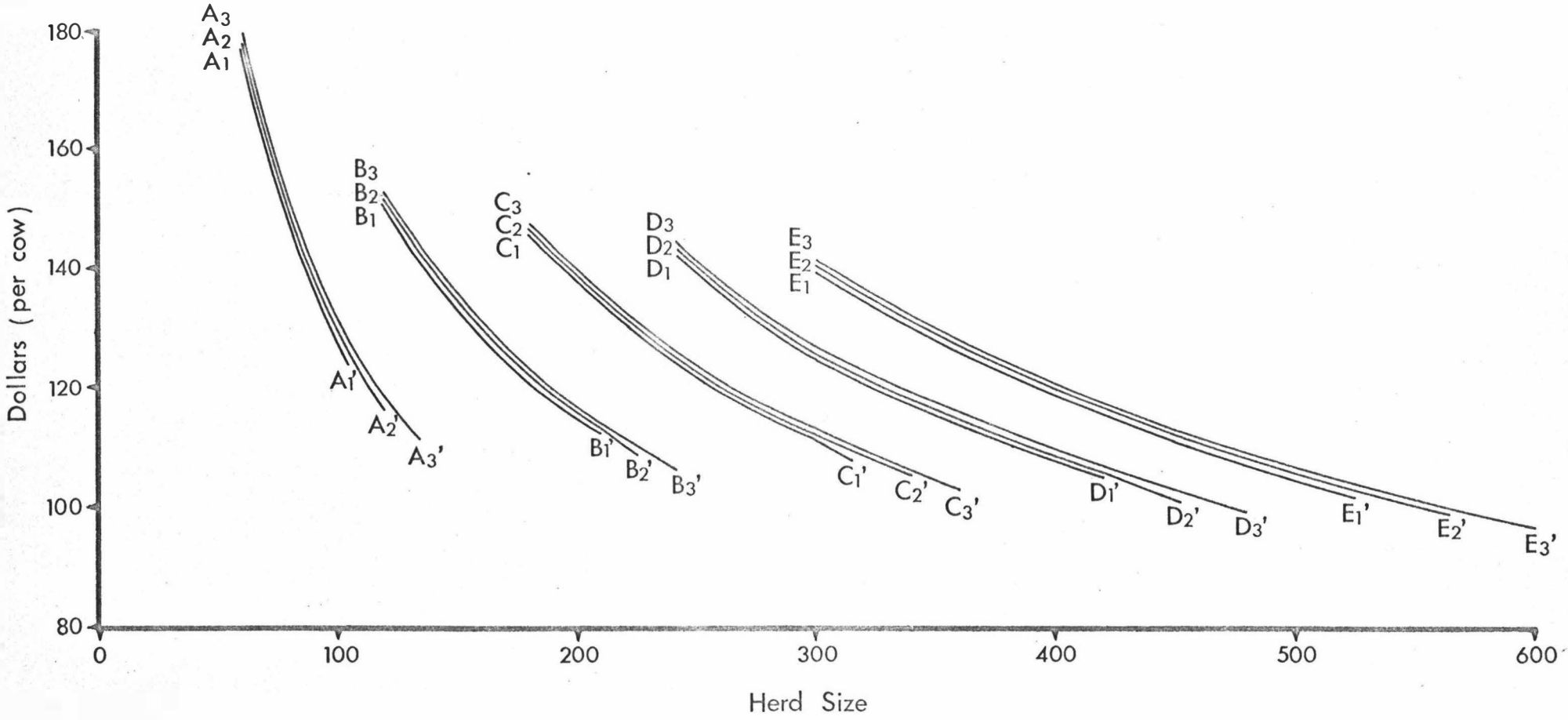
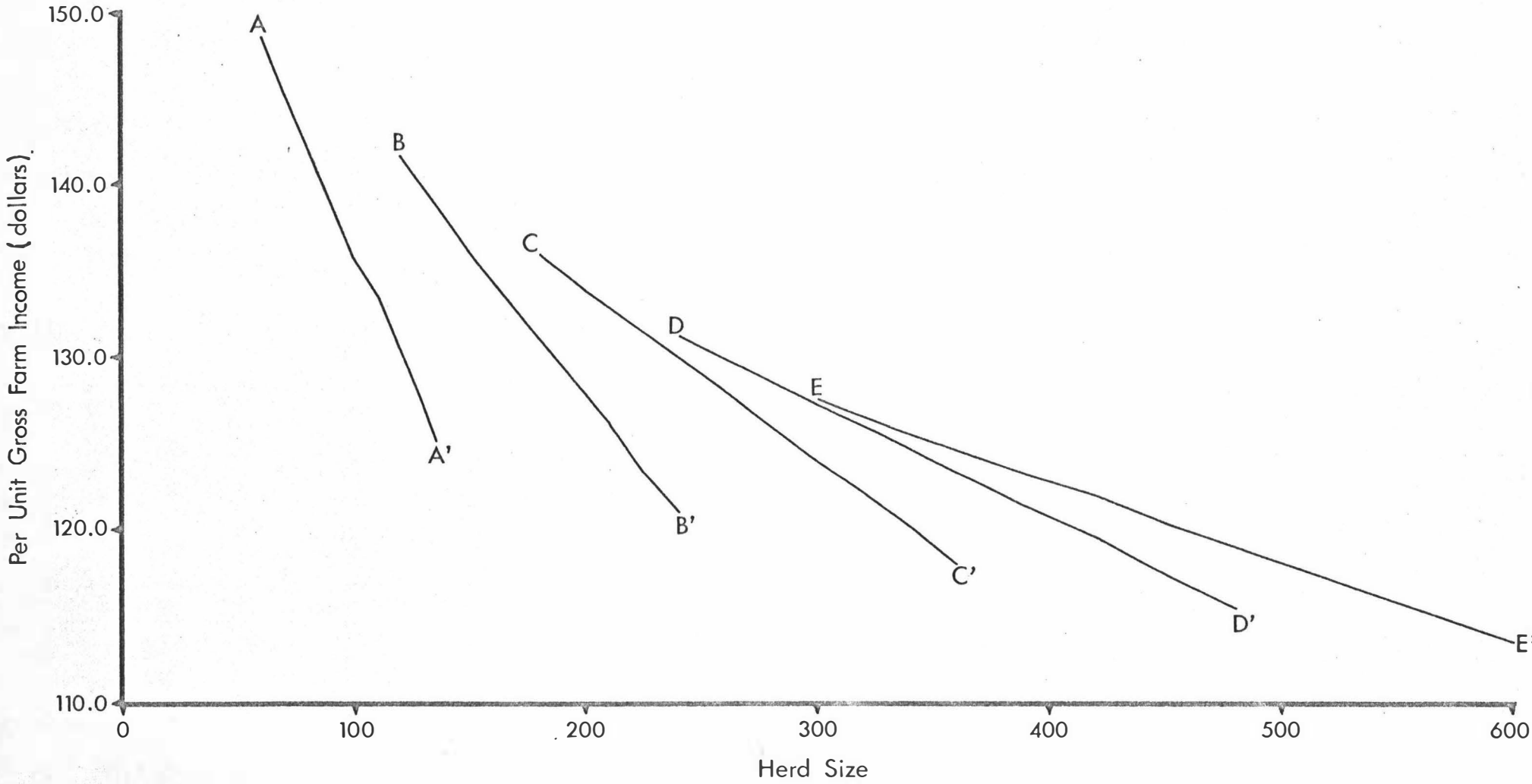


FIG. 7.35 PER UNIT GROSS FARM INCOME ACCORDING TO PLANT AND HERD SIZE (VARIABLE MILKFAT PER COW)



APPENDIX D

SHORT RUN AND LONG RUN AVERAGE COST AND NET INCOME CURVES - BREAKEVEN ANALYSIS CURVES

(The reader's attention is drawn to the fact that on some figures the lowest value shown on the abscissa and ordinate is not zero.)

NOTE: The abbreviations are as follows:

L.R.A.C. Long Run Average Cost Curve

L.R.N.I. Long Run Net Income Curve

The short run average cost and net income curves of plant sizes one to five are designated by the symbols AA', BB',CC',DD,EE' respectively. Within each plant size, the curves corresponding to the three subclasses are denoted by the subscripts 1, 2, 3. This is fully discussed on page 135 of Volume I.

FIG. 8.2 S.R.A.C. AND L.R.A.C. CURVES (FIRST SERIES OF COST REVENUE RATIOS) CONSTANT MILKFAT PER COW

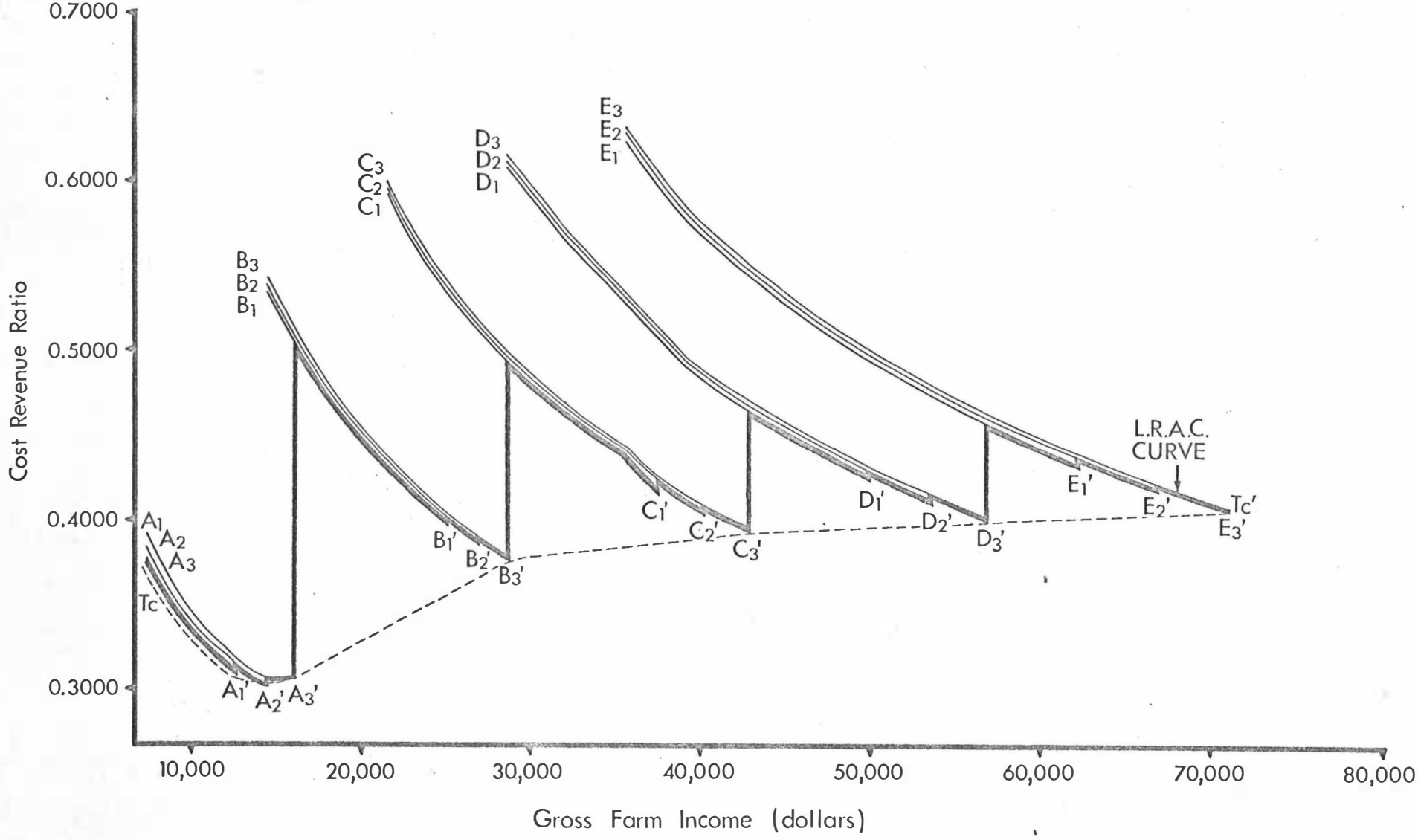


FIG. 8.3 S.R.A.C. AND L.R.A.C. CURVES (SECOND SERIES OF COST REVENUE RATIOS) CONSTANT MILKFAT PER COW

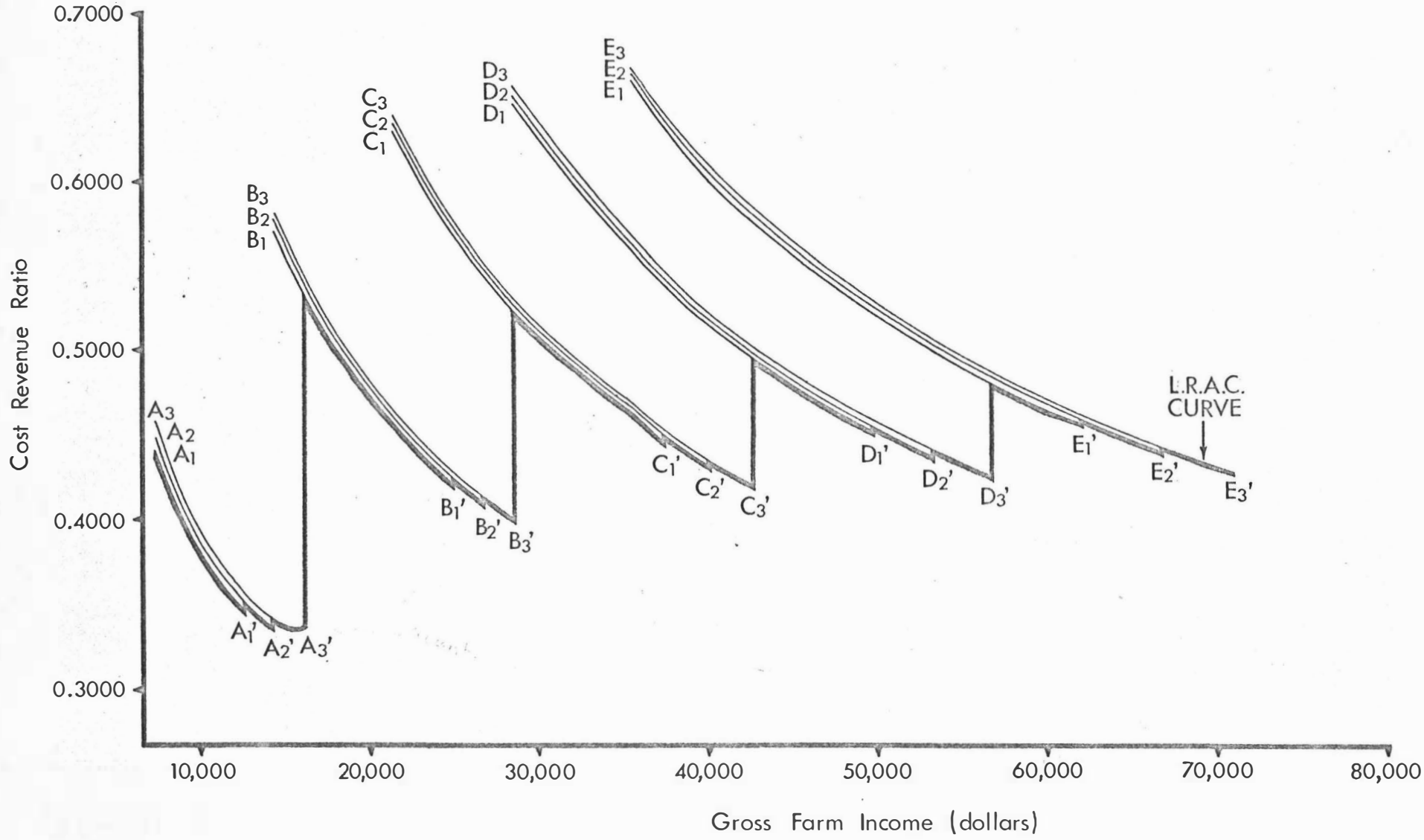


FIG. 8.4 S.R.A.C. AND L.R.A.C. CURVES (THIRD SERIES OF COST REVENUE RATIOS) CONSTANT MILKFAT PER COW

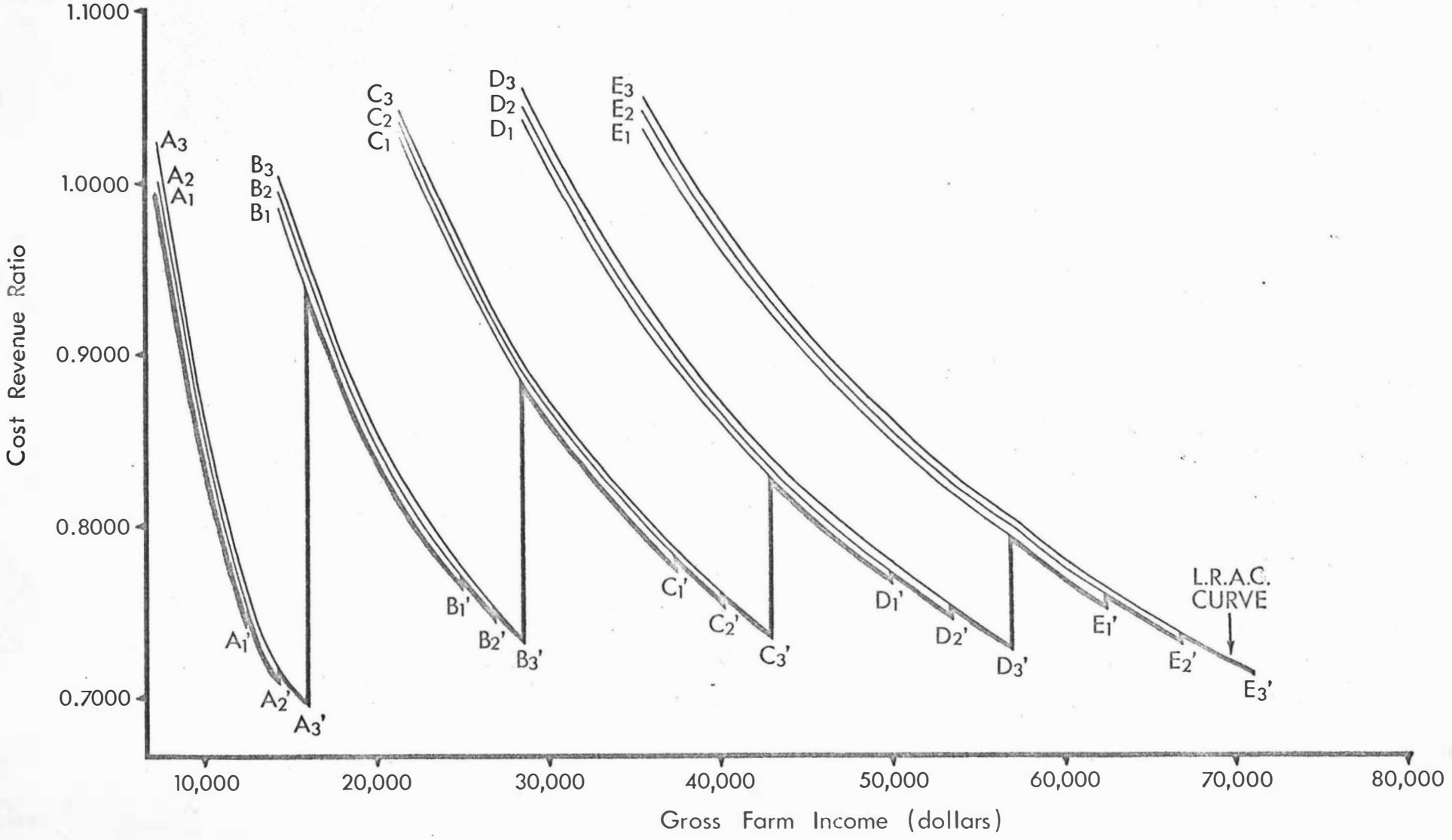


FIG. 8.5 S.R.A.C. AND L.R.A.C. CURVES (FOURTH SERIES OF COST REVENUE RATIOS)
CONSTANT MILKFAT PER COW

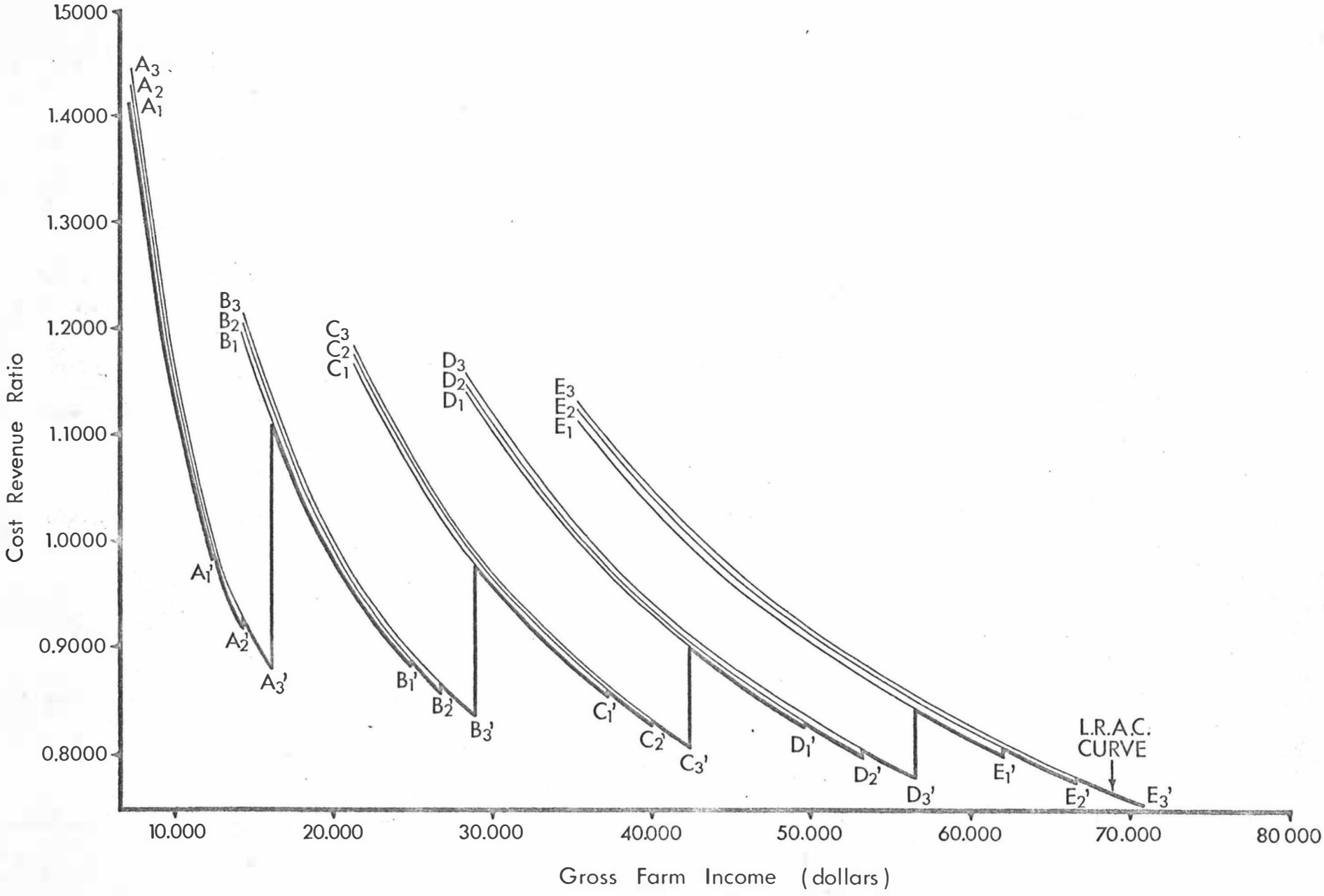


FIG. 8.6 S.R.A.C. AND L.R.A.C. CURVES (FIFTH SERIES OF COST REVENUE RATIOS) CONSTANT MILKFAT PER COW

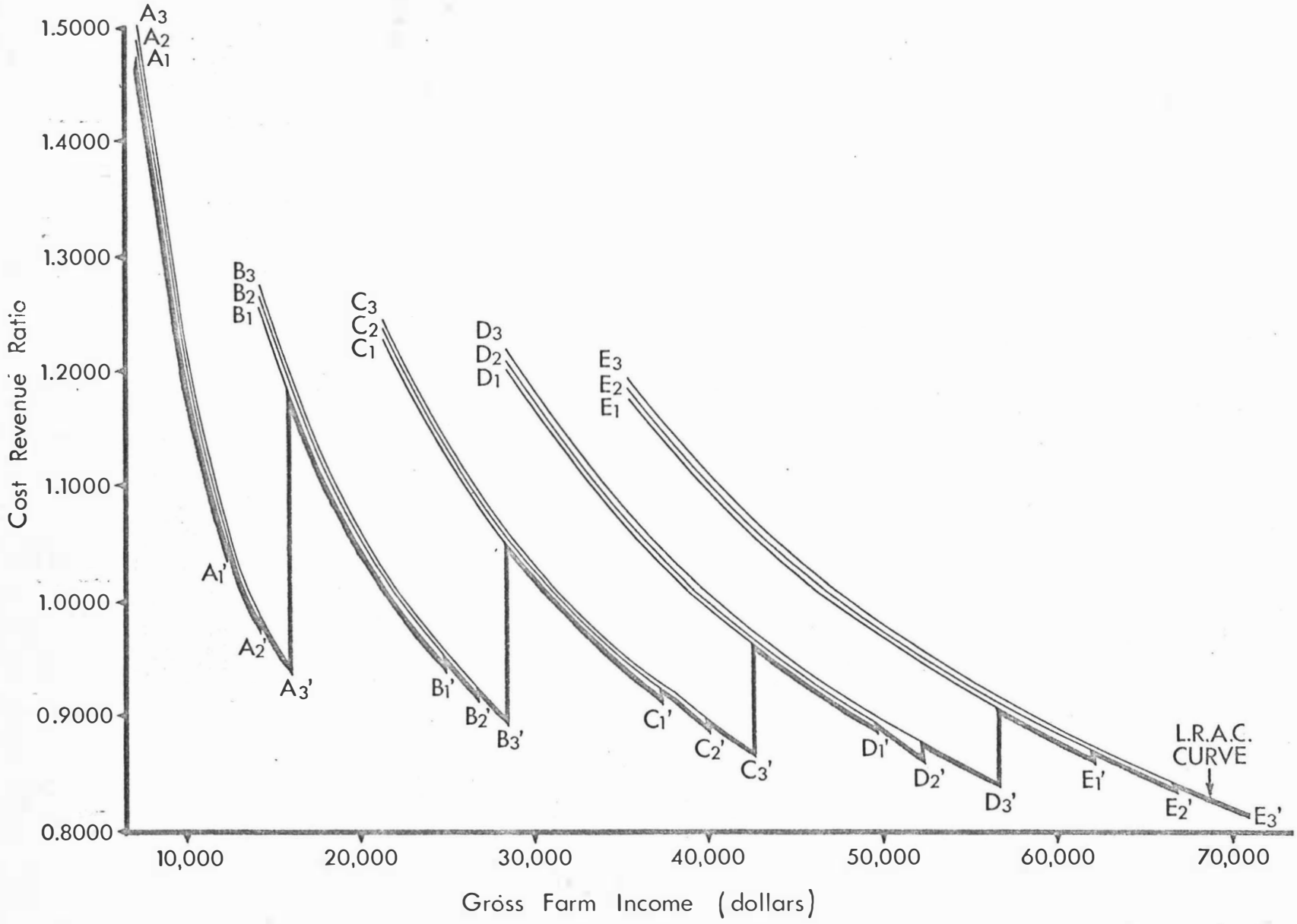


FIG. 8.7 S.R.A.C. AND L.R.A.C. CURVES (FIRST SERIES OF COST REVENUE RATIOS) VARIABLE MILKFAT PER COW

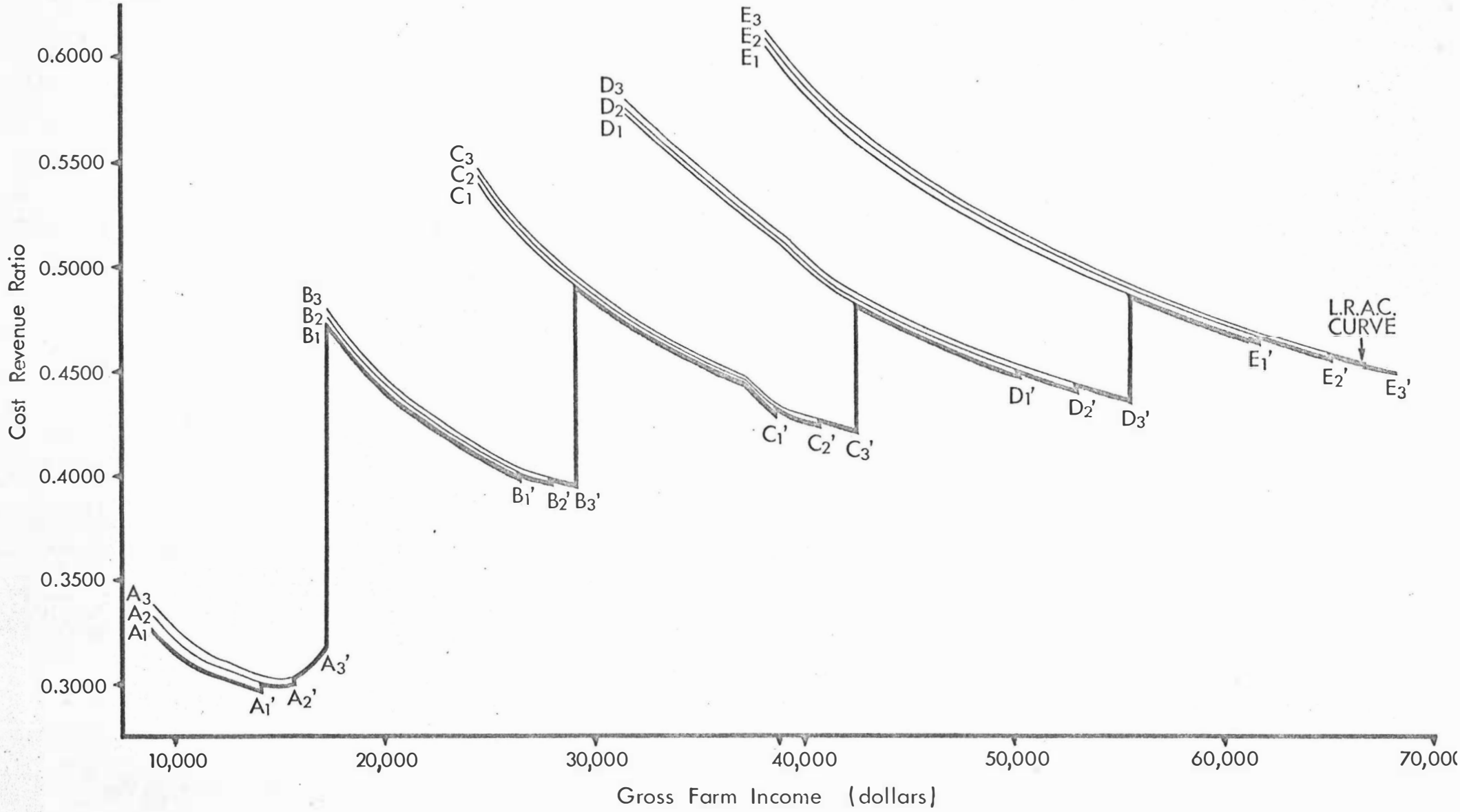


FIG. 8.8 S.R.A.C. AND L.R.A.C. CURVES (SECOND SERIES OF COST REVENUE RATIOS) VARIABLE MILKFAT PER COW

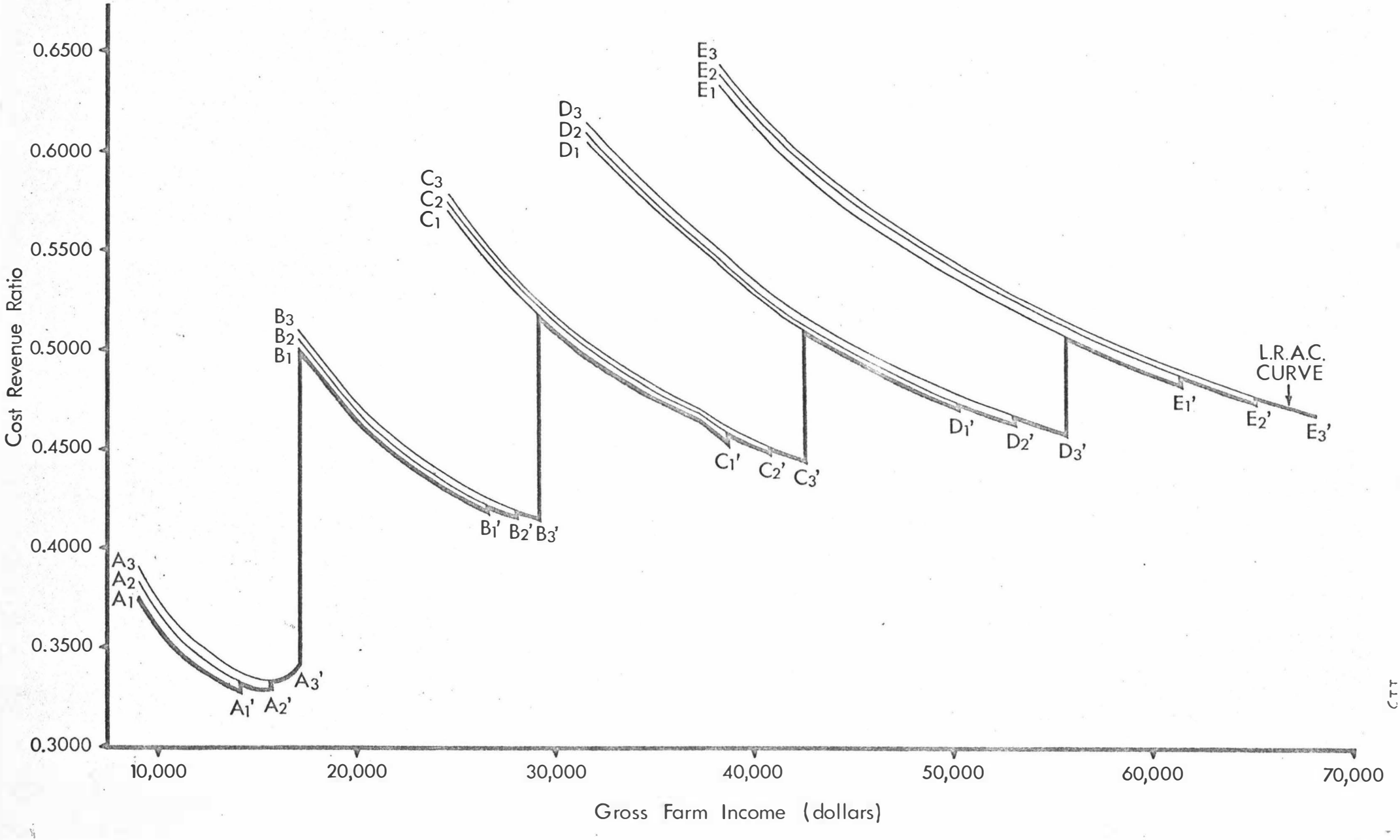


FIG. 8.9 S.R.A.C. AND L.R.A.C. CURVES (THIRD SERIES OF COST REVENUE RATIOS) VARIABLE MILKFAT PER COW

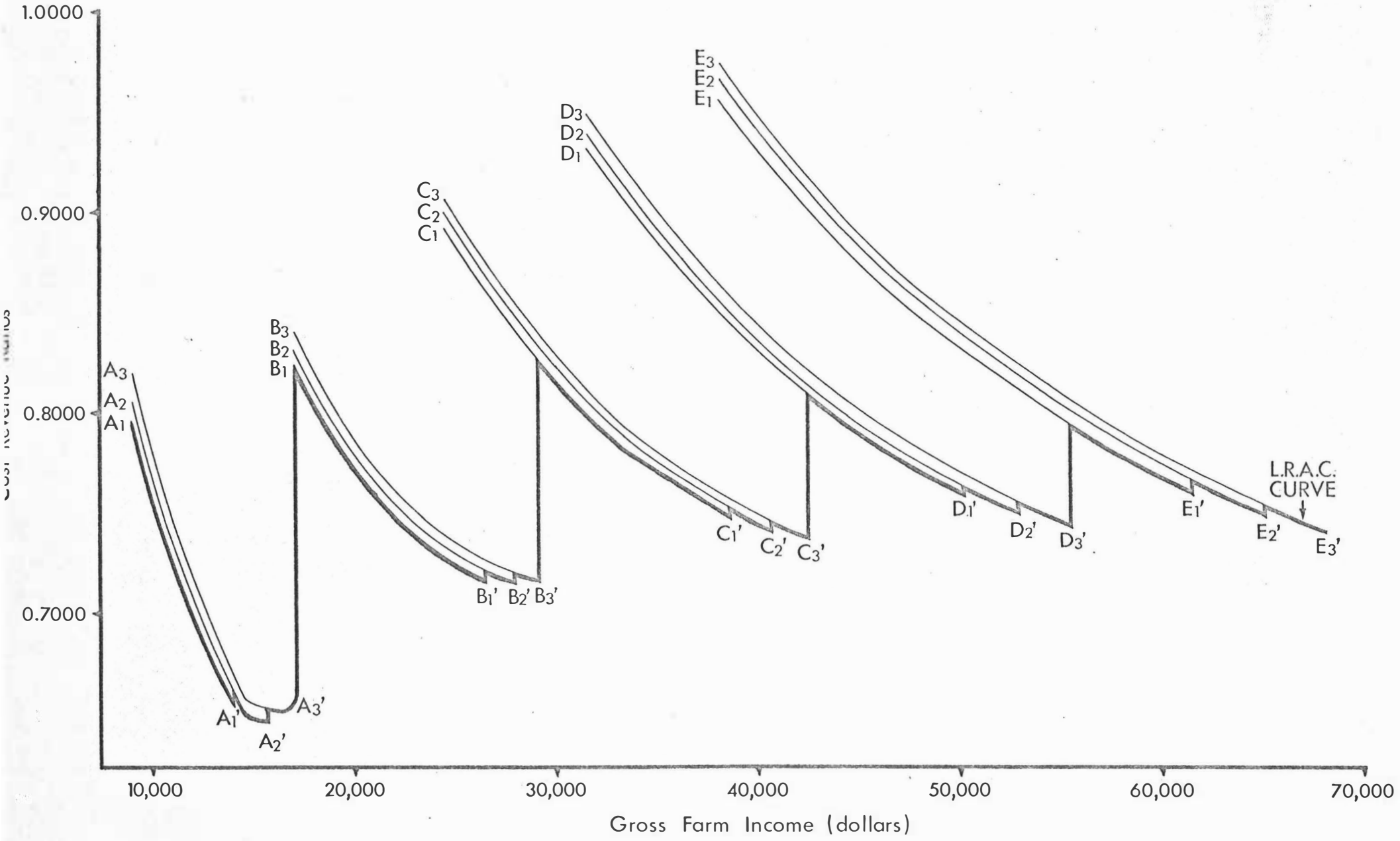


FIG. 8.10 S.R.A.C. AND L.R.A.C. CURVES (FOURTH SERIES OF COST REVENUE RATIOS) VARIABLE MILKFAT PER COW

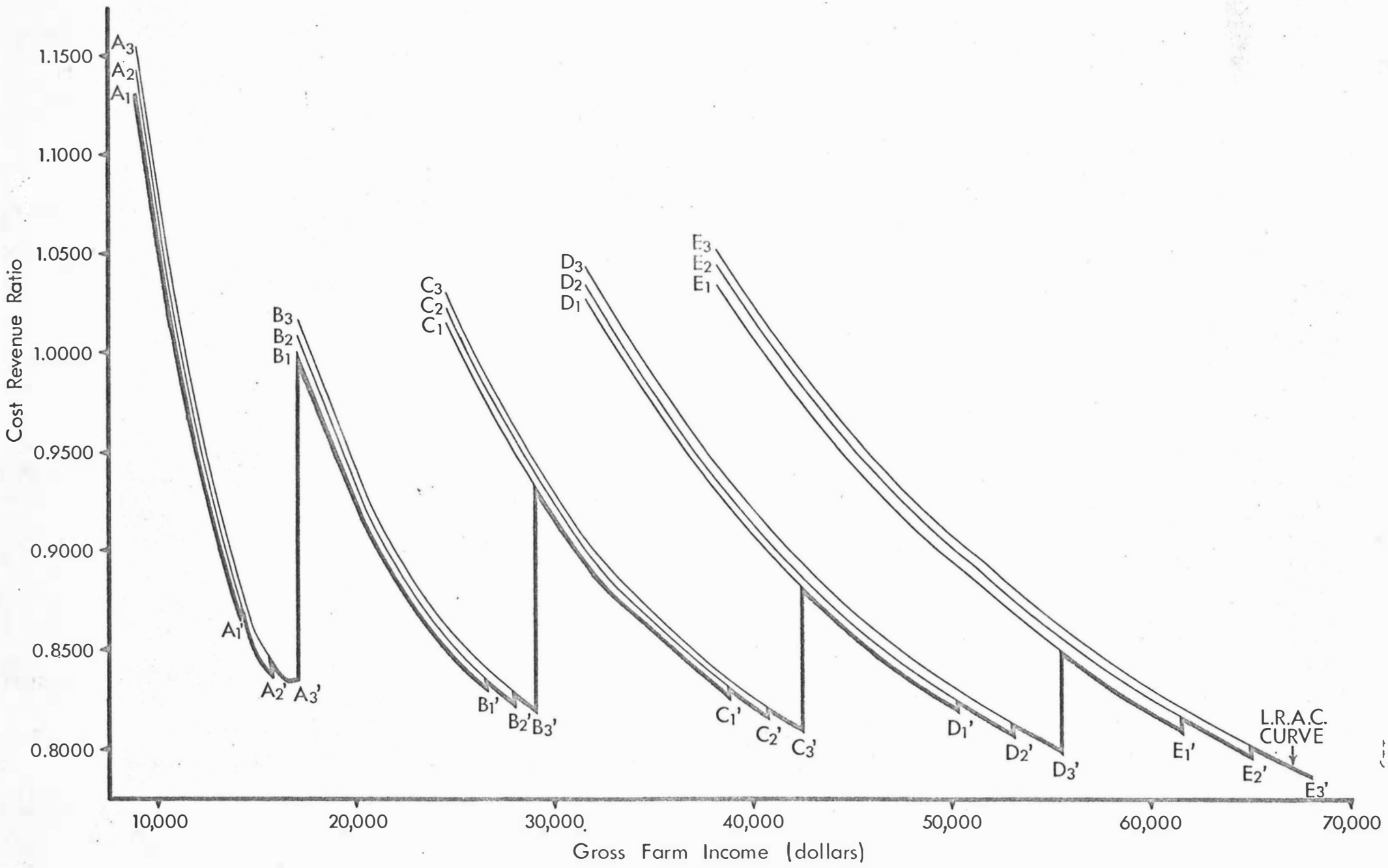


FIG. 8.11 S.R.A.C. AND L.R.A.C. CURVES (FIFTH SERIES OF COST REVENUE RATIOS) VARIABLE MILKFAT PER COW

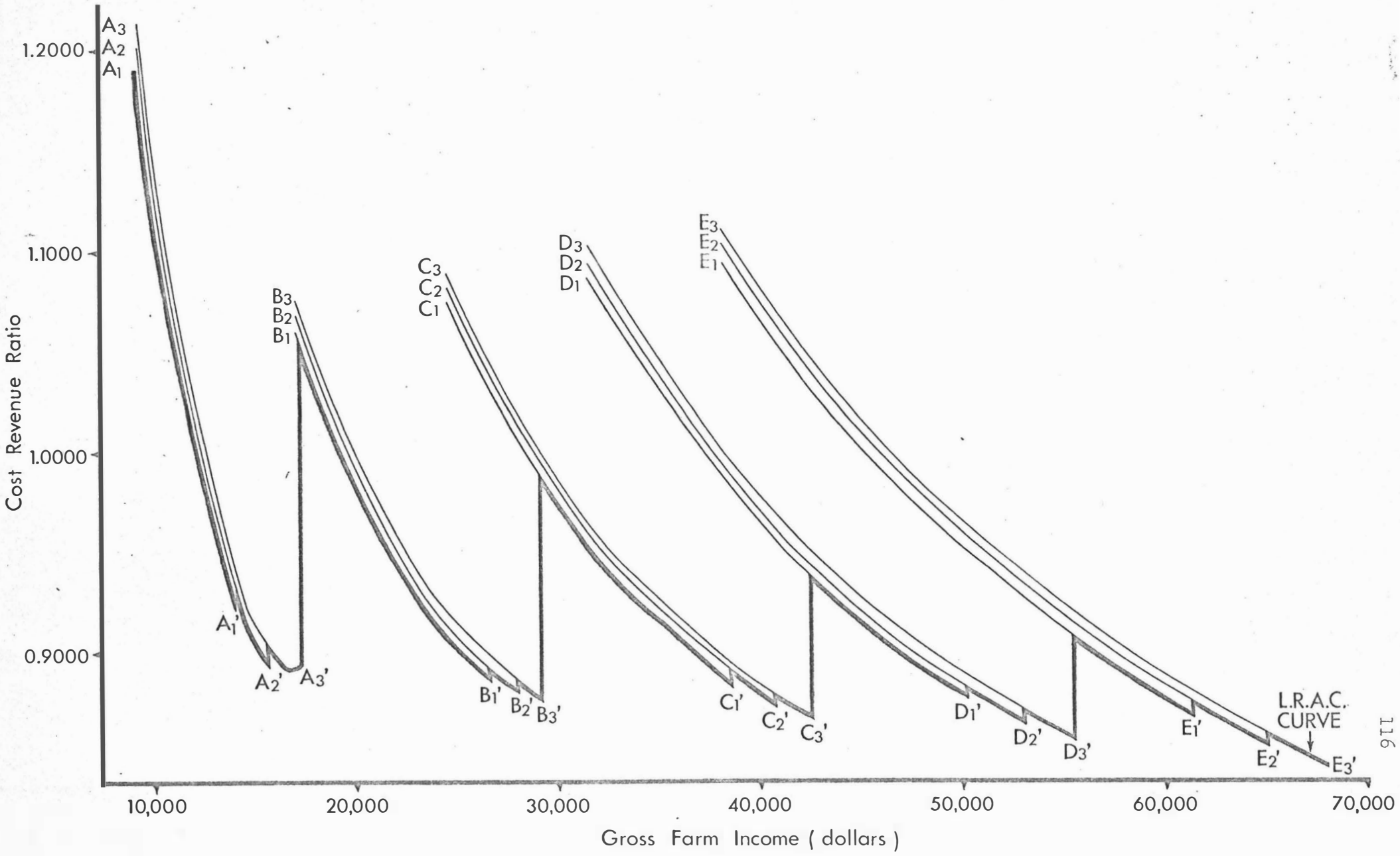


FIG. 8.12 RANGES OF GROSS FARM INCOME OVER WHICH CONTINUOUS BETWEEN SUBCLASS REDUCTIONS IN THE COST REVENUE RATIO OCCUR (CONSTANT MILKFAT PER COW)

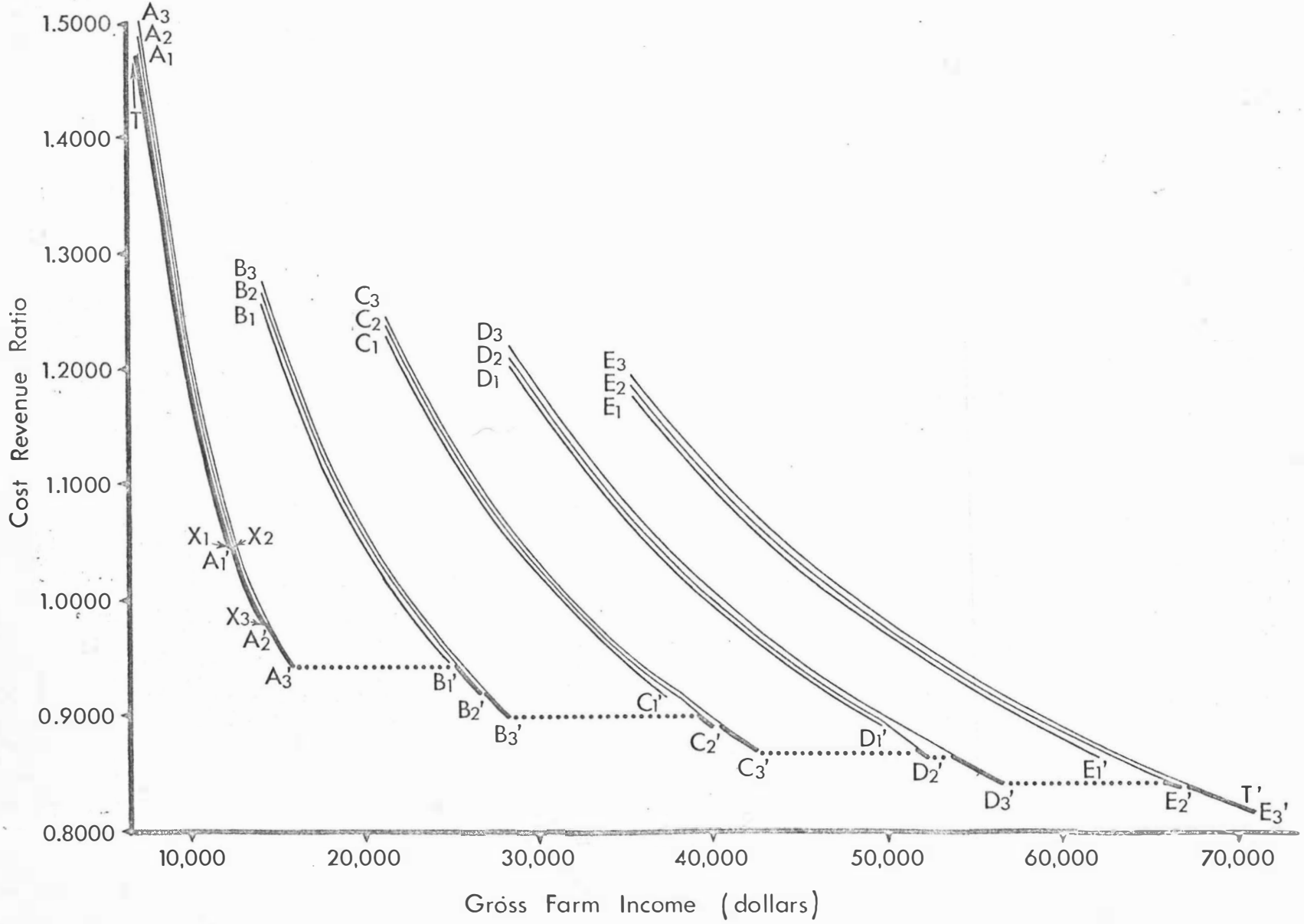


FIG. 8.13 RANGES OF GROSS FARM INCOME OVER WHICH CONTINUOUS BETWEEN SUBCLASS REDUCTIONS IN THE COST REVENUE RATIO OCCUR (VARIABLE MILKFAT PER COW)

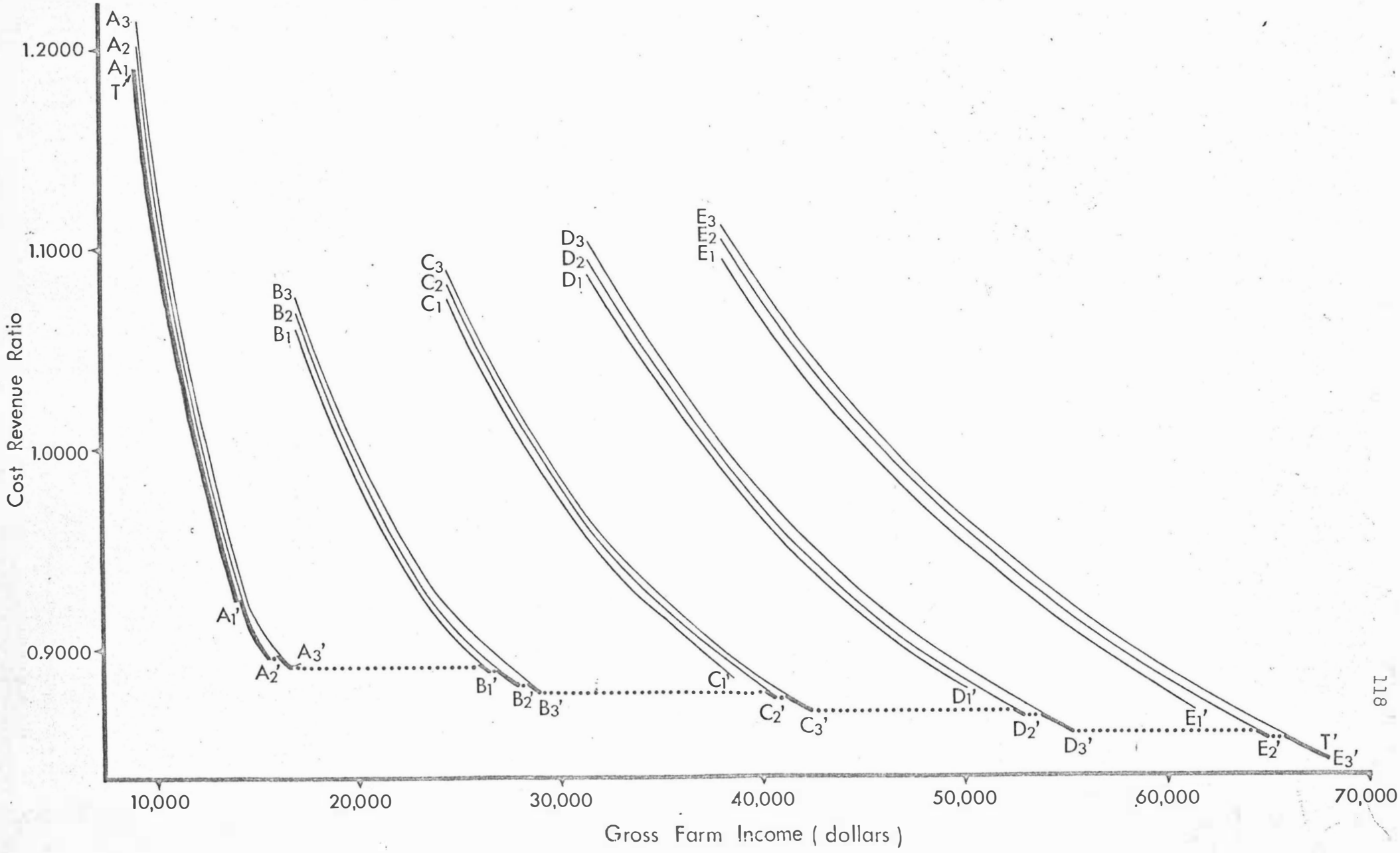


FIG. 8.14 NET CASH INCOME CURVES (CONSTANT MILKFAT PER COW)

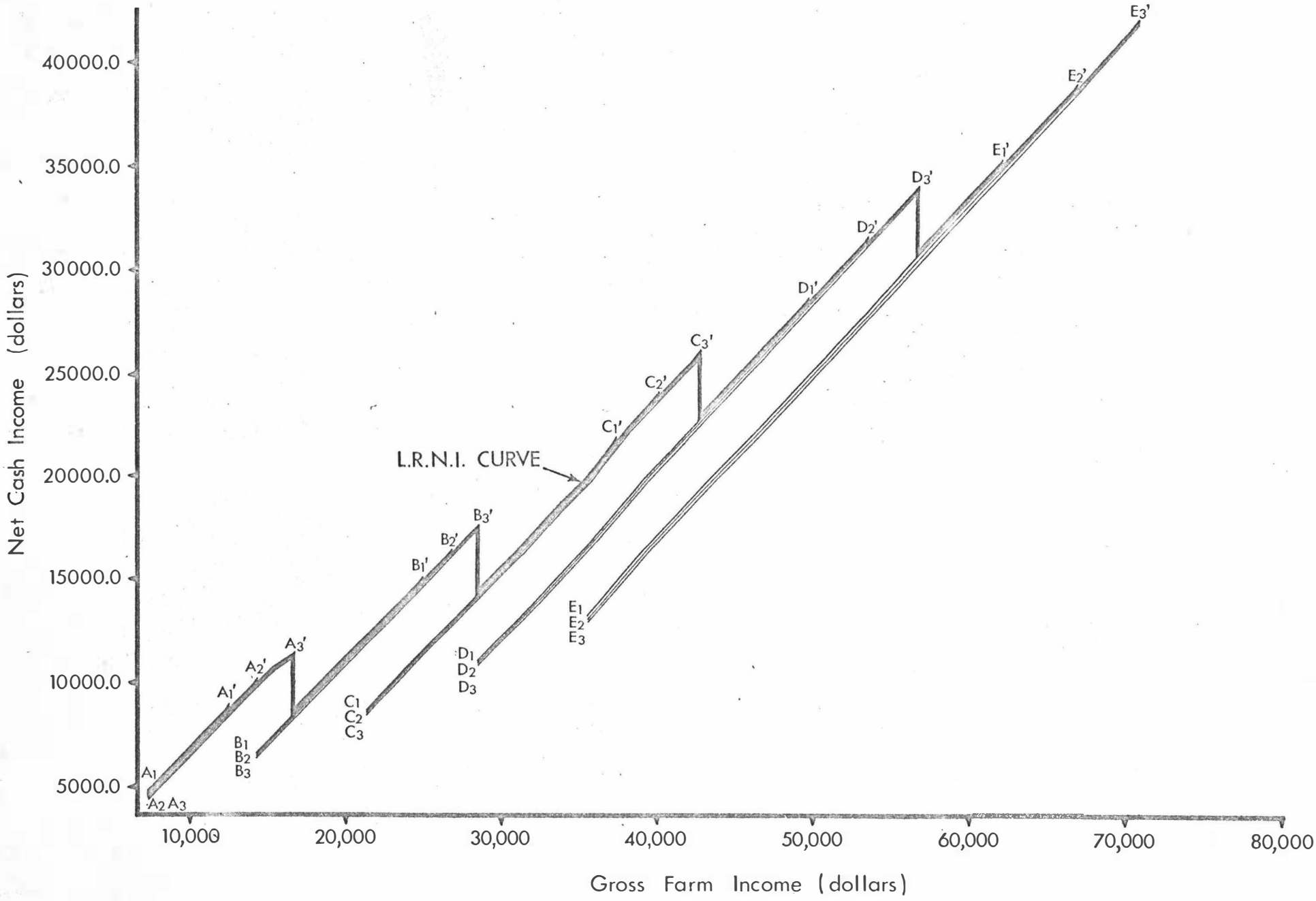


FIG. 8.15 NET FARM INCOME CURVES (CONSTANT MILKFAT PER COW)

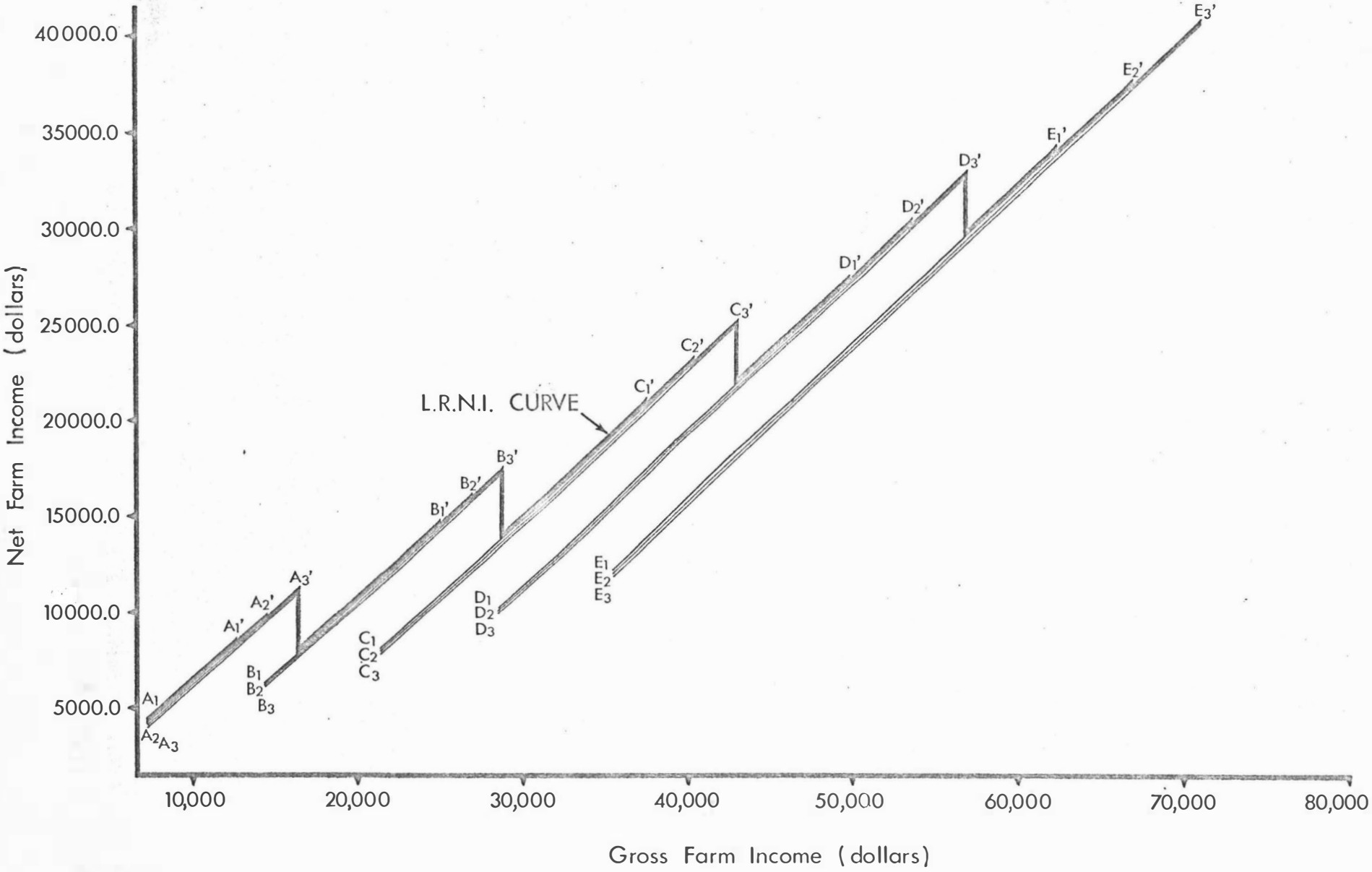


FIG. 8.16 OPERATOR LABOUR AND MANAGEMENT INCOME CURVES (CONSTANT MILKFAT PER COW)

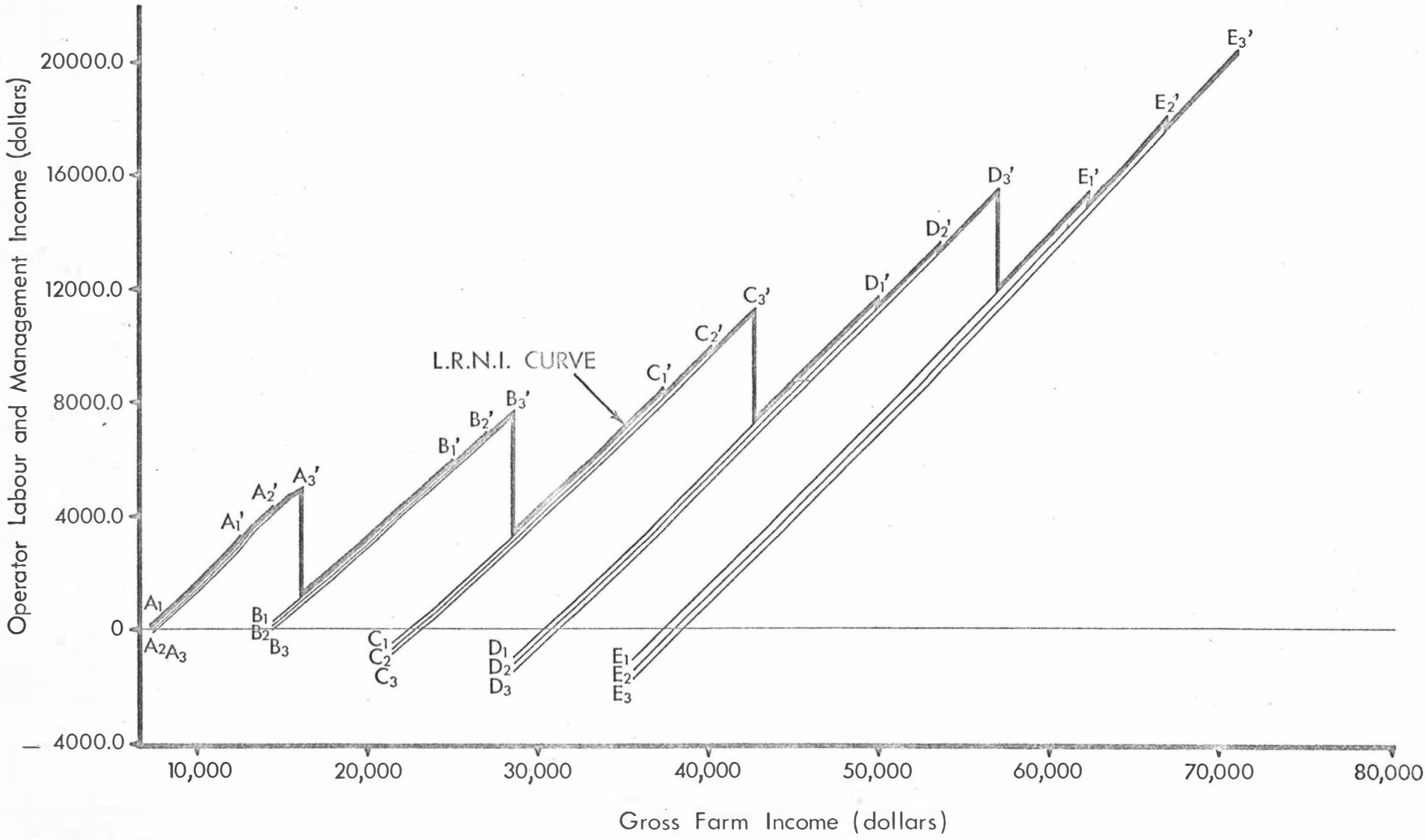


FIG. 8.17 OPERATOR MANAGEMENT INCOME CURVES (CONSTANT MILKFAT PER COW)

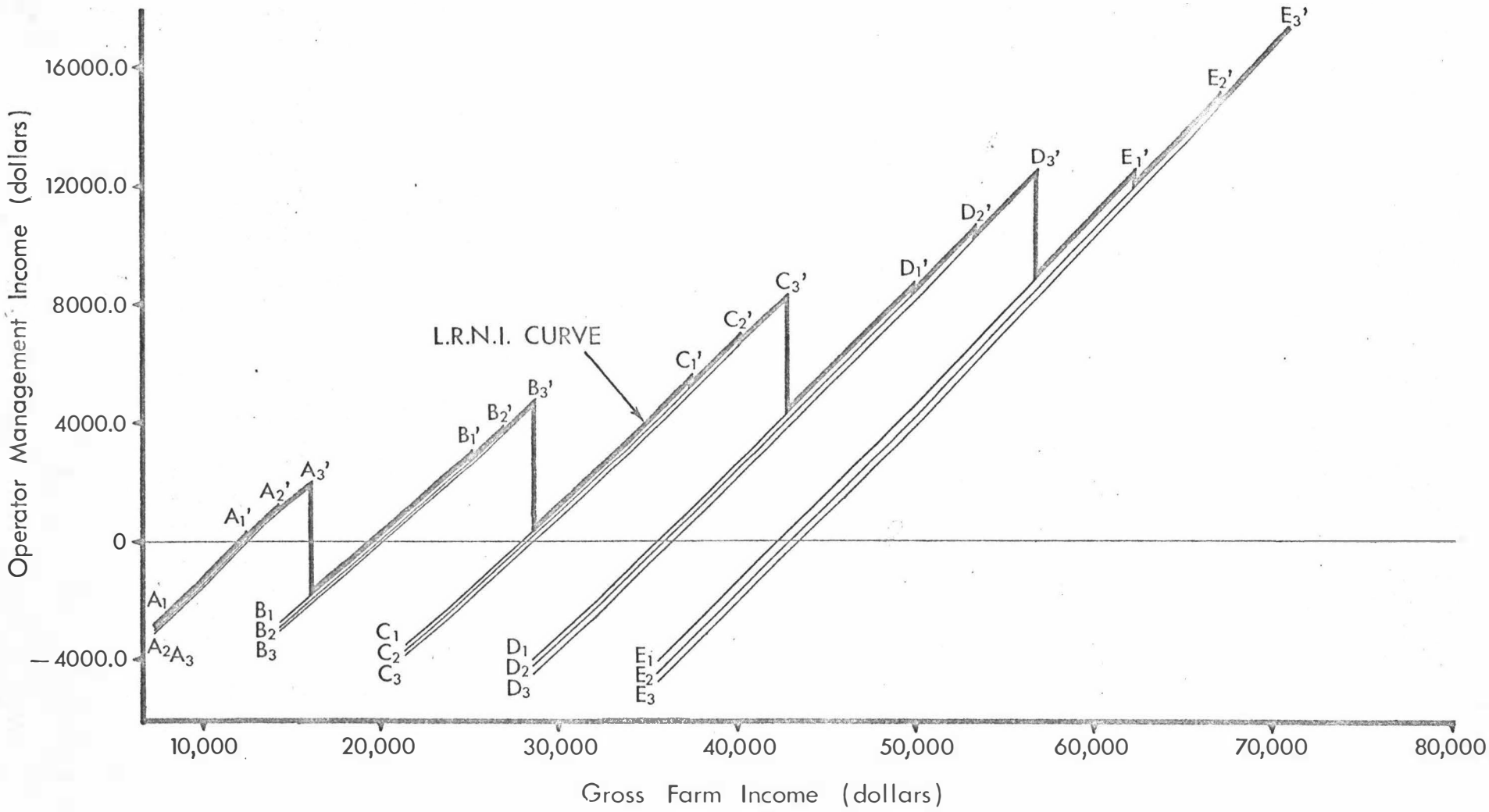


FIG. 8.18 ENTREPRENEURIAL INCOME CURVES (CONSTANT MILKFAT PER COW)

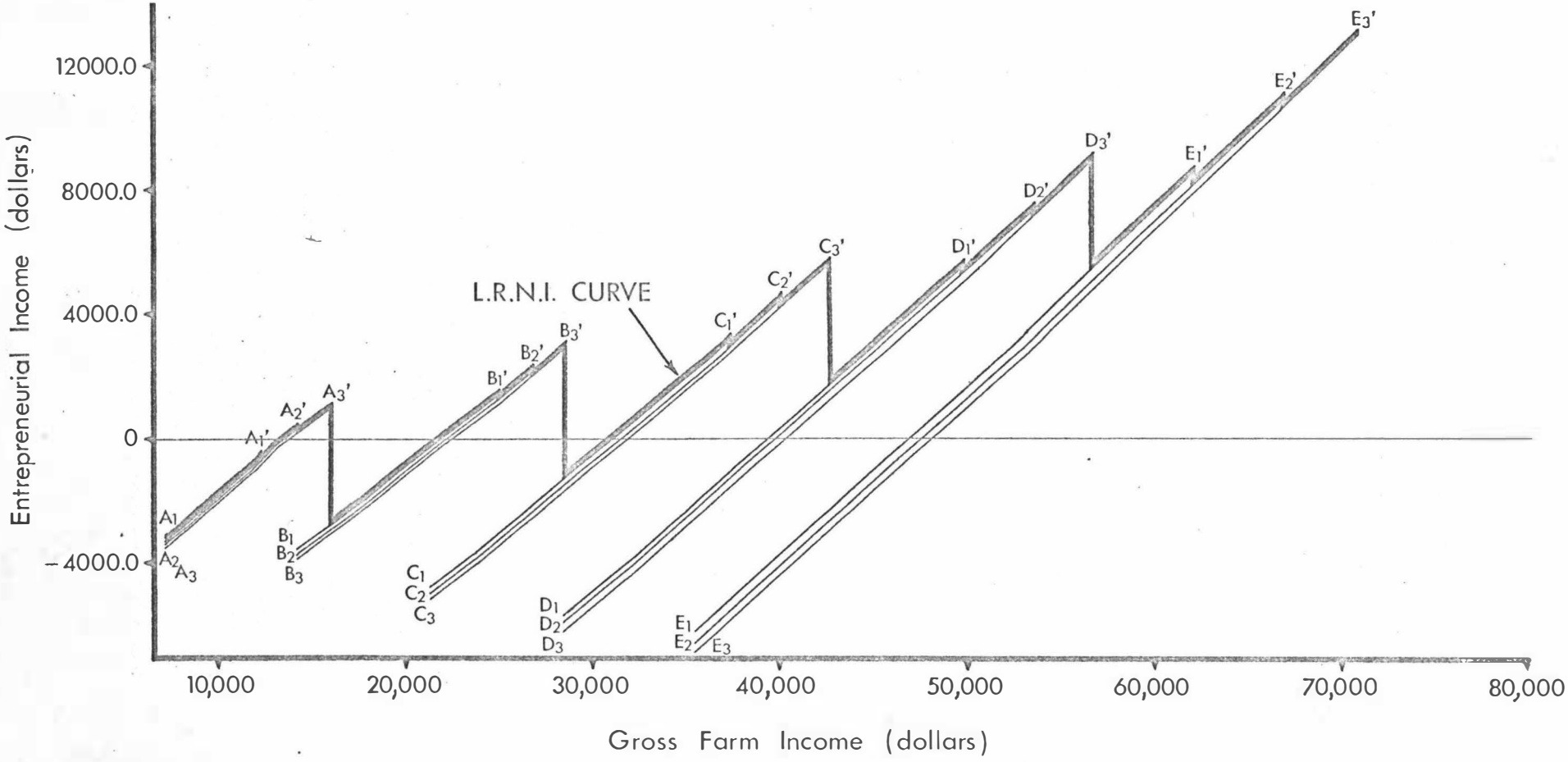


FIG. 8.19 NET CASH INCOME CURVES (VARIABLE MILKFAT PER COW)

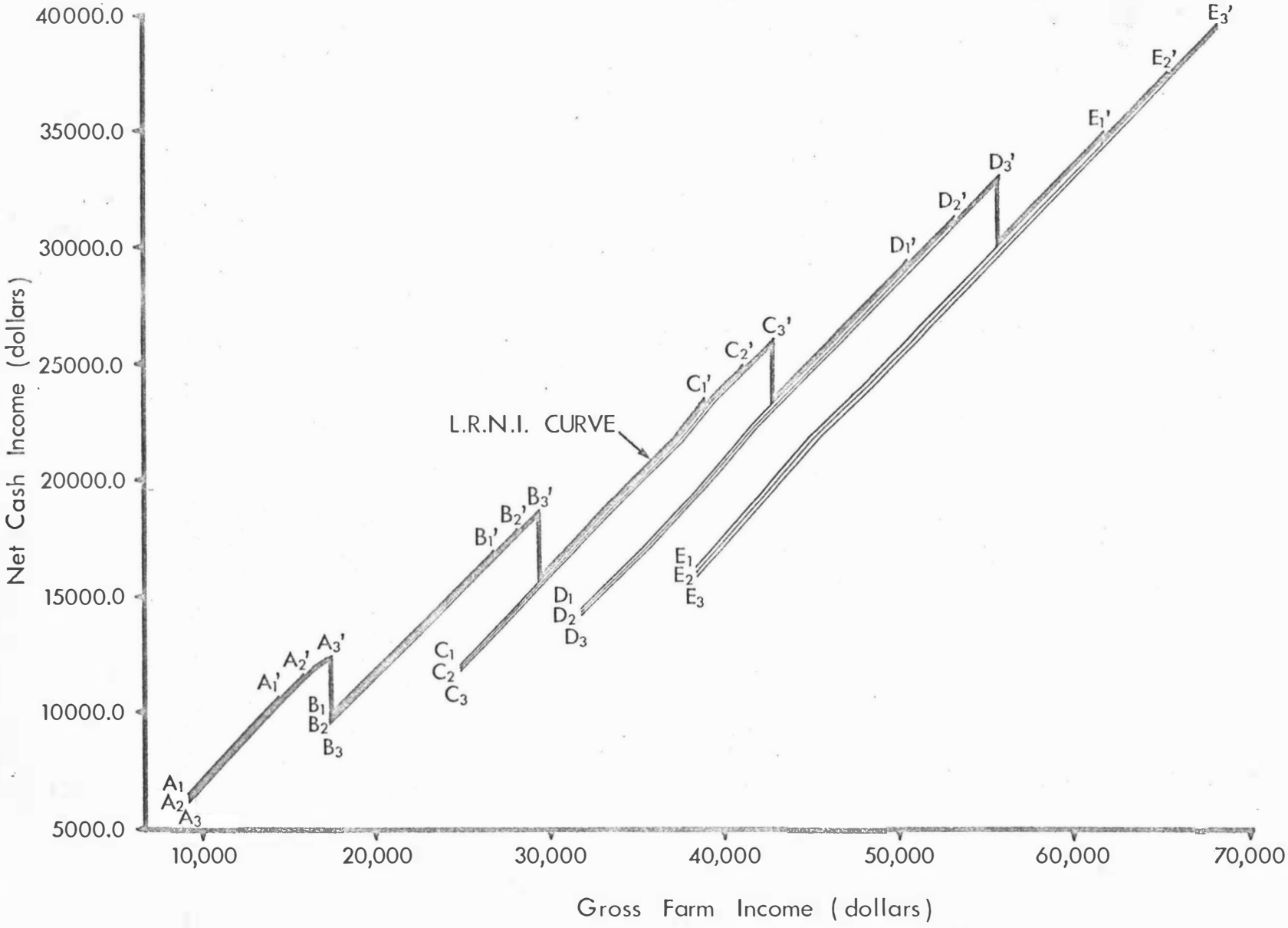


FIG. 8.20 NET FARM INCOME CURVES (VARIABLE MILKFAT PER COW)

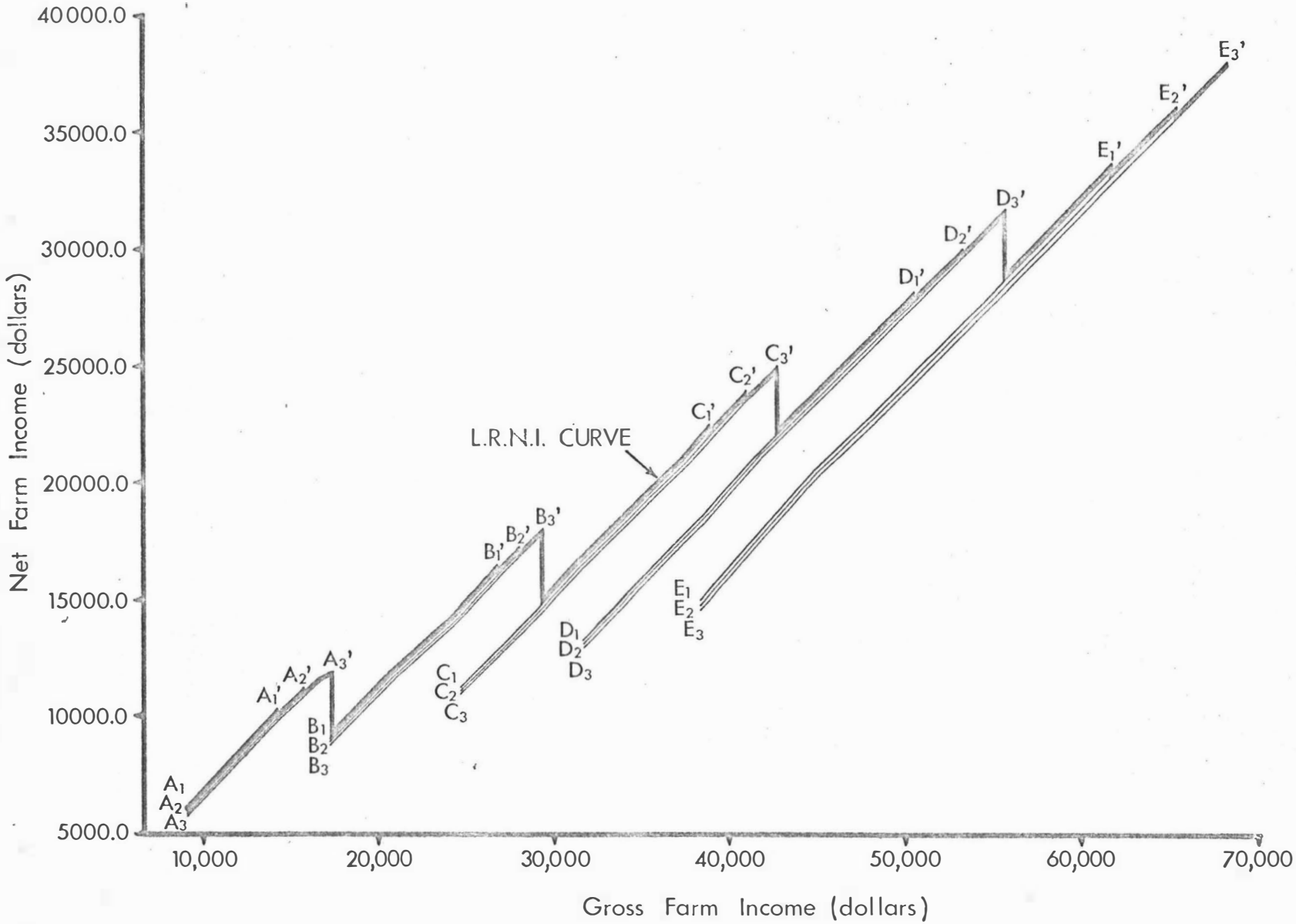


FIG. 8.21 OPERATOR LABOUR AND MANAGEMENT INCOME CURVES (VARIABLE MILKFAT PER COW)

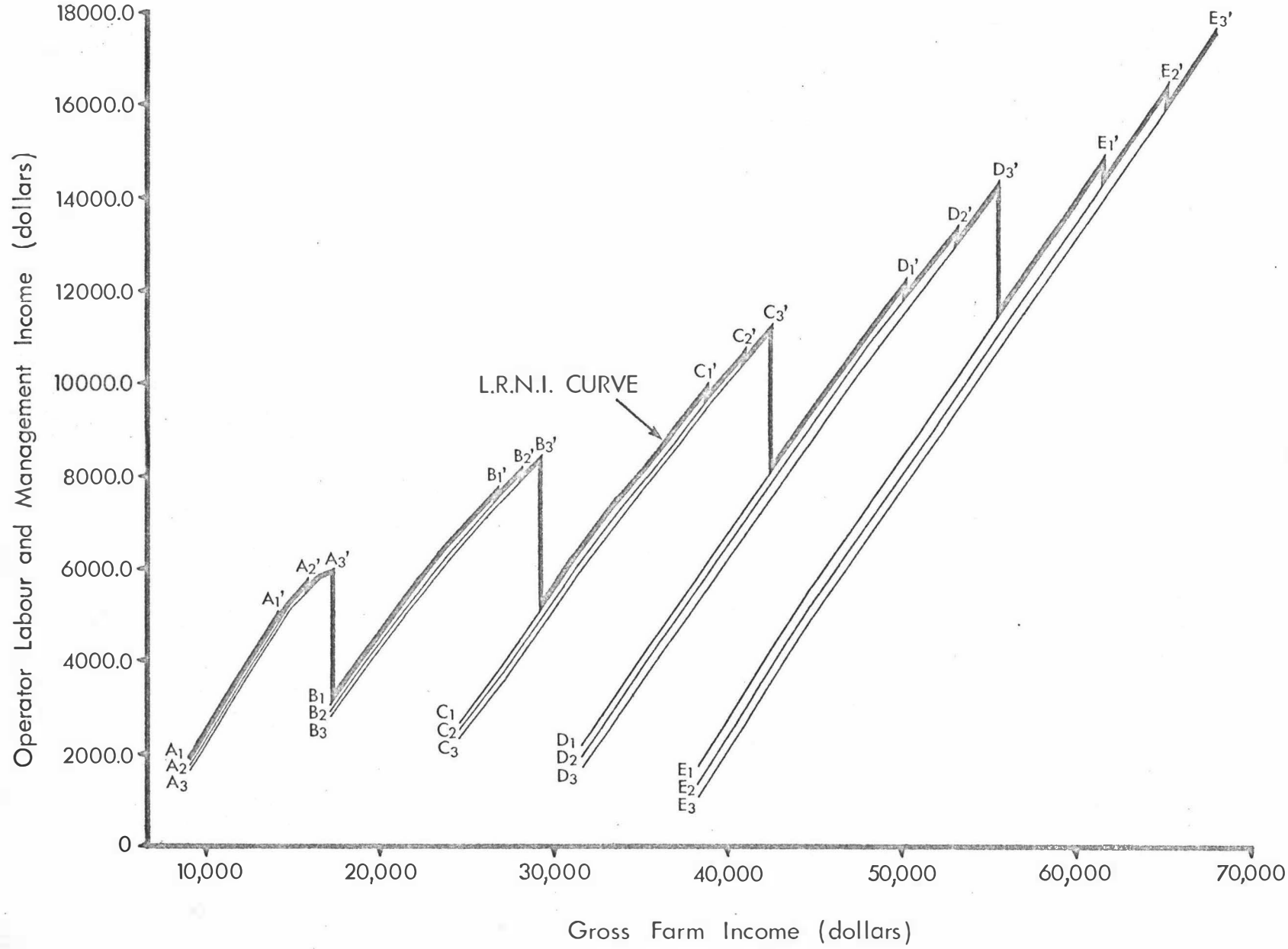


FIG. 8.22 OPERATOR MANAGEMENT INCOME CURVES (VARIABLE MILKFAT PER COW)

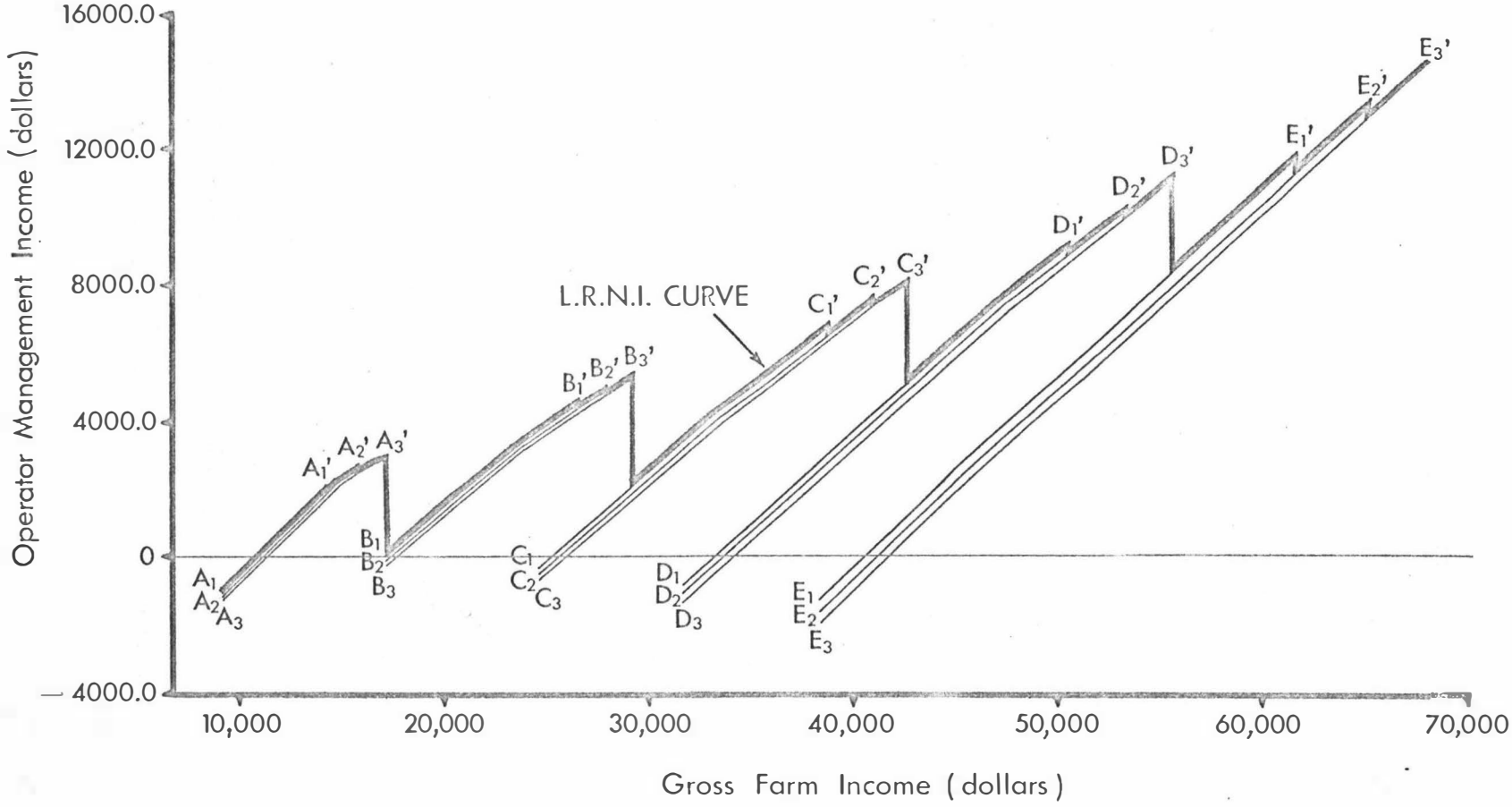


FIG. 8.23 ENTREPRENEURIAL INCOME CURVES (VARIABLE MILKFAT PER COW)

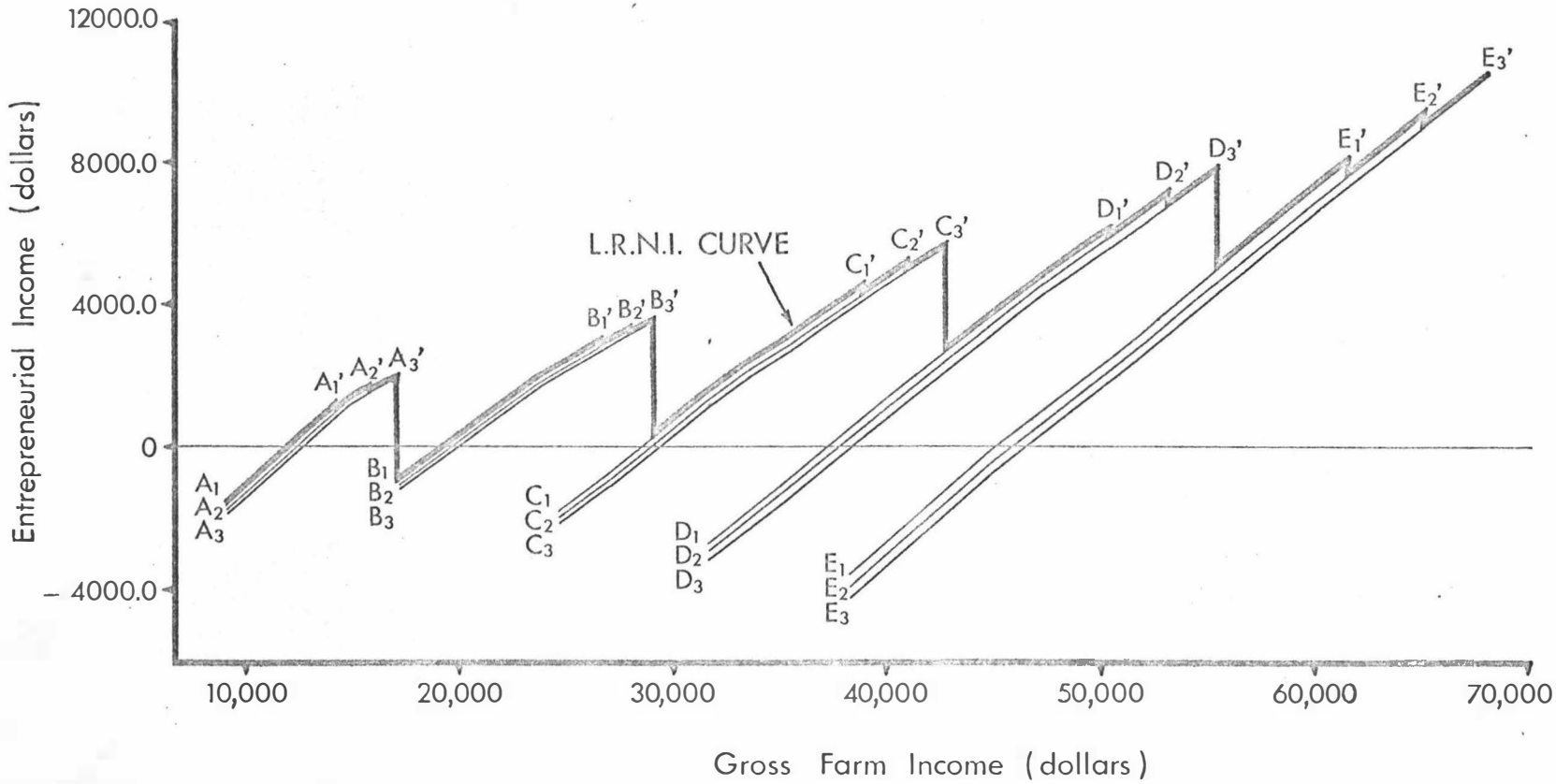


FIG. 8.24 MILKFAT PRODUCTION PER COW REQUIRED FOR THE COST REVENUE RATIOS TO BE EQUAL TO THAT OF THE L.R.A.C. CURVE (CONSTANT MILKFAT PER COW)

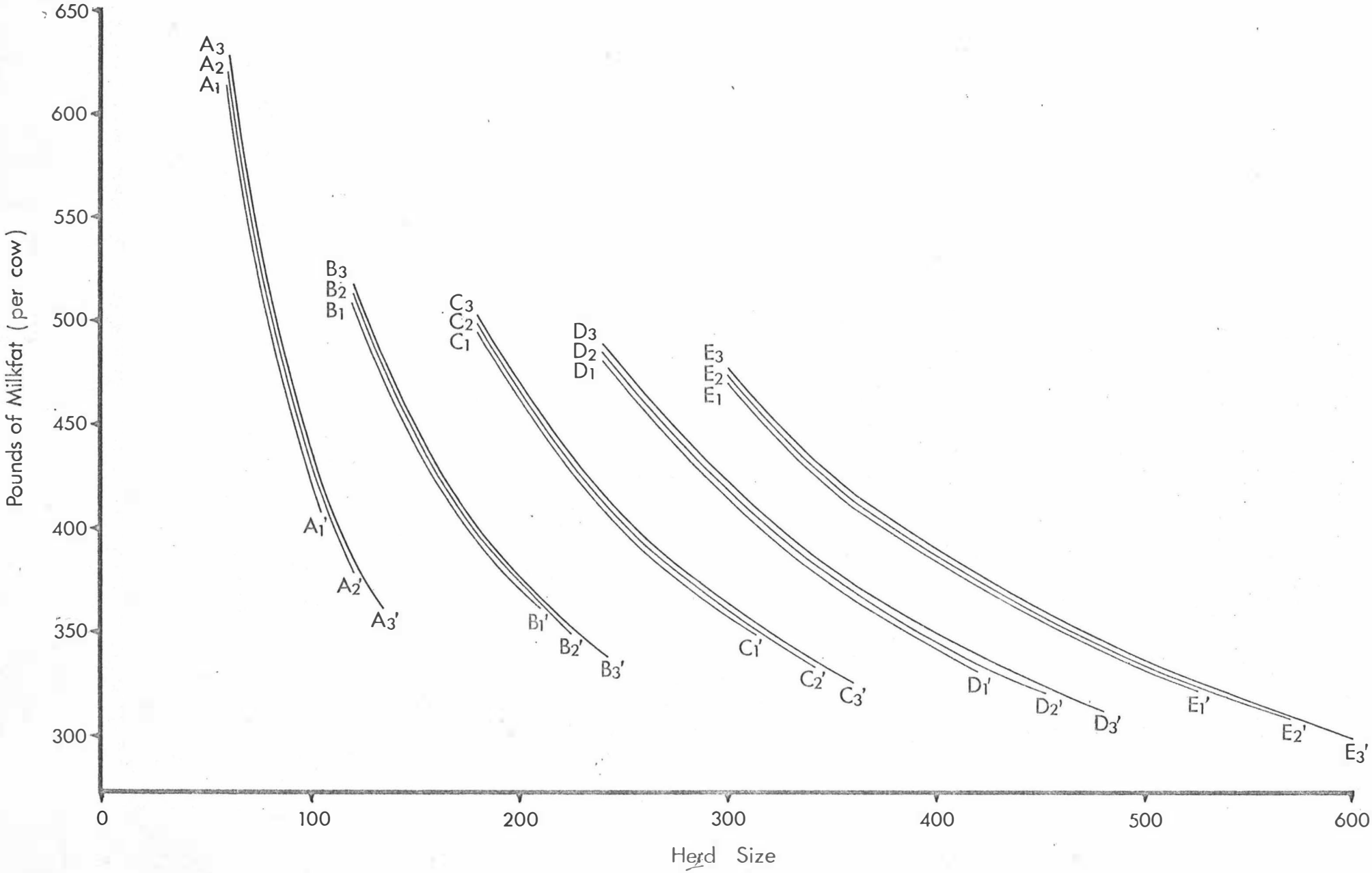


FIG. 8.25 MILKFAT PRODUCTION PER COW REQUIRED FOR THE COST REVENUE RATIOS TO BE EQUAL TO THAT OF THE LOW POINT OF THE L.R.A.C. CURVE (VARIABLE MILKFAT PER COW)

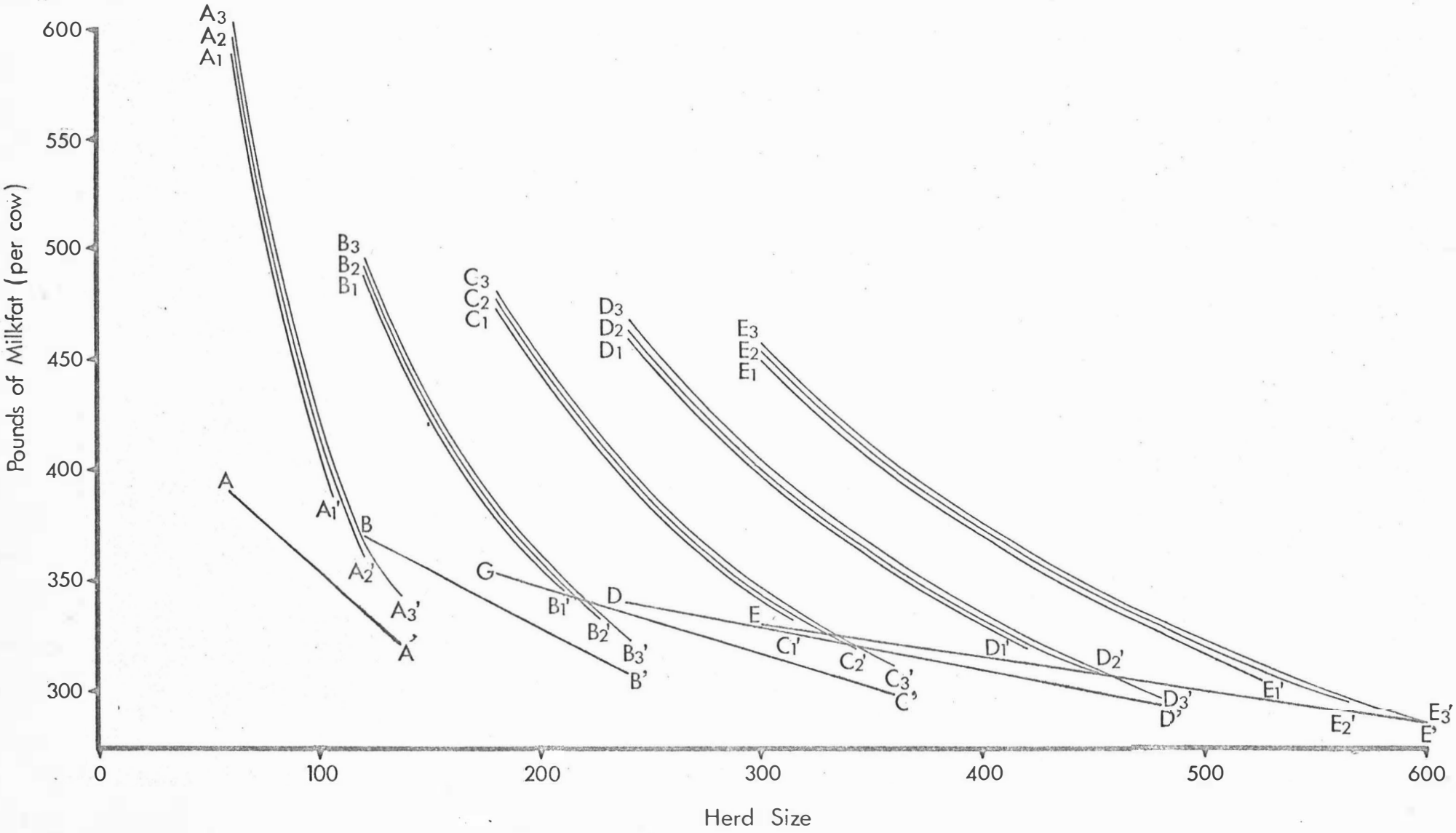


FIG. 8.26 REDUCTIONS IN THE PER UNIT COST OF TOTAL COST (E) REQUIRED FOR THE COST REVENUE RATIOS TO BE EQUAL TO THAT OF THE LOW POINT OF THE L.R.A.C. CURVE (CONSTANT MILKFAT PER COW)

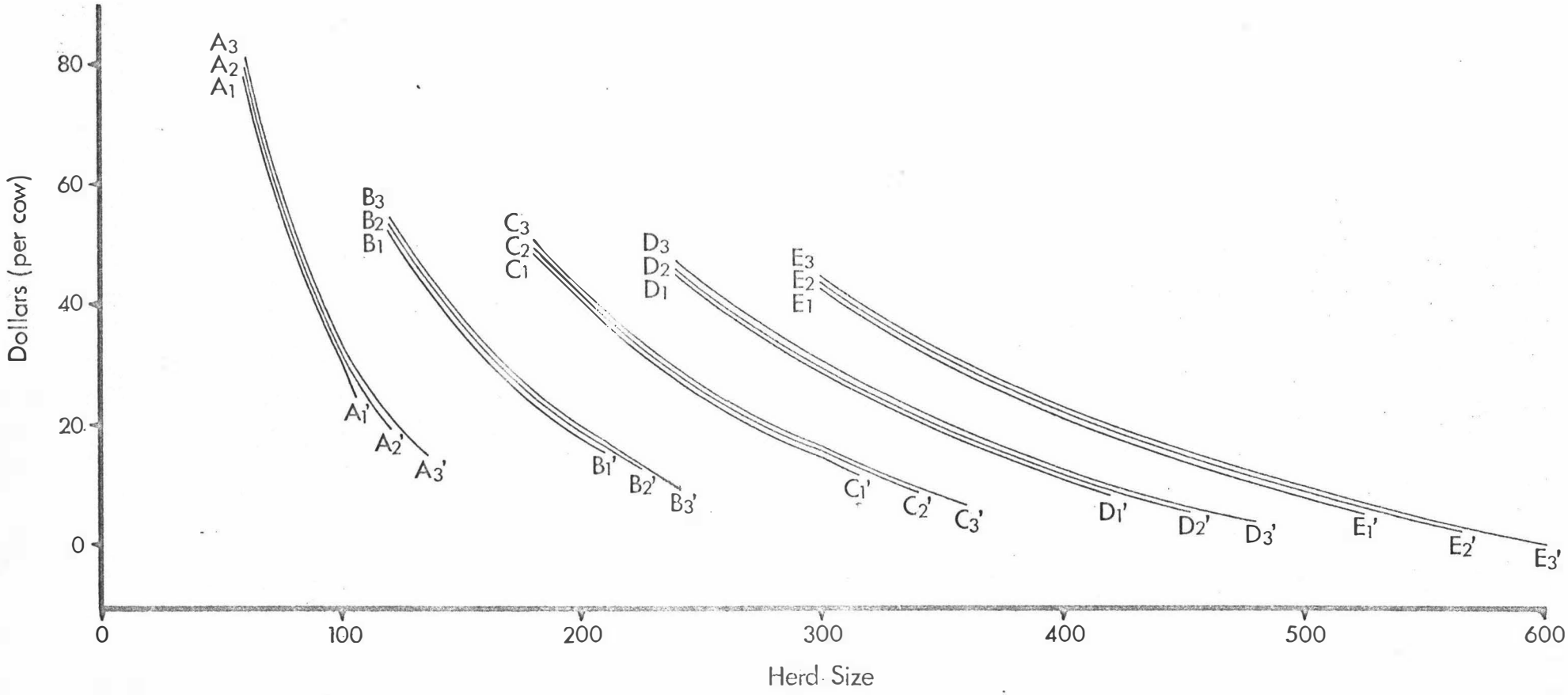


FIG. 8.27 REDUCTIONS IN THE PER UNIT COST OF TOTAL COST (E) REQUIRED FOR THE COST REVENUE RATIOS TO BE EQUAL TO THAT OF THE LOW POINT OF THE L.R.A.C. CURVE (VARIABLE MILKFAT PER COW)