THE LANARKSHIRE MILK EXPERIMENT.

By ETHEL M. ELDERTON, D.Sc.

This experiment was carried out in 1930 and a paper was published in that same year by Dr Leighton and Dr McKinlay*.

For four months in Lanarkshire in certain schools 5000 children were given ¾ pint of raw milk a day and 5000 children in these same schools were selected to act as a control series; in another set of schools, 5000 children were given ¾ pint of pasteurised milk and another 5000 children in these same schools were selected to act as a control; the children were measured and weighed at the beginning and end of the experiment.

"Student" in a paper "The Lanarkshire Milk Experiment" published in 1931 in *Biometrika*, Vol. XXIII, pp. 398–406, dealt with the difficulties of comparison which may be restated briefly from his paper:

(1) Raw milk and pasteurised milk were never given in the same schools.

(2) The initial heights and weights of the children in the control series were greater than those of the children who were milk fed.

(3) The children were weighed in their clothes and the first weighing was in February and the second in June; had there been no selection of cases this would not have mattered but it seems possible that the slightly poorer children who were given milk would lose less weight from change of clothes than the children in the control series who are assumed from their greater height and weight to be slightly more prosperous.

"Student" suggested that the experiment should be carried out on identical twins and if identical twins were more numerous and could with ease and certainty be discriminated from other twins they would be ideal subjects for such an experiment. In the absence of such data Professor Pearson suggested that, from the original cards, enough children of each class—controls, raw milk feeders, pasteurised milk feeders—could be found and paired who would have the same initial height and weight within reasonable limits.

The original cards were most willingly and courteously lent to Professor Pearson by the Department of Health for Scotland and were sorted for each sex into the year of birth; children had been measured to the nearest eighth of an inch in height and to the nearest ounce in weight. Having sorted the cards into heights for each year of birth a selection was made of a child from the control series who was of the same initial height, the same weight within 4 ounces and the same age within a month as one who had been given milk. In practically no cases were the initial conditions the same for the controls, raw milk feeders and pasteurised milk feeders, and therefore a comparison must be made of the three groups individually: controls with those who had raw milk; controls with those who had pasteurised milk; those who had raw milk with those who had pasteurised. The numbers were too few to be satisfactory and I decided to allow a variation of as much as 8 ounces in initial weight. This seemed justifiable since Dr Stocks in his

* Department of Health for Scotland. *Milk Consumption and the Growth of Schoolchildren.* By Dr Gerald Leighton and Dr Peter L. McKinlay. (Edinburgh and London: H.M. Stationery Office, 1930.) See also Stephen Bartlett: "Nutritional Value of Raw and Pasteurised Milk," *Journal of the Ministry of Agriculture*, April 1931, pp. 60–64. Also R. A. Fisher and S. Bartlett, *Nature*, Vol. CXXVII, p. 591, 1931.

study of twins* found differences in weight as great as 28 hectograms (10 ounces) in those twins he regarded as monozygotic whose ages corresponded to the children in the milk experiment. The standard deviation of weight in pounds is roughly twice that of the standard deviation of height in inches, so that if 8 ounces difference in initial weight be permitted $\frac{1}{4}$ inch difference in height could be allowed. Judging also by Dr Stocks' material in which monozygotic twins showed a modal difference of 1 cm. in height it would have been justifiable to allow children to be paired who differed by two-eighths of an inch, but the labour of pairing would have been much heavier if a greater variation than that entered on the cards had been allowed for height as well as for weight. As it was the work of sorting and pairing took much time and the writer is greatly indebted to Miss Margaret Beer for her very ready help in this preliminary work.

The first thing to be noted is that in selecting two children, one treated with milk and one not treated, who have the same height and the same weight within 8 ounces we can only find *average* children; the shortest and lightest and tallest and heaviest will not appear in this selected data. In Table I the standard deviations and coefficients of variation of the initial height and weight for each year of birth are given, and if these be compared with those for Glasgow boys and girls† it will be seen that they are distinctly less. The Glasgow figures were obtained by linear interpolation and are given in brackets after those for the selected Lanarkshire data. At a later stage of the work the children differed in age by as much as two months and the constants in this table are found from the larger group in order to diminish the errors. The central age given is an approximate value only; children born in any one year were paired, but those born in the first two months of any year were also paired with those born in November and December of the previous year.

Table I. *Variability in Initial Height and Weight.*

	Central Age (approximate)	No. of Cases	Standard Deviations		Coefficients of Variation	
			Height	Weight	Height	Weight
Boys	6 years 9 months	382	1·483 (2·58)	3·143 (5·19)	3·41 (6·0)	7·15 (11·7)
	7 years 9 months	337	1·648 (2·82)	3·973 (5·75)	3·61 (6·2)	8·20 (11·9)
	8 years 9 months	360	1·556 (2·83)	4·018 (6·28)	3·29 (6·0)	7·63 (11·9)
	9 years 9 months	323	1·627 (2·82)	4·550 (6·88)	3·32 (5·8)	7·72 (12·0)
	10 years 9 months	243	1·731 (2·84)	5·288 (7·56)	3·37 (5·6)	8·41 (12·2)
Girls	6 years 9 months	356	1·560 (2·59)	3·280 (5·06)	3·62 (6·0)	7·75 (11·7)
	7 years 9 months	307	1·545 (2·65)	3·732 (5·62)	3·42 (5·9)	8·11 (12·1)
	8 years 9 months	375	1·523 (2·77)	4·117 (6·32)	3·22 (5·9)	8·10 (12·5)
	9 years 9 months	344	1·681 (2·85)	5·596 (7·10)	3·38 (5·8)	9·93 (12·9)
	10 years 9 months	274	2·094 (2·95)	6·288 (8·03)	4·08 (5·8)	10·24 (13·4)

If the difference in the standard deviations be expressed as a percentage of the standard deviations found for Glasgow children the variability in height in this selected material is roughly 40 % less except when the year of birth is 1919 when the difference is less, and in weight roughly 30 % less except for girls born in 1919 and 1920 when it is about 20 % less. This difference in variability shows that conclusions reached apply only to very average children and not to those much below or above the mean in height and weight.

The point we have to consider is whether the average child given extra milk gains in height and

* Percy Stocks, assisted by Mary N. Karn: "A Biometric Investigation of Twins and their Brothers and Sisters," *Annals of Eugenics*, Vol. v, pp. 46–50. Francis Galton Laboratory for National Eugenics.

† E. M. Elderton: "Note on Variability in Girls and Boys (Glasgow) for Height and Weight," *Biometrika*, Vol. XXI, Miscellanea, p. 429.

weight over the child not receiving extra milk and whether children fed on raw milk gain more than children fed on pasteurised when their initial heights and weights are the same. In Table II the children included were of the same initial height within $\frac{1}{8}$ in., of the same initial weight within 8 ounces and did not differ by more than a month in age; the numbers of pairs are given in brackets. The change in weight from year to year at the age groups with which we are dealing is about 4 lb. and we should therefore expect over a period of four months an average gain of something over a pound in weight*, but owing to the fact that the children were weighed at the end of June and were in many cases wearing lighter clothes we find only a small average increase of 11·6 ounces in weight for the boys and 8·5 ounces for the girls in the control series, and an extraordinary amount of variation in the amount of increase in weight during the four months. The tables on p. 335 show this very clearly and it will be seen that 19 % of the boys and 25 % of the girls in the control series lost weight while the standard deviation was 20 ounces for both series; it is interesting to note that the standard deviation is no greater for the controls than for those fed on milk.

Standard Deviation in Ounces.

	Controls	Raw Milk Feeders	Controls	Pasteurised Milk Feeders	Raw Milk Feeders	Pasteurised Milk Feeders
Males	20·44 ± ·38	21·10 ± ·40	20·32 ± ·38	19·76 ± ·37	20·20 ± ·51	20·26 ± ·51
Females	21·19 ± ·40	21·37 ± ·40	19·86 ± ·36	21·57 ± ·40	22·48 ± ·59	21·70 ± ·57

In height boys gained ·72 in. and girls ·70 in. in the control series which is an amount of growth to be expected. Owing to the variability in gain in weight the probable errors are large and in Table II A the children of all ages have been combined to see the general effect of giving raw or pasteurised milk to school children. The gain in height and weight of milk feeders over controls and of raw milk feeders over pasteurised milk feeders is given in each case, and a negative sign means that the controls have done better than the children given milk and that those who have had pasteurised milk have done better than children given raw milk.

At all ages children who are given milk gain in height more than the children in the control series though several individual differences are not significant and in some cases are so small that it is not surprising to find them becoming negative though still insignificant when children who differ by from one to two months in age are added to the children included in Table II. Both boys and girls given raw milk gain more in height than those fed on pasteurised, but the differences in this case are never significant. In weight also the children having extra milk generally gain more though exceptions occur; girls benefit more than boys and there is some indication that the older children of both sexes gain more weight over the controls than the younger ones when they take raw milk, but when pasteurised milk is given the differences are more erratic. On the whole children receiving pasteurised milk gained more weight than the children receiving raw milk though they gained less in height, but again no individual difference is significant. An examination of Table II A shows that boys and girls profit equally in height by taking raw milk but that girls gain more in weight than the boys; girls gain more in height than the boys by taking pasteurised milk and more in weight though the difference is not significant. Though raw milk feeders have a slightly greater gain in height than pasteurised milk feeders they have the disadvantage in weight though none of the differences is significant except possibly for height of girls.

* The rate of growth may vary according to the time of year, but probably not greatly or it would have been a subject studied.

Table II. *Gain in Height and Weight of Milk Feeders over Controls and of Raw Milk Feeders over Pasteurised Milk Feeders for five age groups.*

Central Age (Approximate)	Gain in Height in Inches									
	Raw Milk Feeders over Controls				Pasteurised Milk Feeders over Controls				Raw Milk Feeders over Pasteurised Milk Feeders			
	Boys		Girls		Boys		Girls		Boys		Girls	
$6\frac{3}{4}$	(74)	·061 ± ·037	(71)	·100 ± ·039	(85)	·062 ± ·032	(62)	·022 ± ·033	(39)	·016 ± ·051	(31)	·101 ± ·052
$7\frac{3}{4}$	(66)	·114 ± ·038	(59)	·004 ± ·036	(64)	·004 ± ·037	(61)	·131 ± ·036	(41)	·021 ± ·045	(28)	·179 ± ·074
$8\frac{3}{4}$	(71)	·097 ± ·044	(70)	·177 ± ·041	(83)	·042 ± ·032	(84)	·147 ± ·030	(30)	·033 ± ·053	(31)	·097 ± ·052
$9\frac{3}{4}$	(65)	·073 ± ·047	(75)	·152 ± ·035	(69)	·087 ± ·036	(69)	·178 ± ·048	(39)	·090 ± ·052	(31)	−·036 ± ·057
$10\frac{3}{4}$	(61)	·227 ± ·039	(61)	·082 ± ·048	(41)	·098 ± ·052	(49)	·151 ± ·052	(39)	·035 ± ·049	(28)	·125 ± ·072
	Gain in Weight in Ounces											
$6\frac{3}{4}$	(74)	−4·26 ± 2·08	(71)	1·14 ± 1·92	(85)	− ·53 ± 1·85	(62)	4·06 ± 1·83	(39)	−5·54 ± 2·85	(31)	−1·45 ± 2·87
$7\frac{3}{4}$	(66)	1·50 ± 2·22	(59)	3·05 ± 2·47	(64)	4·78 ± 2·12	(61)	·74 ± 2·14	(41)	−8·12 ± 3·42	(28)	−1·29 ± 2·99
$8\frac{3}{4}$	(71)	1·39 ± 2·41	(70)	10·03 ± 2·51	(83)	4·66 ± 2·27	(84)	7·07 ± 2·25	(30)	1·80 ± 3·34	(31)	−1·45 ± 3·60
$9\frac{3}{4}$	(65)	2·77 ± 2·30	(75)	7·08 ± 2·66	(69)	3·52 ± 2·31	(69)	9·39 ± 2·60	(39)	−2·08 ± 2·89	(31)	4·06 ± 4·28
$10\frac{3}{4}$	(61)	2·21 ± 3·09	(61)	10·33 ± 2·79	(41)	1·98 ± 3·50	(49)	−3·12 ± 3·60	(39)	2·31 ± 3·26	(28)	−4·50 ± 5·50

Table II A. *Gain in Height and Weight of Milk Feeders over Controls and of Raw Milk Feeders over Pasteurised Milk Feeders, all ages combined.*

	Gain in Height		Gain in Weight		No. of Cases	
	Boys	Girls	Boys	Girls	Boys	Girls
Raw Milk Feeders over Controls	·111 ± ·019	·108 ± ·018	·59 ± 1·08	6·32 ± 1·13	337	336
Pasteurised Milk Feeders over Controls ...	·056 ± ·017	·127 ± ·017	2·84 ± 1·16	4·26 ± 1·11	342	325
Raw Milk Feeders over Pasteurised Milk Feeders	·039 ± ·023	·091 ± ·028	−2·58 ± 1·43	− ·85 ± 1·77	188	149

To try to discover whether the differences in the effect of milk at the different ages were significant or not I decided to add to the data those children who differed by one to two months in age; including these children may introduce a slight error for one might be pairing children of a slightly different class and the weight of one member of the pair might be more influenced by change of clothing; on the average one would expect the differences to cancel one another out, but if the means of the original heights and weights differ the frequencies in any group will be different and therefore the bias may be always in one direction, but it is not likely that by making the range of difference in age two months instead of one month that any appreciable error will be introduced, and there is a distinct gain since the number of cases is nearly doubled. There are still many irregularities as can be seen from Table III, and it is impossible to deduce much as to the effect of extra milk on children at different ages; on the whole the older the children the greater the gain in weight when raw milk is taken, but this is not the case when pasteurised milk is given. Again girls profit from the extra milk more than the boys, though the difference does not exceed three times the probable error. The gain in weight of raw milk feeders over pasteurised milk feeders is still negative though insignificant for girls, but is positive though insignificant for boys. Combining the first two age groups and the last three we obtain Table IV.

This table adds little to our information; comparing raw milk feeders with their controls the elder girls profit more than the younger in weight but there is no difference in height, while the elder boys also gain more than the younger in both height and weight, but the differences are not significant compared with their probable errors. Comparing pasteurised milk feeders with the controls age makes no difference to the boys, but the older girls who take the milk gain significantly

more over the controls in height than the younger and they gain more in weight, but on the number of cases the difference is not significant. Noticing that the greater difference in weight among the older girls is due to less gain by the controls one wishes more than ever that the children had been weighed without clothes.

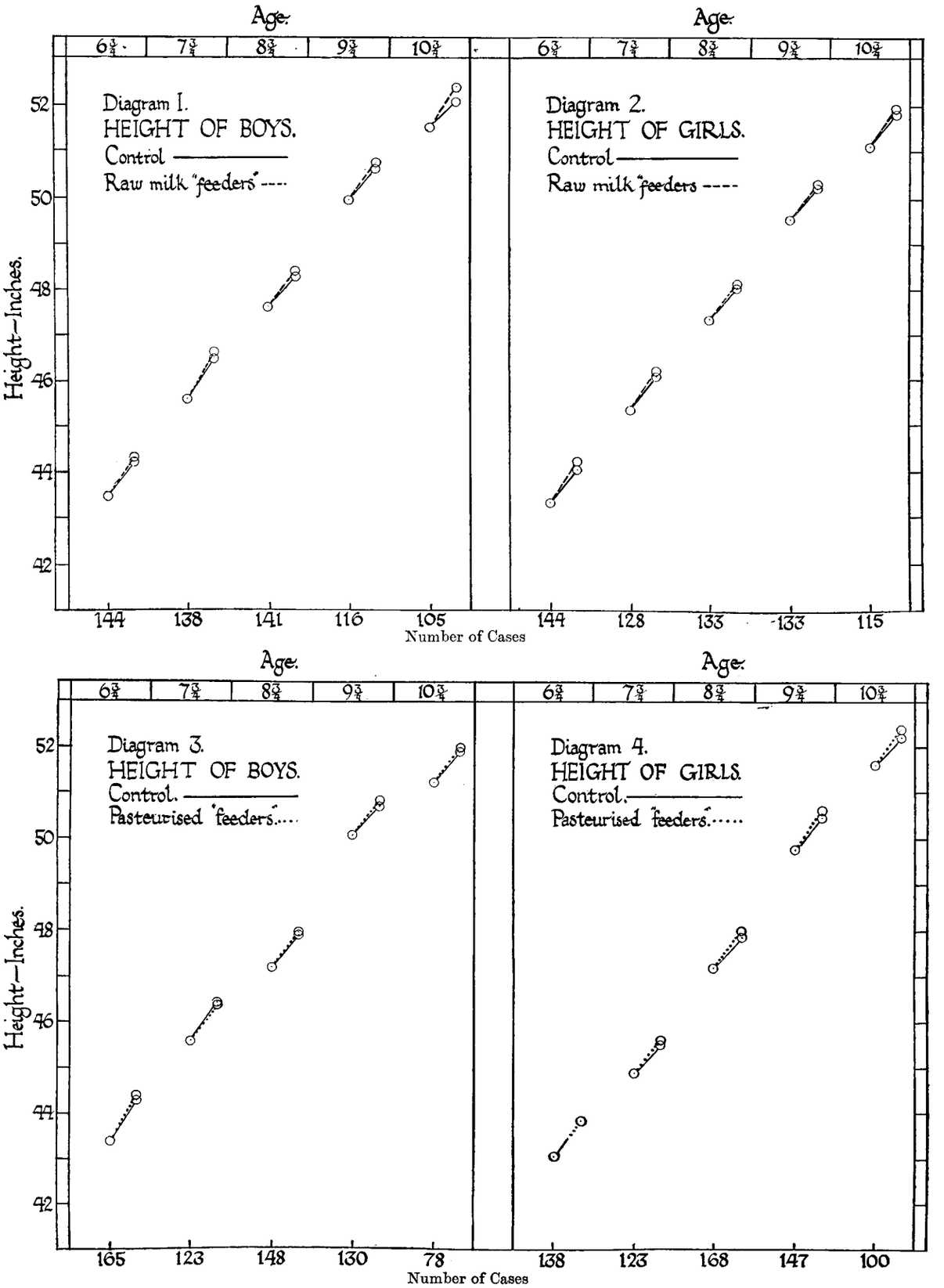
Table III. *Gain in Height and Weight of Milk Feeders over Controls and of Raw Milk Feeders over Pasteurised Milk Feeders when differences in age may be as much as two months.*

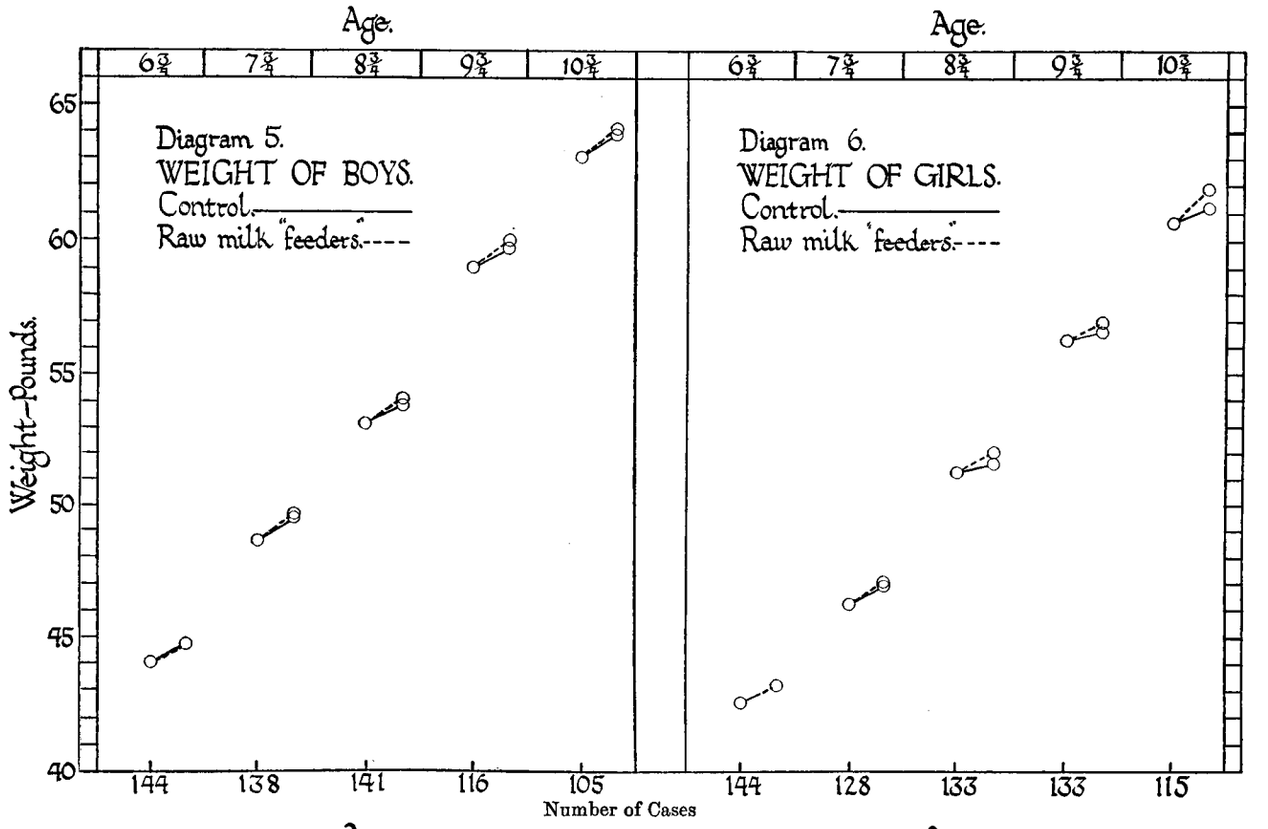
Central Age (Approximate)	Gain in Height in Inches											
	Raw Milk Feeders over Controls				Pasteurised Milk Feeders over Controls				Raw Milk Feeders over Pasteurised Milk Feeders			
	Boys		Girls		Boys		Girls		Boys		Girls	
$6\frac{3}{4}$	(144)	·083 ± ·026	(144)	·167 ± ·028	(165)	·094 ± ·024	(138)	−·004 ± ·028	(73)	−·066 ± ·036	(74)	·110 ± ·040
$7\frac{3}{4}$	(138)	·106 ± ·026	(128)	·023 ± ·027	(123)	−·027 ± ·026	(123)	·105 ± ·026	(76)	·022 ± ·036	(56)	·167 ± ·051
$8\frac{3}{4}$	(141)	·098 ± ·030	(133)	·107 ± ·029	(148)	·046 ± ·025	(168)	·129 ± ·023	(71)	−·003 ± ·035	(74)	·017 ± ·034
$9\frac{3}{4}$	(116)	·112 ± ·034	(133)	·087 ± ·027	(130)	·068 ± ·025	(147)	·134 ± ·028	(77)	·011 ± ·037	(64)	·021 ± ·043
$10\frac{3}{4}$	(105)	·208 ± ·031	(115)	·084 ± ·034	(78)	·057 ± ·036	(100)	·128 ± ·034	(60)	·002 ± ·038	(59)	·080 ± ·045
	Gain in Weight in Ounces											
$6\frac{3}{4}$	(144)	−·88 ± 1·44	(144)	·13 ± 1·36	(165)	·00 ± 1·33	(138)	1·25 ± 1·28	(73)	−3·46 ± 2·02	(74)	−·13 ± 1·89
$7\frac{3}{4}$	(138)	1·36 ± 1·52	(128)	1·12 ± 1·62	(123)	3·54 ± 1·68	(123)	3·36 ± 1·53	(76)	−2·85 ± 2·46	(56)	−4·50 ± 2·23
$8\frac{3}{4}$	(141)	2·50 ± 1·72	(133)	7·98 ± 1·79	(148)	5·28 ± 1·64	(168)	3·96 ± 1·46	(71)	−3·06 ± 2·15	(74)	5·23 ± 2·46
$9\frac{3}{4}$	(116)	4·27 ± 1·77	(133)	5·62 ± 1·87	(130)	·35 ± 1·71	(147)	9·86 ± 1·88	(77)	3·06 ± 2·09	(64)	−1·55 ± 2·90
$10\frac{3}{4}$	(105)	4·80 ± 2·41	(115)	11·66 ± 2·20	(78)	−2·77 ± 2·36	(100)	·36 ± 2·44	(60)	3·15 ± 2·65	(59)	−2·45 ± 3·36

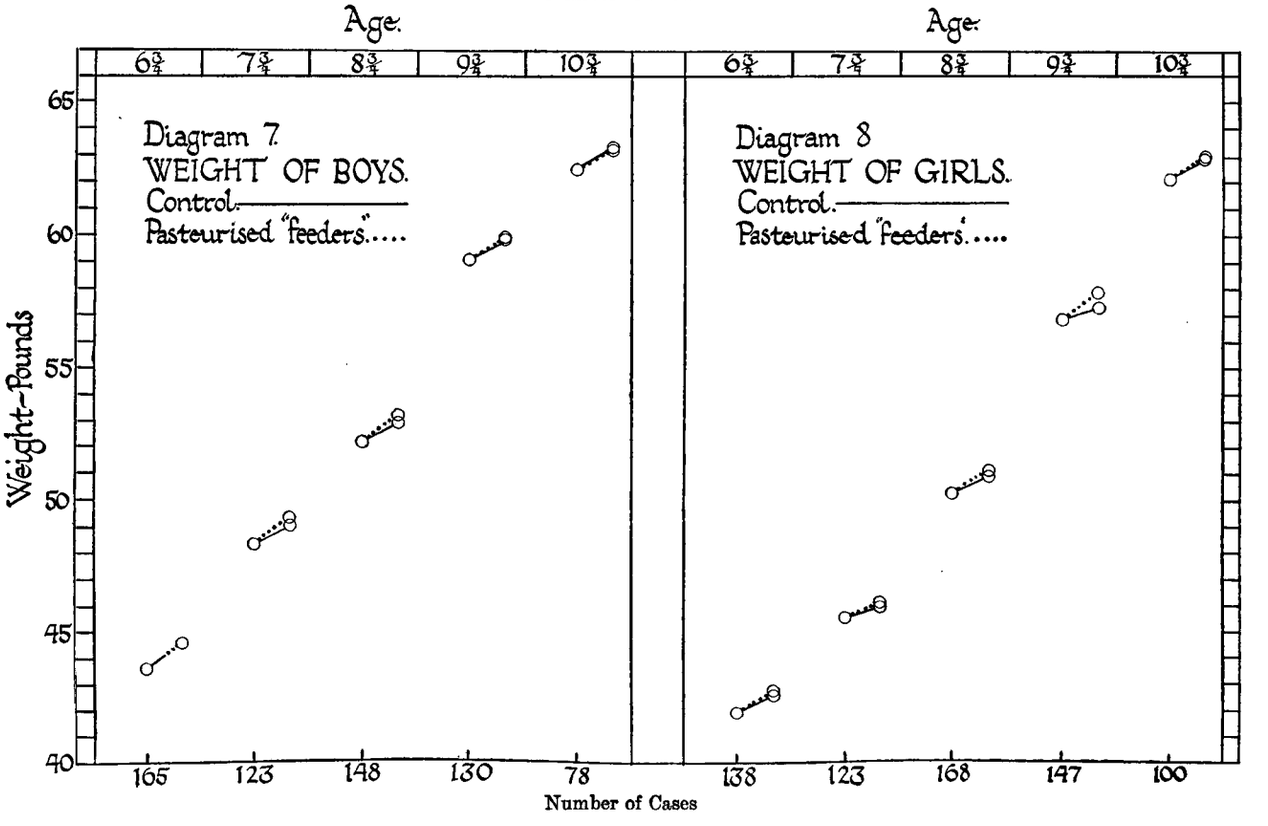
Table IV. *Gain in Height and Weight of Milk Feeders over Controls and of Raw Milk Feeders over Pasteurised Milk Feeders in two age groups.*

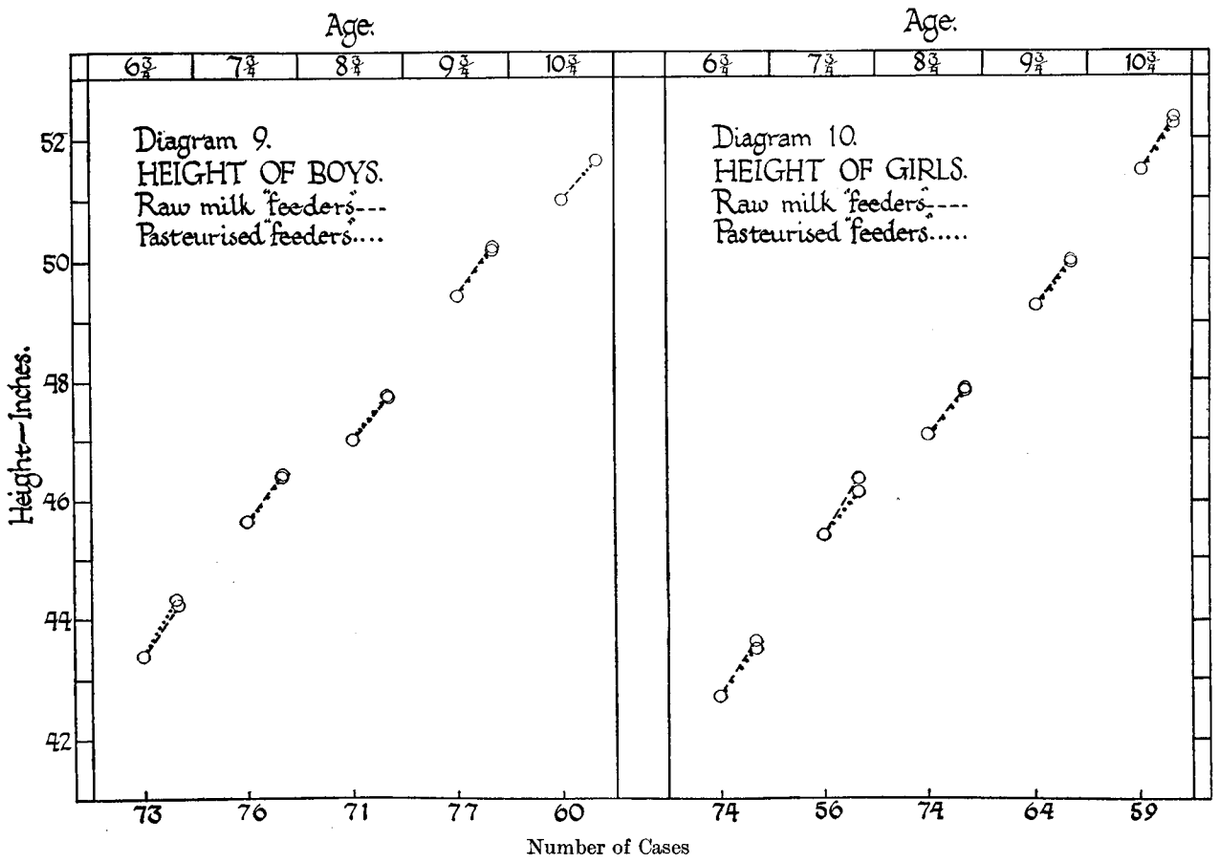
Age Group[1]		Gain in Height in Inches					
		Boys			Girls		
		No. of Cases	Means	Differences	No. of Cases	Means	Differences
$6\frac{2}{12}$–$8\frac{4}{12}$	C.[2]	282	·739	·094 ± ·019	272	·741	·099 ± ·020
	R.[2]		·834			·840	
$8\frac{2}{12}$–$11\frac{4}{12}$	C.	362	·685	·134 ± ·019	381	·678	·093 ± ·018
	R.		·819			·771	
$6\frac{2}{12}$–$8\frac{4}{12}$	C.	288	·782	·043 ± ·017	261	·740	·047 ± ·019
	P.[2]		·825			·787	
$8\frac{2}{12}$–$11\frac{4}{12}$	C.	356	·684	·057 ± ·016	415	·655	·130 ± ·016
	P.		·741			·785	
$6\frac{2}{12}$–$8\frac{4}{12}$	R.	149	·823	−·021 ± ·025	130	·929	·135 ± ·032
	P.		·844			·794	
$8\frac{2}{12}$–$11\frac{4}{12}$	R.	208	·720	·004 ± ·022	197	·801	·037 ± ·024
	P.		·716			·764	
		Gain in Weight in Ounces					
$6\frac{2}{12}$–$8\frac{4}{12}$	C.	282	12·22	·23 ± 1·05	272	10·12	·60 ± 1·05
	R.		12·45			10·72	
$8\frac{2}{12}$–$11\frac{4}{12}$	C.	362	9·89	3·73 ± 1·12	381	6·00	8·27 ± 1·13
	R.		13·62			14·27	
$6\frac{2}{12}$–$8\frac{4}{12}$	C.	288	14·06	1·50 ± 1·05	261	10·38	2·24 ± ·99
	P.		15·56			12·62	
$8\frac{2}{12}$–$11\frac{4}{12}$	C.	356	10·90	1·72 ± 1·06	415	8·39	5·25 ± 1·07
	P.		12·62			13·64	
$6\frac{2}{12}$–$8\frac{4}{12}$	R.	149	10·57	−3·14 ± 1·61	130	9·14	−2·01 ± 1·45
	P.		13·71			11·15	
$8\frac{2}{12}$–$11\frac{4}{12}$	R.	208	11·77	1·00 ± 1·32	197	14·71	·73 ± 1·67
	P.		10·77			13·98	

[1] The overlap in ages of the two groups arises from the two months' difference in age in any pair.
[2] C. = Controls. R. = Raw Milk Feeders. P. = Pasteurised Milk Feeders.


Age.
6¾
7¾
8¾
9¾
10¾
Diagram 1.
HEIGHT OF BOYS.
Control ——————
Raw milk "feeders" ----
Height—Inches.
52
50
48
46
44
42
144
138
141
116
105
Number of Cases
Diagram 2.
HEIGHT OF GIRLS.
Control ——————
Raw milk "feeders ----
144
128
133
133
115
Diagram 3.
HEIGHT OF BOYS.
Control. ——————
Pasteurised "feeders"....
165
123
148
130
78
Diagram 4.
HEIGHT OF GIRLS.
Control. ——————
Pasteurised "feeders".....
138
123
168
147
100


Age.
6¾ 7¾ 8¾ 9¾ 10¾
Diagram 5.
WEIGHT OF BOYS.
Control.
Raw milk "feeders."
Weight–Pounds.
65 60 55 50 45 40
144 138 141 116 105
Number of Cases
Age.
6¾ 7¾ 8¾ 9¾ 10¾
Diagram 6.
WEIGHT OF GIRLS.
Control.
Raw milk 'feeders.'
144 128 133 133 115


Age.
6¾ 7¾ 8¾ 9¾ 10¾
Diagram 7.
WEIGHT OF BOYS.
Control.
Pasteurised "feeders."
Weight–Pounds
65 60 55 50 45 40
165 123 148 130 78
Number of Cases
Age.
6¾ 7¾ 8¾ 9¾ 10¾
Diagram 8
WEIGHT OF GIRLS.
Control.
Pasteurised 'feeders'.
138 123 168 147 100


Age.
6¾ 7¾ 8¾ 9¾ 10¾
Diagram 9.
HEIGHT OF BOYS.
Raw milk "feeders"---
Pasteurised "feeders"....
Height—Inches.
52
50
48
46
44
42
73 76 71 77 60
Diagram 10.
HEIGHT OF GIRLS.
Raw milk "feeders"----
Pasteurised "feeders".....
74 56 74 64 59
Number of Cases

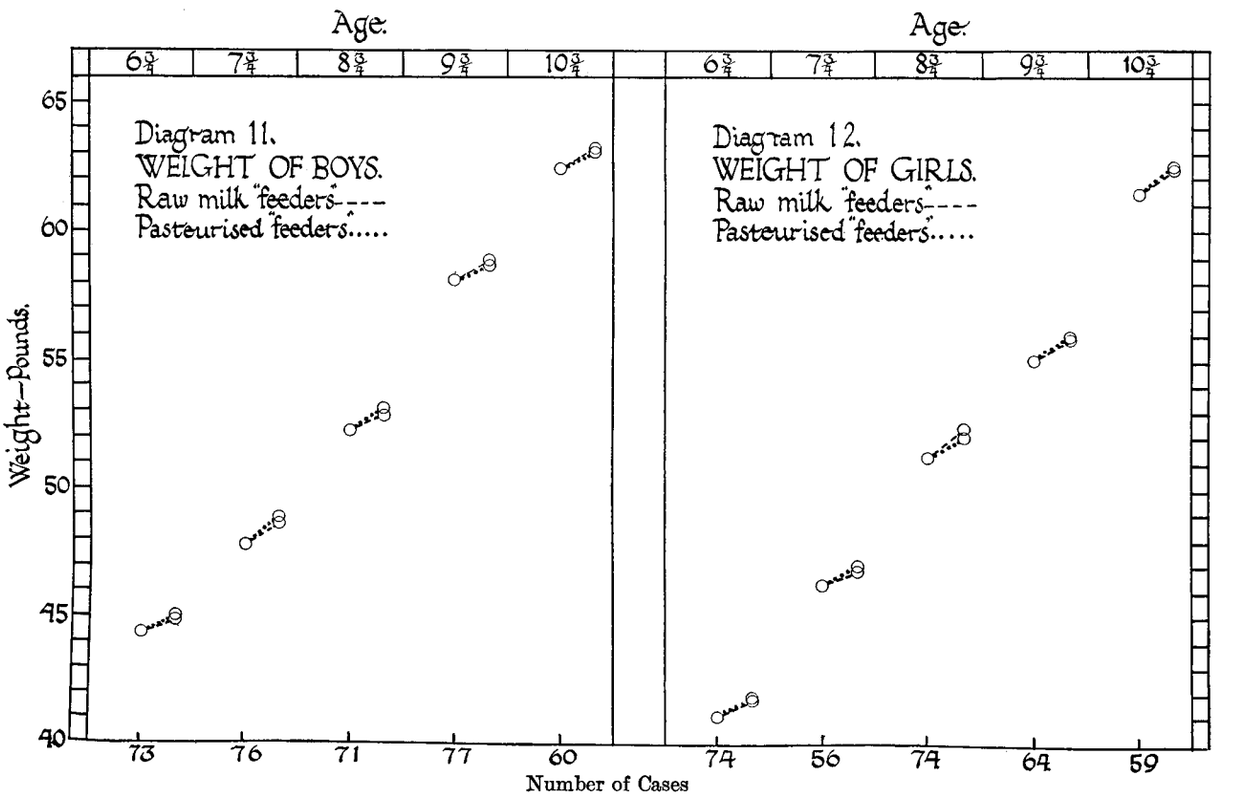

Age.
6¾ 7¾ 8¾ 9¾ 10¾
Diagram 11.
WEIGHT OF BOYS.
Raw milk "feeders"---
Pasteurised "feeders".....
Weight—Pounds.
65
60
55
50
45
40
73 76 71 77 60
Diagram 12.
WEIGHT OF GIRLS.
Raw milk "feeders"----
Pasteurised "feeders".....
74 56 74 64 59
Number of Cases

Table V. *Change in Height (in eighths of an inch). Males.*

Change in Height in eighths of an inch	Controls and Raw Milk Feeders												Controls and Pasteurised Milk Feeders												Raw Milk Feeders and Pasteurised Milk F											
	Controls						Raw Milk Feeders						Controls						Pasteurised Milk Feeders						Raw Milk Feeders						Pasteurised Mi					
	Central Ages[1]						Central Ages[1]						Central Ages[1]						Central Ages[1]						Central Ages[1]						Central A					
	6¾	7¾	8¾	9¾	10¾	Totals	6¾	7¾	8¾	9¾	10¾	Totals	6¾	7¾	8¾	9¾	10¾	Totals	6¾	7¾	8¾	9¾	10¾	Totals	6¾	7¾	8¾	9¾	10¾	Totals	6¾	7¾	8¾	9¾		
0	4	2	1	1	3	11	2	.	2	.	.	4	1	2	1	.	2	6	1	.	4	.	.	5	1	.	1	3	2	7	.	.	.	1		
1	4	4	10	6	4	28	1	2	3	.	.	6	5	3	8	7	2	25	1	.	.	1	2	4	.	2	3	3	.	8	1	1	.	1		
2	6	7	8	10	12	43	5	4	10	7	5	31	4	3	6	8	5	26	1	5	5	4	5	20	4	7	11	3	4	29	2	5	5	5		
3	10	17	15	8	13	63	10	10	9	9	8	46	14	6	14	12	6	52	7	7	11	10	5	40	6	2	5	4	4	21	3	1	8	3		
4	12	13	17	19	19	80	14	11	11	16	9	61	19	9	24	23	16	91	17	14	14	22	15	82	4	4	4	10	10	32	3	6	11	10		
5	20	20	21	13	18	92	9	22	21	8	19	79	24	28	22	25	19	118	19	21	25	26	17	108	8	12	7	6	12	45	7	11	12	10		
6	23	22	20	24	10	99	27	25	18	20	9	99	24	17	26	16	8	91	26	21	32	19	9	107	12	9	11	11	17	60	15	10	13	16		
7	18	17	15	8	9	67	26	18	24	13	18	99	26	17	15	18	6	82	23	26	22	16	12	99	11	14	13	10	2	50	11	15	7	11		
8	27	17	13	9	7	73	22	11	14	16	17	80	20	15	15	11	3	64	38	17	13	11	4	83	11	7	9	11	1	39	17	17	9	7		
9	13	5	10	5	3	36	12	11	13	9	8	53	14	7	3	2	7	33	12	5	11	11	1	40	13	9	3	7	2	34	7	4	4	3		
10	1	9	4	4	4	22	8	13	4	3	4	32	6	7	3	2	1	19	12	4	6	7	3	32	.	2	2	5	1	10	1	5	1	5		
11	5	3	1	1	1	11	.	6	1	7	4	18	4	4	7	.	2	17	3	2	3	3	3	14	1	4	.	2	5	12	1	.	.	5		
12	1	2	1	3	.	7	1	2	7	4	2	16	2	4	.	3	.	9	1	.	2	.	.	3	.	1	1	1	.	3	4	1	1	.		
13	.	.	3	1	1	5	2	1	.	1	1	5	2	.	3	1	1	7	.	.	.	.	.	.	.	2	.	.	.	2	.	.	.	.		
14	.	.	1	3	1	5	2	2	1	2	.	7	.	.	1	1	.	2	2	1	.	.	1	4	1	.	1	.	.	2	.	.	.	.		
15	.	.	1	.	.	1	1	.	1	1	.	3	.	1	.	1	.	2	.	.	.	.	.	.	1	.	.	.	.	1	.	.	.	.		
16	.	.	.	.	.	.	2	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1	.	2	.	.	.	.		
17	.	.	.	.	.	.	.	.	1	.	1	2	.	.	.	.	.	.	2	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.		
18	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.		
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21	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
22	.	.	.	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Totals	144	138	141	116	105	644	144	138	141	116	105	644	165	123	148	130	78	644	165	123	148	130	78	644	73	76	71	77	60	357	73	76	71	77		

[1] Approximately.

Table VI. *Change in Height (in eighths of an inch). Females.*

Change in Height in eighths of an inch	Controls and Raw Milk Feeders												Controls and Pasteurised Milk Feeders												Raw Milk Feeders and Pasteurised Milk F											
	Controls						Raw Milk Feeders						Controls						Pasteurised Milk Feeders						Raw Milk Feeders						Pasteurised Mi					
	Central Ages						Central Ages						Central Ages						Central Ages						Central Ages						Central A					
	6¾	7¾	8¾	9¾	10¾	Totals	6¾	7¾	8¾	9¾	10¾	Totals	6¾	7¾	8¾	9¾	10¾	Totals	6¾	7¾	8¾	9¾	10¾	Totals	6¾	7¾	8¾	9¾	10¾	Totals	6¾	7¾	8¾	9¾		
0	2	.	2	3	1	8	1	3	2	3	1	10	.	3	3	5	1	12	2	.	1	2	1	6	2	.	.	.	.	2	1	.	2	2		
1	5	4	9	3	6	27	1	4	8	5	5	23	1	4	9	8	2	24	1	1	3	3	2	10	2	2	.	1	1	6	2	.	1	3		
2	7	4	7	16	8	42	2	3	4	5	8	22	3	9	14	15	9	50	6	7	5	3	4	25	1	1	4	5	.	11	2	2	3	1		
3	10	6	22	8	11	57	8	6	5	17	12	48	16	11	13	17	9	66	6	15	9	11	6	47	1	4	3	4	1	13	5	4	4	4		
4	11	23	17	17	14	82	10	17	22	15	9	73	13	13	29	14	16	85	22	7	19	16	19	83	2	2	11	11	16	42	6	5	5	10		
5	23	18	16	27	19	103	15	14	12	9	13	63	17	18	24	20	19	98	11	13	35	24	19	102	10	3	14	6	7	40	8	10	14	8		
6	30	24	26	22	18	120	20	22	24	18	10	94	35	28	29	30	15	137	23	22	24	23	11	103	16	9	13	14	2	54	13	10	17	10		
7	24	18	7	16	7	72	29	18	13	23	11	94	21	14	23	12	12	82	19	18	21	16	6	80	14	4	6	7	9	40	14	9	5	6		
8	12	16	11	9	10	58	28	17	15	13	25	98	12	11	10	9	8	50	27	15	22	28	9	101	11	10	10	7	9	47	13	3	8	10		
9	13	7	7	5	10	42	11	17	14	9	6	57	7	8	6	9	6	36	8	18	13	8	8	55	5	10	4	2	5	26	2	9	6	3		
10	5	2	3	2	2	14	8	6	7	8	6	35	4	1	5	1	1	12	7	2	6	3	6	24	3	3	4	3	2	15	6	1	5	5		
11	1	2	2	2	7	14	2	.	4	3	2	11	2	1	1	2	1	7	4	2	6	3	3	18	.	4	.	1	3	8	2	2	3	.		
12	.	1	1	1	.	3	2	.	2	2	2	8	2	.	.	1	.	3	2	2	4	5	1	14	1	1	3	.	1	6	.	.	1	2		
13	1	1	1	.	2	5	.	.	.	2	1	3	2	2	.	3	1	8	.	.	.	.	.	.	1	.	2	1	.	4	.	.	.	.		
14	.	1	1	.	.	2	.	.	.	1	.	1	.	.	.	.	.	.	.	1	.	2	2	5	1	.	.	1	2	4	.	.	.	.		
15	.	1	.	1	.	2	2	.	.	.	1	3	2	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	1	1	.	1	.	.		
16	.	.	.	.	.	.	1	.	.	.	1	2	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.		
17	.	.	.	.	.	.	.	.	.	.	2	2	.	.	2	.	.	2	.	.	.	.	2	2	3	1	.	.	.	4	.	.	.	.		
18	.	.	1	1	.	2	3	.	1	.	.	4	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	1	.	.	.	.		
19	.	.	.	.	.	.	1	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1	.	.	.	.		
20	.	.	.	.	.	.	.	1	.	.	.	1	.	.	.	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
21	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	2	.	.	.	.		
22	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
23	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
24	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
25	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Totals	144	128	133	133	115	653	144	128	133	133	115	653	138	123	168	147	100	676	138	123	168	147	100	676	74	56	74	64	59	327	74	56	74	64		

Table VII. *Change in Weight (in ounces). Males.*

Change in Weight in ounces	Controls and Raw Milk Feeders											Controls and Pasteurised Milk Feeders											Raw Milk Feeders and Pasteurised Milk
	Controls						Raw Milk Feeders						Controls						Pasteurised Milk Feeders						Raw Milk Feeders						Pasteurised M
	Central Ages						Central Ages						Central Ages						Central Ages						Central Ages						Central
	6¾	7¾	8¾	9¾	10¾	Totals	6¾	7¾	8¾	9¾	10¾	Totals	6¾	7¾	8¾	9¾	10¾	Totals	6¾	7¾	8¾	9¾	10¾	Totals	6¾	7¾	8¾	9¾	10¾	Totals	6¾	7¾	8¾	9¾
−59 to −67	.	.	.	1	.	1	.	.	.	.	.	.	.	.	1	.	.	1	.	.	1	.	.	1	.	.	.	.	.	.	.	.	.	.
−50 to −58	.	.	.	.	1	1	.	.	1	.	2	3	.	1	.	.	.	1	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.	.
−41 to −49	1	.	.	.	.	1	.	1	.	.	.	1	1	1	.	1	1	4	.	.	.	.	.	.	.	.	2	.	.	2	.	.	.	.
−32 to −40	1	1	4	2	3	11	1	3	2	4	3	13	.	.	6	2	1	9	1	1	3	4	1	10	1	.	1	.	.	2	.	1	.	1
−23 to −31	4	3	4	1	4	16	.	2	2	1	5	10	2	3	2	3	1	11	.	2	2	2	3	9	2	3	.	2	.	7	2	2	2	6
−14 to −22	4	5	16	8	12	45	6	5	11	4	6	32	4	5	4	14	4	31	5	5	2	7	13	32	6	5	7	6	1	25	5	7	1	2
− 5 to −13	13	14	8	15	4	54	22	14	7	13	14	70	11	9	19	9	10	58	11	10	11	12	6	50	9	8	3	8	7	35	7	7	5	7
− 4 to + 4	23	24	18	17	14	96	20	14	27	17	5	83	29	23	29	23	11	115	27	11	19	24	8	89	17	6	17	12	12	64	7	8	16	11
5 to 13	32	29	31	20	21	133	30	25	26	13	9	103	40	18	22	17	12	109	30	28	35	20	6	119	10	17	13	8	10	58	16	11	14	16
14 to 22	25	31	26	24	23	129	26	33	24	22	25	130	29	25	32	23	11	120	42	28	28	28	19	145	11	15	14	23	14	77	17	11	17	17
23 to 31	19	14	18	14	9	74	24	16	20	19	6	85	19	20	10	16	6	71	24	15	18	14	13	84	7	9	6	5	4	31	13	10	8	7
32 to 40	12	9	6	6	4	37	10	17	10	14	11	62	13	12	14	10	17	66	12	9	13	10	4	48	7	6	4	6	5	28	3	10	6	7
41 to 49	6	3	5	7	6	27	3	5	2	5	12	27	6	3	5	8	3	25	10	8	8	4	2	32	2	5	.	5	1	13	2	6	1	3
50 to 58	2	3	1	1	1	8	1	3	4	3	2	13	6	2	2	4	.	14	1	1	5	4	1	12	.	2	1	.	3	6	.	.	.	.
59 to 67	2	1	1	.	2	6	.	.	3	.	.	3	4	1	.	.	1	6	2	2	2	1	.	7	1	.	2	1	1	5	1	1	.	.
68 to 76	.	.	1	.	.	1	.	.	2	1	2	5	1	.	.	.	.	1	.	3	.	.	.	3	.	.	1	1	1	3	.	.	1	.
77 to 85	.	.	2	.	.	2	.	.	.	.	3	3	.	.	2	.	.	2	.	.	1	.	2	3	.	.	.	.	.	.	.	.	.	.
86 to 94	.	1	.	.	.	1	1	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.
95 to 103	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
104 to 112	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
113 to 121	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.
Totals	144	138	141	116	105	644	144	138	141	116	105	644	165	123	148	130	78	644	165	123	148	130	78	644	73	76	71	77	60	357	73	76	71	77

Table VIII. *Change in Weight (in ounces). Females.*

Change in Weight in ounces	Controls and Raw Milk Feeders											Controls and Pasteurised Milk Feeders											Raw Milk Feeders and Pasteurised Milk
	Controls						Raw Milk Feeders						Controls						Pasteurised Milk Feeders						Raw Milk Feeders						Pasteurised M
	Central Ages						Central Ages						Central Ages						Central Ages						Central Ages						Central
	6¾	7¾	8¾	9¾	10¾	Totals	6¾	7¾	8¾	9¾	10¾	Totals	6¾	7¾	8¾	9¾	10¾	Totals	6¾	7¾	8¾	9¾	10¾	Totals	6¾	7¾	8¾	9¾	10¾	Totals	6¾	7¾	8¾	9¾
−59 to −67	.	.	1	.	.	1	.	.	.	.	.	.	.	.	.	1	.	1	.	.	1	.	.	1	.	.	.	.	.	.	.	.	1	.
−50 to −58	.	.	.	1	.	1	.	.	1	.	1	2	1	.	.	.	1	2	.	.	.	.	.	.	.	.	.	1	.	1	.	.	.	.
−41 to −49	.	.	2	.	2	4	.	.	.	.	.	.	.	.	1	.	2	3	.	.	.	2	2	4	.	.	.	1	1	2	.	.	.	.
−32 to −40	2	2	1	9	1	15	1	2	2	1	1	7	.	1	1	6	.	8	1	.	.	2	2	5	.	1	.	.	1	2	.	.	.	.
−23 to −31	4	1	8	6	6	25	6	5	5	3	3	22	.	.	10	6	5	21	2	1	3	5	4	15	3	1	.	4	3	11	3	.	.	4
−14 to −22	6	6	12	14	14	52	6	6	3	13	2	30	6	8	7	14	5	40	6	4	16	13	4	43	5	5	5	7	5	27	2	2	5	4
− 5 to −13	14	17	26	10	12	79	11	18	16	9	11	65	17	16	22	8	12	75	9	12	12	14	11	58	9	8	5	2	7	31	11	4	8	9
− 4 to + 4	26	23	20	26	15	110	24	22	21	22	14	103	20	27	37	35	10	129	29	21	28	14	15	107	10	7	8	9	8	42	11	11	13	13
5 to 13	26	31	22	16	27	122	32	20	20	27	20	119	36	20	26	26	18	126	12	27	28	23	16	106	19	13	9	11	8	60	15	13	16	8
14 to 22	27	22	17	20	12	98	25	24	25	23	13	110	25	22	28	26	14	115	48	32	35	17	9	141	9	6	17	7	5	44	19	12	9	6
23 to 31	27	9	10	16	8	70	26	10	14	14	18	82	21	16	20	13	12	82	21	14	19	14	12	80	11	6	5	10	7	39	10	6	6	3
32 to 40	8	12	6	3	9	38	8	7	15	14	14	58	9	8	8	3	7	35	6	6	14	15	9	50	6	7	16	8	5	42	1	6	6	9
41 to 49	3	4	4	6	1	18	5	10	5	1	5	26	2	4	2	6	5	19	3	3	7	13	8	34	2	2	3	1	3	11	.	.	5	3
50 to 58	.	1	2	1	4	8	.	2	5	3	3	13	.	1	4	2	5	12	.	.	3	7	4	14	.	.	5	2	.	7	1	1	1	4
59 to 67	.	.	.	4	2	6	.	1	1	.	3	5	1	.	1	1	1	4	1	.	.	3	3	7	.	.	1	.	2	3	.	1	.	.
68 to 76	1	.	.	1	1	3	.	.	.	1	3	4	.	.	1	.	2	3	.	.	1	3	1	5	.	.	.	.	2	2	1	.	2	.
77 to 85	.	.	2	.	1	3	.	.	.	1	2	3	.	.	.	.	.	.	.	.	.	1	.	1	.	.	.	1	.	1	.	.	2	.
86 to 94	.	.	.	.	.	.	.	1	.	1	2	4	.	.	.	.	.	.	.	2	1	1	.	4	.	.	.	.	2	2	.	.	.	1
95 to 103	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	1	.	.	.	1	.	.	.	.	.	.	.	.	.	.
104 to 112	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
113 to 121	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Totals	144	128	133	133	115	653	144	128	133	133	115	653	138	123	168	147	100	676	138	123	168	147	100	676	74	56	74	64	59	327	74	56	74	64

An attempt was made to discover whether the smaller children gained more over the controls from the extra milk than the other children but within the range of heights and weights available the η's were insignificant; if the pairing were done at the beginning of the experiment in the schools the question could have been answered, and it is one of importance as the undergrown child might profit more by extra milk than the child of normal size.

Six diagrams have been constructed from the data in Table III (for which I am indebted to Miss N. T. Pridham) which attempt to indicate the growth of the children in the different groups. The initial height and weight is shown for each age group, the centres being at $6\frac{3}{4}$, $7\frac{3}{4}$, etc. approximately, and the height and weight of the children four months later has been plotted; one cannot assume that the children at the earlier ages who have milk will have the initial height and weight of the selected children of the next age group and consequently no continuous growth curve can be drawn. Nor can we assume that if the children receiving milk for four months had received it from six to eleven years of age their gain over the controls would be the sum of the gains of children at different ages, for it is not only possible, but not improbable that the effect of the additional milk would slacken as the child attained a size, which for want of a better expression, we may term natural to its constitution.

Conclusions.

From this selected material in which the children have the same initial height and weight within fixed limits but in which all undergrown and overgrown children are omitted we conclude:

(1) That those who have extra milk generally gain in height over those who do not and that the older girls gain more than the younger when pasteurised milk is taken, but that otherwise younger and older gain equally in height by having extra milk.

(2) That those who have extra milk generally gain in weight over those who do not; that girls gain more than boys, and the older girls than the younger, and that this difference associated with age is greater when raw milk is taken than when pasteurised is added to the diet. In the poorer classes milk is largely reserved for the younger children, and accordingly there might be less difference between extra-milk feeders and control when the children are young than when they are older. Further the elder girls are nearer pubescence, a period during which girls put on weight from any available source and too often lack a diet with enough fats.

(3) There is no evidence that raw milk has an advantage over pasteurised or pasteurised over raw in increasing growth when the two are directly compared on this selected material. Thus the question of the value of pasteurisation turns practically on the elimination of possible sources of disease, or on determining whether cases of certain diseases are less frequent when pasteurised rather than raw milk is taken*.

(4) I heartily endorse the suggestion made by "Student" in his paper in *Biometrika*, Vol. XXIII, to which reference has been made before, that "controls" and "feeders" should be chosen in pairs of the same age and sex and as similar in height and weight and physical condition as possible, and that the one to be given milk be decided by tossing a coin; it is the method I have tried in this paper, but the weakness in my work is that the undergrown and overgrown children have been omitted, and that no knowledge of the general physical condition of the children was available.

* A certain number of children in both series of milk receivers fell out for causes not stated. A knowledge of these causes might be of the greatest importance in judging between the relative value of raw and pasteurised milk feeding.

APPENDIX TO DR ELDERTON'S PAPER ON "THE LANARKSHIRE MILK EXPERIMENT"

By KARL PEARSON.

It may not be without interest to indicate by a single probability value the result of each of the twelve sets of experiences illustrated graphically in Dr Elderton's diagrams. The method I shall apply will be that of the (P, λ_n) test. If $x_1, x_2, \ldots, x_s, \ldots, x_n$ be n quantities which follow a supposed law $\phi(x)$ of distribution, then let the probability integrals of these n quantities, i.e. $p_s = \int_{x_s}^{a} \phi(x)\,dx$, be computed, where a is the end of the range of x. Let $\lambda_n =$ the continuous product of $p_1, p_2, \ldots, p_s, \ldots, p_n$, be ascertained. Then the probability of a sample differing more from randomness than $x_1, x_2, x_s, \ldots, x_n$ does, is given by $P_{\lambda_n} = 1 - I\,(n-1, -\log_{10}\lambda_n/(\sqrt{n}\log_{10}e))$, where I is the incomplete Γ-function ratio usually represented by $I, (p, u)$ which can be found at once from the *Tables of the Incomplete* Γ*-Function**.

In Dr Elderton's case we have the difference of two means which we may suppose to be due to two random samples from the same population. If we divide such a difference by the standard deviation of the difference as computed from the samples, we have a quantity which should be a random sample from the "z" distribution of "Student." The published tables of "z" do not go far enough to provide the requisite probability integrals. This is not, however, serious, as for the size of samples in Dr Elderton's cases, no error of importance for our present purposes will arise, if we use the normal curve to represent the "z" curve.

We may take one illustration of the method, namely Boys' Height in the case of pasteurised milk feeders and control.

Centre of Age Group	Number	$m_p - m_c$	S.D.	z	Probability Integral p	$\log_{10}p$
$6\frac{3}{4}$	165	·094	·035	2·69	·003,5726	$\bar{3}$·552,9844
$7\frac{3}{4}$	123	− ·027	·038	−·71	·761,1479	$\bar{1}$·881,4690
$8\frac{3}{4}$	148	·046	·037	1·24	·107,4877	$\bar{1}$·031,3602
$9\frac{3}{4}$	130	·068	·037	1·84	·032,8841	$\bar{2}$·516,9859
$10\frac{3}{4}$	78	·057	·054	1·06	·144,5723	$\bar{1}$·160,0845
					Sum=	$\bar{6}$·142,8840

$\sqrt{n}\log_{10}e = \sqrt{5} \times 434{,}2945 = ·971{,}1120, \qquad -\log_{10}\lambda n = 5·857{,}1160$

Accordingly $u = -\dfrac{\log_{10}\lambda_n}{\sqrt{n}\log_{10}e} = 6·03145$, and $P_{\lambda_n} = 1 - I\,(n-1, u) = 1 - I\,(4, 6·03145)$. Interpolating linearly from the *Incomplete* Γ*-Function Tables*, we have $P_{\lambda_n} = 1 - ·9974 = ·0026$. This signifies that, if the control and pasteurised milk feeders were random samples from "z" populations, only 26 times in 10,000 trials would on the average a pair of samples occur differing so much from one another as these two do. We therefore conclude that as far as the stature of boys is concerned the effect of the additional pasteurised milk does differentiate the feeders from the control boys.

Proceeding in this manner I computed from Dr Elderton's data the value of $\log_{10}\lambda_n$ for her

* H.M. Stationery Office, 1922.

twelve cases and thence determined the probability P_{λ_n} that the observed differences could arise from random sampling, and accordingly were independent of the extra milk-feeding, or of its nature. I reached the following system of values:

Table of P_{λ_n}. *Measuring the Probability of Randomness.*

Difference of Means	Boys		Girls	
	Stature	Weight	Stature	Weight
Raw Milk—Control	< ·000,00005	·0588	·000,00055	·00011
Pasteurised Milk—Control	·0026	·1130	< ·000,00005	·00022
Raw—Pasteurised Milk	·7381	·6461	·0088	·6032

Now let us consider these values individually.

(i) *Stature.* In the case of both boys and girls we must discard the hypothesis of randomness. Raw milk undoubtedly accelerated the growth of stature.

In the case of girls certainly, and in the case of boys it is highly probable, although less so than for girls, that pasteurised milk accelerated the growth of stature.

(ii) *Weight.* In the case of boys it cannot be predicated definitely that either raw or pasteurised milk accelerated the growth in weight. In the case of girls it can be asserted that the use of both raw and pasteurised milk accelerated the growth in weight. The probabilities of randomness are of a totally different order from those for the boys.

Can we find any explanation of this sex-difference in the case of weight between boys and girls, while for stature the growth acceleration of both is marked? Is it possible that the milk giving greater growth to the boys, also gives them greater energy, and exercising it, the milk administration does not lead to greater weight than in the control series? In the case of the girls the administration of the milk may lead to a storage of this additional nutrition, and it may not be spent in greater activity in games, etc. This view might be supported by the fact that it is the elder girls, not the younger, which show the superiority of the milk-feeders' growth in weight. This divergence between boys and girls might possibly be taken as an instance of that katabolism of the male and anabolism of the female on which some writers, perhaps too emphatically, have insisted.

(iii) *Difference of the two Types of Milk.* In the case of the boys both for stature and weight there appears to be no evidence whatever that one type of milk more than the other accelerates the growth. This is also true of weight in the girls. But we have the remarkable result that in girls the two types of milk are not indifferent with regard to the acceleration of growth in stature, randomness here is highly improbable, and raw milk seems more advantageous than pasteurised; but why should raw milk have a constituent which accelerates stature growth in girls but not in boys, while the factors for the production of weight acceleration appear to be the same for both types of milk? If this result be true—and it is difficult on the data to disregard it—it would appear that there is some sexual difference in the constituents required for bone growth in the young male and female; or possibly there is a constituent of some form in raw milk, which form preserves it from immediate conversion into fat, so that it may serve better for bone creation. This point deserves fuller physiological investigation.

Of course there is nothing in these results which touches on the question of whether pasteurisation is of value as a preventive of possible disease. But they do seem to indicate that while milk in either form accelerates the growth of both boys and girls in stature, and of girls in weight, yet raw milk has a greater influence than pasteurised in accelerating the growth of stature in girls.