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Studies on Merino Wool Production. Plainbodied and Developed Merino Sheep. I.—The Standard of Production of a Group of Plainbodied Stud Ewes.

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THE relative standards of wool production of plainbodied and developed * stud sheep have been and still are a controversial topic among sheep breeders. Some contend that a certain amount of development is necessary for the desired compactness of the fleece and quantity of wool, others believe that the plainbodied animal can possess the same compactness and quantity of fleece as the developed type. In general, most sheepmen are agreed upon the fact that skinfolds are undesirable from practical standpoints and if it were possible to eliminate skinfolds, without impairing the quantity, compactness and quality of the fleece, skinfolds should disappear.

Since there are still differences of opinion among practical men on the utility or otherwise of skinfolds and wrinkles, research work into the standards of production of different merino types and relevant aspects has been undertaken. The results here outlined describe the laboratory fleece analysis and standard of wool production of a group of extremely plainbodied stud ewes.

Other aspects of this topic will be described in later publications of this series.

REVIEW OF LITERATURE.

In treatises on " Practical Sheep and Wool ", different authors have expressed their views. McKee (1913) holds that wrinkly sheep are necessary in our highest studs to maintain the density and the quantity of wool in flocks.

Mallinson (1915) contends that " large wrinkles or folds on the body do not necessarily indicate density ".

Coffee (1918), in describing the A, B and C types of the American Merino, associates the A type, or the extremely developed type, with a dense, short greasy fleece and the C type, or the plainbodied sheep, with a longer staple and less unwashed fleece than the A type.

McNab (1918) expresses the view that, in general, sheep without skinfolds have a coarse, long, loose wool, lacking in density, whereas developed sheep are associated with a shorter, finer and denser type.

Senator Guthrie (1927) in an address on the Australian Sheep and Wool Industry, said that during the past twenty to thirty years, the average quantity of wool produced per head had doubled itself, concurrently with an improvement

* Among sheepbreeders, the term " developed " means the presence of skinfolds.

in the breeding and character of the wool, this being largely attributed to the condemnation of the wrinkly or Vermont type of sheep and the adoption of a plainbodied type of merino.

Cox (1936) in his book on the " Evolution of the Australian Merino " also records information on the different types of Australian merino sheep, in association with their fleece characteristics.

In an article on " Forty Years of Sheep Breeding—The Development of the Merino Ram in Australia as exemplified in the Sydney Show " (1935), a review is given of the changes that have taken place among the Grand Champion Rams at the Sydney Sheep Shows from 1895 to 1934. During this period there has been a transition from an extremely developed animal to a plainbodied type. Interesting comments are also recorded regarding differences of opinion among Australian stud breeders.

Jones, *et alia* (1936), in comparing the fleeces of Rambouillet ewes, an experiment carried out on 2,280 ewes over a period of 13 years, confirm their previous conclusion that the C type or plainbodied ewes, carrying dense fleeces of combing length, will produce approximately the same amount of wool, clean basis, as is produced by the B type (or moderately developed ewe). Both groups produced 3·6 lb. of clean scoured wool, the C type giving an average of 2·4 inches in staple length, whilst the B type gave 2.1 inches in staple length.

In discussing the results of fleece analyses carried out on two groups of merino rams, Bosman (1937) concludes that plainbodied sheep can have the same standard of excellence in their fleece characteristics of fleece weights (clean basis), number of fibres per square inch of skin, fibre fineness, length and fleece density, expressed as per cent. skin area, as the developed type.

In the report on their visit to Australia, the South African Wool Council Delegation (1937) discuss " Development " in Australian studs and state that " studfasters with whom this point was discussed were of the opinion that a fair amount of body development must be maintained in the top stud, particularly in the sires, if the density and bulk are to be maintained in the stud ".

Belschner and Carter (1936), in their " Studies on the Fleece Characteristics of Stud Merino Sheep in Relation to Skin Wrinkles ", conclude that there is little or no difference in the production of wool by the A and C types of merino sheep, both giving something over 7 lb. of wool (on the clean basis).

Roberts (1938) in his articles on " Merino Development a Symbol of Success " and on " Combining Contrary Virtues in the Merino Sheep " elaborates on the association of fleece density and devolpment and contends that " in an accurate competition, with all things equal, plainbodied sheep cannot possibly carry the weight of wool developed sheep do " and " sheep are plainer because they are of lower grade ".

De la Harpe (1938) in commenting on the views expressed by Roberts, disagrees with an exclusion of " the bulk-plus-plainbodied type " and quotes instances where " development is not indissolubly bound fast with the desirable features constituting bulk ".

Scott (1940) in an article on " The Type that Pays—A Plea for Plainer Bodies, Longer Staple, Higher Yield " contends that the plainbodied sheep can produce as much wool as the developed sheep and is more profitable.

" Maranoa " (1940), in discussing the relative merits of plainbodied and developed sheep in Australia contends that " a dense plainbodied sheep is just as dense as a wrinkled one and his fleece is more even " also " that until scouring tests are rejuvenated it will be hard to tell who owns the best sheep ".

Several authors have recorded the objections to skinfolds in so far as the blowfly menace is concerned and there is a consensus of opinion regarding the desirability of the plainbodied type for reducing blowfly attacks. Among these are Smit (1931); The Australian Joint Blowfly Committee (1933); Belschner (1937); Mönnig (1939); Departmental Experiments, now in progress, and others. The objection to skinfolds for blowfly attacks has also been stressed by the fact that skinfolds are often removed by merino breeders in Australia and South Africa by Mules' operation (1932).

There appears to be differences of opinion among sheep and woolmen regarding a definition of a plainbodied sheep and, in general, most are inclined to tolerate some degree of skinfolding among plainbodied animals whether on the body or as neck folds. In defining a plainbodied sheep, Schuurman and Maré (1933) are of the opinion that " a plainbodied sheep should not show any visible folds between the elbow and stifle joints when in full twelve months wool. A small rose tail and neckfolds are permissible but not essential. Emphasis is placed on the full twelve months' growth of wool ".

In discussing body development in relation to the merino score card, Rose (1935) contends that " absolute freedom from body development of any kind, coupled with a dense bulky fleece is the ideal and should be the aim of every breeder, though it is still contended that a certain amount of development is essential to density and bulk of wool ".

In addition to this bibliography, many other references in the form of short articles and letters to Agricultural Journals are available on the topic. A great deal of information has also been accumulated from personal discussions with practical sheepmen.

In summary, different merino breeders are at variance regarding the relative merits and standards of wool production of the plainbodied merino and the one with skinfolds, and, since this publication is largely concerned with the standard of wool production of an extremely plainbodied stud, some of the published wool production figures are here summarised.

Davenport and Ritzman (1926) in an analysis of different breeds of sheep, and their crosses, give the average clean fleece weight of a group of Rambouillet ewes as 4·6 lb.

Wilson (1927) records the results of scouring tests on 1460 Rambouillet fleeces and concludes that length influences the scoured fleece weights directly and he demonstrates their relationships graphically. The average values range from a staple length of 1·3 inches giving 3.2 lb. of clean wool to 3·3 inches giving 4·82 lb. of clean wool.

In an account of the costs of wool production in New Zealand, Weston (1930) gives the average production of 12,000 merino sheep as 8 lb. in the grease.

Pickrell and Stanley (1930) record the average wool production of Arizona as 8·6 lb. in the grease and Benton (1931) that of North Dakota over 12 years as 8.0 lb.

In discussing the different types of American merino sheep, the American and Delaine Merino Record Association assert that " Wrinkles then came not because breeders worked for them, but as a result of working for greater density

and weight of fleece ". In the A type, or extremely developed type, the fleece weights (greasy) of ewes range from 16-20 lb. but the yield is low. The C type or plainbodied type shear up to 12 lb. of light long stapled wool.

Hultz and Paschal (1930) in an analysis of Rambouillet stud sheep at the International Livestock Exposition, for three consecutive years, give the average standard of production of what might be classed as the best of the breed, and summarise their findings on shoulder samples as 27,936 fibres per square inch of skin, 2·11 inch staple length, etc.

Burns (1933) records the number of fibres per square inch of skin of 15 Rambouillet sheep as 24·592, of 14 Hampshire sheep as 9,016 and of 7 Rambouillet ewes as 29,060.

Burns (1935) in an account of sheep breeding in Germany, describes the German merino as an extremely plainbodied animal giving a fleece of from 10 to 12 lb. for ewes and 12 to 16 lb. for rams

Cox (1936) in summarising the evolution and development of Australian merino studs, asserts that " to-day almost any of our great studs will expect their ewes to average over 15 lb.—in very many the stud will average 20 lb." also: " with wool of 64's to 70's the type, 3½ to 4 inches is easily obtained in the best Australian studs ".

The fleece analysis of a group of stud ewes is recorded by Bosman (1937). The average scoured fleece production is given as 7·2 lb. at 17% regain or 6·1 lb. dry, the average number of fibres per square inch of skin being 46,500 with a mean fleece density of 2·28 per cent. In the same publication the author summarises fleece density figures obtained from different publications and analyses, and these range from 9,000 to 56,460 fibres per square inch of skin.

Burns and Johnston (1940) give analytical results obtained on 72 sheep in the wool producing areas of Wyoming. The maximum number of fibres per square inch of skin of the sheep is given as 49,816. Sheep producing fleeces classed as " Fine French Combing " produced from 8·5 to 14·7 lb. greasy fleece with a clean wool production of from 2·86 to 4·07 lb. respectively and an average of 3·48 lb.

The average South African wool production according to the Director of Census and Statistics (1939) is approximately 6½ lb. in the grease, this applying to the clip as a whole.

There are not many published figures available on stud production in South Africa but a few of these appear as advertisements for studs. Among these, one prominent stud breeder gives the average production of 2,000 stud ewes as 15½ lb. (greasy). Another gives the average of his stud ewes as 14½ lb. (greasy). Another breeder gives the average production of 4,470 stud ewes as 15¼ lb. with 52 per cent. yield, which means a production of 6·8 lb. bone dry wool or 7·9 lb. of clean wool at 16 per cent. Regain.

Material and Methods.

(a) *Sheep Used.*

Fifty stud ewes of an extremely plainbodied type, that is, devoid of any development, even of neckfolds, were used in a special test for wool production. The sheep, illustrated in Fig. 1, were obtained from a breeder who had for at least ten years consistently bred this type of sheep. The stud comprises about 4,000 to 5,000 stud ewes all of one type, no other types being tolerated.

In selecting the ewes care was taken to choose individuals which were typical of the stud as a whole, including rams.* The system of breeding followed, has been to mate extremely plainbodied stud rams to extremely plainbodied stud ewes, and the characteristics of the parents are being successfully transmitted to the progeny. An illustration of the prepotency for plainness of some of the experimental animals under observation is given in Fig. 2.

It is shown that Ram No. 1284 when mated to the ewes Nos. B4, 1789, B27, 1761, 1773, 1757, B16, 1762 and 1798 produced the lambs Nos. H39, H43, H40, H42, H45, H38, H44, H41, 906 and 908 respectively, the lambs being of the same type as their parents.

(*b*) *Management of the Sheep.*

All sheep were run on Karroo pasture and in the same flock for the two years, They received no supplementary feeding.

The animals were subjected to conditions usual to farming practice such as the rearing of lambs, crutching, etc. Over 90 per cent. of the ewes lambed, a fact which would adversely influence the wool production of the group (Bosman, 1937).

(*c*) *Shearing and Sampling.*

On the 6th of August, 1939, 35 young merino stud ewes, with ages ranging from 12-14 months, were shorn under the supervision of the author. The ewes were again shorn under the supervision of the author on the 8th August, 1940.

Each shorn fleece was labelled and packed in a linen bag, and submitted for laboratory testing. In addition, fleece density samples were taken by a modified Wyedena Density Caliper (Burns and Miller, 1931).

On the 8th August, 1940, another group of 15 young stud ewes, ranging in ages from 12-14 months, was shorn under the supervision of the author. These, together with the group of older ewes recorded in 1940, were again shorn on the 5th August, 1941. The shorn fleeces were again submitted for laboratory testing, the results being given in Table 1.

(*d*) *Identity by Nose Prints.*

It has been shown (Bosman, 1940) that the nose printing of merino sheep serves as an infallible means of identification and this has been successfully applied to the recording of merino sheep in wool production tests. Every sheep used in this experiment was recorded by nose prints at each shearing and its identity checked from shearing to shearing.

(*e*) *Photographic Records.*

A photographic record of each animal was taken immediately after the sheep had been shorn. This method shows the true plainness of the skin of the sheep, in contrast to an apparent plainness of sheep that have a twelve months' wool growth.

(*f*) *Laboratory Analyses.*

The fleeces and samples were analysed for—

(i) fleece weights, both greasy and clean washed, and for the yield, by the method described by Botha (1935);

* Stud rams used in 1941 are illustrated in Fig. 1 of the second part of this series (see "Studies on Merino Wool Production; 11 Fleece Density tests on a Group of Extremely Plainbodied Stud Rams."). (This Journal.)

(ii) the average fibre fineness and quality number of each fleece by the method described by Bosman and van Wyk (1940, 1941);

(iii) the average staple length of each fleece by the method of Bosman and Botha (1939).

(iv) the number of fibres growing per square inch of skin (shoulder region) and the fleece density, expressed as per cent. skin area occupied by the fibres, the method of sampling and determination being that described by Bosman (1937) with certain refinements described by by Botha (1941).

Experimental Results.

The photographic records of the sheep are shown in Fig. 1. The ewes are exceptionally smooth skinned and are devoid of body folds and neck fronts. They have strong constitutions and good conformations, characteristics typical of their type.

Shorn Fleeces.

The results of the fleece analyses are summarised in Table 1. Group A, consisting of 35 young stud ewes and shorn in 1940, were all four toothed sheep at the time of shearing. They had a 12 months' wool growth and produced greasy fleece weights ranging from 10·47 lb. to 17·64 lb. with an average of 13·28 lb. for the group. Their scoured fleece weights ranged from 5·67 lb. to 10·47 lb. of clean wool (bone dry) with an average production of 7·47 lb. as bone dry, or 8·7 lb. of clean wool at 16 per cent. Regain.

The fleece analysis of 50 extremely plainbodied merino stud ewes is given. Group A, consisting of 35 ewes, were recorded in 1940 and in 1941. Group B, consisting of 15 similar typed ewes, were recorded in 1941 with Group A.

The yield (given in the 4th column) is expressed as—

$$\frac{\text{the weight of clean dry wool}}{\text{Wt. of greasy wool under air conditions}} \times 100$$

and ranges from 53 per cent. to 64 per cent. with an average of 58·4 per cent. The latter figure, on the 16 per cent. Regain basis (the Bradford standard), or as—

$$\frac{\text{the weight of clean wool at 16 per cent. Regain}}{\text{wt. of greasy wool under air conditions}} \times 100$$

gives an average of 67·7 per cent.

The staple length of each fleece (5th column) taken on the shorn fleece is an average of 10 measurements of the fleece (Bosman and Botha, 1939) and varies from 3·5 to 4·5 inches * with an average of 4·0 inches.

The average fibre fineness of the fleeces ranges from 21·1μ to 25·7μ † with a mean of 22·8μ, a 60's quality number, and coefficient of variability of 4·5 per cent. which indicates a uniform group. Sixty per cent. of the fleeces are of the same quality number, namely a 60's in fibre fineness.

* An account of the degree of uniformity of length within each fleece is given in the 4th article of this series.

† An account of the degree of uniformity of fibre fineness within the fleece is given in the 3rd article of this series.

TABLE 1.

Fleece Analysis of a Group of Pla

Sheep No.	1940 Shearing.						Total (
	Total Wool Produced. (365 days.)			Average Values for Whole Fleece.			
	Grease Weight (including lox).	Scoured Weight (bone dry).	Yield of Fleece (excluding lox).	Staple Length (inch).	Fibre Fineness.	Quality Number.	Grease Weight (including lox.)
1.	2.	3.	4.	5.	6.	7.	8.
GROUP A.							
1752	15·06	8·81	62·0	4·2	21·9	60's	13·13
1753	11·43	6·61	59·0	3·7	23·4	58's	—
1757	15·13	7·88	54·2	4·3	21·1	64's	15·64
1761	14·10	8·65	63·1	4·3	22·5	60's	13·97
1762	11·70	7·07	61·9	3·8	22·4	60's	10·69
1764	11·42	7·04	62·9	4·2	22·5	60's	—
1766	13·36	7·87	62·4	3·9	22·0	60's	12·79
1773	12·86	7·49	59·4	4·3	22·3	60's	12·43
1774	11·70	6·02	53·3	3·2	22·7	60's	—
1776	13·62	8·43	64·0	4·5	24·1	58's	9·49
1777	13·18	6·73	53·2	3·8	25·7	56's	—
1779	15·58	8·50	56·5	4·2	22·1	60's	—
1781	17·64	10·47	60·8	4·0	22·5	60's	15·74
1782	14·97	7·26	54·1	4·5	21·9	60's	13·13
1784	12·89	7·43	59·5	3·9	24·1	58's	12·51
1785	14·02	7·98	58·9	4·1	23·2	58's	14·09
1786	13·26	6·81	53·0	3·5	22·2	60's	11·99
1787	17·55	9·76	59·3	4·2	22·7	60's	15·83
1789	13·76	7·29	55·5	3·7	23·5	58's	12·05
1790	14·52	7·88	56·1	4·2	22·1	60's	13·69
1796	12·66	6·91	56·2	3·6	23·0	60's	11·78
1798	12·36	6·59	55·8	3·7	22·1	60's	—
B. 4	11·91	6·87	58·7	4·0	23·5	58's	12·03
B. 6	11·64	7·00	61·4	4·1	21·4	60's	11·13
B. 7	14·75	7·60	54·0	3·7	22·1	60's	12·88
B. 12	11·02	6·14	57·8	4·1	23·1	58's	10·77
B. 13	13·99	8·55	63·8	3·8	25·5	58's	12·07
B. 15	13·75	7·61	57·3	4·5	23·1	58's	—
B. 19	11·40	6·62	59·7	4·1	23·3	58's	—
B. 20	10·47	5·67	55·4	3·8	23·8	58's	—
B. 21	12·01	6·94	58·8	3·8	21·8	60's	11·67
B. 22	11·74	6·69	58·5	4·0	21·7	60's	10·39
B. 23	12·75	6·63	54·2	3·6	22·0	60's	11·34
B. 24	14·16	8·17	60·0	4·1	22·9	60's	14·04
B. 27	12·56	7·62	62·8	4·5	24·1	58's	11·33
AVERAGES	13·28	7·47	58·4	4·0	22·8	60's	12·56
Standard Deviation	1·698	1·016	3·35	0·31	1·04	—	1·641
Coefficient of Variability (%)	12·8	13·6	5·7	7·8	4·5	—	

E 1.

up of Plainbodied Ewes.

1941 Shearing.								
Wool Produced. (365 days.)		Average Values for Whole Fleece.			Fleece Densities on Shoulder Regions.			
Scoured Weight (bone dry.)	Yield of Fleece (excluding lox.)	Staple Length (inch.)	Fibre Fineness.	Quality Number.	Number of Fibres per sq. inch of Skin.	Fibre Fineness.	Fleece Density as per Cent. Skin Area.	Year of Recording.
9.	10.	11.	12.	13.	14.	15.	16.	17.
7·41	57·9	3·7	23·0	58's	51,200	21·9	3·08	1940
—	—	—	—	—	39,900	23·1	2·68	,,
7·51	49·1	4·2	23·7	58's	40,400	22·8	2·60	,,
7·53	55·4	3·9	22·6	60's	43,000	21·4	2·44	,,
5·87	56·4	3·2	21·6	60's	54,100	21·7	3·15	,,
—	—	—	—	—	41,800	21·7	2·46	,,
7·51	60·1	3·8	23·5	58's	43,100	21·1	2·41	,,
6·56	53·7	4·1	21·5	60's	50,300	21·8	2·97	,,
—	—	—	—	—	41,300	22·6	2·62	,,
5·50	58·1	4·4	22·1	60's	37,800	22·7	2·41	,,
—	—	—	—	—	34,500	24·7	2·63	,,
—	—	—	—	—	45,400	21·1	2·52	,,
8·87	57·3	3·8	21·7	60's	49,200	20·9	2·69	,,
6·53	51·4	4·1	22·5	60's	39,300	21·6	2·31	,,
6·84	55·8	3·9	25·0	58's	33,600	24·3	2·45	,,
7·63	55·2	3·8	23·6	58's	52,900	21·9	3·21	,,
5·67	48·7	3·1	21·7	60's	49,700	21·7	2·91	,,
8·52	56·2	3·8	21·8	60's	34,700	22·3	2·19	,,
6·39	54·4	3·4	20·8	64's	44,400	20·3	2·27	,,
7·12	53·6	3·8	21·7	60's	38,300	21·2	2·15	,,
5·98	52·1	3·2	22·4	60's	38,100	22·8	2·47	,,
—	—	—	—	—	47,100	21·2	2·64	,,
6·26	53·5	3·8	21·8	60's	40,800	22·6	2·57	,,
6·12	55·8	3·8	21·1	64's	39,800	22·0	2·40	,,
6·44	51·6	3·6	21·3	64's	34,500	20·4	1·78	,,
5·81	55·1	4·0	22·8	60's	37,800	22·5	2·38	,,
7·06	60·1	3·2	25·8	56's	48,700	24·2	3·60	,,
—	—	—	—	—	47,200	21·3	2·68	,,
—	—	—	—	—	35,800	22·7	2·30	,,
—	—	—	—	—	31,700	24·6	2·40	,,
6·42	56·2	3·5	21·9	60's	39,800	21·2	2·24	,,
5·58	55·0	3·4	21·1	64's	39,100	19·8	1·93	,,
5·90	53·4	3·6	21·9	60's	39,300	20·2	2·05	,,
7·77	57·5	3·7	24·2	58's	35,600	21·1	1·99	,,
6·62	59·9	4·2	22·0	60's	36,800	22·2	2·26	,,
6·75	55·1	3·7	22·4	60's	41,600	22·0	2·51	—
0·89	3·02	0·34	1·23	—	5,930	1·20	0·378	—
13·3	5·5	9·2	5·5	—	14·3	5·5	15·1	—

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Sheep No.	1940 SHEARING.					
	Total Wool Produced. (365 days.)			Average Values for Whole Fleece.		
	Grease Weight (including lox).	Scoured Weight (bone dry).	Yield of Fleece (excluding lox).	Staple Length (inch.)	Fibre Fineness.	Quality Number.
1.	2.	3.	4.	5.	6.	7.
GROUP B.						
1946	—	—	—	—	—	—
1995	—	—	—	—	—	—
B. 2	—	—	—	—	—	—
B. 5	—	—	—	—	—	—
B. 8	—	—	—	—	—	—
B. 9	—	—	—	—	—	—
B. 10	—	—	—	—	—	—
B. 11	—	—	—	—	—	—
B. 14	—	—	—	—	—	—
B. 16	—	—	—	—	—	—
B. 17	—	—	—	—	—	—
B. 18	—	—	—	—	—	—
B. 25	—	—	—	—	—	—
B. 26	—	—	—	—	—	—
C. 100	—	—	—	—	—	—
AVERAGE	—	—	—	—	—	—
Standard Deviation	—	—	—	—	—	—
Coefficient of Variability	—	—	—	—	—	—
Averages: A. and B.	—	—	—	—	—	—
Standard Deviation	—	—	—	—	—	—
Coefficient of Variability	—	—	—	—	—	—

NOTE.—Ewes were shorn on 5.8.40 with six-months growth and the average of the group for six mo
The object of shearing on 5.8.40 was to control a twelve-months growth for the 1941 she

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TABLE 1 (*continued*).

1941 SHEARING.						Fleece Densities on Shoulder Regions.			
Total Wool Produced. (365 days.)			Average Values for Whole Fleece.						
Grease Weight (including lox.)	Scoured Weight (bone dry.)	Yield of Fleece (excluding lox.)	Staple Length (inch.)	Fibre Fineness.	Quality Number.	Number of Fibres per sq. inch of Skin.	Fibre Fineness.	Fleece Density as per Cent. Skin Area.	Year of Recording.
8.	9.	10.	11.	12.	13.	14.	15.	16.	17.
15·59	8·44	55·2	3·9	23·2	58's	45 200	21·0	2·49	1941
11·68	6·25	54·9	3·5	22·0	60's	54 900	20·4	2·85	
11·81	6·92	59·3	3·6	23·2	58's	43 300	22·4	2·71	,,
11·36	6·22	56·1	3·6	21·2	64's	51,900	20·5	2·81	,,
11·44	6·63	59·3	3·7	21·5	60's	47,300	19·8	2·35	,,
11·20	6·43	58·4	3·7	22·6	60's	30,200	21·0	1·66	,,
11·81	6·86	58·9	3·8	22·8	60's	34,600	21·6	2·02	,,
11·03	6·15	56·5	3·7	21·9	60's	56,600	20·7	3·02	,,
12·45	7·47	61·0	3·8	21·8	60's	71,600	20·9	3·93	,,
13·15	7·01	55·4	3·8	21·6	60's	55,600	19·6	2·71	,,
12·51	6·74	55·5	3·9	23·2	58's	37,000	22·3	2·32	,,
12·40	7·27	59·2	3·8	23·4	58's	35,500	20·8	1·92	,,
11·77	7·29	62·7	4·0	20·2	64's	53,800	19·1	2·42	,,
12·97	7·15	56·4	3·9	22·3	60's	45,000	20·8	2·43	,,
11·37	7·96	62·0	4·0	23·5	58's	37,900	22·7	2·43	,,
12·17	6·99	58·1	3·8	22·3	60's	46,700	20·9	2·54	,,
1·143	0·646	2·56	0·15	0·95	—	10,940	1·02	0·531	—
9·4	9·2	4·4	3·9	4·3	—	23·4	4·7	20·9	—
12·42	6·83	56·2	3·7	22·4	—	43,100	21·7	2·52	—
1·475	0·813	3·16	0·28	1·13	—	8,010	1·25	0·424	—
11·9	11·9	5·6	2·4	5·0	—	18·6	5·7	16·8	—

group for six months growth was 7·33 lb. greasy wool, 4·15 lb. of scoured wool and a yield of 58·2 per cent. for the 1941 shearing.

← 327-328a

Group A were again shorn in 1941 and were about 3 years of age. Their greasy fleece production (8th column) ranged from 9·49 lb. to 15·83 lb. with an average of 12·56 lb.

Their scoured fleece weights (column 9) ranged from 5·5 lb. to 8·7 lb. with an average of 6·75 lb. of clean wool as bone dry or 7·83 lb. of clean wool at 16 per cent. Regain.

The yield (given in the 10th column) ranged from 48·7 per cent. to 60·1 per cent. with an average of 55·1 per cent. on the dry basis. On the Bradford basis the latter figure is 64 per cent.

The average staple lengths (in column 11) ranged from 3·1 inches to 4·4 inches with an average of 3·7 inches.

The average fibre fineness of the fleeces ranges from 20·8μ to 25·8μ with an average of 22·4μ for the group and a coefficient of variability of 5·5 per cent. which again shows a uniform group.

Group B, consisting of 15 four-toothed ewes and shorn in 1941, gave greasy fleece weights ranging from 11·03 lb. to 15·59 lb. with an average of 12·17 lb.

The scoured weights of this group, shown in column 9, ranged from 6·15 lb. to 8·44 lb. with an average of 6·99 lb. on the clean bone-dry basis or 8·1 lb. on the regain basis.

The yield ranged from 54·9 per cent. to 62·7 per cent. with an average of 58·1 per cent. on the dry basis or 67·3 per cent. on the Bradford method.

The average staple lengths (given in column 11) ranged from 3·5 inches to 4·0 inches with an average of 3·8 inches.

The average fibre fineness measurements ranged from 20·2μ to 23·5μ with an average of 22·3μ and a coefficient of variability of 4·3 per cent., again showing a uniform group.

As regards the average production for 41 ewes of mixed ages recorded in 1941, this was 12·42 lb. of greasy wool and 6·83 lb. of clean bone-dry wool or 7·2 lb. of clean wool at 16 per cent. Regain. The yield was 56·2 per cent (as dry) or 65·2 per cent. on the Bradford basis. The average staple length was 3·7 inches and the quality number a 60's. The coefficient of variability of fibre fineness was 5·0 per cent. showing a uniform group.

The average wool production of all the sheep for the two years (based on 76 fleece records) was, a greasy fleece weight of 12·82 lb.; a clean scoured weight of 7·13 lb. bone-dry or 8·3 lb. at 16 per cent. Regain; a yield of 57·2 per cent. dry or 66·4 per cent. on the Bradford basis; a staple length of 3·9 inches and a 60's quality number.

Fleece Densities on Shoulder Regions.

An analysis of the fleece densities on shoulder regions is given in columns 14, 15 and 16. Group A (35 ewes) was recorded in 1940 and Group B (15 ewes) in 1941 but the ages of all the 50 sheep were approximately the same, namely, four-toothed when the tests were made.

The number of fibres growing per square inch of skin of Group A ranged from 31,700 to 54,000 with an average of 41,600.

The number of fibres per square inch of skin of Group B ranged from 30,200 to 71,600 with an average of 46,700. The average figure for the 50 sheep was 43,100.

The values for the fibre fineness, given in column 15, are necessary in the calculation of the fleece density when it is expressed as the percentage skin area occupied by wool fibre.*

The values for the fleece density for Group A (in column 16) ranged from 1·78 per cent. to 3·60 per cent. with an average of 2·51 per cent.

The values for Group B ranged from 1·66 per cent. to 3·93 per cent. with an average of 2·54 per cent. The average fleece density for the 50 sheep is 2·52 per cent.

Differences between Years and among Groups.

The statistical differences of the fleece characteristics between 1940 and 1941 and among the groups are given in Table 2.

TABLE 2.

Yield of Fleece (Excluding Lox.)

		Group A. 1940.	Group A. 1941.	Group B. 1941.	Groups A & B. 1941.
Grease weight (including lox)	Group A, 1940	—	0·72 ± ·190 (Sign. at P = 0·01)	1·11 ± ·480 (Sign. at P = 0·05)	0·86 ± ·364 (Sign. at P = 0·05)
	Group A, 1941	0·72 ± ·190 (Sign. at P = 0·01)	—	0·39 ± ·480 (Insign.)	—
	Group B, 1941	1·11 ± ·480 (Sign. at P = 0·05)	0·39 ± ·480 (Insign.)	—	—
	Groups A & B, 1941	0·86 ± ·364 (Sign. at P = 0·05)	—	—	—
Scoured weight.....	Group A, 1940	—	0·72 ± ·109 (Sign. at	0·48 ± ·285 (Insign.)	0·64 ± ·210 (Sign. at P = 0·01)
	Group A, 1941	0·72 ± ·109 (Sign. at P = 0·01)	—	0·24 ± ·264 (Insign.)	—
	Group B, 1941	0·48 ± ·285 (Insign.)	0·24 ± ·264 (Insign.)	—	—
	Groups A & B, 1941	0·64 ± ·210 (Sign. at P = 0·01)	—	—	—

* It has been shown by Bosman (1937) that the number of fibres per square inch of skin alone does not represent the true fleece density but it is the number of fibres per unit area in conjunction with the fibre fineness expressed as the per cent. skin area occupied by wool fibre.

TABLE 2 (*continued*).

		Group A. 1940.	Group A. 1941.	Group B. 1941.	Groups A & B. 1941.
Yield of Fleece (excluding lox)	Group A, 1940	—	3·3 ± ·310 (Sign. at P = 0·01)	0·3 ± ·969 (Insign.)	2·2 ± ·748 (Sign. at P = 0·01)
	Group A, 1941	3·3 ± ·310 (Sign. at P = 0·01)	—	3·0 ± ·928 (Sign. at P = 0·01)	—
	Group B, 1941	0·3 ± ·969 (Insign.)	3·0 ± ·928 (Sign. at P = 0·01)	—	—
	Groups A & B, 1941	2·2 ± ·748 (Sign. at P = 0·01)	—	—	—
Staple Length.....	Group A, 1940	—	0·3 ± ·035 (Sign. at P = 0·01)	0·2 ± ·085 (Sign. at P = 0·05)	0·3 ± ·068 (Sign. at P = 0·01)
	Group A, 1941	0·3 ± ·035 (Sign. at P = 0·01)	—	0·1 ± ·093 (Insign.)	—
	Group B, 1941	0·2 ± ·085 (Sign. at P = 0·05)	0·1 ± ·093 (Insign.)	—	—
	Groups A & B, 1941	0·3 ± ·068 (Sign. at P = 0·01)	—	—	—
Fibre Fineness.....	Group A, 1940	—	0·4 ± ·232 (Insign.)	0·5 ± ·313 (Insign.)	0·4 ± ·250 (Insign.)
	Group A, 1941	0·4 ± ·232 (Insign.)	—	0·1 ± ·370 (Insign.)	—
	Group B, 1941	0·5 ± ·313 (Insign.)	0·1 ± ·370 (Insign.)	—	—
	Groups A & B, 1941	0·4 ± ·250 (Insign.)	— —	— —	— —
Number of Fibres.....	Group A, 1941	—	—	5100 ± 2390 (Sign. at P ± 0·05)	—
Fibre Fineness.....	Group A, 1941	—	—	1·1 ± ·356 (Sign, at P = 0·01)	—
Fleece Density as percentage of skin area	Group A, 1941	—	—	·03 ± ·132 (Insign.)	—

Greasy Fleece Weights.

There is a significant difference between the greasy fleece weights of Group A in 1940 and those in 1941.

There is also a significant difference between the greasy fleece weights of Group A in 1940 and those of Group B in 1941. Likewise, the greasy fleece weights of Groups A and B together, are different from those of Group A in 1940.

There is an insignificant difference between Group A in 1941 and Group B in 1941.

Scoured Fleece Weights.

There is a significant difference between the clean wool production of Group A in 1940 and that of Group A in 1941, although an insignificant difference between Group A in 1940 and that of Group B in 1941. Group A in 1940 and Group B in 1941 were of the same age and it is suggested that a contributing factor in the lower production of Group A (1941) was that of age.

Yield of Fleece.

Group A produced a significantly lower yield in 1941 compared with 1940 but did not differ from Group B in 1941. This again points to an influence of age in Group A.

Staple Lengths.

As regards staple length, Group A in 1940 differed significantly from Group A in 1941 and from Group B in 1941. There was no significant difference between the staple lengths of Group A in 1941 and those of Group B in 1941.

Fibre Fineness.

There was no significant difference between Group A, 1940, Group A, 1941, and Group B, 1941, all producing a 60's quality number.

Fleece Density.

Group A differed significantly from Group B in the number of fibres per square inch of skin, but there was no significant difference in their respective fleece densities, when these are expressed as per cent. skin area occupied by wool fibre.

Discussion.

Many sheepmen believe that a certain amount of skinfolding in the merino is necessary for producing fleeces that are bulky and dense. This contention has also played an important part in determining the breeding policies of certain studs. Other sheepmen, however, contend that plainbodied sheep can produce as bulky and as dense fleeces as their developed comrades. In consequence, this topic has long been a controversial one among sheepmen, and differences of opinion are probably due to a lack of reliable tests on the standards of merino wool production, in relation to the type, and also to a lack of knowledge on the detailed factors that control production.

This position has prompted more research and has resulted in large-scale laboratory testing of merino fleeces in such characteristics as total wool production (greasy and clean), yield, length, number of fibres growing per square inch of skin, fleece density and fibre fineness.

The results outlined here give an analysis of an extremely plainbodied group of stud ewes from a breeder who has consistently selected and bred for extreme plainness, and at the same time has paid attention to the quantity and the compactness of the fleece.

This breeder has followed a system of breeding " like to like ", both rams and ewes being of an extremely plainbodied type, and producing extremely plainbodied progeny. This method of breeding differs from that of many other stud breeders who follow a system of " corrective mating ". The belief is also held by some merino breeders that development in the studs is necessary for maintaining density and quantity of fleece in the progeny of these studs, the progeny being plainbodied animals and used for flock improvement. Many of these sheepmen believe that the system of consistently mating extremely plainbodied stud rams to extremely plainbodied stud ewes will eventually produce inferior fleeces that lack bulk, fleece density and quantity of wool. From this aspect the results of the tests here outlined on the plainbodied stud are important.

A summarised review of some of the available wool production figures of stud ewes compared with the results of the sheep under discussion is given in Table 3.

Table 3 shows that the production of the sheep described in this publication compared favourably with the production of stud ewes from other sources. As regards the greasy fleeces, it is important to note, from a practical farmer's point of view, that from 22 to 24 fleeces * are necessary to fill a bale of wool of 300 lb. weight. (Approximately 46 greasy fleeces of the size of the Union's average fleece, i.e. 6½ lb. are required to fill a bale of 300 lb.) Furthermore, the fleeces from the plainbodied sheep have a particularly high yielding wool and should command a good monetary return per pound.

As regards the standards of density, Bosman (1933) in discussing the classification of merino sheep into " flocks " and " studs " according to density tests, contends that " flocks " produce from 15,000 to 25,000 fibres per square inch of skin and that " studs " produce from 30,000 to 60,000 fibres per square inch of skin. This basis shows the density of these ewes, with 43,100 fibres per square inch of skin and a fleece density of 2·52 per cent., to be of a good stud standard.

The standards of excellence produced by these plainbodied sheep refute the belief held by many sheepmen that density and bulk of fleece must necessarily be associated with skinfolds. The sheep not only produce profitable fleeces but with their strong constitutions and smooth skins have all the practical advantages possessed by the plainbodied type.

Table 3 also shows that the greasy fleece weight is not necessarily an indication of the clean wool that is produced by the merino, the latter depending very largely on the yield. When sheep of different yields are compared, the greasy fleece weight is no indication of what the clean wool produced would be. This confirms a conclusion previously recorded by Bosman (1933).

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* These fleeces are inclusive of lox and bellies and in practice these portions (approx. 1½ lb. per fleece) are usually transferred to the " outsorts ".

TABLE 3.

Source Author.		Average Fleece Weights. (lb.)	Average Fleece Weights (scoured). (lb.)	Number of Fibres per sq. inch of Skin.	Average Fleece Density. (%)	Feed Conditions.	Number of Fleeces Tested.
Belschner and Carter (1936).....	I	12·20	7·53	—	—	Australian (New South Wales) stud sheep pastures; sheep lambed	64
	II	12·18	7·28	—	—		54
	III	12·73	7·70	—	—		60
	IV	12·65	7·51	—	—		59
Bosman (1937).....	—	15·6	7·1 at 16 % regain 6·1 bone dry	46,500	2·28	Karroo pastures; sheep lambed	26
South African Breeders' Advertisements	I	15·25	7·9 at 16 % regain	—	—	—	4470
	II	14	6·8 bone dry	—	—	—	2000
Experimental ewes tested at Onderstepoort. (Results unpublished.)	I	14·63	8·13 at 16 % regain 7·01 bone dry	—	—	Stall-fed on a sufficiently balanced ration; no lambing	46
Plain-bodied ewes in this publication	I	13·28	8·7 at 16 % regain 7·47 bone dry	41,600	2·51	Karroo pastures; sheep lambed	35
	II	12·42	7·95 at 16 % regain 6·85 bone dry	43,100	2·52	Karroo pastures; sheep lambed	41

The reliability of judging high wool production in practice has been investigated in conjunction with laboratory testing. It has been shown that the judgment of fleece density or fleece compactness can be misleading to the sheepman who, in practice, assesses the wool as well as its impurities. Many cases are on record where a large amount of wool yolk of high viscosity gives an apparently high degree of compactness and it is not surprising that yolky fleeces from developed sheep have given erroneous judgments on fleece density.* The importance of fleece testing therefore is evident when reliable comparisons of wool production among sheep are to be made. For this, and other reasons, fleece testing is also very largely being made use of by sheepbreeders and the demands on the testing service offered by the Onderstepoort Wool Laboratories have increased considerably since its inception six years ago (Bosman, 1936).

The measurement of characteristics, as used in this publication, is also necessary where relationships between characteristics are studied, and it is only possible to determine the coefficients of correlation when characteristics are expressed in arithmetic terms.

The existence of relationships of characteristics that are determined in the laboratory are often useful to the breeder. For example, it is shown that as regards Group A shorn in 1940 the coefficient of correlation between the greasy fleece weight and scoured fleece weight has a value of 0·8827 which is highly significant at the 1 per cent. probability level, and this is due to the fact that among these sheep there is an insignificant correlation of −0·0064 between the grease weight and yield of the fleece. The same conclusion is arrived at when the Groups A and B shorn in 1941 are considered. The coefficient of correlation between greasy fleece weight and scoured fleece weight is 0·8228 which is significant at the 1 per cent. probability level. There is an insignificant correlation between greasy fleece weight and yield of −0·2397. This means that if this breeder wished to raise the average wool production of his stud ewes, then, by weighing the greasy fleeces and selecting out all the highest weights, he would automatically also raise the average standard of clean wool production. As stated before, this method of selecting greasy fleece weights can be misleading in studs or groups of sheep where there is a definite relationship between the greasy fleece weight and yield.

As a practical example, if this breeder selected 50 per cent. of the highest grease wool producers in the Group A (1940) of Table 1, he would raise the average standard of production of the selected sheep from 13·28 lb. to 14·6 lb. greasy wool and the dry scoured wool production automatically from 7·47 lb. to 8·1 lb.

The regression coefficient of the scoured fleece weight on the grease weight of Group A, 1940, shearing, is 0·53. The regression coefficient of the scoured fleece weight on the greasy weight of Groups A and B, 1941 shearing, is ·45. This means that on an average, every increase of 1 lb. in grease weight results in an increase of half a pound in the scoured fleece weight.

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* This point has been forcibly demonstrated by the construction of models of fleeces which have different quantities of grease. For example, a fleece was degreased and cleaned. Into a portion of the fleece an amount of grease was introduced, equivalent in quantity to that of a fleece with low grease content. Into the adjacent portion, an amount of grease was added equivalent in quantity to that of a fleece with a high grease content.

Practical judgments for fleece compactness on these two regions clearly demonstrated that the fleece region with the high grease content was considered " compact " and " of high stud standard of production ", although in reality it had the same fleece density and amount of clean wool as its counterpart which was judged as " loose ".

Summary and Conclusions.

The wool production and fleece analysis of 50 extremely plainbodied stud ewes are given. The ewes were typical of the sheep of the stud (including the stud rams) and were obtained from a breeder who had consistently bred for extreme plainness, so that this characteristic is successfully being transmitted to the progeny.

Thirty-five four-toothed stud ewes, recorded in 1940, gave an average greasy fleece of 13·28 lb.; a clean scoured fleece of 7·47 lb. as bone dry, or 8·7 lb. at 16 per cent. Regain; a yield of 58·4 per cent as dry or 67·7 per cent. on the the Bradford system; an average staple length of 4·0 inches and a 60's quality number with a coefficient of variability of 4·5 per cent., indicating a uniform group.

The number of fibres per square inch of skin ranged from 31,700 to 45,000, with an average of 41,600. The average fleece density was 2·51 per cent.

Fifteen four-toothed stud ewes, recorded in 1941, gave an average greasy fleece weight of 12·17 lb. with 6·99 lb. of clean scoured wool as bone dry, or 8·1 lb. of clean wool at 16 per cent. Regain. The yield was 58·1 per cent. as dry or 67·3 per cent. on the Bradford system. The average staple length was 3·8 inches and the quality number a 60's with a coefficient of variability of 4·3 per cent. showing a uniform group.

The number of fibres growing per square inch of skin ranged from 30,200 to 71,600 with an average of 46,700. The average fleece density was 2·54 per cent.

It is concluded that the extremely plainbodied stud here described possesses a good stud standard of production in regard to the total wool, the length, and the fleece density.

The view held by many sheepmen that extremely plainbodied sheep must necessarily have inferior fleeces, cannot be substantiated.

Not only do these sheep produce profitable fleeces, but by virtue of their smooth skins and strong constitutions, they possess the practical advantages of the plainbodied type.

The reliability of judging merino wool production in practice is discussed. It is contended that the judgment of fleece density and quantity of wool is difficult because of the grease factor and an increased need for fleece testing has been experienced.

In the stud analysed there is a highly significant correlation between greasy fleece weights and scoured fleece weights and an insignificant correlation between greasy fleece weights and yield. In consequence, the breeder can, by selecting the highest greasy fleece weights, automatically improve upon the clean wool production. This recommendation does not hold where there is a definite relationship between greasy fleece weights and yields.

Acknowledgment.

The author is indebted to the breeder on whose stud these investigations were carried out. He wishes to record his appreciation for the material itself and for the help given him in many ways while the experiments were in progress.

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Fig. 1.—The photographic records of the plainbodied stud ewes whose fleece analyses are given in Table 1.

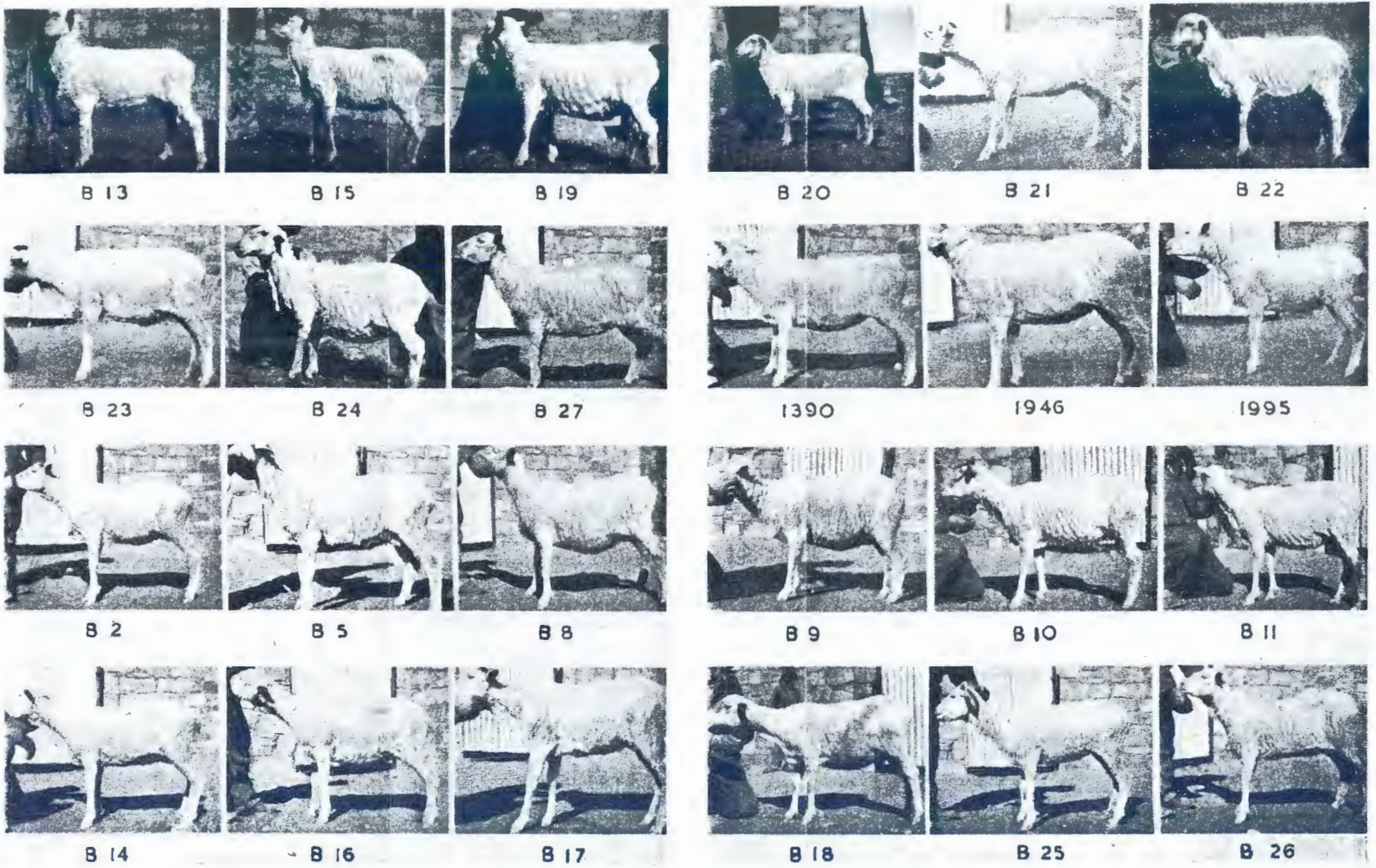

Fig. 1 (*continued*).—The photographic records of the plainbodied stud ewes whose fleece analyses are given in Table 1.

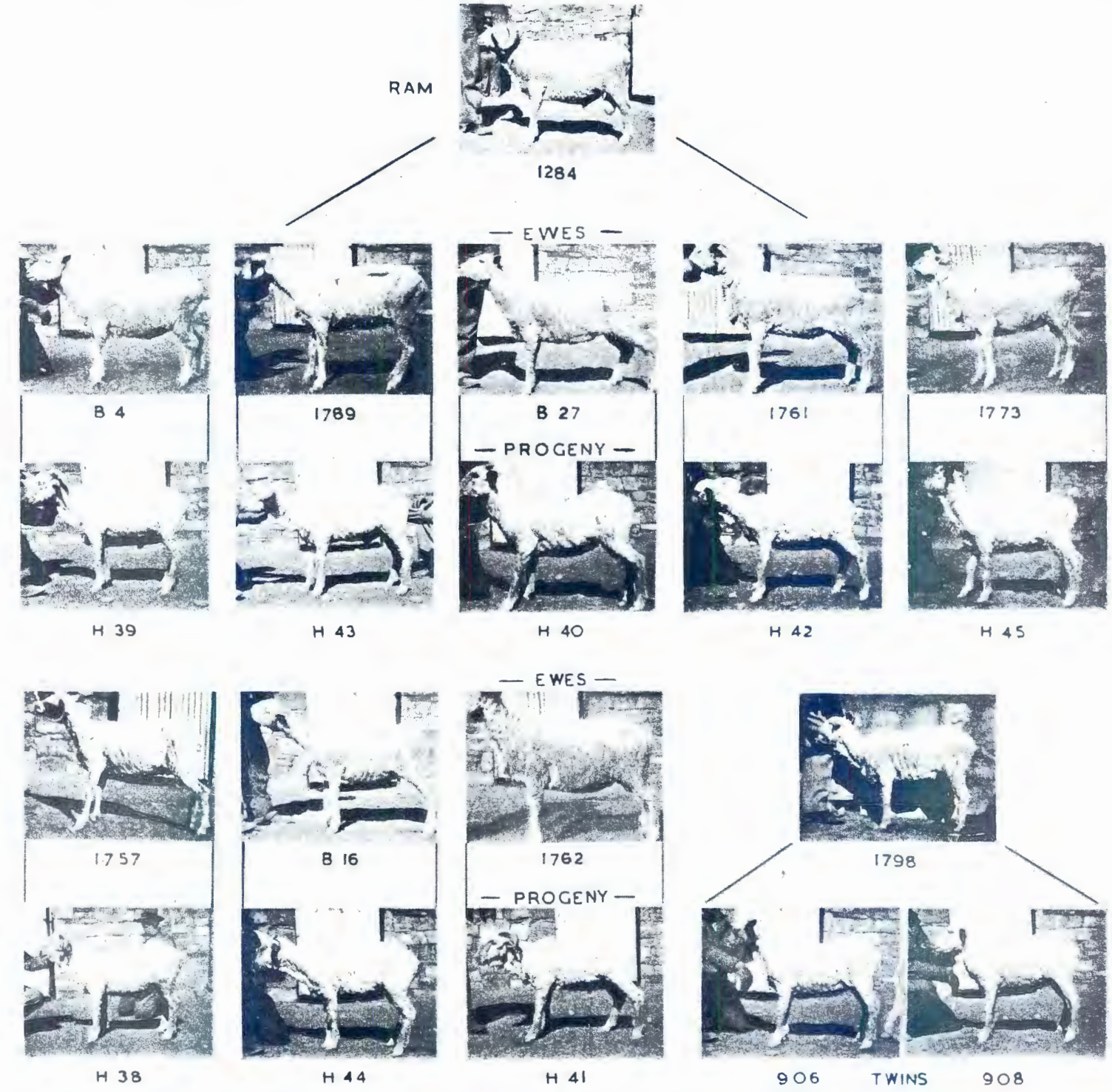

Fig. 2.—The plainbodied ram and some of the experimental ewes with their progeny, the latter being of the same type as their parents.