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CARDING AND COMBING OF MOHAIR

PART III: RECTILINEAR COMBING

by

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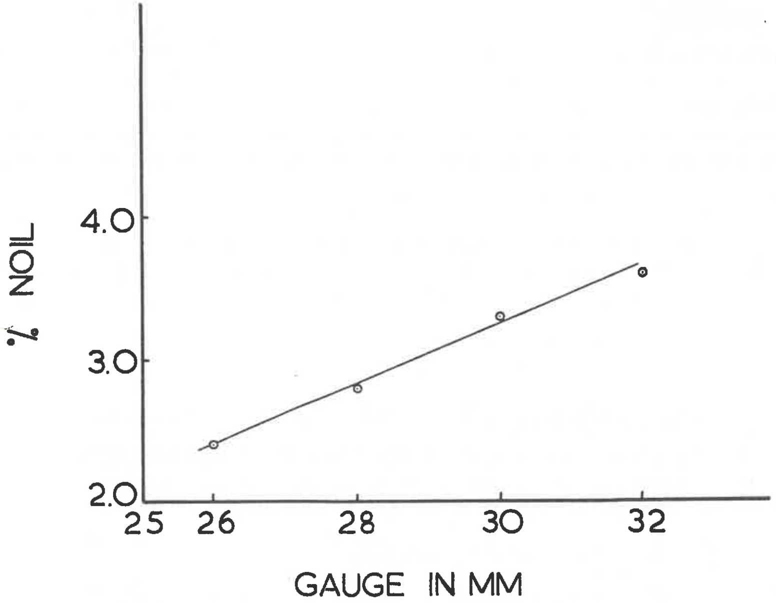

Fig. 1: Variation of percentage noil with gauge setting.

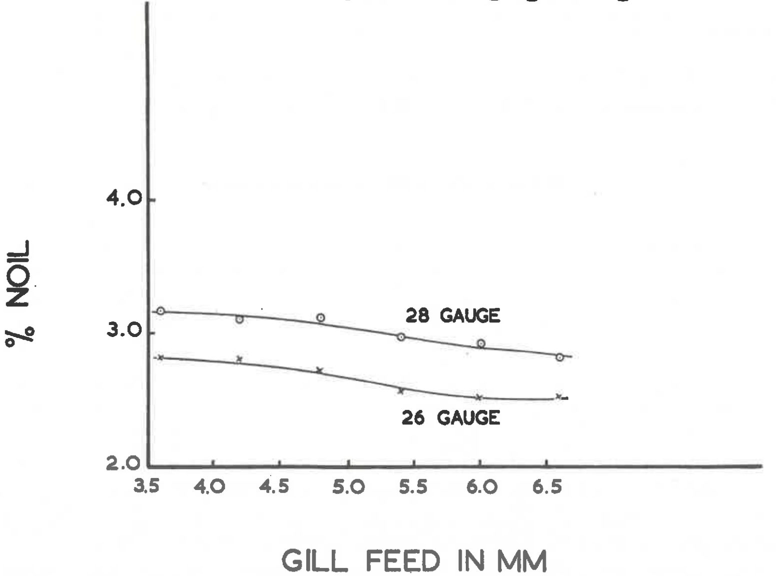

Fig. 2: Percentage noil against the feed of the gill of the rectilinear comb at gauge settings of 26 mm and 28 mm.

Fibre breakage

The formula used for determining the percentage fibre breakage on the Noble comb[2] was not suitable for rectilinear combing. A new formula was, therefore, developed. Details of this new formula are given in the Appendix. This formula is suitable for a blend of any two types of fibres (in this case mohair and kemp). The percentage fibre breakage is given by the expression:

Average % Fibre Breakage = 100 (B – 1)

$$\text{where } B = \frac{P(1-A_t)}{L_{at}x_t} + \frac{PA_t}{L_{bt}y_t} + \frac{Q(1-A_n)}{L_{an}x_n} + \frac{QA_n}{L_{bn}y_n} + \frac{R(1-A_1)}{L_{a1}x_1} + \frac{RA_1}{L_{b1}y_1} + \frac{S(1-A_2)}{L_{a2}x_2}$$

$$+ \frac{SA_2}{L_{b2}y_2} \div (P + Q + R + S) \left(\frac{1-A_s}{L_{as}x_s} + \frac{A_s}{L_{bs}y_s}\right)$$

where A = Percentage by weight of type two fibre
L = Mean Fibre length
x = mass per unit length of fibre (g/cm) of type one fibre
y = mass per unit length of fibre (g/cm) of type two fibre
P,Q,R,S = Weights of top, noil, shoddy 1 and shoddy 2.

The subscripts have the following meaning:

s = before combing sliver, t = top, n = noil, 1 = shoddy 1, and 2 = shoddy 2, and a = type one fibre and b = type two fibre.

For example,

L_{at} = Mean fibre length of type one fibre in the top.
and A_s = Percentage of type two fibre in pre-comb sliver.

RESULTS AND DISCUSSION

The cohesion of the fibres in mohair slivers is so low that special care must be taken not to break the slivers during any stage of processing. A support by means of aprons is often necessary. Two particularly difficult stages are the output of the rectilinear comb and the subsequent feed of the combed sliver into a gill box. The fibres delivered from the comb are loose and disentangled, and the cohesion between them is therefore very low. The overlap of the fibre tufts during combing should be large enough and the output web thick enough to prevent the sliver from breaking as it enters the can. It is necessary to use spring-loaded bottom supports in the cans throughout. It is also rather troublesome to feed this combed sliver into a gill box because the sliver must travel a fair distance in the creel before it reaches the positive grip of the back rollers. A normal can feed creel was used during these experiments but it required a close supervision throughout the experiments because of the high number of sliver breakages. A better arrangement should be an apron which can support the sliver from the edge of the can to the nip of the back rollers of the gill box.

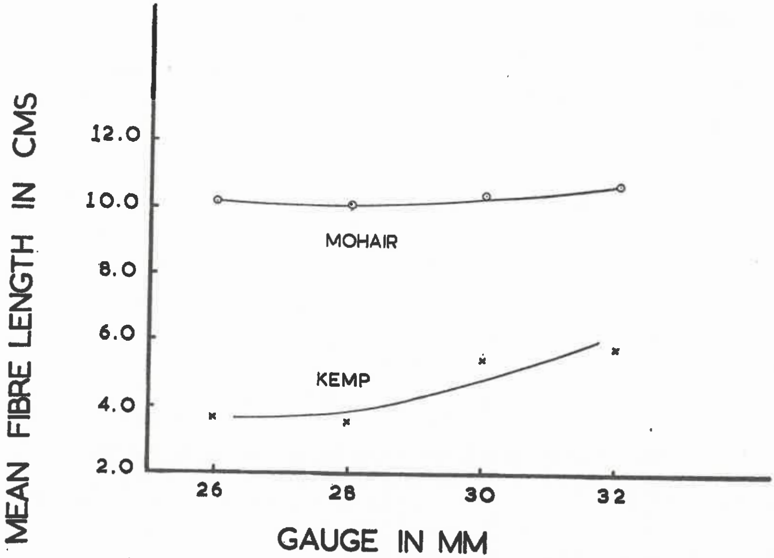

Fig. 3: Mean fibre lengths in the TOP for different gauge settings.

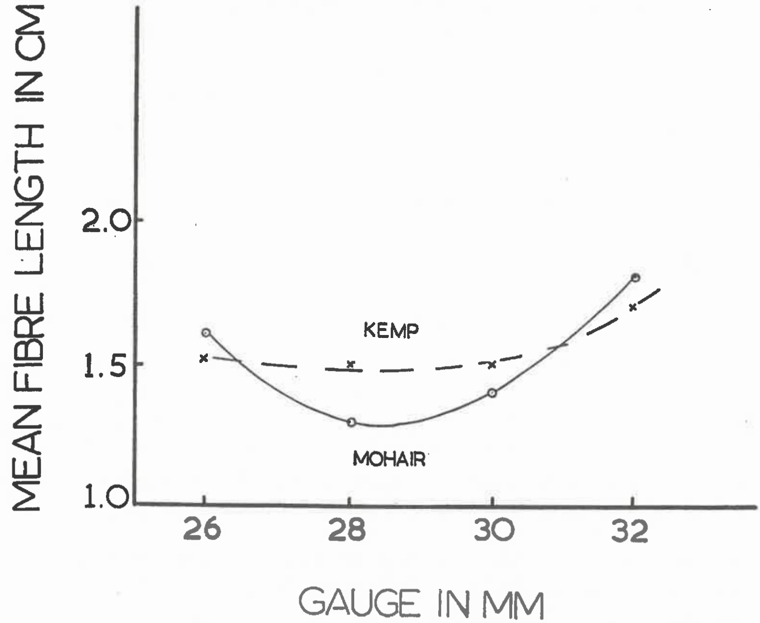

Fig. 4: Mean fibre lengths in the noil for different gauge settings.

TABLE II

Details of trials on the rectilinear combing of mohair

Gauge	Feed	Tear	% Noil	Percentage Kemp					M.F.L. of Mohair (cm)				M.F.L. of Kemp (cm)				% Kemp ratio	% Fibre Breakage	
				Top	Noil	Shoddy 1	Shoddy 2	Average for total noil	Top	Noil	Shoddy 1	Shoddy 2	Top	Noil	Shoddy 1	Shoddy 2	Noil/Top	Over-all	Mohair only
26	5.4	40.8	2.39	0.87	10.1	13.6	18.0	11.1	10.2	1.62	0.71	0.65	3.7	1.56	1.09	0.98	12.8	7.1	7.7
28	5.4	34.6	2.81	1.03	13.4	14.0	15.6	13.6	10.1	1.33	0.68	0.97	3.6	1.53	1.19	1.24	13.2	10.4	10.6
30	5.4	29.5	3.28	0.45	10.3	15.2	16.0	11.0	10.4	1.41	0.68	0.83	5.5	1.52	1.35	1.20	24.4	11.9	13.0
32	5.4	26.7	3.60	0.61	9.6	15.2	19.2	10.5	10.7	1.79	0.68	0.86	5.8	1.73	1.37	1.19	17.2	7.0	7.9
26	3.6	34.6	2.81	1.06	8.6	21.1	13.8		10.8	1.64	0.68	0.60	4.8	1.62	1.38	1.07		5.4	5.9
	4.2	34.7	2.80	0.93	10.0	17.9	15.4		10.5	1.39	0.71	0.75	4.0	1.49	1.06	1.08		9.4	9.9
	4.8	35.8	2.71	0.63	10.7	12.6	11.4		10.5	0.96	0.63	0.81	4.2	1.47	1.21	1.29		15.8	17.1
	5.4	37.8	2.58	1.27	10.0	14.5	18.0		10.3	1.62	0.67	0.65	4.1	1.56	0.86	0.98		7.1	7.3
	6.0	38.7	2.52	0.94	9.3	16.2	18.0		10.8	1.69	0.62	0.68	5.0	1.52	1.21	1.05		2.0	2.6
	6.6	38.6	2.53	0.61	10.5	12.4	17.3		10.8	1.68	0.74	0.68	5.1	1.56	1.07	1.04		0.8	1.9
		Average		0.91	9.9	15.8	15.6	11.0									12.1		
28	3.6	30.5	3.17	0.73	13.0	16.6	17.4		10.8	1.91	0.72	0.75	4.7	1.45	1.18	1.14		4.5	4.4
	4.2	30.9	3.13	1.01	9.4	26.8	17.6		10.7	2.15	0.83	0.74	4.1	1.58	1.08	1.22		2.2	2.1
	4.8	30.9	3.13	0.64	18.8	14.9	14.8		10.8	2.16	0.66	0.81	5.0	1.32	1.14	1.31		2.2	1.8
	5.4	32.4	2.99	0.85	13.4	14.0	14.1		10.9	1.33	0.68	0.80	3.2	1.53	1.19	1.19		9.7	9.4
	6.0	33.3	2.91	0.82	10.2	12.8	18.0		10.3	1.66	0.71	0.69	4.3	1.39	1.01	1.19		8.2	8.8
	6.6	34.2	2.84	1.25	11.7	16.6	14.6												
		Average		0.88	12.8	16.9	16.1	13.3									15.1		

Percentage Kemp in pre-comb sliver: 1.46%

The amount of material fed into the comb should be much higher than for wool. During combing of merino wool a normal feed for the particular comb used is 35 to 38 ounces per 5 yds. In the case of mohair it can be about 55 oz per 5 yds.

Percentage noil

When the gauge setting was changed the percentage noil changed accordingly. From Fig. 1 it can be seen that a linear relationship exists between percentage noil and gauge settings, which is similar to that for normal combing of wool.

When the feed of the gill of the comb was increased from a minimum to a maximum the percentage noil decreased. The change of feed was investigated for gauge settings of 26 mm and 28 mm. From Fig. 2 it can be seen that the percentage noil decreased slowly at low feeds, then dropped more rapidly for an increase of feed from 4.5 to 5.5 mm. For larger feeds it decreased only slightly. It would appear that there is a critical feed value for the gill below which more noil can be expected. It was found that an optimum gill feed exists for wool and the value of that optimum feed depends on the fibre length of the particular type of wool. This optimum value is, however, not apparent from Fig. 2 but it is clear that the gill feed should be 5.5 cm or larger for the least noil.

Fibre lengths

The m.f.l. of mohair fibres in the top increased only slightly when the gauge setting was increased, as can be seen from Fig. 3, while the m.f.l. of kemp fibres increased significantly with an increase in gauge setting. This is feasible if we keep in mind that most of the kemp fibres lie in the short or medium short ranges and that a change in length selection will be more critical in the case of kemp than in the case of mohair for which the majority of the fibres are much longer than the noil length setting.

The lengths of kemp and mohair fibres in the noil are of the same order (see Fig. 4 and Table II). On the Noble comb[2] the kemp fibres in the noil were much longer than the mohair fibres which implies that a selective kemp removal took place. On the rectilinear comb, however, no difference existed between the effective removal of kemp and mohair. It is, therefore, clear that the rectilinear comb will not be such an effective machine for kemp removal.

The variation of m.f.l. at different gauge settings for the noils is given in Fig. 4. These fibre lengths are the m.f.l.'s of the total comb waste, i.e. of noil and shoddy. From Fig. 1 it is clear that more noil was removed when the gauge setting was increased, and this should have resulted in an increase in the length of the noil. However, Fig. 4 shows that the noil length decreased for mohair fibres when the gauge was increased from 26 mm to 28 mm which indicates that a significant increase in fibre breakage took place for this increase in gauge setting. The lengths of the kemp fibres were very similar for gauge settings of 26 mm to 30 mm and it was only at the 32 mm gauge that the mean lengths of the kemp fibres increased. This indicates that some of the kemp fibres were broken during the combing trials at gauge settings of 28 mm and 30 mm. The mean fibre lengths for different gill feeds did not vary significantly (see Table II).

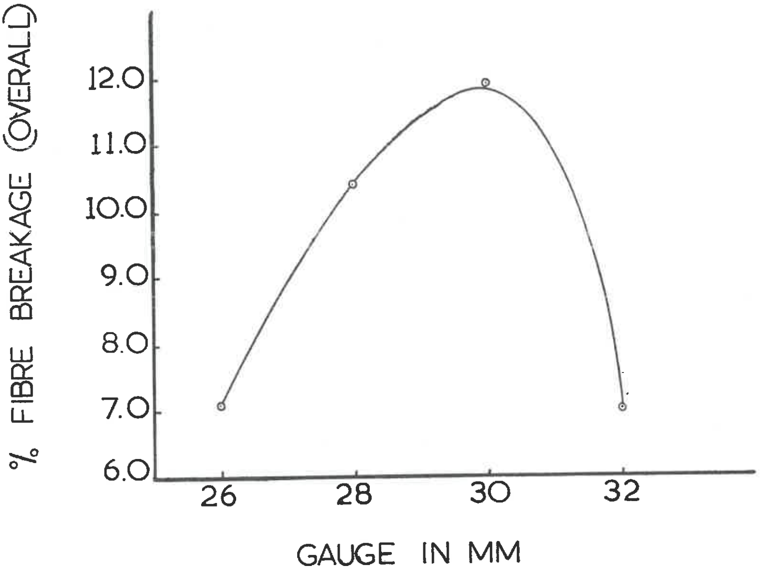

Fig. 5: Overall percentage fibre breakage against gauge setting.

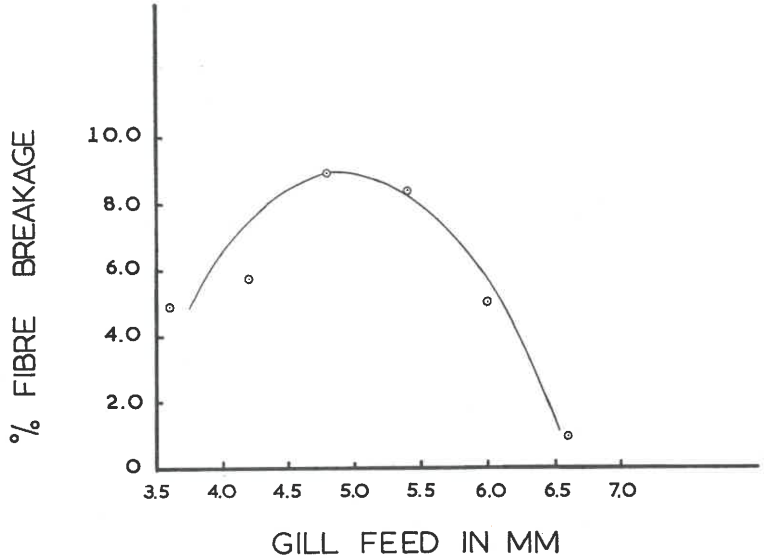

Fig. 6: Overall percentage fibre breakage (average of 26 mm and 28 mm gauge settings) against the feed of the gill of the rectilinear comb.

Fibre breakage

The percentage fibre breakage was calculated for each combing trial. From Fig. 5 it can be seen that the overall percentage fibre breakage increased significantly for an increase in gauge from 26 mm to 30 mm and dropped rapidly at the wide gauge setting of 32 mm. This fibre breakage was mostly due to the breakage of mohair fibres. The percentage fibre breakage for mohair only and for the blend of mohair and kemp are given in the last two columns of Table II. It can be seen that the percentage fibre breakage for mohair fibres only are almost consistently higher than for the mixture. This means that the fibre breakage for kemp was always lower than for mohair. Considering that the kemp content was of the order of only 1—2% in the pre-combed sliver, it is clear that the amount of fibre breakage for kemp must have been almost zero to effect such a reduction in the fibre breakage figures as shown in Table II. In some cases the kemp breakages appear to be less than zero, but these discrepancies are probably due to the fact that relatively few kemp fibres were available for measurements, with the result that the fibre length values quoted were, in fact, less accurate.

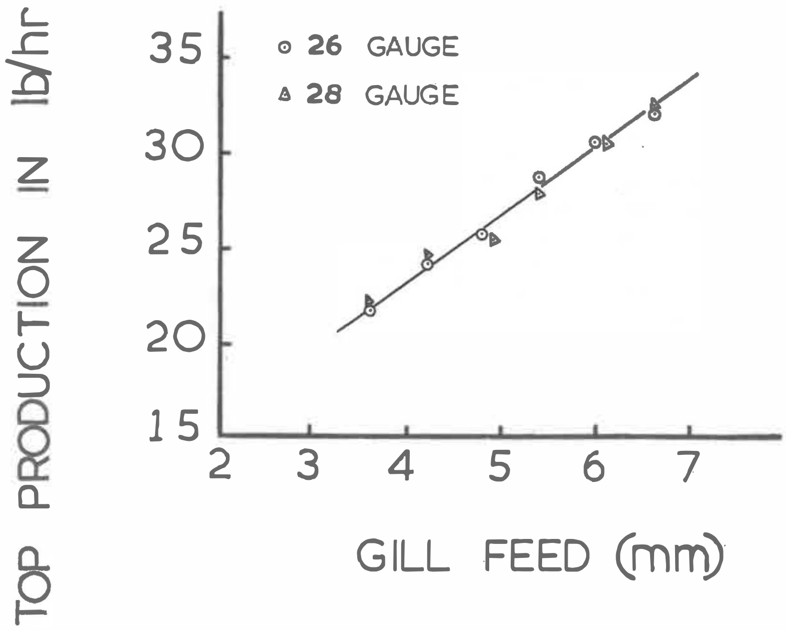

Fig. 7: Production of top against the feed of the gill of the rectilinear comb.

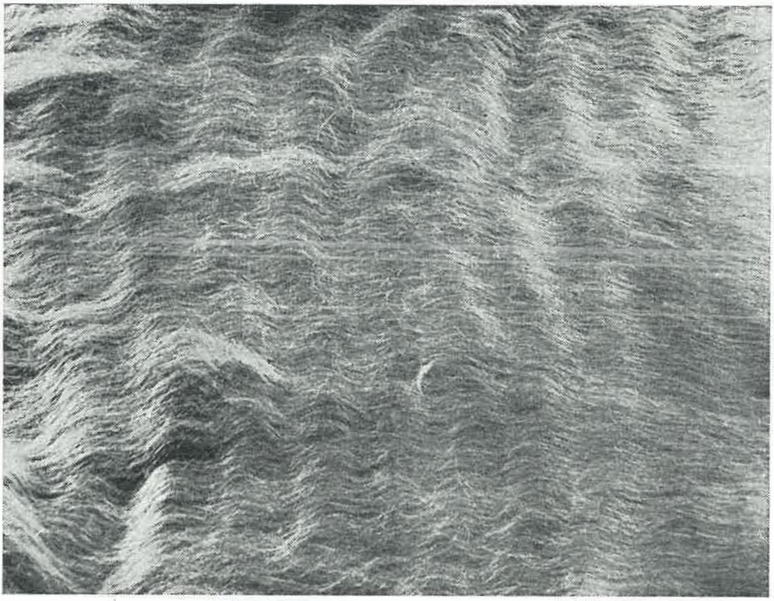

Fig. 8(a): Top surface of comb web.

The fibre breakages at different feed settings are shown in Fig. 6. The breakage values used in this graph are the averages of the breakages obtained at the two gauge settings of 26 mm and 28 mm respectively. It is clear that medium feeds result in relatively high levels of fibre breakage. The large feed settings will, therefore, result in better combing performance. At the same time these large feed settings will also result in the highest combing production as shown in Fig. 7, and the lowest amount of noil (Fig. 2).

Kemp removal

The percentage kemp in the sliver before combing was 1.5% and the percentages in the top, noil and shoddy for each trial are given in Table II. The percentages are also given for the combinatoin of noil and shoddy, referred to as total noil in Table II.

From Table II it is clear that the kemp content of the top is of the order of 0.9% and that of the noil about 11%. If we compare these figures with those on the Noble comb of 0.8% and 25% for top and noil respectively, when the kemp content of the pre-combed sliver was about 2%, it is clear that the Noble noil contained much more kemp than the rectilinear noil. This means that the Noble comb was much more effective in the removal of kemp. The ratio of percentage kemp in the noil to that in the top was about 32 in the case of the

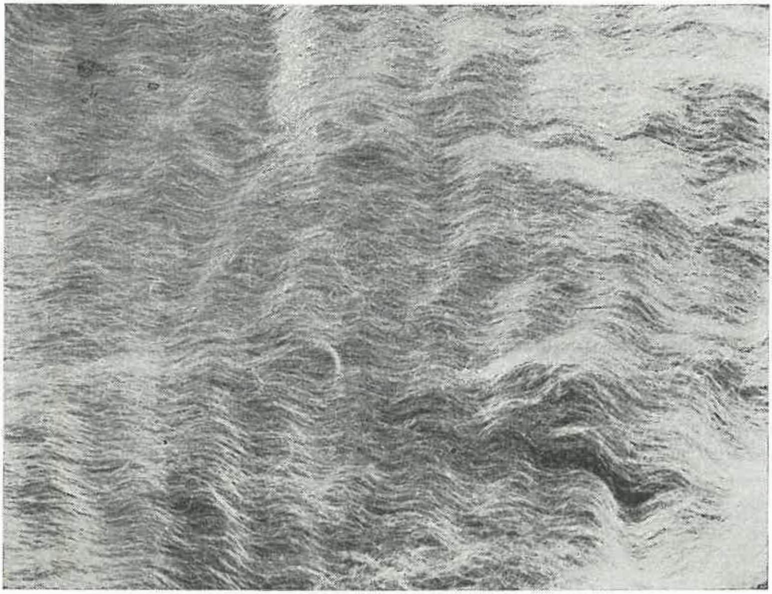

Fig. 8(b): Bottom surface of comb web.

Noble comb as compared with between 12 and 24 for the rectilinear comb which, once again, proves the Noble comb to be superior in respect of kemp removal.

No definite trend for kemp removal at different comb settings emanated from the results given in Table II. However, the figures for the ratio of kemp content in noil and top increase for increasing gauge settings, i.e. from 12.8 at 26 gauge to 17.2 at 32 gauge. This shows that more kemp was removed at 32 gauge than at 26 gauge which is acceptable if we keep in mind that the kemp fibres are mostly short or medium short fibres. This corroborates the findings discussed under fibre lengths.

During the combing of mohair it was noticed that the top surface of the web on the leather appeared very kempy, but when this layer was turned upside down it appeared kemp free. A typical web was mounted between two glass plates and photographs taken from both sides. In Fig. 8(a) the top surface (as it should be on the comb) is shown, while Fig. 8(b) shows the bottom surface. It is clear that, while the top surface appears very kempy, hardly any kemp fibres are noticeable on the bottom surface. The reason for this phenomenon is that most of the kemp fibres are located in the leading end of the withdrawn fringe. In Fig. 9(a) a typical withdrawn fringe is shown with the leading end at the top of the picture, while Fig. 9(b) shows the beard in front of the gill

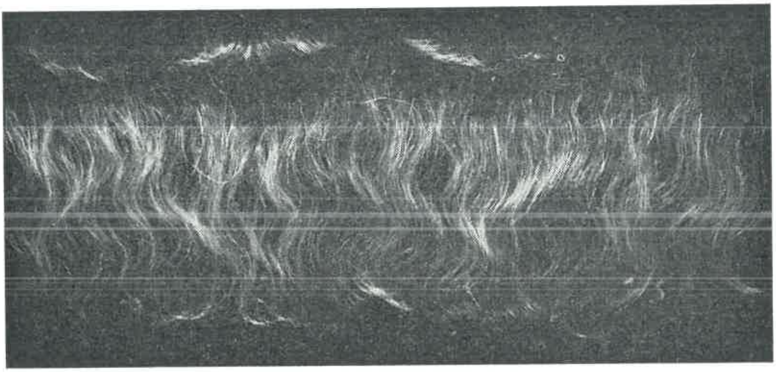

Fig. 9(a): Typical withdrawn fringe with the leading end at the top.

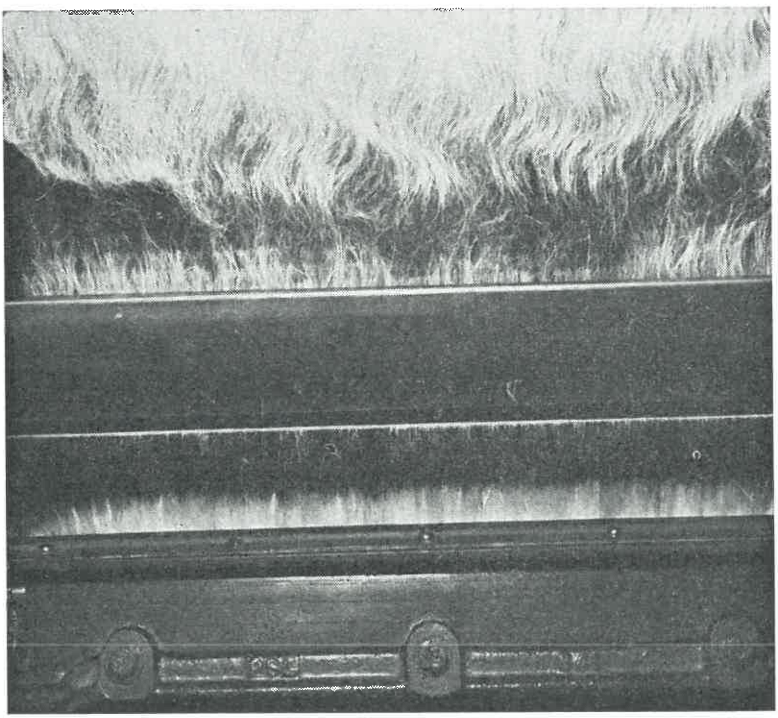

Fig. 9(b): The beard in front of the nipper jaws with the withdrawn fringe at the top.

TABLE III

Properties of fibres of BSFH Mohair as combed on the Noble Comb

	Fibre diameter (microns)		*Mean Fibre Length (cm)*		*Percentage*
	Mohair	*Kemp*	*Mohair*	*Kemp*	*Kemp*
Before combing	36.1	56.5	10.8	2.6	2.40
Top	37.9	63.9	11.3	4.0	0.72
Noil	34.5	55.8	1.90	2.30	25.3

TABLE IV

Properties of fibres of a different lot of BSFH mohair as combed on the Rectilinear comb

	Fibre diameter (microns)		*Mean Fibre Length (cm)*		*Percentage*
	Mohair	*Kemp.*	*Mohair*	*Kemp.*	*Kemp*
Before combing	38.0	58.1	9.7	3.1	1.46
Top	38.3	58.5	10.7	4.25	0.90
Noil	35.0	56.0	1.51	1.39	11.8

of the comb. The preponderance of kemp fibres in the leading ends is clearly noticeable.

A summary of some of the results for the Noble and rectilinear combs is given in Tables III and IV for two different lots of BSFH mohair. Comparing these two tables it is once again clear that the Noble comb removed *longer* kemp fibres and also *more* kemp than the rectilinear comb. Although the pre-comb sliver in the case of the Noble comb contained more kemp than the pre-comb sliver of the rectilinear comb, the Noble top contained less kemp than the rectilinear top because of the more efficient kemp removal of the Noble comb.

CONCLUSIONS

The percentage noil produced during rectilinear combing was linearly related to the gauge setting of the comb. An increase in the gill feed at constant gauge caused a slight decrease in percentage noil. The m.f.l. in the top and the noil first decreased somewhat when the gauge setting was increased and subsequently increased for a further increase in gauge setting.

The mohair fibres in the top were significantly longer than the kemp fibres left in the top, while the lengths of the two types of fibres in the noil were about the same. This differs from Noble combing where the m.f.l. of the kemp fibres in the noil was significantly longer than that of the mohair fibres.

The kemp contents of the different components were not significantly affected by different comb settings although there was a tendency to remove more kemp at larger gauge settings. The percentage kemp in the noil is much lower in the case of rectilinear combing than in the case of Noble combing. The Noble comb top contained less kemp than the rectilinear comb top.

Percentage fibre breakage increased significantly for an increase in gauge setting but dropped rapidly at the very wide setting of 32 mm. The medium gill feed settings resulted in greater amounts of fibre breakage, the best combing performance being for large gill feed settings.

APPENDIX

Percentage Fibre Breakage During Rectilinear Combing for a Blend of Two Types of Fibres

The following symbols are used:

X_s = number of fibres of type one entering the comb per unit time.
Y_s = number of fibres of type two entering the comb per unit time.
X_t = number of fibres of type one going into the top per unit time.
Y_t = number of fibres of type two going into the top per unit time.
X_n = number of fibres of type one going into the noil per unit time.
Y_n = number of fibres of type two going into the noil per unit time.
X_1 = number of fibres of type one going into shoddy 1 per unit time.
Y_1 = number of fibres of type two going into shoddy 1 per unit time.
X_2 = number of fibres of type one going into shoddy 2 per unit time.
Y_2 = number of fibres of type two going into shoddy 2 per unit time.

x_s = mass per unit length of fibre (g/cm) of type one entering the comb.
y_s = mass per unit length of fibre (g/cm) of type two entering the comb.
x_t = mass per unit length of fibre (g/cm) of type one in the top.
y_t = mass per unit length of fibre (g/cm) of type two in the top.
x_n = mass per unit length of fibre (g/cm) of type one in the noil.
y_n = mass per unit length of fibre (g/cm) of type two in the noil.
x_1 = mass per unit length of fibre (g/cm) of type one in shoddy 1.
y_1 = mass per unit length of fibre (g/cm) of type two in shoddy 1.
x_2 = mass per unit length of fibre (g/cm) of type one in shoddy 2.
y_2 = mass per unit length of fibre (g/cm) of type two in shoddy 2.

L_{as} = Mean fibre length of type one in pre-comb sliver.
L_{bs} = Mean fibre length of type two in pre-comb sliver.
L_{at} = Mean fibre length of type one in top.
L_{bt} = Mean fibre length of type two in top.
L_{an} = Mean fibre length of type one in noil.
L_{bn} = Mean fibre length of type two in noil.
L_{a1} = Mean fibre length of type one in shoddy 1.
L_{b1} = Mean fibre length of type two in shoddy 1.
L_{a2} = Mean fibre length of type one in shoddy 2.
L_{b2} = Mean fibre length of type two in shoddy 2.

$$\% \text{ Fibre Breakage} = 100 \left(\frac{X_t + Y_t + X_n + Y_n + X_1 + Y_1 + X_2 + Y_2}{X_s + Y_s} - 1\right)$$

Percentage of type two in blend, in

(a) Pre-comb sliver $A_s = \dfrac{Y_s L_{bs} y_s}{X_s L_{as} x_s + Y_s L_{bs} y_s}$

(b) Top $A_t = \dfrac{Y_t L_{bt} y_t}{X_t L_{at} x_t + Y_t L_{bt} y_t}$

(c) Noil $A_n = \dfrac{Y_n L_{bn} y_n}{X_n L_{an} x_n + Y_n L_{bn} y_n}$

(d) Shoddy 1 $A_1 = \dfrac{Y_1 L_{b1} y_1}{X_1 L_{a1} x_1 + Y_1 L_{b1} y_1}$

(e) Shoddy 2 $A_2 = \dfrac{Y_2 L_{b2} y_2}{X_2 L_{a2} x_2 + Y_2 L_{b2} y_2}$

Furthermore, if

P = Weight of Top per unit time
Q = Weight of noil per unit time
R = Weight of shoddy 1 per unit time
S = Weight of shoddy 2 per unit time

Then,

$$X_t = \frac{P}{L_{at} x_t}(1-A_t)$$

$$X_n = \frac{Q}{L_{an} x_n}(1-A_n)$$

$$X_1 = \frac{R}{L_{a1} x_1}(1-A_1)$$

$$X_2 = \frac{S}{L_{a2} x_2}(1-A_2)$$

Therefore,

Overall % Fibre Breakage = 100 (B – 1)

$$\text{where } B = \frac{P(1-A_t)}{L_{at} x_t} + \frac{PA_t}{L_{bt} y_t} + \frac{Q(1-A_n)}{L_{an} x_n} + \frac{QA_n}{L_{bn} y_n} + \frac{R(1-A_1)}{L_{a1} x_1} + \frac{RA_1}{L_{b1} y_1} + \frac{S(1-A_2)}{L_{a2} x_2}$$

$$+ \frac{SA_2}{L_{b2} y_2} \div (P + Q + R + S) \left(\frac{1-A_s}{L_{as} x_s} + \frac{A_s}{L_{bs} y_s}\right)$$

And,

% Fibre Breakage
for type one fibre only = 100 (C – 1)

where

$$C = \frac{\dfrac{P(1-A_t)}{L_{at}x_t} + \dfrac{Q(1-A_n)}{L_{an}x_n} + \dfrac{R(1-A_1)}{L_{a1}x_1} + \dfrac{S(1-A_2)}{L_{a2}x_2}}{(P+Q+R+S)\ \dfrac{(1-A_s)}{L_{as}x_s}}$$

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