

# Microscopic Study of Alpaca Fibers

By H. S. SCHENKER and LOUIS S. POTSDAMER\*

Due to the present widespread use in fabrics, of Llama, Alpaca and in a lesser degree, Guanaco and Vicuna, this discussion of the American cousin to the Camel should be of interest. During the past four or five years, our Mr. Weinberg has been instrumental in the production of probably the most successful overcoating, topcoating and suiting fabrics containing these hairs; in which actually hundreds of thousands of pounds of these stocks were brought into this market from South America for this purpose. The facts herein contained are not common, and we doubt whether any other scientific organization, mill or research department has made such a complete study of these fibers, in order to successfully duplicate fabrics year after year, from a source of supply in no way collected uniformly.

These fibers first appeared and were known as "Arequipa" Alpaca, baled in South America, containing not as the name indicates merely Alpaca, but all the hairs in the above mentioned four groups. It is impossible, even at the date of this writing, to import uniform deliveries containing these fibers separated, in spite of the large demand in the clothing field.

For many years back, large quantities of these fibers were used in the carpet industry, where they were more concerned with the coarser classification; for when too much of the fine staple, as often appears in the Guanaco (Huanacu) and Vicuna as well as some cross breeds of Alpaca, crept into the deliveries, yarns made therefrom produced inferior and spotty plushes and carpets, the individual fibers of the finer variety being too soft to stand upright alongside of the coarser fibers, as is required in the construction of a plush, carpet or any pile fabric. In the manufacture of clothing fabrics, however, it is the increasing quantities of these finer fibers that make their adaptability for proper drape and serviceability more valuable.

It is well to note here that Vicuna, as such, cannot be secured in the present market, due to restrictions made by the Peruvian Government, against exportation, because it is necessary to kill the animal in order to market the fiber. The animal is totally wild and in no way domesticated. In some parts of Peru a fine is levied for the possession of Vicuna fiber, indicating that the mere possession required killing of the animal. However, quantities of Vicuna have been found in shipments of stocks known as Arequipa Alpaca prob-

ably admixed without the knowledge of the packers, in order to overcome the embargo placed against it.

The fibers are characterized by their uniformity of diameter throughout their length, by the fact that they are smooth in structure, and exhibit little, if any, scale formation. In these respects they differ widely from sheep's wool, the fibers of which are more or less irregular in diameter, possess definite dentate serrations, and have decided scale formation.

The vast majority of Alpaca and Llama fibers show well developed medullæ (more prominent in the Llama than in the Alpaca), which are either continuous throughout the length of the fiber, or else broken, forming what are known as "medulla islands." These medullæ generally compose from one-third to one-half of the diameter of the woolly fiber and in the case of the beard hair may take up as much as three-quarters of the fiber diameter. In all the colored varieties of Alpaca or Llama, the fibers show distinct longitudinal pigment granulation, giving the appearance, under the microscope, of more or less continuous longitudinal striations.

In making the survey of the Alpaca or Llama fiber, the first step was to obtain samples as nearly representative as possible, of the average run of stock found on the market. For this reason samples were taken from a regular shipment of 100 bags of stock as received by a prominent mill in Philadelphia.

An ordinary purchase of 100 bales of Alpaca stock will be delivered, ready sorted, in approximately the following classification:

White .....	10 bags
Piebald .....	10 "
Fawn .....	15 "
Light Brown .....	15 "
Gray .....	15 "
Dark Brown .....	20 "
Black .....	15 "

This is of tremendous advantage to the larger consumer for it enables him to obtain the lighter shades at an "inside" figure and in many instances the "sorts" just mentioned can be hand-picked further to enable increased savings.

The fibers were first prepared for examination by washing in ether and alcohol, and at this point it may be noted that the grease and dirt present in the raw Alpaca or Llama stock are much lower than that found

\* Industrial By-Products & Research Corp., Philadelphia, Pa.

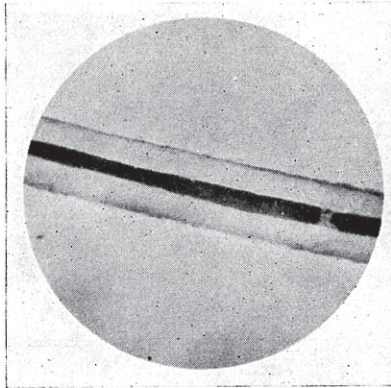
in raw sheep's wool. Ether extractions made on samples of these seven stocks gave the following values for grease and dirt content:

Piebald .....	1.70%	Ether extractable matter
Black .....	3.27	
Light Brown ..	9.00	
Dark Brown ..	3.05	
Fawn .....	1.20	
Gray .....	4.28	
White .....	0.95	

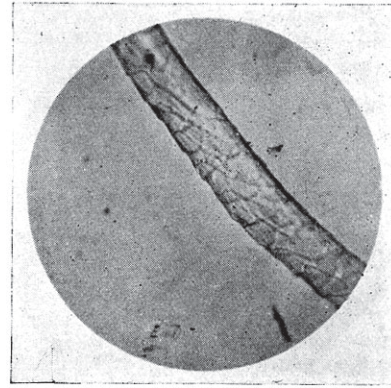
Fiber diameter measurements, as in the case of our previous surveys on wool and mohair, were made by means of a microscope equipped with an ocular micrometer scale, reading in microns (1 micron equivalent to 0.000039"), and the distribution among the various diameters was determined by measuring some 1,000 fibers of each type.

The results are tabulated in Table I and are summed up on a cumulative basis in Table II.

From the results listed in these tables, the average



Alpaca



Wool

TABLE I

Alpaca Stocks Measured for Fiber Diameter  
Percentage of Fiber Content Tabulated Individually

Diameter in Microns	Percentage of Fiber Content						
	White	Gray	Lt. Brown	Dk. Brown	Black	Fawn	Piebald
15.7	1%	1	0	0	0	0	0
17.3	0	2	0	0	0	0	0
18.8	3	6	0	3	3	2	1
20.4	6	8	0	3	4	0	1
22.0	5	6	0	3	1	4	3
23.3	3	13	0	12	4	3	4
25.1	10	10	0	12	5	8	10
26.7	13	9	1	15	11	12	10
28.3	12	16	6	15	12	10	10
29.8	13	8	5	8	7	10	11
31.4	13	5	10	9	12	11	10
33.0	6	3	9	2	7	5	6
34.5	4	3	5	1	3	7	8
36.1	6	3	16	1	5	11	10
37.7	2	3	6	1	1	5	4
39.3	1	2	18	1	0	4	5
40.8	2	2	12	0	5	4	5
42.4	0	0	6	1	2	2	0
44.0	0	0	1	1	1	0	1
45.6	0	0	3	0	2	0	0
47.1	0	0	2	4	3	1	0
48.7			0	0	3	0	1
50.2			0	1	3	0	0
51.8			0	1	1	1	0
53.4				2	1	0	0
55.0				2	1	0	
56.5				1	0	0	
58.1				0	0	0	
59.7				1	2	0	
61.2				0	0	0	
62.8				0	1	0	

TABLE II

Alpaca Stocks Measured for Fiber Diameter  
Percentage of Fiber Content Tabulated Cumulatively

Diameter in Microns	Percentage of Fiber Content						
	White	Gray	Lt. Brown	Dk. Brown	Black	Fawn	Piebald
15.7	1%	1	0	0	0	0	0
17.3	1	3	0	0	0	0	0
18.8	4	9	0	3	3	2	1
20.4	10	17	0	6	7	2	2
22.0	15	23	0	9	8	6	5
23.3	18	36	0	21	12	9	9
25.1	28	46	0	33	17	17	19
26.7	41	55	1	48	28	29	29
28.3	53	71	7	63	40	39	39
29.8	66	79	12	71	47	49	50
31.4	79	84	22	80	59	60	60
33.0	85	87	31	82	66	65	66
34.5	89	90	36	83	69	72	74
36.1	95	93	52	84	74	83	84
37.7	97	96	58	85	75	88	88
39.3	98	98	76	86	75	92	93
40.8	100	100	88	86	80	96	98
42.4			94	87	82	98	98
44.0			95	88	83	98	99
45.5			98	88	85	98	99
47.1			100	92	88	99	99
48.7				92	91	99	100
50.2				93	94	99	
51.8				94	95	100	
53.4				96	96		
55.0				98	97		
56.5				99	97		
58.1				99	97		
59.7				100	99		
61.2					99		
62.8					100		

or mean diameter of each of the types was then computed, giving values as follows:

Piebald .....	31.1 microns
Gray .....	26.7 "
White .....	28.4 "
Light Brown .....	36.3 "
Dark Brown .....	27.9 "
Black .....	31.7 "
Fawn .....	31.2 "

This gives a total average diameter of 30.5 microns for the seven types of Alpaca stock examined, representing samples taken from a representative shipment of Alpaca. It will be seen that there is a total variation in average diameter, from maximum to minimum, of 9.6 microns.

Upon comparing these results with those previously obtained in the examination of the Government Wool Standards, a set of figures is obtained which is shown in Table III.

TABLE III  
Comparison of Average Diameters  
Government Standard Wool Tops      Seven Representative Alpaca Stocks

Grade	Average Diameter Microns	Stock	Average Diameter Microns
80's	17.6		
70's	18.6		
64's Fine	19.6		
60's	21.4	Gray	26.7
58's 1/2	22.8	Dark Brown	27.9
56's 3/8's	28.7	White	28.4
50's	32.6	Piebald	31.1
48's 1/4's	33.4	Fawn	31.2
46's Low 1/4's	35.7	Black	31.7
44's common	40.0	Light Brown	36.3
Over braid	Over		

It is observed from this table that the total variation in average diameter of representative lots of Alpaca stock is but slightly more than that between a 56's wool and a 46's wool.

Referring again to Table I, if we determine the percentage of the total fiber content within a small range above and below the average diameter for each of the seven stock types, taking 6 microns as the limit of variation, the following figures are obtained:

% within 6 microns		Mic. av. diam.
79	White .....	28.4
78	Gray .....	26.7
83	Light Brown .....	36.3
77	Dark Brown .....	27.9
63	Black .....	31.7
79	Fawn .....	31.2
79	Piebald .....	31.1

From this it can be seen that the variation in diameter from fiber type to fiber type is very small, since the greater majority of the fibers are to be found within a close diameter range of one another. There are very few extremely fine or extremely coarse fibers; the latter being representative of the "beard" hairs.

From the work outlined above, it may thus be concluded that a representative lot of Alpaca or Llama has an average or mean fiber diameter varying from 26 to 36 microns, corresponding approximately to the variation between a 58's quality wool and a 46's quality wool.