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Date: Jan 4, 2020
DISCOVERING ALPACA FIBER

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SUMMARY

This is an in depth study of alpaca fiber.

It begins with a brief look at the history of alpacas and facts about the animal.

The nature and properties of alpaca fiber are explored in some detail and includes research on its elasticity and ability to nap.

Methods of washing raw fleece and fiber preparations are discussed in detail.

Spinning alpaca for beginners as well as for advanced spinners are covered. Exercises in grist and twist explore spinning possibilities and the point at which over twisting causes harshness in alpaca yarns.

Dye tests were made on acid, fiber reactive and natural dyes to explore its dye properties. Sun and light tests were exercised on the dyed yarns.

An extensive sampling of blends was undertaken and comments made on sample results.

A brief discussion on care and uses of alpaca concludes this study of alpaca fiber.
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PREFACE

The purpose of this research report is to learn about alpaca fiber.

When I purchased a small herd of alpacas in 1989, I could find no information on this animal or its fiber. There were reported to be, at that time, less than 100 such animals in Canada and as few as 500 in North America with the exception of the zoo population. Since then, importations have expanded the population to well over 10,000 animals in North America. The focus of alpaca ranching in North America, however, is breeding not fiber production, leaving a fragmented and sparse amount of knowledge about the fiber and its uses for handspinners. This is what I have set out to start to correct. I was not able to conduct what I shall describe as "hard core research" as I have not that scientific knowledge or the facilities to perform adequate testing. I was, however, able to look at alpaca as a spinning fiber from what I shall describe as an "at home" or outside a laboratory perspective. My background as a textile teacher for thirty years; an alpaca rancher for nine years; a spinner for seven years and my diligent readings and personal research have given a wealth of experience from which to draw.

When I began, two things were apparent. First there was little correct information available on the properties of alpaca fiber and second there was no way to spin a yarn in Canada except by handspinning.

Facts on fiber are slowly emerging but there is a long way yet to go.

The following are samples from different common sources illustrating exactly how poor the information on alpaca as a fiber is:

A classroom textile book states:

"Alpaca consists of two varieties of fiber: soft, woollike hair, and stiff beard, or outer hair." (Textiles: Fiber to Fabric by Dr. Bernard Corbman-book not available)

This more aptly describes a llama rather than an alpaca. Alpacas are essentially a one-coated animal. Alpaca may exhibit some secondary fiber but it is never stiff. An alpaca with "stiff" outer hair is a llama/alpaca cross.

A popular spinning book says that:

"The finer fibers need to be separated from any guard hair." (Raven 10)

On the contrary, typical alpaca fleece, especially from the blanket area, should not contain guard hair.
A popular knitting text mentions:

"Alpaca is an expensive soft yarn, spun from the long woolly hair of llamas."
(Compton 269)

Of course, llamas and alpacas are two different animals.

In another spinning book, Field writes:

"The color ranges from beige to almost black." (69)

However, alpacas produce more colors than any other fiber producing animal in the world. There are as many as 250 possible colors categorized into 22 main ones ranging from white to true black as well as brown and most shades in-between.

The illustration shown here is from a hand spinning expert's textbook:

![Illustration of Llama, Alpaca, Guanaco, Vicuna](Ross, Yarn Design, 84)

These animals are incorrectly identified. The animal labeled "llama" is an alpaca; the "alpaca" is a vicuna; the "guanaco" is a llama and the "vicuna" is the guanaco. They are readily identifiable as the llama is the largest of the group, the alpaca the woolliest, the vicuna the smallest and the guanaco is about the same size as the llama. This could be a publishing error yet it was not obvious enough to be corrected.

After three years of searching for alpaca fiber information and finding little, I was pleased to hear the following from an alpaca rancher in Australia. Upon setting out to do "hard core research", Australian research textile scientists canvassed world libraries to ensure that the topic they were about to study had not already been undertaken. They reported to have found nothing! And so we start from scratch.
In the following discussions, there is, then, a distinct lack of documentation and an abundant amount of anecdotal information. In this presentation, I have put together an overview of my experiences together with what I could find from others. Because this is such a new industry in North America, it is a given that as more facts are uncovered and figures are documented, information will be in a constant state of change for some years to come.

I have chosen to present this information in much the same style as traditional books written about specific fibers. A brief historical overview in the introduction sets the stage for highlights on facts about the animal, its fiber and production which are found in Chapter 1 and 11. Excellent information is now available on these topics and can easily be further researched by anyone who needs more detail. The difficulties on topics with no readily available information run from Chapters 111 to V1 and deal with spinning, blending, dying, care and uses, respectively. In many instances, I have only my own experiences or research from which to draw. Unfortunately, here is the case that for as many questions as one can answer, a hundred more need to be asked. So the best is to hope this will work will prove a base for further study.

The assumption is made throughout my discussions that the reader has basic knowledge of spinning and spinning techniques but little knowledge of alpaca fiber. In an effort to be succinct, I have not described many processes except as to where they may differ using alpaca fiber.
DIFFERENCES BETWEEN A LLAMA AND AN ALPACA

"banana", long ears
large, 300 - 450 lb.
tall, 40 - 45" at withers
high tail set
clean face
guard hair overcoat

short, spear shaped ears
small, 90-190 lb.
short, 30"-36" at withers
rounded rear end
low tail set
wool on face
no guard hair in blanket
INTRODUCTION

I think it is not only helpful but interesting to have some knowledge about the animal that produces the fleece from with which one has chosen to spin. Thus it seems appropriate to begin a discussion of alpaca fiber with an overview of the ancient and fascinating history of the animal.

Alpacas are one of a group of four classified as camelidae. (See Appendix A for complete taxonomy.) They are commonly known as camelids, llamas or lamoids and consist of alpacas, llamas, guanacos and vicunas.

Forty million years ago the precursors to the camelidae were native to North America. The Ice Age forced the migration of what was to become camels over the Bering land bridge to Asia and the camelids over the Caribbean land bridge to South America. These ancient progenitors were the size of small dogs and had none of the characteristics of today’s camelidae. Camelids are now native to the high Andean mountains shared by Peru, Bolivia, Argentina and Chile in South America and camels are native to Asia and North Africa.
Dr. Jane Wheeler of the University of Colorado at Boulder made a remarkable discovery at a dig called Telarmachay high in the Andes of a large number of ancient camelid skeletons. From this and other excavations, especially one at Chiribaya culture sites on the coast of Peru, she has concluded that alpaca domestication was well under way as long as 7000 years ago. (Alpacas/Winter 1994: 19) This makes them one of the oldest domesticated animals in history. Llama domestication paralleled alpaca though evidence is more circumstantial. Wheeler has become convinced that alpacas are closely related to vicunas and llamas are more closely related to guanacos. That evidence is based on camelid teeth or dentition and D.N.A. testing. Alpacas and vicunas both have regeneration incisors with no enamel on the tongue side and llamas and guanacos have permanent incisor all encased in enamel. Dentition is well recognized as a means of distinguishing between species.

By 5000 B.C., alpacas and llamas were domesticated in the highlands of South America centered around Lake Titicaca and by 1,500 - 1,000 B.C. on the coastal regions of Peru where a series of advanced cultures rooted in Andean pastoral life flourished and cared for the animals.

Around 600 A.D., a powerful highland state named Wari emerged in the Andes to the south of Lake Titicaca. It eventually conquered much of what is known as Peru today. Wari textiles were distinctive, reflecting a unique and established tradition. They made tapestry an art form. This Wari influence declined after 900 A.D. leaving behind domestication and breeding practices of camelids for the pre-Inca cultures. They formed the foundation of the Inca world as these peoples were captured and integrated.

The 11th to 14th century saw the rise of the Inca Empire, one of the greatest early American civilizations. With victories over rivals, the Inca Empire expand over what is now Peru, parts of Columbia, Equator, Argentina and Chile. It was a powerful and highly organized authority whose economy was based on redistribution, exchange and tribute rather than destruction of the territories and peoples it captured. The major sources of wealth and prosperity in Inca times were potatoes, corn, llamas and alpacas. Huge numbers of llamas were used to transport armies and trading goods; as tribute payment; for sacrifice in religious ceremonies; to provide clothing, ropes, slings and sacks; as food; as skins and for fuel and fertilizer.

Alpacas were highly valued for their fiber and the textiles made from their fleece. Weaving was a primary obligation of the state. Specialized groups were set up to meet the demands by weaving only for state and church. Cloth, camelids and coca leaves were the principal gifts. Cloth was, also, used to outfit armies; as gifts to the newly conquered; for curing favor among lords; for robes and wall hangings in shrines; for hundreds of textiles burned at sacrifices; and for everyday clothing. Two types of cloth were produced and known as qompi and awaska. Qompi was the finest and most delicate made of vicuna and alpaca and reserved for the Inca royalty. Lower grades were used for ethnic lords. No one was allowed to wear qompi unless it was a gift from the ruler. Awaska was woven from llama and coarse alpaca for rough, ordinary wear and other daily objects. Camelid herders were accorded much
prestige. Elaborate and extensive ceremonies were carried out before shearing and slaughter, especially for alpacas. Some of these traditions are still carried out today.

Alpaca husbandry was more controlled than that of llamas. Finds of whole fleeces from before Inca times show finer fleeces than are produced today. This confirms a high degree of selective breeding practices and herd management developed by the pre-Inca cultures and carried on by the Incas. Wheeler's work with comparisons of ancient fleeces with today's, indicate a rigorous selective breeding program that has taken until today to reestablish. In these ancient fleeces, the micron count is lower by 5 microns and the fiber more denser, more uniform, of higher crimp and with less guard and secondary fibers than today's.

The Spanish invasion of 1532 effectively ended the age of the "golden alpaca" up to and including today. The Spanish introduced European livestock, cattle and sheep particularly, and camilids were relegated to marginal pastures. Llamas were valuable for transportation and meat but they preferred sheep wool to alpaca. In 1540's a mange epidemic decimated the alpaca herds and within 50 years sheep had replaced the alpaca.

In one of the few books available concerning alpacas from South America, a Peruvian scientist, Rigoberto Calle Escobar in his book "Animal Breeding and Reproduction of American Camelids" describes four stages of the alpaca evolution as follows:

1) The Inca Period - a time of highly organized, selective breeding of alpacas for fiber used only by Inca rulers.

2) The Colonial and Early Period - an era characterized by the decline of fiber production and an ascendancy of the llama as a beast of burden.

3) 1915 - 1920's - the decline of both species in importance and gross interbreeding.

4) Present and future - the realization of the importance of alpaca fiber and the need to promote quality breeding and management practices for its production.

The industrialization of alpaca fiber started in England with a manufacturer by the name of Sir Titus Salt from Bradford, England. In 1834, he came across an annoying pile of unknown fiber waiting for a purchaser in a Liverpool warehouse. Escobar reports that what was thought to be sheep wool from Peru was baled alpaca fiber and it was this material that drew Salt's attention. It had been there a long time and was about to shipped back to its owner in Arequipa, Peru. Sir Titus scoured and combed the material, carefully examining it to find a long, glossy wool which was admirably adapted for the light, fancy fabrics in great demand during that time. He developed the appropriate cleaning, carding and combing systems which allowed the fiber to be processed industrially. Alpaca easily carved a niche as a luxurious alternative to cashmere and silk. When England lost interest in the manufacture of alpaca, it was taken up by the Peruvians, themselves. Historically, Arequipa, a port city, has been the world center for commercial
production. Although the alpaca culture in Peru has remained the same for centuries, the commercial endeavor in Arequipa have developed a multi-million dollar industry where expertise in handling alpaca has reached the highest level of craftsmanship. They have had and will have for many years to come a complete monopoly on the alpaca fiber market as they own 80% of the world's alpacas.

In 1845, William Walton authored "The Alpaca" with the prospect of introducing herds into England. He wrote "this wool differs from ordinary sheep, exceeding it in length, softness and pliability". Many attempts were made to import and acclimatize alpaca outside the Andes. As early as the seventeen hundreds, alpacas went to Spain, followed by imports to France and Europe. Final attempts were made to send animals to Australia in 1857 and again in 1858. All failed, so it was determined that it simply was not possible. However, successful imports have been made since 1984 to the U.S., Europe, New Zealand, Australia and Canada.
ALPACA BREEDS

SURI
CHAPTER I

ABOUT THE ANIMAL

Breeds and Cross Breeds

There are two breeds of alpaca: Suri and Huacaya. Figures quote 90% of the alpaca population are of the Huacaya breed and 10% the Suri. A cross between a Suri and a Huacaya is called a Chili. A cross between a vicuna and an alpaca is called a Paco Vicuna. The vicuna/alpaca cross may be the wave of the future giving domestication with the finest of fiber. A cross between a llama male and an alpaca female is a Huarizo and a cross between a llama female and an alpaca male is called a Misti. Most crosses are Huarizo likely due to the smaller size of the alpaca male. Llama/alpaca crosses produce the worst of both breeds having poor fleece and reproductive capacities.

Size, Shape and Life Span

Alpacas are about half the size of llamas weighting around 100 to 180 plus pounds and measuring between 30 to 36 inches at the withers. The average height of an alpaca, from head to toe, is about 5 feet. They have short, spear-shaped ears, a low tail set making the rump appear round, a short muzzle and a dense fiber top knot between their ears. Their life span is estimated at 15 to 25 year. They have a shortened life-span in their native land due to poor nutrition and a difficult environment and have not been raised outside of South America long enough to determine their exact life span, ideal weight and size under our technologically improved conditions. Figures for weights and size vary from source to source and likely will continue to do so as ideal breeding and growing conditions continues to improve health and vigor.

Standards for Identification and Breeding

Alpacas in Canada are registered with the Canadian Livestock Association. Animals must be properly identified and this is normally accomplished by microchipping. This is the safest, most painless, aesthetically pleasing and securest method of identifying animals. It is a requirement here and in the United States to have animals blood tested to confirm parentage, and if needed to confirm unknown parents, DNA tested. This assures accurate parentage records. With these records a rancher can work to improve the herd by careful and selective breeding to increase vigor and fiber quality. Breeding should be done with only well conformed and healthy animals. Animals with any serious genetic faults should be eliminated from the herd as a breeding animal and only superior males should be allowed to stand at stud. With such a new industry, it has taken time to not only learn about these animals but to educate. There has been excellent information forth coming on the animal and its genetics.
The income from alpaca ranching has been, to date, in the sale of stock and not in the fiber. Therefore, the emphasis has been on breeding and not fiber production. As the industry grows it is hoped that high quality fiber production will follow efforts to strive for high quality, healthy, well conformed animals.

Reproduction

Males are sexually mature at 2 1/2 to 3 year and females at 15 to 20 months. There are many and varied breeding theories and much work being done and still to do in understanding this area.

Camilids breed laying down, a most unusual but comfortable position. Gestation is about 11 months producing one cria (Spanish for baby) a year. Crias usually weigh between 11 and 16 pounds at birth. Twins are exceptionally rare. They are induced ovulators. Ovulation occurs in response to breeding and they do not have a specific breeding season. They can be and are breed at any time of year. Breeding takes place 2 to 3 weeks after birth. Birth usually takes place in the day, an adaptation to the cool nights in their native land. Weaning is done when the cria is 5 to 6 months old.

Sombria and new baby (cria)
Temperament

Alpacas are a herd animal and should never be kept alone. When moving from one location to another, the entire group will go. Great stress can be created in isolating an animal so a friend is usually provided, even on trips to the vet. The typical alpaca temperament is quiet, calm, alert, intelligent, curious, and reasonably predictable. They are more restless, more skittish and more easily frighten than llamas. They do not like to be touched and, like a cat, would prefer to make such a decision. They are usually safe around children as they like to keep their distance. Being head shy, they will run when a hand is extended. Under adverse conditions, they can scream, spit and kick as a means of defense and can use spitting as one way of establishing pecking order in the herd. Such reactions to normal human encounters are unacceptable and can be overcome with training and handling. They are quick to learn and it takes little time to understand what is required and with more intensive work can be very well trained. Alpacas are more vocal than llamas with humming, grunting, and, if displeased, screeching to each other. They, also, produce a rather effective and disturbing alarm call of an weird, high pitched shriek, when perceived to be in trouble or seriously threatened. However, alpacas are normally quiet and calm and are best handled in that fashion so are very relaxing to work with and be around. They are very intelligent animals and can be counted on to stay out of trouble with the exception of the odd breeding male and intact male youngster that may insist on fighting. Separating troublesome males is an easy answer.

Care

Alpacas are hardy and relatively disease free. They need yearly vaccinations, regular worming, toe nail trimming and dental checks. With the exception of the odd breeding male or rambunctious youngster, alpacas do not usually challenge fences so minimum enclosures are needed. It is more important to fence against predator getting in than alpacas getting out. Shelters must be provided against the extremes of cold, rain, heat and cold wind. They are more affected by hot than cold conditions. Heat stress can kill. Unfortunately, they do not lick their crias dry after birth so this presents a serious situation for the new born baby in freezing weather. In cold parts of Canada, the choice is made not to have winter cria or, if necessary, a close baby watch is instituted and barn facilities are bumped up to provide a warm environment for birthing and the first few days of life.

Alpacas are modified ruminants with a three compartment stomach. It is estimated that their digestive system is about 50% more efficient than that of sheep so they cost less to feed than most other domestic animals. Very rich grasses and high protein feed promote overweight animals. With Canadian long cold winters, grain supplement is used. Animals must always have access to vitamins, minerals, salt and fresh water.

We know animals live 11 to 18 years but it is hoped that they will have a much longer life given the excellent care and feed available.
Environmental Impact

Alpacas are an environmentally friendly animal. Their soft padded foot and trimmed toenails are easy on pasture grasses. They eat high and low vegetation not eaten by other animals keeping pastures pruned. They do not pull plants up by the roots as they have no top front teeth. They use communal dung piles making their areas clean and easy to keep. Pellets make excellent garden fertilizer. Their fiber is renewable and 100% usable. Experiments with tags (waste fiber) provides an excellent compost material as well as usable material to line hanging plant baskets for moisture retention. Their body and fiber are free from strong odor. Fiber can be pleasantly spun raw as there is little smell or grease and, if cleaned before shearing, little dirt. Large quantities of heated water and laundry products are saved in fiber processing as washing can take place after spinning when setting the twist and the very low grease content is easily removed.

ABOUT THE FIBER

Wool and Hair

Terminology is always an interesting topic when talking about alpaca fleece. The broad definition of "wool" can be applied to alpacas as it is a fiber bearing animal and for fine alpaca it can be used in a more technically sense as it has no medullation and has both a paracortex and an orthocortex. I find most people using the term wool think sheep so my preference, and much of the industry as well, is to refer to alpaca as fiber and leave the term wool to the sheep.

Since alpacas are considered an essentially one coated fiber producer, the goal of breeders should be to breed for a quality fleece in the blanket areas that is free of secondary fiber and guard hair. Due to a history of periods of interbreeding that have occurred from the fall of the Inca world to almost today, alpaca fleeces are not completely homogeneous as is seen with centuries of selective breeding in sheep and other fiber animals.

Three types of fibers maybe found in the alpaca fleece: a prime or predominate fiber, a secondary or intermediate fiber and a guard hair. Very fine fibers at 15 to 20 microns are non-medullated or have a hollow core. Fine fibers at 20 to 30 microns have a fragmented medullation. Coarser fibers at 30 to 40 microns have a interrupted medullation. Very coarse fibers approximately 40 to 60 microns have a medium wide unbroken medullation and over 60 a very wide unbroken medullation.

Wool-like finer fibers have both an orthocortex and a paracortex accounting for crimp. As fibers increase in medullation and as animals age and their fiber coarsens, the orthocortex and the crimp tends to disappear.
THREE TYPES OF FIBER IN ALPACA FLEECES

PRIME - BLANKET

SECONDARY - FRONT SHOULDERS, REAR, NECK

GUARD HAIR - APRON, LEGS, BELLY
Prime fibers only should be found in the blanket area of a fleece and should extend well
to the front and rear of the animal. A mixture of fibers is found in any one blanket. The
more consistent the fibers in a particular fleece the higher its quality. Consistency means
similarity in fineness, crimp, handle and staple length. The average micron count for al­
pacas has been found to be 27.

Secondary fibers in alpaca are a wool or wool/hair combination depending on how fine
or coarse they maybe. Secondary fibers can be readily identified as fibers that are slightly
longer and slightly coarser than the main fleece and if crimp is present, slightly straighter.
The degree of fineness of the secondary fibers is directly related to the fineness of the
main fleece and are just slightly coarser. I find many alpacas have a small proportion of
secondary fibers mixed through the blanket. An amount of secondary fibers over 5%
tends to interfere with the fineness of the prime fleece. When a fleece contains a large
amount of secondary fiber, I remove them or down grade the fleece.

Guard hair maybe found and is acceptable in some parts of the fleece other than the
blanket. It can be located in the front bib, neck, apron, legs, britch and belly and is espe­
cially noticeable in older animals. It is a true hair with an unbroken medulla and absence
of orthocortex making it straight. Coarseness ranges from approximately 40 to 60 mi­
crons. Guard hairs are easily recognized as being much longer, coarser and straighter than
any other kind of fibers. Guard hair in the blanket areas of an alpaca is unacceptable and
may mean a llama cross in the background of that alpaca. Removing guard hair from oth­
erwise good fiber can extend the percentage of quality fiber available from that fleece.

The future for alpacas, it is hoped, will be in the complete absence of secondary fiber and
guard hair from any part of their fleece.

Shearing

Alpacas, like sheep, do not shed and fiber can be harvested at the owner's wish. Sheep
must be shorn once a year to produce usable fleece but alpacas can have a healthy
two year fleece. There are interesting discussions, both here and in Peru, on when to
shear. In Peru, because the original British processing equipment was set to process long
fiber and a one year growth was too short, shearing every two years was the rule. In the
1930's, American equipment was introduced using shorter fiber but the South American
alpaca ranchers stuck with the two year notion and are now trying to be convinced its
economically sound to shear every year. There is evidence being compiled, now, that
shearing every year is best for both commerce and the health of the herds. The animals I
did not shear for two years produced 10 inches and over staple lengths. This is much too
long for industry and, in my opinion, a difficult and needless length for most handspin­
ners. In extremely warm weather, heat stress is a major concern as breeding comes to a
halt and, if not keep cool, animals can die. The easiest way to deal with this problem is to
shear before the heat sets in every year. The majority of hand spinners are quite pleased
with a staple length of 4 to 6 inches, a one year growth, and so is industry. In fact, the
Blanket

Top knot 3rds

Tags

Neck 2nd or 3rds

Bob Apron 3rds

Hay Mound tags

Mid line 3rds

Blanket 1st

Belly 3rd

Leg 3rds

Leg 3rds

Tail 3rds

Mamie Krieger 1954
small custom mills who spin alpaca are taxed with a staple length of 5 inches and over. As well, a two year growth can have breaks, tip damage and weather damage, to say nothing of the dirt accumulation, all reducing the quality of the fleece. I liked to shear my babies as close to their first year as possible because this is their prime fleece and I feared letting it get damaged or incurring an increase in micron count as it grew older. I have let my older low fiber producing mom’s have a rest from the stress of shearing and do every two years. Most agree a three years growth is a wasted fleece. In Canada, shearing must take place early enough to grow enough fiber back for winter. Slick shearing methods prevail as only well trained animals will stand for hand shearing where some fiber can be more easily left on. Electric shearing equipment designed to leave an even short layer on has not worked well. How animals are shorn is often determined by their temperament and training. Because my animals were not use to being handled a lot, we used an Aussie restraint system that was fast and safe.

Shear weights in Peru quote an average of 4 pound per year and my alpacas sheared out at an average of 5 pounds with a 1 1/2 to 3 pound blanket.

Sorting and Grading

Sorting is done much the same as in Peru but with a lack of the discriminating hands of a Peruvian grader. Older Peruvian women grade by hand for the major processors. It can be sorted and graded as many as three times.

Fleeces in Peru are separated according to varieties into seven basic grades: Huacaya or Suri; age: baby or adult; adult by micron: extra fine - 22-24.9, medium - 25-29.9, thick - 30-35.9, skirtings - more than 30; and tags. An individual fleece is sorted by blanket (sides) - the most valuable; neck - usually shorter than blanket and may or may not be as fine; chest - which is likely contaminated with guard hair (a hang over of the vicuna
bib?); front shoulders - may contain guard hair; rump - may contain guard hair; leg wool - 
coarsest; and belly - coarse, short, scarce, dirty and often containing guard hair.
In Canada, no common method of grading or sorting is formalized as there is not enough 
fiber for commercial production so it is up to the rancher to deal with his own fiber.

I sorted my fiber by micron count, handle and color. An individual fleece was sorted into 
three groups for young fleeces and four groupings for older fleeces. Weathered or con-
taminated fiber found along the very center of back, especially at the end of the neck 
(often referred to as "the hay mound") needs to be removed first as even small bits left 
from grooming are present and can fall into the rest of the fleece. It is important to skirt 
out the blanket next to keep it clean and in tact. How well the blanket extends to the front 
and rear of animal, will depend on the blanket size. Where there is a change in texture 
and coarseness or the presence of noticeable amounts of secondary fibers, the blanket 
ends. The front shoulders and rump are separated out next and are most often quite simi-
lar. They can be further sorted into two or possible three more grades. The fiber that 
grows closest to the blanket is usually quite nice and I set it aside as "good second". They 
have provide me with fibers for soft outer wear and blending. Fibers with excess amounts 
of guard hair are put with the tags or thirds and the remainder classifies as regular sec-
onds. Fibers from the legs, belly, apron and britch are usually very coarse in all but very 
young animals and rank only as tags or thirds. Clean thirds make excellent strong yarns 
for many items such as rugs.

PROPERTIES

Alpaca is classified as a natural fiber from an animal source. It is similar in nature to 
sheep wool and other animal fibers as it is composed of a complex protein called keratin.

Much of the void in information about alpaca properties has been filled by extrapolating 
from the sheep industry but as new facts are slowly emerging that information is now 
found to be somewhat misleading. Certain properties are able to be measured. These in-
clude fiber diameter, crimp, tensile strength, staple length and fleece weights. The dis-
ussion of these numbers becomes centered upon their relevance and use.

Priorities in evaluating fiber properties are different and vary according to needs. A dis-
tinct difference will be found from the fiber producer to the fiber processor and then, 
again, for the user. For example, shear weights are of a major concern to the producer 
and staple lengths of prime importance to the processor.

My discussion, for the most part, will limit alpaca fiber properties importance to the hand 
spinner and consumer.
Suri versus Huacaya Fiber

With a large importation of Suri alpacas just coming into the U.S., it is well to look closer at these two varieties of alpaca fibers. Only 10% of alpacas are of the Suri breed. The major difference is in their fiber. Suri has long, straight fiber with little crimp that hangs down and flutters in the wind. The Huacaya appears to be a "pasture poodle" with fiber that grows straight out from the body like a puff ball.

The Suri fleece is superior in fineness with an average of 26.8 microns to the Huacaya at 27.7. These are Peruvian figures as no figures are yet available in Canada. Suri is longer, silkier, softer, cleaner, dryer, brighter, more elastic, more flexible and more lustrous than Huacaya. Huacaya is stronger, denser and has better felting capacity than Suri. The Suri fleece is solid, compact and shiny like mohair where the Huacaya has a more sponge-like wool texture. Huacaya can have a great luster but it differs from animal to animal, higher luster Huacaya being more prized.

Fineness

Fineness describes the diameter of the fiber and this is measured in microns. The smaller the fiber diameter the finer the fiber. One micron is one millionth part of a meter. Fiber diameter is accurately measured by Laserscan where 2,000 chopped up pieces from a handful of fibers can be read in seconds. When quoting a micron count on a given animal's fleece, what is used is the over-all average of fibers tested from the mid blanket area of that fleece. Such an accurate and objective measurement is replacing all other standards used for determining fiber fineness. It is an excellent tool in helping ranchers design their breeding programs as well as hand spinners their next project. Today, it is an inexpensive and easy measurement to know. As a consumer of alpaca fiber, it is one of the first question I ask when purchasing alpaca fiber as it maybe one of the determining factors dictating a possible end use.

Alpacas likely produce one of the widest ranges of fiber diameters from animal to animal within a given breed. My own few alpaca blankets ranged from 22 to 34 microns. If the blanket has a micron count averaging in the lower ranges, approximately under 27, it is considered a quality fleece. There is also a wide variation of fiber diameters within a given fleece. Micron counts on individual fibers within the blanket can range from as low as 10 to over 60 microns. It would be rare, indeed, to find an entire fleece in the 11 to 17 or over 40 average micron range. Most fleeces average 22 to 34 microns mid blanket. To find such a variety in sheep wool, one must choose from many different breeds. One of my older animals measured a 22 micron blanket but went to over 50 microns in the legs giving me baby sweaters to rugs which is a great diversity of end uses from one animal. This diverse range should be remembered in purchasing a whole fleece.

Fineness for me as a hand spinner is a top priority in selecting an alpaca fleece. With the labor intensive nature of hand spinning, I prefer to work with only the finest fibers an
save the seconds and thirds for mill spinning. Fineness is also of major importance to breeders as higher prices for fine alpaca are paid increasing farm incomes. To achieve higher prices next-to-the-skin quality is required. It is suggested the micron count needs to be 22 or lower to be completely comfortable next to the skin. Only about 7% of all alpaca graded in Peru are of this quality. At these low micron counts the "prickle factor" is eliminated meaning that the fiber is not itchy next to the skin. However, each person has their own sensitivity level and some people are comfortable with alpaca down to 27 microns. Most animals grow a fleece at 24 to 30 microns. The average in Peru is 26.8 to 27.7 microns and mine was similar.

It should be noted here that there are advanced Peruvian alpaca ranchers that are producing exceptional animals whose fleece has very low micron counts in the 18 to 22 range and very high shear weights, upwards to 10 pounds being reported. They have not followed the traditional ways but sought enlightened breeding programs. These exceptional animals are presently finding their way to North America and should make a marked improvement in genetic possibilities for animals with high quality fiber and heavier shear weights.

It is the Peruvian experience to find production maximizes at 3 years to 8 years, at which point the fiber starts to coarsen. I had some animals not coarsen until much older than 8 and many older animals retained their fineness but had a reduction in blanket size and staple length. A increase in micron count in fleeces is noticed from cria to adult as is typical of most fiber bearing animals. Accurate figures are not yet available on these changes.

The Prickle Factor and Allergies

There are reported to be 30% of people who are allergic to wool. New science is looking at the fact that this may not be an allergy at all but a painful response to the skin being pricked by coarser fibers. It has been determined that if an item contains over 5% of fiber with a diameter in excess of 30 microns, it will prickle or itch and that the prickle factor begins to occur in item that exceeds 22 microns. The variations from 22 to 30 account for personal differences in reaction to the problem. Alpaca has been reported as having less allergic reactions than wool as quality alpaca is usually lower than 27 microns. Prickle apparently results from high-load supporting fiber ends on the fabric surface indenting the skin enough to activate pain, prickle or itch and instigating skin discomfort to inflammation. Remembering alpaca has a long staple, is interesting to note that prickle is reduced as mean fiber length increases. Prickle factors, also, increase with sweating. It is more noticeable in woven fabrics than knitted and more pronounced in woolen than worsted fabrics. This information can be critical to spinners and consumers cursed with sensitive skin in knowing what quality is needed for next-to-the-skin items and baby wear.
However, the nature of allergies are not completely understood and, as well, people can be sensitive to other aspects of fiber. Alpaca seems, at this point, to evoke far less allergic responses than sheep wool.

Handle

To the Peruvian processor, handle is the single most important characteristic and it is left to the skilled hands of older, experienced women to determine. The discussion rages as to what all it is they feel!

If any property can be describe as the true essence of alpaca, for me, it is in the handle of alpaca as I think it is truly unique. I describe the handle as the sum total of softness, smoothness, silkiness and lightness. To some extent the silky slippery factor is attributed to the scales cuticle cell structure and the height of separation of the edges. These have been measured at approximately 0.4 microns. Compared to sheep wool at approximately 0.8 microns that gives alpaca a considerably softer smoother feel. When alpaca and wool of the same micron are compared by touch, the alpaca actually feels lower in microns than the wool by some 2 to 3 of microns (Holt, Alpacas International News/Dec.'96:9). Because alpaca feels so smooth it has been thought to be a difficult fiber to spin but it is not and does have adequate grab. I, as well as many other alpaca ranchers, learned how to spin using only alpaca with little trouble.

Softness is also attributed to the high frequency of scales along the fiber's shaft. Alpaca has the same scale height as mohair but feels softer because it has a frequency of greater than 9 per 100 microns to mohair’s 6 to 8 per 100 microns (Safely, Alpacas/Sept.'94:48).

Lightness or airiness are less clear but attributed to the ability of alpaca to trap air which not only adds to its lightness but insulating quality. This factor is not completely understood.

People know what fibers are comfortable and what are not and everyone has their own opinion. Handle can be a very subjective property. It takes experience to develop the ability to judge alpacas handle. Spinners and consumers know what they want and will decide to buy based on the fiber's handle (and likely color as well) and without ever knowing its particular micron count.

Color

Alpaca is available in a wider range of natural colors than any other fiber bearing animal in the world. This is another most unique characteristic of alpaca. There are many shade of whites, champagnes, tans, browns, reds, chocolates, grays, pearls, charcoals and roses to name a few. Whites and blacks are available in true white and non fading black, colors not usually found in other fiber animals. The Canadian alpaca associations have adopted the Peruvian color chart as a means of better describing alpaca fiber colors.
The large powerful fiber processors of Peru determined a need for white and light colored fibers because of the their flexibility in dying. However, the "light is right" axiom of the 1980's no longer holds with the move to natural color by the fashion industry and the sophistication of computerized dying. Peruvian breeders met this need to the exclusion of many natural colors, particularly silver gray, true black and darkest fawn of which there now is a dearth (Hoffman, Llamas/Jan./Fed.'95:92).

So, the movement is back to the greatest color diversity the fiber world has known, of which over 250 separate colors have been identified from 8 basic colors and compiled into a 22 shade color chart.

Strength

Tensile strength has been studied by Australian research scientists and determined to be three times stronger than that of Merino sheep wool. It is to be remembered that wool is only medium in strength as fibers go. This means alpaca is tough, durable, long lasting and a hard wearing fiber. It, also, means it is suitable to the rigors and stress of most textile process without fear of breaking. Further, the strength of alpaca does not diminish as it becomes finer which makes it ideal for industrial or home processing.

On the farm, strength can be tested by pulling a lock to determine its breaking point. It is difficult to break healthy alpaca in this fashion. Examination of causes of a break, if they occur, can be usually found by looking at the health and any stress history of the animal. Strength may be one of the greatest attribute that coarser grades of alpaca can contribute to it's usability and blends with other fibers.

Staple Length

Staple length is related to strength as the longer the fiber the greater its strength especially when spun. Alpaca fiber can be obtained in many staple lengths making it suitable for either the woolen or worsted system. Alpacas are one of the few fiber animals that have great flexibility in providing almost any staple length required. I recorded one year’s growths from 3 inches to 6 1/2 inches and two year’s growths from 10 inches to 13 inches. Shorter lengths are suitable for woolens and longer lengths for worsteds.

Staple length is important to the rancher in that it increases the volume to be sold and premium prices are offered for longer lengths. Longer staple lengths are important to the spinner because they offer more variety in choice of yarn design and are faster and easier to spin.

Abrasion Resistance

Australian research found alpaca not only has great strength and resilience but great abrasion resistance. This is the ability to bend many times without breaking and adds to the wearability and usability of a fiber and of major importance in fabrication. The ancient
STAPLE LENGTHS

1 YEAR

2 YEAR
Incas as well as their modern day descendants relied heavily on coarse camilid fiber for every manner of cordage and heavy duty household textiles. This usage can be attributed to alpaca's strength but also to its excellent abrasion resistance. Very little experimentation has been done today with the use of alpaca thirds and it will be interesting to see how this area develops. At first, I threw the thirds away, then I put them in compost but just recently sent some off to be spun and was amazed at the wonderful utilitarian yarns that came back. I have seen some excellent products made with thirds on lead ropes and rugs.

Abrasion resistance is equally important in fine fibers to increase wearability and longevity of alpaca products. I am just beginning preliminary work on alpacas suitability for embroidery, tapestry, needlepoint yarns as they all require strength and abrasion resistance. Abrasion resistance is also a major property required for use as warp yarns. It will be interesting to watch and work on developing alpacas usefulness in all these areas.

Yield

At first glance, yield would seem important only to the rancher as it relates to his income but after having bought and sold much alpaca, this is of a great concern to hand spinners as it relates to end product costs. Alpaca is 100% usable, if one includes what hits the compost pile. The American alpaca association quote "87 to 95% (clean fleece yield) for alpaca versus 43 to 76 for sheep's wool". The actual yield will depend on the what parts of the fleece is purchased, the condition of fiber and the amounts of contamination. An important thing to remember is, that in the raw, grease content is very low for alpaca and estimated at 4 to 5% which makes it a marked improvement over sheep wool or mohair where losses can run as much as 30 to 50%. With such a low grease content and lack of strong odor, alpaca fiber can be readily spun raw.

The best yield, and likely the best buy, is in the purchase of rovings given that they be free of secondary fiber and contamination as they should be 100% usable. I have lost up to 30% in cleaning a dirty fleece, to say nothing of the time it took to do this.

It maybe important to remember that the blanket section of a fleece always runs at least 1 1/2 pounds and upwards to 3 giving a good yield for most knit sweaters. Given alpacas diverse color, this is critical if using alpaca in its natural hues as it could take a year before that particular color maybe come available again.

Absorability

Like all natural fibers, alpaca has the ability to absorb moisture. It has a natural regain of 15% (Holt 10). Wool is higher but alpaca is still considered comfortable in absorbing moisture from the air as well as the skin. It is thought that alpaca can absorb almost as well wool which is at 30% of its weight. I have found alpaca absorbs well but at a little slower rate than wool.
Elasticity

Bette Hoschberg suggests in her book "Fiber Facts" that to understand a fiber's elastic abilities, it needs to be studied at the molecular level. I have not uncovered this kind of study or any other such research on alpaca's elasticity. Therefore further comments remain in the subjective realm.

Wool is the most elastic of the natural fibers and has become the standard for judging others fibers. Many "wool" people think alpaca has no elasticity and it needs the addition of wool to be usable but this has not been my experience. In point of fact, I have seen poorer looking wool sweaters for recovery, creating stretch and sag, than alpaca. I think two things are happening here. First, alpaca does have good elasticity leaving wool's at excellent. Second, elasticity can be built into knits not only in the spinning process but in the knit construction. I have found alpaca sweaters keep their shape well and it takes extensive wear to cause them to loose shape. When washed, memory returns and they easily blocked back to shape. I have never notice a wrinkled alpaca knit garment and find creases hang out more quickly than in wool items. I have not worked sufficiently enough with woven alpaca to make any comments except to say there should be some carry over from knit to woven items with regards to elasticity. Alpaca is considered elastic enough to accept the rigors of the industrial process.

In an attempt to test one aspect of alpaca's elasticity, I spun samples of Merino, high crimp alpaca, medium crimp alpaca, Border Leicester wool and mohair. All samples were prepared and spun the same way using a woolen system. I used the Merino as the standard of excellence for elasticity. Since alpaca fleeces present with a variety of crimp and crimp is one means to determine elasticity, I included a high crimp and medium crimp alpaca sample. I used Border Leicester as an example of medium crimp wool. The mohair is an example of low crimp and low elastic fiber. I designed the test by measuring each sample to the same lengths at a state of rest and anchored one end in place so the opposite end can be stretched. I then measured the amount of maximum stretch on each sample and compared.

I expected and found that the most stretch was in the Merino as it is know to have the best elasticity of the natural fiber group (Ross, The Encyclopedia of Hand Spinning 23). The surprise was in how close the high crimp alpaca was to the Merino and how much more than that of the Border Leicester. I, also, did not think the medium crimp alpaca would surpass the Border Leicester but it did, even if by just a bit. The elasticity of alpaca has been compared by many as close to mohair, here however, there is a wide gap. For me, this test confirms my experience that alpaca does have elasticity and is in the approximate medium range as compared to Merino and mohair.
Crimp

In his article about the role of crimp written for the American Alpaca Association, Mike Safley, explains that understanding the nature of crimp in a fiber and its function in a textile have been under review by researchers in Japan, Australia and New Zealand. There now exists the ability to isolate by measurements the crimp factor of a given fiber and to assess its impact on an end product. The traditionally held view that more crimp means the finer the fiber is proving to be a misconception. As it turns out, it is only a rough indicator at best. This was good news for alpaca fiber as its crimp factors are erratic and much lower than wool. The crimp average for alpaca is stated at 7 crimps per inch. The research was done on sheep wool not alpaca but can be used to help answer alpaca crimp questions. The bottomline on this research that I found significant to alpaca was that lower crimp wool had a preferred handle because they proved softer and smoother than the fabrics made from the higher crimp wools of the same micron count. I was pleased to read about this as crimp in alpaca has been a puzzle for me. The "rules" that applied to crimp for wool did not seem to fit for alpaca. I have worked with many an alpaca fleece that exhibited "poor crimp" without a problem. In fact, since the crimp factor varies so much from fleece to fleece, I simply dismissed it as having any importance or relevance much like the Peruvian sorters. My guess is that, since alpaca has good resilience (as proven by researchers in Australia) and some measure of elasticity (the exact science of which is still to come), these factors may accommodate what was thought that crimp contributes to the fiber.

High crimp fibers were determined by this latest research to produce better woolen fabric than worsted. This would suggest to look for high crimp in alpaca for end products suited to the woolen system.

Resilience

Australian research proved that alpaca is a resilient fiber. I have had report of less tired and better feeling feet when wearing alpaca socks and of alpaca rugs displayed a nice feel on impact and noticeably more comfort when standing. Further, I was amazed when unpacking a suitcase of alpaca knitwear that had been sitting for months, to notice the unwrinkled condition the garments showed when hung up.

Resilience, along with strength and abrasion resistance, is critical to the ease with which a fiber can be texturized and fabricated. I am convinced that alpaca resilience will be one day recognized as a very important characteristic.

Thermal Properties

Alpaca is well known to be an excellent insulator. It is know to be much better than wool. The full mechanics of this are not completely understood and need more research. Escobar thinks this superior quality relates to the necessity of survival for animals in a
cold climate by making a "high-powered thermal coat". In the altiplano, 300 nights of the year are below freezing. The American alpaca association pamphlet on fiber says "Alpaca has developed more thermal capacity in its fiber than almost any other animal". My experience is that alpaca is, indeed, a very warm fiber. It can have great warmth without weight. Poor yarn construction can produce garments that are oppressively warm. Good yarn design and blending are the keys to making alpaca suitable to all manner of garments and occasions.

Odor and Grease

Alpaca is a fiber virtually grease-free. Escobar reports 4 to 5% grease content compared to sheep at 10 to 20%. I believe sheep wool can be even higher, especially in fine wools. Raw, clean alpaca can be 90 to 95% usable by the hand spinner and under commercial production 80% usable.

Animals have a very mild and non-offensive body odor. This does transfer to the fiber but quickly dissipates within days of shearing. With little grease and no smell, alpaca can be pleasantly spun raw.

Flame Resistance

Only the protein fibers are flame resistant and so it is with alpaca. It burns slowly and tends to snuff out leaving a soft ash that does not stick to the skin. This is an important consideration, especially, in clothing for children and the elderly.

Felting

Alpaca does have the ability to felt. It is not nearly as quick as sheep wool since alpaca has a smoother scale cell structure than wool and just takes more work. Fineness and crimp also contribute to felting ability. Most fine alpaca with higher crimp is not used for felted items so a percentage of sheep wool will help to speed up the process when using alpaca seconds or thirds that have lower crimp factors.

Under careful hand washing conditions, alpacas felts little but a whirl through the automatic washer and dryer will result in the same problems as with wool resulting in a noticeable reduction in size and a permanent matting and meshing of fibers.

Bulking

Alpaca holds air in its fibers very well as is known in its ability to insulate. Alpaca is noted for warmth without weight. Bulking allows fibers to spring back into shape, to resist compression, to have a decrease of static build up as its absorbency is increased and to have a softer hand.
FLUFFING TEST

COMPARISON OF FOUR FIBERS BY NAPPING

MERINO ALPACA ANGORA MOHAIR
I think the most interesting aspect of a fibers ability to bulk is the that surfaces can be brushed to create a nap thereby further increasing and trapping air. This is an essential property in the making of good woolens.

Fluff or Halo

These are terms generally used to describe how much the fibers ends stick out from surface of a textile. All fabrics do have some surface texture. The nature of the fiber, staple lengths, spinning systems, weaving techniques and finishing processes all affect the amount of surface texture present or lacking in a fabric. Some fibers out do any and all attempts to keep the texture smooth and a fuzziness will appear, sooner or later. Angora and mohair are two such fibers and I think alpaca is a third.

This has not been described or written about by alpaca fiber experts that I can see but it has been noted by alpaca spinners with whom I compare notes. In particular, it was noted by the world's most renown wool comber, Peter Teal. I had occasion to deal with him in my search for wool combs suitable for alpaca. In our correspondence, he described a "hairiness" to his finished alpaca worsted yarn samples that would not go away. Since wool combing is the ultimate method for preparing smooth fibers, this confirmed my thinking that there is a good chance that a halo is inherent to the nature of alpaca.

To looking at this question, I prepared four samples to compare napping abilities. I used Merino to represent the "norm"; mohair and angora as examples of high fuzz fibers and alpaca. I prepared and spun the samples using the woolen system as it more conducive to lofting than the worsted and any conclusions would be more obvious. I brushed all samples together to ensure even treatment. It should be noted that it is not generally accepted practice to brush Merino but was necessary for efficacy.

I thought the test went well in identifying alpaca's natural ability to loft. It is easy to see the alpaca fluffed almost as well as the mohair and angora while that of the Merino has less fluff than the other three. The Merino's fuzz is the only one of the three that came up in spots while the others are much more even up and down the yarn. This suggests to me that Merino lacks the of natural ability to loft as the others do and the resulting fluff is more a propensity for ends to fuzz upon agitation and, also, accounts for the pill on wear under rough treatment.

Pilling

I have found some alpaca projects prone to pills. When I looked at the possible causes, I went back and examined the supply. In most instances, the rovings contained second cuts and short fibers which easily are known to work their way to the surface upon wear. I think if alpaca has a serious pill problem it is directly related to the presence of short fibers. The fuzzing of fiber ends, as well, will contributes to some minor pilling. The other observation of note about the alpaca pills is that they are always easy to remove with just a quick pinch. They seldom get completely entangled so that they are difficult to remove
and need to be cut off. This is likely due the slipperiness of the alpaca fiber allowing them to be moved out without difficulty. It has been my experience to be able to keep alpaca items looking good and free from pills.
Planning Projects

Alpaca offers incredible flexibility for end uses from within a single fleece as well as from one animal to another. Projects range from next-to-the-skin fineness from prime fibers to warm outdoor items from seconds and then hard wearing thirds for household items and cordage.

Staple lengths can be customized to any requirement. Short neck fiber and short clips from cria fleeces and older animals give lengths of 2 to 4 inches that are suitable for the woolen system. Averages of 5 to 6 inches from one year growth and over 10 inches from two years growth are appropriate for any type of worsted systems.

No other fiber animal offers alpaca's great diversity of natural colors from which to choose. Of particular interest is the availability of true black, a color which no other animals provides without dying. White, light and medium colors dye well. Dark grays are usually made up of black and white fibers and the white will dye giving the most unusual grays. Dyed lighter brown tones give lovely muted colors.

Alpaca's natural properties combines unique and versatile characteristics that can give a product cashmere like softness, silk like smoothness, nylon like strength and wool like comfort, to name a few. Alpaca blends readily with most other fibers adding their important properties not found in alpaca thus making for almost endless list of possible end products. Alpaca offers a wide assortment of crimp styles, luster and handles so most any idea can be pursued.

So many options requires thinking and planing ahead so the best possible fiber is used for an end product that meets the guide-line of budget and design constraints.

Choosing Fiber For End Use

Alpaca offers more choices for end products than usually presented within a specific fiber, especially with colors and fiber diameters. Once familiar with alpaca and its versatility, deciding what kind of alpaca is needed for a specific use gets easier. Fiber suppliers are becoming more abundant and specific orders can be readily filled. However, most "would be" alpaca spinners start with a sample or small supply they were given or purchased to try. The most often asked question I get from new alpaca users is "what shall I do with it"? At the point where the fiber is in hand, the color, handle, fineness and condition are a given so deciding on its end use is more limited. Restrictions also fall into place with a discussion on abilities to spin and fabricate. Often it is thought that alpaca
must be blended with sheep wool to make it usable or easier to spin and, I find, it can be quite a revelation to suggest otherwise. The most limiting condition is if the alpaca is in poor condition. Alpaca producers do a very real disservice to the industry by sending out poor quality and dirty fiber to the public. A little work can solve many problems in picking out secondary fiber and debris as well as flicking and carding where necessary.

It is exciting to make suggestions for end projects when a particularly nice quality of alpaca is in hand. I generally recommend spinning thin rather than thick for a broader choice of end uses and the possibilities of dye results with medium to light colored fiber. I find spinners have a much longer list of what projects to make with fine fibers than coarser ones so it is enlightening to see what one can do to broaden the use of lesser quality horizons as well.

When supply is limited, it is fun to discuss stretching by blending. I seldom recommend wool unless the alpaca is seconds. With fine quality alpaca, it is amazing to watch the "wheels clicking" as I try to uncover what other fine fibers might already be available from "the fiber stash". With spinners, one thing that can be counted on is a large supply of small bits of stashed fibers. Small amounts of good quality alpaca will blend with the leftovers or amounts too small for projects that can include silk, tussah, quivit, cashmere, angora and camel down.

Very fine and very coarse fibers provide an almost automatic list for end uses but in-between gets more difficult. Determining the user's "prickle factor" can draw the line on next-to-the-skin quality items. If fiber has too much "itch" that will eliminate all garments that will be next-to-the-skin but still leaves a wide selection for outer wear.

Availability

Alpaca can be purchased for spinning as raw fleece or in rovings. This can be done by mail or in person at a fiber store or from a farm. Most ranchers will provide samples and can be canvassed for color, quality and price. It maybe more fun to visit the farm and see the fleece right on the animal. Raw alpaca can be acquired even before the animal is sheared. This is a good idea as the rancher can take special care to properly clean "sold" fleece before shearing.

Rovings are available in both woolen and worsted from ranchers. Rovings purchased from commercial fiber stores are, as yet, of Peruvian origin. It is hoped that in the not to distant future we may see the advent of a Canadian made product in these stores.

When checking samples of raw alpaca fleece for possible purchase, I think it is important to wash a lock. Washed fibers tell much more about the true color, luster and handle which maybe disguised with dust and dirt.
Grooming and Cleaning the Fleece

Just before shearing is the ideal time to groom and clean the fleece. It is much easier to clean fiber on the animal than off. Fiber should not be brushed until shearing time as nature has a way of keep the fleece clean by "sealing" the locks at the tips thus preventing the passage of contamination and debris into the center of the fleece. On animals not groomed, the majority of the dirt will cling only to the surface of the fibers. When locks are brushed, the locks open allowing the dirt to find its way in and gather deep inside the fleece. When alpacas are judged in the show ring, the fleece is not allowed to be "opened" by brushing or washing. Neither are fiber enhancing products allowed as they interfere with its handle and appearance of the fibers.

In preparation for shearing, the fleece should be cleaned by hand picking debris and blowing out the dust. If tips are damaged, they need to be flicked off and this can be done without disturbing the full lock structure. The secret of a clean fleece is in how clean the pastures are kept, the type of bedding and the feed used. The worst type of contamination can be with bedding, feed, and pastures that contain seed heads and burrs that catch in the fiber and break apart when dry, for example Timothy and Thistle. It is amazing how clean an animal's fleece can be with proper attention to these management details and careful grooming on the way to the shearer.

Sorting

If an entire fleece is purchased, it is necessary to sort for quality or grades. Unroll the entire fleece and spread out. It is important to keep the lock structure intact. If the fleece is unrolled cut side down on a wide hole screen and very gently shaken so as not to break the lock structure, loose second cuts and dirt can be released. Turning the fleece cut side up allows the second cuts to be picked free by hand. The shearing crew may or may not have shaken the dirt free and separated out the tags.

Tags are easy to distinguish as they will have copious quantities of guard hair, coarse fibers and contamination. Neck fiber is, as well, easy to distinguish as it will be shorter than the main fleece. Check and make sure the hay mound has been removed and look for further contamination in the fibers that run down the top line at center of back between the two halves of the blanket. Remove the blanket sections first for fear of contamination by other fibers and debris. It, usually, sheared in two sections. Look for a change in fineness and the addition of secondary fiber to find the blanket edges. Next, find the "good" seconds around the blanket edges. A fine quality fleece or a cria fleece often produces good seconds in the entire front shoulder and rear sections. In older animals and with coarser fleeces, look for fibers with long pointed locks that end in longer secondary fiber to identify seconds or guard hairs to identify thirds. Thirds are most often found on the top knot, belly, legs, tail and apron.
It maybe necessary to "sort" a roving by hand picking out the odd coarse fiber and vegetation from the supply. Holding the roving to the light helps the coarser fibers and dirt to be seen more clearly.

The less coarse fiber; the better the quality of the product. The suggestion that over a five percent amount of coarse fiber will increase the micron count is true.

Fiber Problems

Unfortunately, there can be a fair amount of contamination in a fleece. Ranchers are still on the "learning curve" as to how to produce a clean fleece. Raw fibers need to be inspected for secondary fibers, guard hair, dead tips, seeds, burrs, hay, straw, feed, vegetation, breaks and color anomalies.

Small amounts of contaminants do find their way out with spinning, washing and fabrication so pose no problem. Raw locks can be cleaned, even when completely contaminated but it takes time, patience and, in the worst scenario, up to a 50% loss of supply. If the price is right and time and patience are not of the essence, cleaning a very dirty fleece can net some very valuable and usable fiber. It is impossible to clean a very dirty roving, especially if contaminated with dry seeds, second cuts and dead tips that cannot be picked out.

Secondary fiber and guard hair are easy to remove by spreading out the fleece cut side down and pulling by hand the tips of every lock. These unwanted fibers are longer than the prime fibers and are easy to grab and slid out. They can be recycled for use as thirds or composted. As each lock is separated from the fleece, secondary fibers and guard hairs can be removed as well.

Individual locks can now be held for flicking with a dog brush or flicker to remove vegetation, dirt, second cuts and dead tips. I start with the cleanest end which is usually the cut one. The lock should be held close to the middle and given a half twist to stop the fibers from sliding on through. A piece of heavy fabric, like denim, should be used under flicker to protect clothing or skin. I like to sit and flick over my thigh. Flick the cut end then turn to do the tip end. Check the middle of the fibers but they most often are quite clean. This is a good time to have a final inspection for coarse fibers. If dead tips are not completely removed with the brushing, they can be pinched off with the fingertips at this time. Since they are damaged, they have little strength and are easy to removed.

Cleaned flicked locks should be stored in all the same direction with cut and tips in the same direction. This is particularly important if fibers are to be processed with wool combs for a true worsted.

Color anomalies or irregularities are difficult to correct unless spotted at the outset and planned around. One of these is stray fibers of a different color found in an otherwise
solid looking fleece. I have had a white fleece with a 1% black fiber and a black fleece with a 2% white fiber. Another color anomaly is streaking of colors. I had a gray fiber with streaks of black and a gray fleece that slowly faded from medium gray to dark gray. A very nasty finished product can result if a streak of black shows up on gray or a band of odd color runs across a garment. The quickest way to identify a fleece with find odd colored fibers is to wash several locks of the raw fleece and examine them when wet. Odd color fibers show up very clearly when clean and wet and yet are hard to find in a dry fleece. I have tried pulling out odd fibers but one missed black fiber in a white yarn shows up well in a finished product. The best I can suggest for fleeces with stray colors is to save such fleeces for dying especially in darker colors where the color differences are not in such sharp contrast or use for blending with other colors. Alpaca fleece that are multi colored, spotted or streaked are easier to deal with as they can be blended by carded to even out the color variations.

Washing the Fleece

Alpaca can be washed in the lock, in the roving or in the spun skein.

Raw alpaca fleece is best washed in the lock before spinning, especially light and white colored fibers. Washing fibers in the lock can be done in one of several ways depending on personal time constraints, the color of the fiber and the quality of the product required. I think it worth one's while to take as much time as necessary to process expensive alpaca fiber.

By far the most time consuming but the most effective method of washing alpaca is lock by lock as described by Margaret Stove in her book written for fine wool (Stove, 13-15). When I read that she processed entire Merino fleeces by dipping each and every lock in first hot soapy then two rinse waters, I was sure she was demented. I am glad I decided to tried it as it turned out to be a perfect method for alpaca and, as promised, not as slow as it sounded.

It is to be remembered alpaca has very little greasy so requirements for large amounts of product as required for sheep wool washing is not necessary. I use double the amount of soap required for normal hand washing as raw fibers are likely to contain more dirty dirt than normal. Alpaca contains only about a 4 to 5% grease content as well as suint, a sweat gland secretion, plus whatever dust the animal last rolled in. It should be noted that alpacas love their "dust" bath. This serves to effectively remove a lot of debris clinging to the outside of the lock but can pack fine dust particles into the lock structure. This dust can be removed, for a large part, if the animal is "blown" out before shearing. Conscientious fiber ranchers do this prior to shearing. I have seen the color of the dust actually "dye" the raw fleece, especially red colored mud and dirt. This dirt is especially difficult to remove except by lock by lock washing. The type and amount of laundry products will change with other washing conditions. The worst is hard water conditions such as seen in mountain regions. Triple amounts of laundry products are needed for hard water as well as a water softener.
The consensus of opinion from myself and fellow alpaca fiber washers on what is the "best" washing product comes down to Ivory liquid dish detergent and Wisk or Tide liquid laundry detergent. I use Ivory for small jobs and Wisk or Tide liquid for large jobs and all work well in hard water.

To wash a fleece lock by lock, fill three containers, one with detergent and hot water and two with clear warm rinse water. Swish the flicked lock first by the butt end then by the tip end in and out all containers squeezing off excess moisture with fingers between containers. Alpaca locks are longer than most other fibers so easy to hold and swish. Stoves has found that very dirty tips may need to be further rubbed to remove dirt and suggests that any agitation of the fibers be done under water to prevent felting. Dry flat. Dry time can be hastened by rolling wet locks in a towel and pressing out excess moisture. This is readily accomplished by walking on the rolled up towel and locks. Fiber lock structure is kept almost in perfect shape and little to no felting takes place on the butt end with this washing method. Keeping the lock structure intact is important as much fiber can be lost in flicking if fibers are random. Locks should be well flicked before washing to remove contaminants. If contamination is still seen in the washed locks, they can be readily flicked when dry without a major loss of stray fibers.

If time is of the essence, locks can be packed into net bags. Plastic net bags can be saved from onions and oranges and work well for this job. It is important to pack the bags lightly with only one layer of locks with butt and tip ends in the same direction. Fibers must be secure in the bags so they cannot float around. Filled bags can be washed in the sink or in the washing machine. It is critical not to allow the machine to agitate but only use the machine on fill and spin cycles. The washer is an easy answer to handling very large amounts of fleece. Water must not be allowed to run on top of fiber for fear of felting. Filling needs to be accomplished for washing and rinsing before bags are lowered into water.

My rule of thumb for how long to soak is until the water cools. This usually takes close to one hour. The secret is to use no agitation whatever. In the sink, it is hard to press or squeeze water out between washing and rinsing without some agitation and in the machine fibers tend to float around more than in the sink causing some agitation as well. The spin cycle in the washer does an excellent job of removing excess water so bags can be soaked in sink and spun out in washer.

The results of washing bagged fiber are about the same in the sink as in the washing machine. Lock structure is maintained, for the most part, when fiber is bagged well and great care taken but not as well as washed lock by lock. Very muddy fiber or very dirty tips are not as clean as when dipping locks. This may not be all that important if the major dirt is removed as final bits of dirt can be removed when washing the spun skein. Poor washing procedures or extreme dirt may require a repeat of washing procedure when fibers are washed in bags but never when done by the lock.
WASHING

RAW

LOCK BY LOCK

BAGGED BY HAND

BAGGED BY MACHINE
Dipping individual locks produces cleaner fiber and maintains the best lock structure. Washing in the bags does seem to allow enough fiber movement to cause some mild felting, especially at the cut end, and further flicking maybe required to untangle. In the long run, if fibers remain dirty or tips are not clean and further washing or flicking is required then it actually saves time to wash each lock by hand.

Washing Rovings

Alpaca ranchers usually send fiber to the mills dirty. I have washed fleeces and then sent them off for mill carding but the bottomline of this experiment turned out for the most part a waste of time. The big exception was with the whites. Exceptionally dirty, dusty whites are near impossible, in my experience, to wash perfectly clean in the skein. I did have great success with prewashing this one color group before mill carding. Custom mills that card rovings may or may not washed the fiber prior to processing. Mill that claim to wash the fibers send it back dirty with carding oil. So roving are usually dirty. I do not wash purchased rovings before spinning as the commercial or custom carding operation effectively removes a lot of dust and dirt contamination and oils readily wash out in the skien. It would be difficult to wash large amounts of roving for fear of having them stick together and then needing to be recarded. Roving, for the most part, are best spun as is and washed in the skein.

Fiber Preparation

Lee Raven in her book "Hands On Spinning" says "the aim of preparation is to make the fibers suitable for drafting with the degree of control you want. The more careful and through the preparation, the more control you have over the size and texture of the yarn. Fiber preparation fall into two major categories: carded and combed" (Raven, 56).

Woolen Preparation

If fibers are carded only, the result is a woolen or semi-worsted. Only shorter fibers less than 4 inches produce good woolens. Shorter alpaca staple lengths can be found from animals who are poorer fiber producers, cria fleece less than a year old and the neck fiber from most animals.

Carded fibers can be prepared with hand carders, a drum carder or custom mill machines. In most instances, little cleaning of the fibers is accomplished by the carding process so it is important to start with well cleaned fibers. It is always best to wash and flick fibers to be carded.

Large amounts of fiber and lesser quality fibers are worth the trip to the mill for carding. Mills have limits on poundage for carding which ranges from 2 to 20 pounds. Amounts under 2 pounds are easy to process with hand carders and over that amount with a drum
FIBER PREPARATION

WOOLEN

HAND CARDED ROLAGS

DRUM CARDED ROLAGS

FLICKED

HAND CARDED SAUSAGE

DRUM CARDED SAUSAGE

WOOL COMBINGS
carder. Results from each type of equipment can be excellent when properly executed. Alpaca is best carded with hand cotton cards and a fine cloth drum carder. Some problems can be experienced with static, especially in dry climates. A light spraying of water or Static Guard solves this condition.

Hand carding for woolen yarns takes little time or trouble with alpaca fibers as they are naturally smooth causing less tangles. They fluff up readily with few passes and do not form neps easily unless contaminated with small bits. Finished carded fibers need to be rolled towards the handle to make a rolag of open, airy and fuzzy fibers.

The exact same comments can also apply to drum carded alpaca. Nice batts are produced in as little as one trip through the drum carder. Because alpaca fibers are at the longer end of the staple length required for woolens, I think that drum carded batts are best rolled into rolags rather than torn into lengthwise strips. The alpaca batt produced from the drum carder tends to have fibers lying a little too parallel if used in long strips and a much better woolen preparation is accomplished if the batt is separated into crosswise lengths and rolled to trap the air and loft. As rolags are prepared from either the hand or drum card, it is well to elongate them to a thickness required for spinning. This can be done by gently stretching between the hands.

Worsted Preparation

Tops can be prepared for worsted spinning by flicking with a comb, brush or flicker; by hand cards rolled into a sausage (from side to side of the cards); by a drum carder splitting the batt lengthwise and, lastly, by wool combs. All these methods will produce parallel fiber formations to a more or less degree.

Flicked locks produce the least successful worsted preparation and spinning from such locks means a lot of joins that are difficult make and can result in weak spots in the yarns. Holding flicked locks in such a manner as to allow them to fan out to catch the draft and at the same time remain parallel is difficult and can result in a semi-worsted yarn with an uneven grist.

Both hand and drum carding should take place with washed and flicked locks as this is the only way to ensure the removal of dirt and short fibers in the alpaca. Hand carded sausages, like flicked locks, need a lot of joins but they seem to me to be easier and smoother to make than with the flicked locks. It is easier to ensure an overlap from one sausage to the next and thus keep a ready fiber supply. The hand carders prepare the fibers in good parallel alignment and sausages can be extended to suit the grist of the yarn. Finished yarns have better integrity and are more even than the ones using only flicked locks.

The same can be said for drum carded sausages and, I think, they work even better than hand carded or flicked fibers. Most importantly, they can be made into longer supply
lengths for quicker spinning. The entire batt can be rolled lengthwise (side to side) then extended by hand into the size of roving needed for spinning or the batt can be split lengthwise in correct size strips. I was quite surprised to see the excellent quality of worsted prepared fibers the drum carder can make and with very few passes.

By far, the very best method of preparing alpaca worsted is with traditional style wool combs. Only wool combs will assure complete parallel formation, the laying of all fiber butt to tip, the removal of short fibers and contamination as well as provide a good continuous supply of fiber all in one operation. Wool combings are considered the only true worsted preparation. Long, smooth, strong alpaca staple is perfect for wool combing and worsted spinning system.

Since wool combing is the least known and best method of preparing alpaca, I looked for more information. Research very quickly brings one to Peter Teal and his book called "Hand Woolcombing and Spinning". Mr. Teal is unequaled in the world for his work on traditional wool combs and wool combing. When the wool combs I had on hand were not operating well, I took the liberty of writing to Mr. Teal with my problems. It was with great surprise and gratitude that he and his wife not only answered all my questions but provided a substantial and informative amount of research. Here is one topic where truly expert advice is available on alpaca. It is not possible here to discuss the full details of wool combing. They are well described in Mr. Teal’s book. With the Teal's permission, I can quote from his letters to me areas he found of peculiar for alpaca.

On the types of wool combs he found best suited to alpaca he states:
"There are 4 pitch combs (model 4/100) with a 3mm. diameter tines set at 7mm centers with the rows 10mm apart. (It should be noted here that the Teals custom make these excellent combs.) Each comb head holds 50 tines and presents quite a forest of spikes to the fiber, promoting good drag on the fibers to help them separate while at the same time enhancing the ability of the tines to retard the passage of noils".

On the process he suggests:
"Because of the very smooth nature of the fiber (alpaca), we decided against using any lubricant other than water, which we found essential to prevent the generation of static electricity - which soon presented a problem as the warmth of the combs was transferred to the fiber. We found the amount of spray pretty critical, too little and the fibers fluffed out, too much and they developed tails as fibers clung together - something I haven't experienced before with wool. We used an atomizer which produces a veritable mist of moisture, difficult to measure, but the total amount was not more than 1ml. over the 8 gr. We did not experience any problems at all in the combing and were agreeably surprised at the small amount of noils. Care does have to be taken not to enter the combs too deeply into the fiber mass, for there is a tendency for quite large clumps of fiber to pull clear of the static comb in the early stages, less liable to happen later as fibers build up around the base of the tines."
"I had to support the fiber on a high chair (as it was being draw off) so that it didn't fall apart. The chair was about 18 inches under the combs and removed during the combing process."

"I found that the winding the final roving into a nest round my hand adding a little twist was better than our usual method of winding it onto a spindle (fat knitting needle). It kept the fibers looser and easier to spin."

These findings answered all the problems I had had in my beginning experiences using wool combs. Needless to say, I happily purchased the recommended set of combs from the Teal's and now am anxious to become proficient in their use. Thank you, Jaquie and Peter.

Semi-worsteds

Semi-worsteds are produced by either preparing fiber woolen and spinning worsted or preparing fiber worsted and spinning woolen. Semi-worsteds do make acceptable knits so this maybe a valid choice. In a woolen preparation, it is difficult to keep long fibers from draw out in a parallel formation. This scenario is the most frequent in producing semi-worsteds with longer alpaca fiber.
CHAPTER III

SPINNING

Some of the questions I have tried to answer in this discussion of spinning with alpaca are:
Why hand spin alpaca?
What kind of equipment is needed for spinning alpaca?
What are the different methods for preparing alpaca actually like to spin?
How suitable is alpaca for spinning woolen and worsted?
How appropriate is alpaca for use by beginning spinners?
What are some suggestions for advanced spinners?
Are there parameters for grists and twists in spinning alpaca?
At what point does twist cause harshness in alpaca?

Why Hand Spinning Alpaca?

Alpaca is one of the most unique, elegant and rewarding of the spinning fibers. Learning how to spin alpaca gives many more options for end uses than is currently available with commercially spun alpaca yarns which come in few colors, grists and twists.
For me, it is magical and mystical to work with such an ancient fiber and one that was accorded such prestige as to have had only royal usage by a powerful and ancient culture. As its value was recognized in its early history so, I think, it will be rediscovered in our modern world.

Spinning Equipment

Alpaca can be spun on most types of spindles, spindle wheels or flyer wheels. Very high drive ratios will likely run the risk of putting too much twist into the yarn and causing harshness. But it might be interesting to see what a charkha would do to alpaca for end uses that require hard and extra hard twist like some tapestry yarns or hard embroidery yarns? Lower twist ratios are best as alpaca does not need high twist. Indian head spinners work well for bulky yarns and are marvelous for seconds destined to become lopi style yarns. Support and drop spindles work well but the alpaca slipperiness in a factor to consider as it is hard to keep the supply for falling apart. It might be well to put a slight twist into the rovings or provide support for the fiber supply.

Hand Spinning Techniques

Alpaca can be spun from the lock, from the fold, from rolags or sausages prepared by hand or drum carders, from mill carded or combed rovings or from wool comb tops. It can be spun woolen, semi-worsted or worsted. Alpaca runs the gamut for spinning choices.
Decisions on how to spin are usually determined by abilities of the spinner, spinning equipment, fiber constraints and requirements of the end use. However, it is my experience that there is one more consideration in deciding how alpaca should be spun and that is based on the eccentricities of the particular fleece one is using. It has been mentioned in previous discussions that alpaca lacks the consistency of most fiber producing animals. If spinning Merino or Border Leicester fleeces, there is little difference in the handle of fleeces from one body to another, all things being equal, like the part of the fleece being used and the age of the animal. However, each alpaca fleece is unique and each one has its own characteristics, staple length and handle. So in spinning, that relates to what is the best suitability of that particular fleece for a yarn designs. A simple thing to describe is the propensity for very long staple lengths to spin themselves only worsted or semi-worsted as no matter what the preparation as the fibers will draw out parallel due to their length and smoothness. A more subtle factor is the amount of grab one alpaca fleece will have over another which varies with slipperiness, smoothness, amount of crimp and fineness. Some alpaca fibers seem to run right off the supply and spin like silk and others grab much like wool. High luster fibers are enhanced with the worsted system and high crimpy and shorter fibers are best for the woolen system. The bottomline is to sample and feel what that particular fleece says to your fingers and try to find where the comfort zone is for yarn design, spinning technique as well as grist and twist. I take a handful locks from a new fleece before it is processed and play with spinning to see what it says to me. If I need to change my mind for its end use, I can easily do this. This sounds a strange way to determine a spinning method but, for me, has been very effective. I am not saying that alpaca cannot be spun anyway that is necessary for a predetermined end use but it is interesting to work from both directions and get the best results from a fleece for a particular end use.

For experienced spinners, spinning from the lock or fold produces about the same poor results. Both require many joins and difficulties in keeping an even flow of fiber supply and an even grist. It is a hard task to become proficient in spinning either way. If proficiency is not mastered, yarns are characterized with poor, weak joins and uneven grists. Spinning should give a worsted style yarn but likely ends up a semi-worsted as fibers jumble, especially at the end of each handful. The trouble is that alpaca fibers look so wonderful with only a flick that one thinks the preparation is good enough to be spin right away. Experience has taught me that carded and combed fibers produce a much more satisfactory yarn with more variety and much more integrity. Carded or combed fibers also produce a more constant fiber supply for quicker spinning. Yarns are more adaptable to specific end uses, particularly very fine and very bulky yarns. It is also true with alpaca that the better the preparation the better the spinning. It is of utmost important that one try alpaca, by sampling, with different kinds of preparation and spinning technique.

In my experience, by far the best alpaca yarns are produced from wool comings. If one likes worsted yarns and plans on using alpaca, traditional style wool combs are an excellent investment.
Beginning Spinners

When learning to spin, it is just so delightful to produce any sort of yarns that little attention is paid to the kind of yarn made. I still do recall, and have the sweater to prove it, that a combination telephone cord complete with squiggles looked great. However, it is surprising how little time it takes to progress to a more even yarn. I contend, that at this point, we settle into being a woolen or a worsted spinner. I claim it is inherent in the fingers and how our brains are oriented. Nonetheless, I think it is important to learn both systems of spinning to be able to accomplish a wide variety of end products. Alpaca offers such diversity that it is a good fiber to try different techniques.

The best features for beginning spinners about alpaca are its ease of preparation, long staple length, and wonderful strength. Even with the most cursory preparation, alpaca is very spinnable so is a no muss no fuss fiber and that is important for those with limited equipment and abilities. Very short and very long fibers can be exceedingly difficult to spin. With fibers running at 4 to 5 inches, it is easy to hold the supply and "inch" along. Frustration levels are greatly reduced by using a fiber with excellent strength that is completely up to the rigors of taking anything that is handed out.

It is said alpaca is too slippery a fiber for beginners but this is untrue. It does have good grab although not as good as some wools. I will agree that alpaca may not be the best fiber for the first spinning lesson but is can be used as soon as the rudiments are learned. The biggest problem I see is the cost of alpaca can be high so it maybe best to wait till a good quality of yarn is possible and take no chances on wasting expensive fiber. Good buys can be had with alpaca seconds and it is here that great fibers can be supplied for the beginning spinners. The easiest spinning is from well prepared fibers so mill rovings and drum carded rovings are likely the best choice but very acceptable yarns can be achieved from a simple hair brush to open locks.

The most useful suggestion on the actual spinning of alpaca for beginners is to say go slow, use less twist than more and a finer grist than a thicker. It is usually a given that beginners mostly use what is described as the inch worm technique and this works just fine and I still use it when all else fails. Do what it takes to make a soft yarn as high twist causes harshness. Alpaca is also better spun thin than thick as it can be compacted and become oppressively warm and heavy. Most beginning spinners can achieve grists of 10 to 14 wraps per inch with ease which are excellent for a wide variety of knitted, crochet or woven projects.
Advanced Spinners

I need to say at the outset that I have no experience with using singles and my experience is only basic in designing yarns for weaving. My parameters, here, are for basic yarns and mostly ones suitable for knits. As well, decorative, fancy and specialty yarns must also be left for another day. There are too many varied and different spinning methods to belabor descriptions of “how to” but rather will try to describe yarn out comes.

I describe an advanced spinner as one able to make a woolen and worsted yarn of good integrity and that has a knowledge of how to reproduce a yarn successfully. I am truly amazed to see spinners do this with just their eye. But to describe a yarn with accuracy and no confusion, it is necessary to use measurements for grist, twist and twist angles. Grist I measured with wraps per inch; twist in twists per inch and twist angles with a protractor.

Twist Angles

I wanted to test alpaca to see at what point it became harsh due to over twisting. I used twist angles to do this, as no matter what the grist, the twist angle remains constant. My samples show that a twist angle of more than 25 to 27 degrees causes harshness in alpaca. Even given the differences in the coarseness of the fleeces which can be wide, alpaca likes lower limits of twist angles and gives the nicest handle at between 10 to 21 degrees. Also, it can be spun with great integrity at lower limits due to its strength and longer staple lengths. Coarser alpacas assume their very best possible handle at 7 to 14 degrees twist angles. Warp yarns are always a concern and I think are strong enough for this job in areas of 21 to 30 degrees using the higher angles for finer yarns and the lower angles for coarser yarns and provided the alpaca is of average staple length or more. Lovely knitting yarns can be produced at 14 to 21 degrees but as the angle increases after this the yarn starts to become harsh. Alpaca's claim to fame is its softness so the object is to do everything possible to keep that softness in spinning and using lower limit twist angles works well.

Grist and Twist

I suggested for beginners that less twist is better for alpaca than more and thinner is better than thicker but what exactly does that mean in terms of measurements?

Alpaca can be spun in quite low grists as it is resilient, long and strong. Low drive ratios, large hooks and orifice are a must. Indian head spinners are well designed for such jobs. The ability of a yarn to hold together well at wraps of 3 or 4 inches, I think, are uncommon but alpaca can do it nicely. If accomplished with lightness, alpaca makes exquisite yarns in the lopi style for such end products as heavy knits, rugs and carpets. The problem will be to keep the fibers from compacting producing oppressively heavy, overly
Grist

2 ply - app. 21 degree twist angle

3 wraps per inch

6 wraps per inch

12 wraps per inch

24 wraps per inch
TWISTS PER INCH
WITH FINE ALPACA

2

3

4

5

6

8
TWIST ANGLE

WITH AVERAGE/MEDIUM ALPACA

VERY SOFT
APP. 10 DEGREES

SOFT
APP. 14 DEGREES

SOFT MEDIUM
APP. 14 DEGREES

MEDIUM
APP. 21 DEGREES

MEDIUM HARD
APP. 24 DEGREES

HARD
APP. 27 DEGREES
Take a length of spun yarn, holding it firmly to prevent the twist unwinding. Lay the yarn parallel to the centre line in Figure 5.3. A magnifying glass may be needed for very fine wool. Determine the angle of twist in your yarn. The yarn illustrated has a twist angle of 25°. For each bobbin, until that particular project is finished, spin with the same twist angle.

5° = very soft twist  
10° = soft twist  
15° = soft/medium twist  
20° = medium twist  
25° = hard/medium twist  
30° = hard twist  
45° = very hard twist

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**Fig. 5.3 Measuring the twist angle**

**Twist Gauge**

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by Steve and Rita

Buchanan
warm and weighty items. A woolen system will greatly help to add air and keep the alpaca lightness.

At the opposite end of the spectrum, extremely fine yarns are quite possible with alpaca fiber and do not require an extremely high twist to keep yarn integrity as alpaca's strength and length comes to the rescue. My samples show a fairly fine 2 ply yarn at 25 w.p.i. at only 8 t.p.i. It feels soft and has good integrity.

My favorite grist for knitted projects is between 12 to 16 wraps per inch with the most projects at 14 wraps per inch which I find suitable for knitted mittens, scarves, hats and sweaters. It is interesting to note that my sampling nearly always ends up at 14 wraps per inch, 3 twists per inch and a twist angle of 21 degrees. I think now when I see the samples here on grist, twist and twist angles that this was not an accident or just my particular preference but what gives a good multi-purpose yarn with an excellent handle and good integrity.

Generally, I have found between 2 1/2 to 4 twists per inch with grists between 10 and 16 to be adequate in making a good yarn with a soft handle.

Woolen and Worsted

I have enjoyed spinning alpaca with woolen techniques. This is because alpaca has a lightness and a fuzziness that makes woolens feel wonderful to spin and use. Woolen systems for finer, shorter, crimpy alpaca are particularly nice. Seconds, definitely, feel finer than they really are with a woolen system.

On the other hand, worsted techniques are easier to spin and enhance lustrous alpaca. I very much agree with Peter Teal that worsted yarns "are the elite among all those which can be spun from wool fiber" and feel this to be especially so for alpaca (Teal 9).

Review of Spinning Technique Samples

In these samples, I wanted to compare the results of spinning from all the methods of preparing fiber: from the lock, from the fold; from hand cards both woolen and worsted; from the drum card both woolen and worsted and from the wool combs for true worsted with wet and dry techniques.

For these samples I used a fleece with a micron count averaging 26 microns and a staple length of 5". The fiber was quite clean but had dead tips which were removed. The samples from the lock and from the fold were spun from raw flicked locks and the rest were spun from washed and flicked. The fleece was very lusterous and very slippery with a medium low crimp.
A quick glance at these 10 samples shows the best yarns produced from the true worsteds and the least acceptable from the lock, fold, and hand carded woolen. This was as I predicted with the exception of hand carded woolen. In theory, it should have been possible to supply short fibers for woolens by cutting long fiber in half as this is what is done in industry for synthetic staple lengths. I tried this idea with the hand carded woolen samples much to my sorrow. It was a complete disaster as the ends of the short 2 ½" pieces would not feed into the twist and wanted to stick out. It was a fight to the finish to spin this small sample. I have had better luck spinning sisal. A crimpier long fleece might have helped but I think not to the extent to make it worth while. I shall not recommend long alpaca fibers be cut in half to provide a source of fiber suitable for woolens. The woolen sample done on the drum carded spun very well. I used the shorter bits from the fleece that measured 3 ½ inches.

Even though I spun all the samples at the same twist and grist, the woolen yarns are fatter, fluffier and softer than the worsteds. This means the alpaca did, indeed, actually trap more air than with the worsted system and, thus, is suitable for both systems.

I tried, yet, another idea with the true worsteds in an attempt to see if I could minimize the fuzzing by wet spinning. This works well with flax but did not carry over to the alpaca as no difference is noticeable in these yarns.

Spinning from the hand cut fibers, as well as, the lock and fold were the most difficult and produced the least acceptable yarns. I thought the fold would turn out better than the locks as it did seem the fold drafted better but once washed the lock actually showed better consistency than the fold. It should be noted that the consistency is not good in either yarn. This may only prove I am more proficient with the locks than the fold?

The wool combed fibers almost spun themselves and a close second was the drum carded yarns. The mill carded rovings, as well, spun nicely both with woolen and worsted techniques.
SPINNING TECHNIQUES

FROM THE LOCK

FROM THE FOLD
SPINNING TECHNIQUES

WOOLEN - HAND CARD

WORSTED - HAND CARD
SPINNING TECHNIQUES

WOOLEN - DRUM CARD

WORSTED - DRUM CARD
SPINNING TECHNIQUES

TRUE WORSTED

DRY SPUN

WET SPUN
For these samples, I used a fleece with a micron count average of 26 and a staple length of 5 inches. The fleece was quite clean but had dead tips for the last ½ inch. The dead tips were removed by flicking, pinching off or cutting off. The samples from the lock and from the fold were spun from raw flicked locks and the rest of the samples were prepared and spun from washed locks. This fleece was very lustrous, very slippery and had a medium low crimp. This was one fleece that definitely wanted to be spun worsted.

A quick glance at these 10 samples shows the best of the lot to be the true worsted and the worst the woolen hand cut hand carded sample.

Spinning from the hand cut fibers, from the fold and by the lock were the most difficult. I thought the fold would turn out better than the lock as it did seem at the time of drafting that things went more smoothly but once washed the lock shows better consistency than the fold. This may only prove I am more proficient with the lock than from the fold. I find that it is not possible to watch the draft zone and at the same time watch how the fibers are being held for even feed to the draft zone. Seems the problem here is too many things to do at once and not an enjoyable way for me to spin. On the other hand, the combed fibers almost spun themselves, so much so one got complacent about paying attention to the draft zone.

I had suggested that a possible supply for shorter staple length alpaca for woolens would be to cut long fibers in half. So I tried this idea out. I think it is clear that cutting this alpaca in half was definitely not the answer. I would guess that the lower crimp factor and sleekness of this particular fleece caused the ends to stick out more than usual. This resulted in difficulties getting the ends to feed evenly into the draft and thus produced a very poor, uneven yarn. It was the worst preparation I have ever spun and will not ever recommend that again.

The woolen samples done on the drum carder spun well and were from a collection of shorter staple lengths of 3 ½ inches. I tried to spin all the samples at approximately the same grist but the woolen yarns look fatter than the worsteds as when the woolens were washed they lofted more than the worsteds. They definitely feel softer and fluffier than the worsteds.

I tried, in the true worsted samples, actually spinning the fibers wet in an attempt to see if I could produce a smoother yarn as can be done with flax. I did this with a light mist of water on the fiber supply. It is easy to see that no difference in the yarns occurred.

The best of the best method for spinning alpaca is from true worsted yarns prepared with wool combs. This was especially true for this fleece. A close second to the wool combs, I think, are the mill carded rovings samples followed by the drum carded ones.
CHAPTER IV

DYING

Dying with alpaca could be an exhaustive study in itself so I have narrowed the questions to the basics on:
How well does alpaca dye?
Does it dye as well as other fibers?
What kinds of dyes can be used?
Does dying cause harshness or damage to alpaca?
How do dyed alpaca yarns stand up to washing, light and sun?

Excellent instructions are readily available on all dying procedures and in the interest of brevity, they are not included in this discussion. Dyes colors were chosen at random.

Why Dye Alpaca?

When I first worked with alpaca, I was so delighted with the wonderful and vast array of natural colors, it did not seem important to dye it but once I found out how use dyes, it was hard not to stop. Color is, after all, the first thing you notice about an object. It, therefore, becomes a key element in any design or project. Dying fiber greatly increases the power of design by opening the door to a never ending list of possibilities. I think dying alpaca in no way takes away from its natural beauty but rather increases it a hundred fold. It can be seen from the dye samples that alpaca dyes as well as wool. Dying alpaca is fun, exciting and rewarding.

Kinds of Dye

There are two basic kinds of dye available to home dyers: natural and synthetic. If one is a purist or a back to nature type, nature dyes will be of great interest. But if fast results, unlimited colors, repeatable colors and bright colors are what is required then synthetics may be a safer way to go.

Alpaca can be successfully dyed using washed locks, roving, spun skeins or in the piece. Fibers should be clean and washed as the small amount of grease in raw alpaca and any dust may alter colors. I have yet to experiment with dying alpaca in washed locks or rovings but I have seen lovely samples of both.

The closer to white, the truer the color. However, wonderful colors can be achieved with creams, tans, browns and grays. Gray and some brown alpaca are made up of varying proportions of white fibers that grab the dye well to create quite unique and unusual color combinations.
I had poor results with dying alpaca using extremely high heat and have had the best results following directions for mohair and silk that use heat no higher than 180 degrees F. as a cooking temperature. My experience is that alpaca is a high heat sensitive fiber like mohair and silk. A candy thermometer is a must for alpaca dying and one mounted in metal more suitable than glass.

I think it is safe to say, and this is confirmed to some degree in the dye samples, that alpaca does not dye with quite the color intensity of wool and other fibers. I find, in general, one can expect a degree of color slightly less than shown on dye color charts. A slightly stronger dye stuff than recommended helps to compensate when brighter colors are required. Each class of dye differs slightly in color results so samples would need to be run when trying a new one.

Nature Dyes

Natural plant material dyestuffs tends to be unpredictable and produce soft, gentle tones of mostly yellow, green and brown that usually go well together. As the seasons, climate, water and soil conditions change so will the color results. Each dye pot can produce a unique color. It is important to be sure to dye the correct amount of fiber and collect the right amount of raw materials for a project at one time as trying to match a color may not be possible. For the most part, natural dyes need help to stick the color to the fiber so mordants must be used. These mordants are fairly toxic so need a high level of safe practices.

I made the test samples of nature dyes with a collection of onion skins; an excess of the herb, sorrel; bits of lichens from my rock garden and the leftovers from black current jelly. The alpaca dyed well in all cases. The onion skins were no mean feat to collect in enough quantities for dying. The skins were well crushed and simmered in water to produce a strong dye liquor. The residue from jelly making produces excellent dye liquors and just need a further boil in water to produce a good dye liquor. The problem with using fruits for dye stuffs, of course, is that they tend to be fugitive. Scraping wee orange dots off rocks is very laborious and netted me a very small amount of dye stuff resulting in a very pale liquor. I identified this lichen as Xanthoria and used the ammonia fermentation method to extract the dye. A good view of what changes in color no mordant and different mordants have on color results can be seen in the nature dye samples. Colors are much nicer and brighter with the use of mordants and the each different mordant gives a different shade.

The problem I see with using alpaca with nature dyes is the long cooking periods needed for mordanting and then dying yarns. I find alpaca fibers subjected to extended high heat causes harshness. With the exception of alum, I find the mordants, also, cause harshness to a more or less degree. Some solutions would be to look for nature dye recipes that use
the mordant and dye in the same cooking period; use alum only as a mordant; keep a close watch on cooking temperature with a thermometer; keep the stirring of the brew to a minimum so as not to agitate fibers and leave the yarns in the dye liquor to cool or over night to maximize color adherence. The indigo, a nature dye from a dyehouse, worked very well as the procedure calls for only a dip and no long cooking period and the alpaca stayed in perfect shape under these conditions.

Synthetic Dyes

Synthetic dyes come in a wide and confusing array of names and brands but I have used only two workhorse dyes: acid and fiber reactive. Acid dyes are used for protein fiber. Fiber reactive dyes are recommended for cellulose fibers but also come with directions for use with protein fibers. My samples show that both acid or fiber reactive dyes are good choices for use with alpaca. If directions are followed to the letter, ideal dye properties can be met using these dyes and alpaca fiber. These give bright and clear colors; good mixing abilities; color reproducibility; even dying; economy; ease of use and most important fastness.

Acids dyes in solution can give off toxic fumes so should be cooked outside or in well ventilated areas. Fiber reactive dyes are toted as being a little more stable in solution and I use them in my kitchen - no kids or dogs! However, they are toxic in the power form and need to be measured outside or in a well ventilated area.

I have not used weak acid dyes extensively but the few samples I have done had excellent results. I have see wonderful colors produced using alpaca with acid and weak acid dyes that others have produced.

The first kind of dyes I ever used for alpaca were the fiber reactive group. The colors from this dye class are exceptional but the learning curve to use these dyes, for me, has been long. I think my problem lies with trying to keep the heat as low as possible to prevent fibers from becoming coarse and end up under cooking. The cooking time is a full hour and not arbitrary as complete color transfer does not take place till the 50 minute mark. This, as well, means one is not sure of the exact color produced until the dying procedure is almost completed. Corrections can be made by over dying. I have had disasters when the heat was not watched closely and allowed to raise to a boil at over 200 degrees F. and causing quite a noticeable increase in harshness to the yarns. This was particularly noticeable when dying seconds. The other major cause for concern is the great amount of bleed I get with these dyes but I am not willing to blame this on the dye but rather my lack of experience and possibility of under cooking. I have had the odd items that continued to bleed dye color even after repeated washings. When they have worked well, fiber reactive dyes give wonderful colors and stand up to wear very well.

The one dye line I have used extensively is Gaywool dyes made in Australia and available through Louet. These dyes are a premixed acid dye. Gaywool dyes take only 1/2
NATURAL DYES

ONION SKINS

NO MORDANT  ALUM  TIN

BLACK CurrANT

ALUM  TIN
NATURAL DYES

INDIGO / HALF MINUTE

SORREL / ALUM

INDIGO / ONE MINUTE

LICHEN
GAYWOOL DYE

COMPARISONS

COLOR HIBISCUS

SILK

BORDER LEICESTER

ALPACA

MERINO

MOHAIR
GAYWOOL DYES

FULL STRENGTH

PLUM

CYCAMEN

THREE QUARTER STRENGTH

CORNFLOWER

WATERMELON

HALF STRENGTH

HONEYCOMB

VIOLET
FIBER REACTIVE DYES

COMPARISONS

COLOR MEDIUM ROYAL PURPLE

SILK

BORDER LEICESTER

ANGORA

ALPACA
FIBER REACTIVE DYES

PROCION MX

COLORS PALE
Dyed Alpaca

Light and Sun Test

Right - control, no sun, no light

Middle - midwinter, north window, indoors, three weeks

Left - early spring, outdoors, full sun, two weeks

Natural

Chemical

- Onion
- Onion: tin
- Onion: alum
- Lichen
- Black currant
- Black currant
- Tin
- Indigo
- Indigo: medium
- Sorrel: alum

- Weak acid
- Fiber reactive
- Fiber reactive
- Fiber reactive
- Fiber reactive
- Gernwool
- Gernwool
- Gernwool
- Kool & A
hour to cook. In my opinion, they are the best dyes for alpaca because of this shorter cooking period and come with the added bonus of being premixed for simple use. The shorter cooking period and the ability of the dye to grab at temperatures of 180 degrees F. is the best combination I have found to keep alpaca's softness and luster. My favorite thing about this dye is that color reacts during the first 5 minutes of the cooking period so one can see at the beginning what is happening. I have been known to make "corrections" for fear of getting too dark a color by dumping out the extra color and replacing with clear water of equal temperature and carrying on with great results. I have also lifted out the fibers and added additional dye for more depth of color. I love a dye where one can cheat. There are at present 32 hues available and strengths can be varied by cutting back or increasing the proportions of dye recommended to fiber. I have also found less color residue with these dyes and almost no bleeding as items are laundered. The down side is that they are a little more expensive than other kinds of dye and until recently a wide range of bright strong colors were not available. New colors are being added to this line and include some of these missing ones.

Kool-Aid dying is safe and fun for big and little kids. There are an interesting, if not weird, group of colors available. I have one sweater dyed with cherry Kool-Aide that turned out exceptional well and has been washed many times with no bleed or color loss. Colorfastness to washing, light, and sun test results were exceptional and proved that alpaca does dyes and hold the color extremely well. I had expected the natural dyes to be less so and they were not quite as good as the synthetic dyes but still did rather well. Despite the limited numbers of natural dyes tried, it is likely safe to assume that alpaca will be as colorfast as natural dyes are with other fibers.
CHAPTER V
BLENDING

Blending is the combining of two or more things in some manner to produce a new item. Successful blends should have some improvements from the originals in function or in aesthetics or both.

It is possible to create an infinite number of combinations by blending different colors; different fibres; or different fibres and colors. I have limited this discussion to the blending of different fibers. Fibers can be blended by either carding or plying. Since plying is the least reliable method and can be fought with problems, it has been eliminated.

The general guide-line for blending are:
1- use at least 25% of a fibre to ensure keeping some of the qualities of that fiber (exceptions are 10 to 15% nylon is needed for strength, 65% polyester is needed for wash and wear properties and only 2% spandex is needed for elasticity);
2 - generally do not use more than three different fibres together as the usefulness of each becomes limited; exceptions are trims.

Some questions to be answered are:
How does alpaca blends with other fibers?
How does the alpaca preform?
Why would one want to use alpaca in that particular blend?
How do they look and feel?
How might they function?

I choose a sampling in three areas to give an overview as to how alpaca may preforms in a blend:
Blends of 25%; 50% and 75% with Merino wool and alpaca.
Blends of 30% wool and 75% alpaca with fine, medium and coarse wool and the equivalent qualities of alpaca.
Blends of 50% and 50% with 10 other fibers and alpaca.

It is beyond the scope of this report to be able to test the functionality of each blend. However, one can try to extrapolate given an examination of both characteristics of the fibers in the blend.
ALPACA BLENDS

MERINO AND ALPACA

25% MERINO & 75% ALPACA  50% & 50%  75% MERINO & 25% ALPACA
All sample construction followed these guidelines:
Alpaca was chosen to match as near as possible the staple length and/or micron count of the other fiber.
All fiber proportions were weighted carefully on an accurate scale with a .1 gram readability.
Samples were all blended with cotton hand cards and prepared as a worsted sausage fiber supply.
A worsted spinning technique was used. The average t.p.i. is 3 1/2. The average w.p.i. is 12. The twist angle is approximately 21 degrees. This was not the best choice for many samples but did allow for easier comparisons.
All yarns were washed by hand with Ivory liquid dish detergent, rinsed three times and dried flat with no tension. Yarn samples measure 5 yd.
Knit samples were done on 3.25 mm. needles and measure approximately 3" x 3" and are steamed flat for presentation.

ALPACA BLENDS

IN 25%, 50% AND 75% WITH MERINO

Sheep wool is the major choice of fiber for use in spinning. Merino is considered the top quality of all the sheep breeds for softness, fineness and crimp. It is highly important and prized by the wool industry and, it seems to me, has set the standards for assessing and understanding all other wools. It was, therefore, important to have a look at Merino wool and alpaca.

Properties - Merino is an excellent choice to blend with alpaca. The main reason for its use is to improve alpaca's elasticity. Merino is the only choice of wool for blending with super fine qualities of alpaca to ensure softness as no other breed offers a finer fiber. The micron count of Merino is listed at 15 to 25 and super fine and fine alpaca are in that same range. Alpaca offers Merino an increase in strength. Since alpaca has a smoother scale structure fiber, some help can be expected to Merino's felting, shrinking and pilling problems. Merino's copious and protruding scale structure helps the spinnability of smoother fibers like alpaca and is often chosen for a blend on this bases.

Preparation and Spinning - I used a commercial Merino top and a raw alpaca. The alpaca tested at 22 microns and the Merino is listed as 17 to 22 microns. I flicked the alpaca locks to remove any second cuts, short fibers and debris. The staple length of the alpaca measured 5" and the Merino 2" to 4". The Merino top had a surprising amount of shorter fibers that made the carding difficult and caused some neps. The very crumpy wool did not card easily or well with the slipperier and smoother alpaca. The Merino improved the spinning quality all three blends. The more alpaca the more the slip but even a beginner could manage. The only problem in spinning came in sorting out the lumps and neps.
ALPACA BLEND

30% WOOL AND 70% ALPACA

FINE  MEDIUM  COARSE
formed in carding. Things looked good until the skein was washed when the Merino popped out of the twist in spots so the yarn is not as smooth as I would have liked.

Evaluation - In the samples of 50% and especially 75% Merino, it is difficult to tell what other fiber is in the blend. I think it is easy to feel that the wool overpowers the alpaca in all 3 samples to a more or less degree. Merino gives a distinct spongy feel to the yarns. Mabel Ross describes it as "soapy" (Ross, The Encyclopedia of Hand Spinning" 122). I think the addition of alpaca is of little aesthetic value in any of these blends. The alpaca will contribute to functional properties by increasing the strength and resistance factors of the blend. It does seem to me to be a waste of alpaca not to enjoy its aesthetic as well as functional properties. So I find the addition of wool to fine alpaca in these samples self defeating as the "woolliness" comes through to destroy the alpaca handle. Some alpaca handle is noticeable in the 75% alpaca sample but it is still too wooly for my liking. My preference is to use 10% to 15% wool with fine alpaca, if at all. I find that sufficient to keep the alpaca feel yet increase the spinnability and elasticity of the blend.

ALPACA BLENDS

IN 30% WOOL AND 70% ALPACA USING FINE, MEDIUM AND COARSE FIBERS

Keeping with in the guidelines for blends that recommends using at least 25% of a fiber to keep some of that fiber's qualities, I decided to see what blends in 30% wool and 70% alpaca might be like. As well, alpaca and wool are two of the few fibers available in a wide range of micron counts so a look at these was, also, in order.

Coarse - 30% Lincoln and 70% Alpaca

Properties - Lincoln is described as one of the largest breeds of sheep and it produces a lustrous longwool of staple lengths up to 30". It is more curly than crimpy. It is very coarse and to me has the look and feel of buck mohair. The Lincoln is listed as falling between 33 and 37 microns and the raw alpaca seconds I estimated to be in this same range as the blanket tested at 31.6 microns and these seconds contained a lot more coarse fiber than the blanket.

Preparation and Spinning - I used washed locks of alpaca seconds and Lincoln lamb. Both fibers were flick before hand carding to produce perfect locks. They hand carded together well. Ease of carding was, also, enhanced as they were of similar staple lengths at 4 1/2". They did blend quickly and nicely. Since coarse fibers have been sent to custom mills for spinning, it was a different and enlightening experience to spin this blend. The coarseness makes for a much less pliable fiber and reminded me of spinning flax. This blend spun rather well with a nice long draw due, in no small part, to the excellent preparation. The resulting yarn looked good but hairy, stiff and very coarse.
Evaluation - Alpaca seconds and thirds are a perfect place, in my opinion, for blends with wool. For as much as I dislike wool with fine alpaca, I appreciate wool with coarse alpaca. However, I was not pleased with the Lincoln as I felt it was just too stiff and too coarse thus overpowering the alpaca. My rule of thumb for alpaca seconds has been to blend with a longwool breed of the softest quality available. This helps keep the alpaca feel. The breed that has been available and has done a superior job is Border Leicester. Alberta Agriculture also lists Romney and Karakul as possibilities for coarse breeds. I have seen both and have my doubts about Karakul as it may present with the same problems as Lincoln, being very coarse and giving a less pliable or lusterous finished product than that given by Border Leicester or Romney. In all these longwool breeds, the staple lengths are perfect for blending with alpaca seconds.

Medium - 30% Romney and 70% Alpaca

Properties - The Romney breed of sheep is an ancient breed that has much popularity even today. It produces an excellent demi-luster spinning fleece for both worsteds or woolens. The micron count is listed at 27 to 33 microns. Only exceptional fleeces would be of next-to-the-skin quality which makes Romney a nice choice for a medium quality wool. The staple length is 4" to 6". I used a particularly nice lamb fleece so it would be at the lower end or better of this micron count and a raw alpaca I considered good seconds. This blanket measured at 26.4 microns so my good seconds would have some secondary fibers to raise the micron to that close to the Romney lamb.

Preparation and Spinning - Here was one sample where the wool had a longer staple length than the alpaca. The Romney measured 6" and the alpaca 4". The Romney was carefully washed and flicked and the alpaca was raw but clean and in perfect locks. The carding was quite different in this sample as the longer, crimpier wool kept catching first and it was difficult to get the smoother alpaca to blend. With care not to gut the sausage of the longer wool fibers, this blend spun extremely well and fast with a nice long draw. The yarn felt very nice and looked good both before and after washing.

Evaluation - I think this is an excellent sample of what can be expected from blending alpaca seconds with a particularly nice wool even though the coarseness was medium. I think it looks and feels great. The addition of the wool, even at only 30%, gives a definite woolier texture but it added elasticity thus possibility expanding uses for the end products. Romney is not to be overlooked as a wool to blend with less fine alpaca. Other breeds producing medium fibers listed by Alberta Agriculture are Cheviot, Hampshire, and Suffolk. I have no experience with these breeds but it would be interesting to explore.

Fine - 30% Rambouillet and 70% Alpaca

Properties - Rambouillet is listed at 18 to 25 microns and has a staple length of 2" to 4". The local Rambouillet I have used was at least 3 1/2" to 4 1/2 " and made an excellent...
staple length to blend with alpaca. I have a definite preference for Rambouillet over its competitor Merino. The two reasons I prefer Rambouillet over Merino for blends with alpaca are Rambouillet has a longer staple length and it feels less spongy than Merino. Both breeds have wonderful elasticity, bounce and crimp which are the major factors for choosing them to blend wool with fine alpaca.

Preparation and Spinning - I used washed flicked locks of both Rambouillet and alpaca. The micron of the alpaca is 21 and the wool not quite that fine. Both staple lengths were the same at 3 1/2", each on the shorter side. With both of the same length, they carded very quickly and easily. Spinning was also quick and easy. I tried this sample with super fine and fine alpaca and with Merino and Polwarth. They all turned out slightly different. The nicest was the super fine alpaca and Rambouillet, the second the Polwarth and the least interesting the Merino. They all, however, feel wooly to me with the "wooliest" being Merino.

Evaluation - My personal choice is not to blend fine alpaca with wool of any kind and especially in percentages of over 20 % wool. I think it is clear from these samples the wool overpowers the alpaca. It has been my experience to use wool successfully with fine alpaca in 10 to 15% amount only. This adds a lovely bounce and elasticity yet keeps the smooth, soft alpaca feel. Polwarth, Bond and Targhee are close runners up to blend with fine alpaca with micron counts listed at 21 to 26. They, also, can have a staple length close to alpaca at 4" to 4 1/2". Polwarth and Bond are typical New Zealand breeds of sheep and not easily found in Canada. Other breeds available in Canada that are listed as fine are Columbia, Corriedale, and Dorset but their micron count range from 23 to 33 and may not give next-to-the-skin softness. Consideration for use would have to be given to the alpaca's micron count and the quality of the individual wool fleece available. Blends in this category maybe of particular value when an alpaca fleece is very poor in crimp as the odd one can be.

ALPACA BLENDS

IN 50% - 50% WITH OTHER FIBERS

There are more fibers available for spinning than ever before and there are endless proportions to choose from. I decided on the basis of each fiber having equal opportunity to preform, thus, a 50 - 50 blend.

I choose fibers in the four categories readily available to home spinners: protein fibers - angora, camel, mohair, qiviut; cellulose fibers - cotton, flax, ramie; a man - made fiber-rayon and a synthetic - nylon.
PROTIEN FIBERS

Silk

Properties - Silk is considered the queen of fibers as it has so many important and unique characteristics to share. It can be both warm and cool. It is comfortable with good absorbency and a soft, silky feel. It is highly prized for its luxurious luster which is considered the best of any fiber in the world. It is one of the few fibers noted for good elasticity and lightness and so is a top choice to blend with alpaca. Alpaca offers abrasion resistance and resilience. Both fibers are strong.

Preparation and Spinning - I used a cultivated silk roving and a fine alpaca roving. The micron count of silk is listed between 10 and 13 and I estimate the alpaca close to 22 microns. The staple length of the spun silk measured from 1 1/2" to 4 1/2" and the alpaca 2" to mostly 5". It seemed to me this silk roving had many more short fibers than in the brick, which I usually use. Hand carding went fairly well. I extended the sausages by hand for easier drafting. The spinning got tricky as the short fibers, mostly silk, wanted to end up last. Care not to gut the supply of long alpaca was a problem. I felt the resulting yarn has more glitches than usual. Two slippery, smooth fibers are always difficult to spin but this drafted quite nicely except for the patches of short fibers. I think the alpaca really helped here.

Evaluation - I love silk and alpaca so this blend was sure to be my personal favorite. I think the silk had dominated this 50 - 50 blend and would use no more than 30% silk in the future. I have seen as little as 10 % silk used successfully, especially in increasing the luster and handle of alpaca. If lightweightness, smoothness and elasticity are wanted, I would increase the silk to 20 to 30 % silk. Silk is certainly an important and excellent choice in a blend with alpaca. Unfortunately silk is almost twice the cost of alpaca.

Angora

Angora's major claims to fame are its wonderful napping ability and exquisite softness. Depending on the kind of angora, the aura can range from a gentle halo to strong spikes. Alpaca, also, has some napping ability but it is much less than angora. Alpaca offers the angora an increase in strength, abrasion resistance and resistance to felting and matting for better wearability and washability. Both fibers are excessively warm, absorbent, resilient, smooth, fine and slippery. The lack of barbed protruding scales on angora and very fine alpaca account for their soft and slippery handle. Alpaca will help to control angora's ability to pill, matt and fly away. The problems are that they are both low in elasticity and both can be oppressively warm. Much thought and care needs to be given to yarn design and garment choice to overcome these negatives, especially for items to be worn indoors. Washing carefully will eliminate some of the negative allergic reactions to angora. Alpaca seems to have very low allergic responses and may make the angora more acceptable. In keeping with the lovely soft handle of the angora, one would want to
choose an alpaca of low micron count, certainly under 24 to ensure next-to-the-skin quality.

Preparation and Spinning - I used a commercial raw angora which was likely from Giant/German cross. The fleece was consistent with this breed in that it had a long staple length and some guard hair. The alpaca roving had a staple length of 5" with some fibers as short as 2" and the angora's staple length was 2 1/2" to 3 1/3 " with some very short fibers. The micron count of the alpaca is estimated at about 22 microns and the angora averages 13 to 16 microns. The angora had to be hand picked to remove second cuts which can be copious with commercial production. Carding was not as bad as I expected but it did form nep's with each pass. Angora is always fly away and static so needed a good squirt of "Static Guard" or moisture to maintain control. Angora requires a good twist to improve strength and prevent excess shedding and pilling. The addition of the longer stronger alpaca relaxes this rule to some extent. My sample is acceptable but I think a bit more twist would still have had a nice feel but have given more security to the wear on the angora. The sample borders on being too thick. This blend spun much better than 100% angora which can be difficult as it tends to slide right on by the draft. This may not be a great choice of a blend for a beginner.

Evaluation - Angora is a wonderful fiber to blend with alpaca and I quite like this sample but the angora wins. It looks and feels to me essentially angora and it would be difficult to guess what other fiber was used. However, I think the alpaca would pay off in functional qualities. The use of large amounts of angora usually produce garments that are too warm, too fly away and too weak in wash and wearability. If one wanted a fundamentally alpaca product, it is nice to know that as little as 2% angora will create a soft halo and a soft handle (Ross, The Encyclopedia of Hand Spinning 19). Between 10% to 30% angora added to alpaca, will give not only an excellent nap but an great improvement in handle and especially wearability of the angora by reducing shedding. I think alpaca makes a wonderful extender for angora and improves on its poor characteristics and problems in preparation and spinning. One would choose the amount of each of these fibers in a blend depending on their end use.

Camel

Properties - Camel is an excellent choice to blend with alpaca as they are similar in nature being a related species, even if quite distantly. They both are strong, fine, smooth and very warm. Alpaca has a longer staple length, more crimp, higher elasticity and a higher luster than camel. These are the main reasons for such a blend. Camel colored alpaca is readily available if one wanted the appearance of camel to be kept. The lower elasticity values of both could be considered a negative and compensations need to be make in yarn design and garment choice. They are similar in price.

Preparation and Spinning - The fibers used in this blend were both rovings. The camel roving was shorter and more varied in staple length and ranged from 1/2 " to 3". The
alpaca was a little more consistent and ranged from 2" to mostly 5". Both had stray
guard hairs. The average micron count for camel is 21 microns and the alpacas was tested
at 26 microns. I did remove by hand a lot of secondary fiber from the alpaca bringing the
fineness factor closer to the camel for better comparison. They carded well and easily
except the fine, smooth, long fibers tend to fold back on itself and the very short fibers
create neps. Spinning was slippery going and the fiber supply was so light it tended to fall
apart. It might have been well to make a thin roving by drawing out carefully, twisting
slightly and storing on a fat needle. This is a suggestion given by Peter Teal for handling
wool combings (Teal, 75). It was easier to spin by letting a bit of twist into the draft
triangle as fiber it was being extended. Care needed to be given to not allowing the
longer alpaca fibers to grab first leaving the camel behind. In general, the spinning went
much as in spinning any fine alpaca. The distinction between the fibers was not
discernible.

Evaluation - I like both alpaca and camel by themselves and if I were to blend camel I
would use only 20 to 30% alpaca. I like the exotic reputation of camel and would only
alter it for very specific reasons. A fine, lusterous alpaca of the same color as the camel
would be my choice and I wished I had had some available for this samples. A small
addition of a lusterous alpaca would give some life and sparkle to the camel. I suggest
spinning such a blend thin and light to prevent it from being oppressively warm and
compact as these fibers can tend to be. It is interesting to note that the sample looks and
feel like either alpaca or camel.

Qiviut

Properties - Qiviut is truly one of the finest and most exotic fibers in the world. The
main reason to blend alpaca with qiviut is to add qiviut's exquisite softness. An alpaca
with a micron count of at least 22 or under would be needed. Qiviut will also add airiness
and help keep the alpaca light. Both fibers will puff and loft, qiviut more so than alpaca.
Both have a lusterous glow and a silky hand due to lack of protruding scales. Musk Ox
and alpaca have lived for thousands of years in extreme and harsh environments and both
fleeces have adapted a "thermo" nature in their fiber making them likely the warmest of
any other fiber producers. This means a warm garment unless care is taken in planning
yarn and design structure. A negative in both fibers is the low elasticity, particularly in
qiviut, allowing a poorly designed garment to sag and droop. Alpaca adds strength and
abrasion resistance for longer wearability. The longer staple length of alpaca gives easier
spinning control. The cost of alpaca is about a fourth of that of qiviut so is an excellent
choice as an extender for the quivit.

Preparation and Spinning - I used raw qiviut and a fine but dirty alpaca roving. Both
fibers were contaminated with numerous things from guard hair, secondary fiber, hay and
dead tips. The micron count of qiviut is listed at 14 to 19 and the alpaca tested at 22
microns. The staple length of the qiviut fell between 1" to 3 " with a small percentage of
short bit and the alpaca was a roving of super fine cria fleece at 2 to 5" staple length with
also a small percentage of short bits. Unfortunately, the contamination and the wealth of short lengths in both fleeces made for very difficult carding and spinning. Carding resulted in well formed and tight nepes. Spinning produced a poor uneven yarn. The inch worm technique was used in hopes of stretching the nepes. The yarn looked poor in the spinning process but after it was washed the qiviut puffed right out of the twist and together with the nepes created an uneven and terrible looking yarn. I did find a super fine 3 1/2" alpaca in perfect condition to blend with the qiviut and the yarns are like day and night and the problems being clearly with the use of a particularly poor alpaca roving. The small sample with the clean alpaca is excellent.

Evaluation - Despite the problems, working with qiviut is always interesting. I love the exquisite softness of this fiber and it works exceptionally well with a fine alpaca. The cost of qiviut is so prohibitive that an extender allows for more of its use. I think alpaca is a perfect extender. The look and feel of the qiviut overpowered the alpaca in this sample but this is one blend I would recommend using in 50 - 50 proportion because the essence of qiviut is kept while the alpaca gives longer life with its strength and abrasion resistance. I would prefer to spin such a blend much finer for a more delicate and light product. With the addition of longer alpaca, the need to use a high t.p.i.'s is reduced and thus maximizes the softness of the blend. Wendy Chamber recommends, in her article in "Spin Off", Summer 1993, on qiviut the use of a t.p.i. of 9. I used 4 and felt that was adequate. This is the least I would use, however. Qiviut can run up to $400.00 per lb. and the best alpaca available under $100.00 per lb. so costs could be cut to less than half. This is a substantial saving and an excellent reason to blend alpaca with qiviut. No other acceptable extender has the combination of fineness, softness, strength and staple length as that of alpaca. It is also worthy to note alpaca is available in any of the varied colors of qiviut for a complete match.

Mohair

Properties - The choice of adding mohair to alpaca is centered around the mohair's superior napping capacity and high luster. Even though alpaca has these qualities, they are quite different than in mohair. Alpaca loft is low whereas the mohair is pronounced. The mohair luster is much more brilliant than alpaca's. The lack of elasticity in both fibers, and especially in mohair, is a major cause for concern and items must be designed to accommodate this potential problem. These fibers, otherwise, go very well together being of similar staple length, strength, abrasion resistance, smoothness, ability to release dirt and high warmth factor. Both are available in a wide range of micron counts so can be matched for softness and function. For example, tough buck mohair is wonderful in a blend with alpaca thirds and fine kid mohair excellent blended with baby fine alpaca. Kid mohair and fine alpaca sell for about the same price.

Preparation and Spinning - I used a kid mohair with excellent softness and luster and an alpaca rovings. The locks of mohair were wash and flicked to remove dirt, poor tips and second cuts. The staple length of the mohair was 4 1/2" and the alpaca mostly 5". With
only the difficulty of restraining the long staple from folding back on itself, carding went very well. The mohair was fairly static and needed a squirt of "Static Guard" for better control. This blend was great to spin, if not slightly slippery but better than either by themselves. There was no fighting in the draft as to long fibers first being both were of relatively similar lengths.

Evaluation - I particularly like mohair blended alpaca. I love the addition of the mohair’s loft and luster. I do not like the addition of more than 30% mohair as, above that, the mohair dominates and the alpaca is lost, as in this sample. The sample looks and feels essentially mohair. Since they are similar in characteristics there seem few advantage to me to use mohair in larger amounts than 30%. An addition of as little as 20% and up to 30% will give alpaca a boost of brilliance and a lovely halo. Care must be taken to plan garments well to accommodate the inevitable sag and bag of, especially, dense thick blends. Here is where adding a third fiber maybe of use such as a high crimp, springy and elastic wool.

VEGETABLE FIBERS

Cotton

Properties - The major reasons one might want to blend cotton with alpaca is for cotton’s versatility, high absorbency and comfort levels. Cotton has only medium strength but this increases by 30% when wet making it extremely launderable. It is wonderfully absorbent and soft with a micron count of 14 to 22 (Hochberg, Textile Articles back inside cover). Cotton has virtually no prickle factor and is one of the most comfortable fibers in the world. Alpaca will add to cotton its strength, abrasion resistance, resilience along with some luster, silkiness and woolliness. The big draw back is the non elastic nature of cotton together with alpaca’s lower elasticity. Planning will be essential to minimize this potential problem. Interestingly, top quality cotton is about the same cost as alpaca.

Preparation and Spinning - Getting a very short staple fiber to hand card with a long one, in my mind, is a nightmare and it was. I was fortunate to have some lovely Pima unbleached cotton rovings on had for this job. Pima is noted to have one of the longer staples of any other cotton at 1 1/2" - 1 3/4" (Hochberg, Textile Articles inside back cover). I would not even have attempted this blend with the more popular Acala or worse brown cotton. One errors on the side of gross under carding as the neps build readily with two such diverse fibers lengths. Long tendrils of alpaca extended out of both ends of the sausage promising to gut the supply of alpaca and leaving behind a handful of cotton. By extending the sausage into a narrow roving prior to spinning, it was hoped that this could be avoided. Spinning was, to say the least, a bit of a scream. The inch worm technique was employed and a further preparation of the supply took place during drafting to keep the mix of cotton and alpaca somewhat even. Surprisingly, things got better as one when along and the alpaca allowed for a bit longer draft for a more relax spin than is usual with cotton. I thought the yarn looked, if not like the proverbial “bit of string”, rather good.
That only lasted till it was washed when bits of cotton puff right out of the twist attesting to its under carding. It might be well to card a cotton alpaca blend on a drum carder and spin using Mabel Ross’s long draw with a double draft to even out the grist when using fibers of different lengths.

Evaluation - I thought the sample of this blend interesting but not, of particular value. There seems to me no burning reason to want this mix. On the other hand, it is very different. I think the teens would call it "funky". It may prove that the functional properties of alpaca will lend the cotton something of great value that I am not able to test here. The cotton seems to have dominated the blend which gives the sample a great handle. It might be well to work with bleached or colored cotton to give more interest and versatility. The only reason I will carry on with my research of cotton and alpaca is for socks. I think the very high comfort and absorbency levels of cotton may have something to add to alpaca socks. Then again, I might just make a cotton/alpaca vest but just for fun.

Flax

Properties - Flax tow is a great choice to blend with alpaca as their staple lengths are more compatible than line flax. Tow flax is the waste from processing (scutching and hackling) of line flax. Line flax has a staple length of 18" to 30" (Hochberg, Textile Articles inside back cover) and would be difficult to card, to say the least. The exception might be a 2 year growth of alpaca that is 10" to 14" in staple length. It would be interesting to card such a blend using wool combs. Tow is inferior in quality to line because of its shorter lengths from 1" to 10". It can contain problem bits of waste fluff and stem or boon. Tow is less strong, less lusterous, coarser and hairier than line flax. Nevertheless, good quality tow flax is available and offers some unique properties to alpaca. Linen offers to a blend much more than cotton in that it is more absorbent, more lusterous, more soil resistant, more launderable, higher in wet strength at a 70% increase, cooler and stronger. On the down side, linen is non - elastic, stiff, low in abrasion resistance, low in wrinkle resistance, and has low resilience. I think it is interesting that alpaca offer improvement in all these negative areas. Linen yarns need a cellulose dye and alpaca a protein dye so using a bleached and commercially dyed flax can eliminate a possible problem unless the creamy to beige natural colors are wanted.

Preparation and Spinning - Working with two fibers seeming diametrically opposed is at once weird and fun. I used a bleached flax tow of quite good quality and a fine alpaca roving. The micron count for linen is listed at 15 to 18 microns but would be much higher in tow and the alpaca I estimated around 22 to 24 microns. The carding went quite well. It was possible to pick all but the worst bits of waste out of the flax. However, by leaving them in a linen slub texture for which tow is noted could be created. Spinning was tricky but interesting. It took a little getting use to the seemingly stiff flax fibers drafting out with the more flexible and supple alpaca fibers. Running into neps impossible to draft was inevitable and I allowed them to pass in the interest of texture.
The tenancy to gut the supply of alpaca was high and good attention was necessary or the short flax bits would have collect at the end of the supply. I spun the blend dry. This made quite a mess and would be well to remember to spin in an easy place to clean. The worry about it being too hairy was unfounded as the washed yarn was acceptable on that point. It would not have bothered the alpaca to have spun wet, however, and just may have produced a smoother yarn. When I blend with the wool comb a line flax with the two year growth alpaca, I will use a wet spinning technique in the quest for luster and smoothness.

Evaluation - I love the elegance of both alpaca and linen although they are so different. Here is where I feel opposites attract. What one fiber lacks, the other supplies giving a totally new fabric. It is not perfect and needs thought in design especially to overcome the lower elastic nature and poor drape. I think this blend maybe more suitable in a woven construction than a knit. In a knit or a weave, there are some real possibilities for lightweight summer garment. I have dubbed linen and alpaca blends as "Summer Alpaca". In this blend of 50 - 50, the linen dominates. I would like to sample alpaca and linen till I found a blend where the alpaca holds its own and would guess at a 25% flax and a 75% alpaca doing the job. I would like the feel of alpaca yet have enough linen to keep its intrinsic value.

Ramie

Properties - Ramie is a little known vegetable fiber, something between cotton and linen. It has been described as looking like silk but feeling like linen and an altogether wonderful fiber. If one needed to blend alpaca with a vegetable fiber, this is the one to look at. It offers good strength, great luster, a silky hand, light weightless and a coolness. It has a very high degree of absorbability which means a good ability to draw moisture away from body offering coolness and comfort. Ramie's luster, together with that of the alpaca, should give a unique elegance and sparkle to this blend. Ramie's poor flexibility will increase with the addition of alpacas. The stiffness of the ramie should be softened quite nicely by the alpaca as the stiffness in ramie is not near that of linen. Ramie has excellent launderability and a high wet strength. If time allowed, it would be an interesting to test the washability of this blend. I predict it would be excellent. Ramie sells for just slightly less than fine alpaca.

Preparation and Spinning - Ramie blended with alpaca is excellent to hand card and went quickly and easily. It reminded me very much of the silk and alpaca blend. I used a great commercial ramie top and the fine alpaca rovings. The staple length and micron listings for ramie vary from source to source at 1" to 12" and 4" to 10" for staple lengths but the actually measurement of my supply turning out to be 2" to 8" with more long fibers than short. The micron counts are listed at 20 to 80 and 25 to 75 and mine I estimated to be mostly very fine at 20 microns with very few coarse fibers in the mix. Fine ramie is very light and tends to fly away so needed a squirt of "Static Guard". The long fibers needed a good flick of the wrist to prevent them from folding over on the
hand cards. It was amazing how well this blend spun. The stiffer smoother ramie worked well with the fuzzier supple alpaca. Both fibers were similar in length and drafted as one and there were very few neps. It felt odd but defiantly interesting. I choose to dry spin. I think alpaca works much better with ramie than linen when it comes to spinning. This is likely because the ramie fibers are a bit softer.

Evaluation - This blend, in my mind, is one of the most exciting of any alpaca blend. Ramie has most of the properties of cotton and linen being a similar cellulose fiber. However, it is more lusterous and much longer than cotton and has better drape and less stiffness than linen. I think the combination of luster, fineness and suppleness makes ramie the most elegant and beautiful of the vegetable fibers to mix with alpaca for an exciting and elite new fabric. The same problem exists with these samples as with every other blend here in that the ramie dominates and it is difficult to tell what other fiber is in the blend. I would like to cut the ramie back to the 30% and allow the alpaca to play a larger role. I was particularly pleased with this blend and see excellent possibilities for light weight garments. I call ramie/alpaca blends "Spring Alpaca".

A MAN MADE FIBER

Rayon

Properties - Rayon is a surprisingly great fiber to blend with alpaca. This particular preparation from Louet is called Bright Viscose top. It has obviously been texturized to look and feel like silk and it does. As a man made fiber, it shares some things in common with completely synthetic fibers as well as true cellulose fibers and in particular cotton. It actually starts out like cotton and is then chemically altered like a synthetic. Thus it has many cotton like properties but the look and feel of silk. So one has softness, silkiness, high absorbability, great comfort and excellent dyability, all of which are a good choice to blend with alpaca. Rayon's major problem is its poor strength and, in particular, even poorer wet strength. Rayon is, also, one of the weakest fibers available unless it has been texturized. Alpaca has a lot to offer rayon in high strength and high abrasion resistance for longer, stronger wear. The synthesized part of this rayon product is clear in the high bright luster, the uniform staple length and the extreme fineness. Rayon, as it is used in industry, offers a great choice for an extender by reducing the cost of products as it is one of the least expensive fibers on the textile market. It sells for a fourth of the cost of alpaca and a fifth that of silk.

Preparation and Spinning - Carded was quick and easy. No doubt, the rayon top was texturized and processed especially for spinners. It measured 6" in length and worked well with the 5" alpaca rovings to make a neat sausage. It actually carded better than the cultivated silk as the staple length was more consistent and had no short bits to form neps. Being extremely fine and long, the fibers wanted to fold back but that was the only concern. Spinning this blend went too well. It spun better than the yarn looked after
washing as little bits of rayon puffing out of the alpaca. The wooliness of the alpaca really helped to counter the super softness of the rayon. This was definitely interesting spinning.

Evaluation - I am quite excited about using rayon as an extender for alpaca, especially, for lowering product costs and thus making alpaca more available and it works very well in increasing luster and handle. In this sample, it is difficult to identify the alpaca and one might think the luster and handle are from silk. On closer inspection, I think the handle slightly "mushy" (this is more evident in the skein than knit sample) and the luster a bit too shiny. I suspect a blend of 20 to 30% rayon would be more than adequate to allow the alpaca to be enhanced with the handle and shine of the rayon. The real test would be how low a percentage could one go with the rayon get some of these qualities. However, from a price point, the higher the rayon the lower the costs so a 25% mark might be a good choice.

A BLEND WITH A SYNTHIC FIBER

Nylon

Properties - The choice to blend nylon, a synthetic fiber, with alpaca, a natural fiber, may seem distinctly repugnant to a purist. However, nylon has many features to add to any blend. A major characteristic of nylon needed by alpaca is that of being light in weight as alpacas has the ability to compact. Lightweightness is critical for many designs. The major drawback of nylon is its non-absorbing nature but this is countered with alpaca’s absorbency. Both have high strength, resilience, abrasion resistance and resistance to molds and mildew and nylon in high rates than alpaca. Both shed dirt well because they are smooth fibers. The thermoplastic property of nylon is further useful in its ability to be wrinkle free, quick drying and in providing excellent dimensional stability (holding shape both wet and dry). Alpaca’s tendency to stretch and bag due to lower elasticity can be contained by a fiber with good dimensional stability. Synthetics, and especially nylon, can be engineered and it seems that nylon rovings produced for spinners have been. It feels soft and slippery but it has lovely "grab" making spinning very easy. Also it has a fair bit of bounce and spring so one can assume some elasticity has, also, been built in. Nylon dyes well with good fastness with acid dyes. Acid dyes are also used for protein fibers such as alpaca. The cost of nylon is less than half that of alpaca.

Preparation and Spinning - I used nylon rovings from Louet called Fake Cashmere Tops. The alpaca was raw and carded into rovings. I estimate the micron count of the alpaca to be under 24 giving it nice softness and fineness and the nylon, as advertised by its name, to be that of real cashmere at 14 to 19 microns. To ensure softness, it well to choose an alpaca that would compliment that of the nylon. The staple length of the nylon measured about 4" and the alpaca between mostly 5". The staple lengths were close enough to hand card well. The problem of long fibers flipping back was a concern so care was given to
getting a good flick of the wrist with each pass. Because of the lovely "engineering" of the nylon, the carding was extremely easy. It was a bit static and fly away but a small squirt of "Static Guard" cured the problem. As in the preparation, spinning was a delight. The nylon seemed to have lots of grab or "teeth" so neither slipped or stuck. It was a lot easier than spinning with 100% alpaca or any other blend in this group. Although the nylon looks and feels very silky, it spun much like Merino tops. The alpaca followed the lead of the nylon and made an enjoyable spin.

Evaluation - I think this blend made, at first glance, an excellent yarn. The nice soft loft is apparent due to both the alpaca and the "fake cashmere" and it feels wonderful. But as I worked with it, it became more and more questionable. In this 50% - 50% blend, the nylon defiantly won and the "plastic" nature of the synthetic comes shinning through and worse yet the alpaca gets quite lost. It seems to me self defeating to hide the lovely qualities of alpaca and with a synthetic. It also occurs to me that not only the aesthetic qualities of alpaca are lost but likely the important functional ones as well. However, it is not necessary to use this much nylon and in fact very little nylon is actually required to have it preform in a blend. It is recommended that as little as 10 to 15% nylon will do the job of giving strength to a blend. However, strength is not an important quality one would look for in a blend with alpaca as it has strength in its self. An exception might be in a yarn for a warp where strength is of the essence. What I recommend is a blend of at least 20 and up to 30% nylon with alpaca. Any more and the nylon may come through and any less what nylon offers may be lost. I think with at least 20% nylon, one would get an essentially alpaca yarn with some improvement in the handle; good improvement in dimensional stability and easy care but a major improvement in lightweightness and total project costs. And "for my money", altogether a worthwhile blend.
ALPACA BLENDS

50% CAMEL & 50% ALPACA

50% QIVIUT & 50% ALPACA
ALPACA BLENDS

50% SILK & 50% ALPACA

50% RAMIE & 50% ALPACA
ALPACA BLENDS

50% MOHAIR & 50% ALPACA  50% ANGORA & 50% ALPACA
ALPACA BLENDS

50% LINEN & 50% ALPACA

50% COTTON & 50% ALPACA
ALPACA BLENDS

50% RAYON & 50% ALPACA  

50% NYLON & 50% ALPACA
SUGGESTIONS FOR BLENDS

Expensive - Qiviut, cashmere, silk.

Inexpensive - rayon, nylon, some wools.

Luster - silk, linen, ramie, rayon, nylon, mohair, longwool sheep breeds.

Loft/Nap - angora, mohair, qiviut.

Softness/fineness - qiviut, angora, cashmere, silk, cotton, rayon, nylon.

Absorbency - wool, silk, linen, ramie, cotton.

Lightweightness - cotton, linen, ramie, rayon.

Poor strength - rayon.

High strength - ramie, linen, silk, nylon.

Elasticity - wool, silk.

Abrasion resistance - nylon, linen.

Flame resistance - wool, silk, cashmere, angora, camel, mohair.

Flammable - cotton, linen, ramie.

Wrinkle resistance - wool, silk.

Reference - Bette Hochberg - “Fiber Facts”
CHAPTER VI

CARE AND USES FOR ALPACA

The questions to be addressed are:
How does alpaca generally wash and wear?
How well does alpaca resist staining?
What laundry products and procedures work well for alpaca garments?
What would be the results of washing alpaca numerous times?
What is a basic procedure for laundering alpaca knits?
What is a basic procedure for fulling weaves?
What are some common uses for fine, medium and coarse alpaca yarns?

Wash and Wear

In general, I find alpaca garments do not attract or hold dirt readily so stay clean longer than many other of the natural fibers. This is attributed to the smooth scale structure of alpaca and as well its long staple length. One would have expect a similarity to wool but actually alpaca behaves closer to the synthetic fibers in this feature. A major surprise was, in trying to artificially place stains on the alpaca samples, to find the liquids bead and roll off as well serious pressure was needed to adhere dryer stains to the fibers. Then, I was really amazed at the ability of the alpaca samples to shed these stains with no more than average stain removal techniques and washing procedures. This test confirmed for me alpaca’s ability to reject staining well. It also suggests the great need to make sure plenty of time is allowed in wetting alpaca for dying and laundry procedures as alpaca does have some initial resistance to moisture. It was seen that alpaca does have the ability to absorb moisture but at slower rates than wool. Fibers that stays cleaner longer wear better as less laundering is required.

Alpaca will shrink, matt and felt like wool. The washing tests and an unintentional trip through the washer and dryer with a pair of socks proved that for me. On the other hand, I knit a pair of over sized mittens with the thought of felting them down to size. I put them through the washer and dryer twice with no success. I finally resorted to the old fashioned scrub board with great success. This just proves that conditions of heat, moisture and agitation have to be right to shrink and felt wool and wool like fibers.

I have noted earlier alpaca’s wrinkle resistance which I think it is better than wool and suggests excellent resilience. I have not needed to press an alpaca knit taken out to wear and seldom press a garment after laundering especially if blocked properly before drying flat. Like wool knits, alpaca knits should not be hung on hangers to store for fear of stretching. I have not experienced a great deal of stretching, bagging or sagging in my alpaca knits. I have tried to accommodate alpaca’s lesser elastic nature by knitting tight ribs and have tried to design lightweight yarns and avoid heavy compact yarns, the
Stains on Alpaca

- Mustard
- Ketchup
- Orange Juice
- Coffee
- Red Wine
- Lipstick
- Makeup
- Salsa
- Grass
- Butter
- Chocolate
STAIN REMOVAL RESULTS
weight of which would stretch out the fibers. Every knit garment has some amount of movement as that is the nature of knit fabrication. Any normal movement in my knit alpaca was readily blocked back after hand washing. Ribbing tightens back up and any shape distortions go back to original.

Alpaca has a slight tendency to pill but the pills are not serious and are easily removed. Pills will occur more readily if very short fibers are left in fiber supply. Short fibers do work their way to the surface of a textile upon wear especially in knits. Some pilling is caused by alpaca’s propensity to nap. This happens with extended laundering and general wear. I have used a soft brush to lift slight tangles returning the garment to like new condition. If guard hair has been left in the fiber supply, these, also, readily work their way to the surface and usually can be pulled clear. One interesting suggestion on removing copious quantities of protruding guard hair in a garment constructed from seconds, was to shave or trim the surface. As these coarse fibers work up to the surface, they could conceivably be eliminated in this manner.

Alpaca is a very strong, abrasion resistant fiber and these account for extremely long and hard wear abilities. I have not had alpaca long enough to be able to report on what that actually means in terms of time but reports have been that it is difficult to wear out. Any problems I have had have been directly attributed to construction faults and not the fiber itself.

Laundry Products

As was discussed briefly in washing fleeces, my favorite laundry washing product is Ivory hand dish washing liquid but, I am sure, any good quality liquid dish washing product would do. For extra dirty garments, liquid Wisk or Tide, will work as well as they do with raw fiber. I have used hair shampoos and specialty hand washing products like Woolite, Zero and Meadows Wool Wash. My feeling is that this last list is expensive and gives no better a job than Ivory.

The key to success in choosing a good washing product usually rests with the existing water conditions with hard and extra water hardness being the most difficult. The use of a soap rather than a detergent with hard water will cause a binding with water minerals to form a precipitate that attaches to items being laundered. My recommendation is to always use a detergent in hard water areas. Water softener products are useful to improve the workings of the washing products and their removal in rinsing. Other factors that affect washing are amounts and kinds of dirt or stain; the amounts of cleaning products used; the volume of water used and the length of time soaked. Failure to pretreat difficult stains: too little cleaning product, too little volume of water, too short a soak period and poor rinsing will all produce poor cleaning conditions in alpaca as well as any other fiber.
The Washing Test

Since alpaca has been with us such a short time, I tried to design a test that might give an indication as to its washability over a long period. I added other fibers into the test for comparison. I proceeded by knitting a batch of samples from yarns that were prepared, spun and knit the same way. The worsted yarns averaged 3 t.p.i., 14 w.p.i. and a twist angle of 21 degrees. The knit samples were 3” x 3” and done on 3 mm needles. With each wash, I tried to use the same procedures, products and time frames as given for washing an alpaca knit. The other fibers used for comparison were llama, mohair, Merino, Border Leicester, angora, silk and ramie. I used a white as well as a black alpaca to prove true black alpaca keeps that color. I am happy to note it did.

As I washed the swatches, I saved a sample for comparison on wash number 1, 5, 10 (alpaca only) and finally 15 times. I predicted that the angora and Merino would perform the worst and ramie the best and the alpaca better than most other fibers. The only guess that was correct was the ramie. I was very disappointed to see the alpaca was the very first fibers to show signs of distress and this happened as early as wash number 5. A close inspection of that sample shows a slight matting of fibers and shrinking of the size. The other wool samples followed suit but not to the extent of the alpaca and actually look much better than the alpaca through all 15 washes. A surprise was in the angora which washed very well right along with the mohair and did not show major sins of distress till the close to wash 15. The silk was amazing too, despite the differences in yarn construction of the 3 samples, in washing well through all 15 times. Since ramie is a vegetable fiber well noted for its washability, it was no surprise to see little change in it though all 15 washes except it seems to have become whiter in color. I cannot account for this but wonder if that sample caught some sun in the many drying times. Speaking of odd color changes and unknowns, I, as well, cannot account for the color change in the other white samples. It is of particular note in the alpaca and wools. There are many possible speculations but I simple have no sure answer. My best guess is a continuous residue of Ivory detergent from the use of too much product and improper rinsing, even though I did rinse each wash 3 times?

I am not sure what I learned about alpaca in this test as nothing turned out as I expected and I have more questions than answers. It has not been my experience to have any alpaca garment washed over a period of 7 years shrink, matt and felt as did these samples. In fact, I have had excellent success and can send to shows alpaca sweaters years old that still are like new yet have been through many wearings and washings. I would need to redo the experiment and tighten up the controls. It would be interesting to try this same test using different qualities of alpaca and alpaca from different fleeces.

If anything, this washing tests says alpaca is subject to problems in hand washing and care must be taken to keep garments looking fresh and new.
WASHING TEST

ALPACA

1X  5X

10X  15X
WASHING TEST

15X

MERINO

BORDER LEICESTER

RAMIE

MOHAIR
Washing An Alpaca Knit

I hand wash alpaca knits as I do wool knits. I use warm water and a mild detergent. The secret to hand washing is not to use actions that agitate as this could cause felting. Gently swish, push, poke and squeeze. I soak garments in warm soapy water for about half hour to thoroughly wet the fibers and leave another half hour to lift the dirt. Rinse well three times in warm water. In final rinse water, I use vinegar to increases shine and make sure detergent is cut and fabric softener to improve the handle and reduce static. A drop of favorite scent in the final rinse gives a pleasant smell to the garment. A lovely scent that is safe for children and protects against moths is the essential oil of lavender. For long storage, essential oils of lavender, pennyroyal or eucalyptus help protect against moths.

Large garments can be soaked in washing machine. Fill with warm water and washing product before adding item. Never allow water to pour on alpaca as this can cause felting. Do not allow washer to cycle. Soak and spin only. Remove garment to add rinse waters.

When rinsing is complete, squeeze out excess water, roll in towel, step on it to remove more moisture or spin excess moisture out in washer.

Blocking back shape and dry flat. Block by push rib together at neck, cuffs and bands. Alpaca has less elasticity than wool and tends to stretch rather than shrink. To maintain absolute correct size, trace shape of dry garment before washing on wax or brown paper and lay wet item over shape. Block back to original by pressing the knit to outline.

Remove any pills by hand. Brush nap up on mohair/alpaca and angora/alpaca blends with a soft brush in one direction. If pressing is required, use wool heat setting on the iron and use an up and down light steam. It is possible to stretch alpaca knits out of shape with heavy back and forth ironing motions.

I blocked lace knits wet by stretching out with pins as for Shetland laces. This worked very well with the alpaca which accepted and held this shape. I finished with a light steam mostly to even up edges where necessary.

Fulling Weaves

I have fulled several woven alpaca pieces and followed the same procedures as for wool with good success. I did pieces in the washing machine as well as by hand in the sink. Alpaca does not take readily to fulling and I did find it took a bit more work than with wool to see the fibers interlacing to the right amount needed. However, I do not like alpaca well and properly fulled as I found it tends to loft too much. I preferred a smoother look so full items a lot less than recommended. I think this is a very individual choice so one would start with less rather than more fulling. It is easy enough to redo but impossible to undo.
Uses For Fine, Medium and Coarse Alpaca

Alpaca International News ran an article written by Cameron Holt, an Australian fiber expert, who listed alpaca uses by micron counts that was very interesting and useful. He suggests 18 to 20 microns suitable for underwear; 20 to 23 microns for fine to medium knits, men's suiting and light weight worsteds; 23 to 26 microns for woven outer wear and machine knitting yarns; 24 to 29 microns for hosiery; 26 to 29 microns for hand knitting yarns and 30 + microns for hand knitting, interior textiles, very strong fiber and carpets (12). I think this is a great list.

It has been seen that alpaca can be spun successfully in all manner of twist and grists producing yarns that can range from bulky lopi style right to extremely fine Shetland style. I have coarse bulky yarns both in handspun 2 ply and mill spun 4 and 6 ply for ready to make rugs. I have seen a most exquisite wedding ring fine shawl made from handspun alpaca that was exceedingly beautiful.

I think alpaca would be a perfect fiber for embroidery, crewel and tapestry yarns. They have a good abrasion resistance and strength for these jobs and can readily be spun in a fine hard twist. The problem maybe with the lofting or fuzzing of the fibers as they travel back and forth through the backings. The use of a worsted yarn and short sewing lengths should accommodate this potential problem.

My couple of attempts to use alpaca seconds and thirds for rugs had been very promising. They had a noticeably comfortable foot feel, especially when standing for longer periods. Alpaca's lofting ability can be used to full the rug nicely. I did have a lot of short fibers fall off with each laundering as these fibers are not usually well sorted. The coarse fibers and guard hairs worked themselves to the surface and gave an great texture and catch dirt. This is useful, especially, at entrance ways. I allowed my entrance way rug, which needed lots of cleaning, to go through the washer and dryer. It felted beautifully but, of course, is greatly reduced in size. One would want to accommodate for shrinkage and felting in designing a rug in heavy wear areas that need could be put through the washer for ease in care.
Alpaca Fiber Applications

Safley, Alpacas / Summer 1994
CONCLUSION

I have discovered much about alpaca fiber but with each question answered there were many more to ask. However, I believe this study may afford a bases for further research.

A summary of alpaca's taxonomy, historical roots and animal facts are:

The group of four camelids known as the llama, alpaca, guanaco and vicuna are a distinct classification of animals and only very distantly related to the camels. There are some similarities found in the alpaca, camel and llama down fiber. Alpaca appear more closely related to the vicuna than the llama or the guanaco. Therefore the propensity for producing a fine, dense, single coated fleeces should be found in the selective breeding of the alpaca and the alpaca/vicuna cross.

Alpacas have a ancient history and are proving to be one of earliest animals domesticated by man. The zenith of alpaca fiber production occurred at the time of the Incas. Since that period, alpacas fell into decline, mostly from inadequate nutrition and inbreeding, and only today are regaining the excellence of fleece as seen in ancient times. Industrialization of alpaca began in England during the mid nineteenth century and moved to Peru by the twentieth century. Peru has maintained a monopoly on alpaca fiber production up to today. For the most part, commercial production has been limited to use by the haute courtier of France and Italy. Nothing much mainstream has been seen of alpaca in the last half of this century. As such, it has been classified as one of the most exotic and rare of fibers by the spinning community. With the successful importations of alpacas to many countries around the world during the past two decades, alpaca fiber is once again being recognized. With modern technology, advanced husbandry and selective breeding practices, alpaca has the propensity to capture a significant place in the textile world.

Both breeds of alpaca, the Suri and Huacaya, have an excellent, yet different, fiber. Huacaya's larger herd numbers will allow it to arrive in the mainstream for hand spun and commercial production in the near future. The small herd numbers of the Suri will limit its availability and use for sometime yet to come.

As a farm animal, alpacas are an excellent choice being gentle, trainable, clean and environmentally friendly. They are suitable to small or large acreages and do not require excessive or expensive accoutrements. They are easy to care for and manage. These considerations make them especially appealing to older folks, females and those with children. The raising of alpacas has become a viable livestock alternative.
A summary of the information gathered on alpaca fiber are:

Alpaca is a viable, valuable, multifaceted and beautiful fiber. This was known by the ancient peoples of South America and is known by their modern day ancestors but not by the rest of the world at large.

Today's textiles survive on offering a unique combination of characteristic and I think alpaca has an important and coveted group of properties not found in other fibers or not able to be synthesized.

Alpacas produce more natural colors than any other fiber bearing animal in the world. Color charts classify 22 separate colors.

Alpaca can be found in staple lengths to accommodate most project. The usually one year growth average of 4 to 6 inches provides a desirable staple length for most end uses. Short lengths can be used for woolen spinning systems and long for the worsted systems.

A less than 5% grease content and an odor free fiber allows for pleasant handling in the raw and a saving of time, labor and cleaning products in processing.

The strength of alpaca has been measured as three times stronger than Merino sheep wool. It, also, has been found to have excellent abrasion resistance. Superior strength and abrasion resistance allows for great flexibility in spinning and weaving and offers long hard wear.

Allergic responses to alpaca are reported far less than many other wool type fibers. It also has a lower prickle factor than many sheep wools so feels better next to the skin. Alpaca with a micron count of less than 22 is considered next to the skin quality. Alpaca that has over a 5% content of plus 30 micron fibers will prickle or itch.

Alpaca is an excellent insulator and can offer warmth without weight with good yarn design but can be oppressively warm and heavy with poor yarn design.

Alpaca is reported to have excellent resilience but not a lot has been done with this quality which would be worth further exploration. Knit wear has proven to have high wrinkle resistance.

I have proved to my satisfaction that alpaca has average elasticity but this is a question that can only be completely determined by scientific testing.

Good crimp can be found in alpaca but varies from fleece to fleece and is usually poor in alpaca fleeces with large amounts of coarse fiber and in Suri alpaca. I have not found this a hindrance if accommodations are made at the outset in the yarn and product design.

I claim in my work that alpaca has a natural ability to nap. The aura is very soft and low and somewhat reminiscent of English angora. It is my opinion that this quality enhances an alpaca product.

Alpaca is absorbent but at slower rates than wool. This may account for its ability to be moderately water repellant and stain resistant and it will shed dirt, rain and snow to a higher degree than wool.

As with other protein fibers, it is flame resistant.

For me the most endearing alpaca quality is in its excellent handle. It is unique to alpaca and differs from sheep wool with a less spongy and silky texture.
Conclusions about alpaca as a spinning fiber are:

Since commercially spun alpaca yarn are available in only a few styles, the ability to hand
spinning yarn offers endless variety and the possibility to design any style required for a
specific end use.

Alpaca fiber has great versatility in fineness, color, luster, handle, staple length and in the
possibilities for preparation, spinning, blending and dying.

How to best spin alpaca will depend on many factors and should include the unique
characteristics of each fleece. Alpaca fleeces do not exhibit the same consistency as that of
sheep wool with a history of many decades of controlled breeding. Alpaca fleeces may
vary in amount of crimp, staple length, silkiness, smoothness, fineness, luster and handle.
It may be well to sample each new supply before making firm plans for an end project in
order to make the fullest use of a particular fleece's best qualities.

Fiber problems run from contamination by dirt, secondary fibers and guard hair to dead
tips and color anomalies. There is some poor experiences at the moment with dirty fiber.
Producing clean fleeces is on the learning curve for alpaca producers and should correct
itself upon demand. Fleeces should be well cleaned at the point of shearing to be
acceptable for hand spinners. It is well to check all supplies of alpaca for contamination
and unwanted hair which should be picked free before preparing. Raw locks can be flicked
before and after washing to ensure perfect cleanliness.

Alpaca can be washed in almost the same manner recommended for other wools. Less
cleaning product and lower wash water temperatures can be used as alpaca has far less
grease and odor than sheep wool or mohair. The best method for washing fine alpaca that
keeps lock structure perfect is washing lock by lock. Less time consuming and acceptable
wash methods for lesser grades are by soaking fibers packed in plastic or net bags in the
sink or washing machine and spinning dry. Alpaca should always be air dried as it may
shrink or felt in the dryer.

Most any type of spinning equipment can be used to spin alpaca. Since alpaca becomes
harsh with high twists, high drive ratio equipment may be a hindrance unless speed is
necessary and hands can keep up with the draft required. On the other hand, alpaca is
suitable for low drive ratios, especially for bulky and lopi style yarns. A fiber supply that
has been prepared with a slight twist will help to keep a light or slippery supply from
falling apart. This is particularly helpful when using hand spindles and with spinning wool
comblings.

Alpaca can be spun successfully from most fiber preparations and with most spinning
techniques.
Alpaca is available for spinning in the raw as well as in worsted and woolen rovings from fibers graded as prime, seconds or thirds.

Alpaca fiber can be spun either woolen or worsted depending on the staple length and yarn desired. Alpaca's long staple length makes it a natural for the worsted system. It is my opinion that the best and most successful preparation and spinning for alpaca fiber is the worsted system and wool combings from English wool combs are to best accomplish this. They produces an excellent yarn but one that is described as slightly more hairy than that of sheep wools. Worsted mill rovings and hand drum carded rovings are excellent, as well, but do not match the high quality of the wool combings with which it is considered the only way to produce true worsteds. In these other worsted preparations, it is not possible to match butt and tip ends as needed for a true worsted; the fibers are not quite as parallel; the short fibers may not be completely removed and the consistency of the supply is not quite as good. Alpaca makes excellent woolen yarns as it has some natural loft, the ability to bulk and is lightweight and airy. Woolen preparation from a drum carded rovings or from mill rovings spin almost equally well and make excellent woolen yarns provided shorter staple length alpaca is used. The better woolens yarns are spun using a 3 to 3 1/2 inch staple length as over 4 inches lengths tend to slide out to a semi-worsted style yarn. Hand carded worsted or woolen fiber preparations are acceptable but need more work to keep the supply constant, the yarn consistent and the joins adequate. The least successful yarns are those spun from the lock as the supply is hard to control and joins difficult thereby giving a less consistent yarn, the possibility of poor joins and a slower rate of spinning speed than with better prepared fiber. Yarns spun from the lock usually produce a semi-worsted style yarn as parallel fiber presentation is difficult to maintain especially at the end of each handful.

Beginning spinners have no difficulties in working with alpaca. The long staple lengths compensate for the slipperiness. It may not be the best choice for those just learning to spin because of the slip and because it is expensive to waste. Beginners need to go slow using a lower rather than a higher twist and a thinner than thicker grist. Alpaca lends itself beautifully to both. Alpaca seconds are a great choice of fiber for learning and practicing various techniques.

In tests with grist and twist, I determined the following guide-lines that maybe useful as a starting point for yarn design for more advanced spinner. As with other fibers, alpaca does become harsh with extra twist. In general, a twist angle of more than 25 to 27 degrees caused harshness and can be quite readily felt in the yarn. Softness and silkiness seem to be optimal at twist angles between 10 and 21 degrees. The coarser the alpaca the lower the twist angle is needed to keep the softness. Very coarse alpaca had the best feel at 7 to 14 degrees. Very fine alpacas did well at 21 to 30 degrees. For warp yarns, I recommend sampling at around 21 degrees for coarser fibers and as high as 30 for very fine fibers. Knitting yarns do well at 14 to 21 degrees.
Alpaca can be spun successfully in a wide variety of grists. Because of the long staple length and great strength of alpaca, very thick as well as very fine yarns are possible. Bulky yarns of 3 to 4 wraps per inch held together well. I did not explore grists in the very fine ranges, but it appears that fine grists need far less twist than other fibers to produce yarns with good integrity.

A starting place for spinning alpaca is a 21 degree twist angle, 3 twists per inch and a grit of 14 wraps per inch. From there it will be easier to designing one's own yarn and find the correct twist and grist needed for a particular end product.

Advanced spinners are able to make full use of alpacas diverse qualities.

Conclusions on dying experiments are:

Alpaca dyes well. It most closely resembles sheep wool in results. I had no difficulties using acid, fiber reactive or natural dyes using directions for protein fibers. I did experience some increase in harshness with extremely high cooking temperatures and very long cooking periods where even heat is hard to maintain. I recommend using directions for silk or mohair rather than wool for acid and fiber reactive dyes that recommend a cook temperature of 180 degrees F. Methods involving short cooking periods are preferred over longer ones. Of the dyes I used, the best results were achieved with Gaywool dyes which are premixed, easy to use and require about half the cooking time of the other dyes.

Grey alpacas made up of combinations of white and black fibers dye with a uniqueness not usually seen.

Colorfastness to washing, light and sun tests results were exceptional in all samples. I had expected the natural dyes to be less so and they were not quite as good as the synthetic dyes but still did rather well. Despite the limited numbers of natural dyes tried, it is likely safe to assume that alpaca will be as colorfast as natural dyes are with other fibers.

Results of experiments blending alpaca are:

I think the most important and interesting finding made was to identify that alpaca is camouflaged in a blend unless it is used in very large amounts. Alpaca allows the feel of the fiber it is blended with to overpower and the essential quality of alpaca is lost. This affects its aesthetic qualities rather than its functional properties. In general, I would say if the feel of alpaca is wanted then it needs to be used in percentages of 70% or more. Exceptions are when alpaca is used as an extender or when only functional properties are needed.

The micron count of the alpaca should be matched to that of the other fiber for best results.

Alpaca mixed well, for the most part, with all fibers except those with a wide difference in staple length which was expected.
Blends of alpaca and sheep wool work best when the wool is slightly softer than the alpaca. Blends under 75% alpaca with sheep wools feel essential woolly so it seems self-defeating to make such a blend unless the alpaca is needed only for its functional properties. I see few advantages in blends of fine alpaca with fine wools. Conversely, I see great advantages to blending second and third alpaca grades with wools of similar qualities.

As with the wool blends, I think alpaca best blends with other fibers in percentages of over 75%. I did not find any blend I would repeat in 50-50 proportions with the exception of qiviut. I think the 50% qiviut and 50% alpaca the most successful of the blends I tried as it took advantage of the best qualities of each fiber. The least successful I considered the cotton and alpaca not only because of the difficulties of mixing a short and a long fiber but from a lack of aesthetic and functional appeal. Alpaca blends with silk, angora and mohair are superior to any I have seen with wools. Camel and alpaca are so similar that I think the only function for using alpaca with camel is as an extended. The blends with the most intrigue and interest were the ones with the long vegetable fibers and the synthetics.

Proportions for blends will depend on the end product one envisions and on personal preferences. My recommendation for a starting point in finding the appropriate proportions for an alpaca blend is a 80% alpaca with 20% other fiber.

Conclusions on care and uses of alpaca are:

Being a long smooth fiber alpaca does not attack dirt easily and sheds it readily in the wash water.
I amazed with the stain tests when I saw alpaca's ability to shed the various stains. With the difficulty in make alpaca fibers hold the stains and with the beading of liquids on the fiber surface, I think it is safe to say alpaca has good stain resistance. Alpaca's capacity to resist dirt and stains means it will stay cleaner longer.

Alpaca fiber will shrink and felt. This means end products need to be carefully hand washed or dry cleaned.
In the washing tests the alpaca samples did the worst of the lot yet I have not had this problem in actual hand washing many alpaca products. I have no idea why the wash sample shrunk to the degree they did when garments did not. Most work needs to be done here.

I have not found alpaca garments to wrinkle excessively and stored items do not need touch up pressing before wearing.
If alpaca stretches out of shape, it easily returns to original if washed, blocked and dried flat. I think a lot of stretching of alpaca products is more due to poor yarn or product design than a failure attributed of the fiber.

Alpaca is known to give extremely long and hard wear.
Liquid dish detergent has proved as effective a cleaner for alpaca as any other like product. Hard water needs water softener added to ensure proper action of the cleaner. Vinegar in the rinse water helps cut soap residue and improve luster. Fabric softener improve handle and control static. Essential oils of lavender, penny-royal and eucalyptus are recommended for moth protect.

Alpaca needs to be hand washed as for wools. Agitation, high heat and pressure will contribute to fibers shrinking and felting.

In my limited experiences with fulling woven alpaca, it seems that alpaca fulls more readily than wool. This is likely due to its propensity to loft. I recommend care be giving when preforming this treatment.

I think the best summary of uses for alpaca is that presented by an Australian fiber expert, Cameron Holt, and I quote:
"-18 to 20 microns suitable for underwear; 20 to 23 microns for fine to medium knits, men's suiting and light weight worsteds; 23 to 26 microns for woven outer wear and machine knitting yarns; 24 to 29 microns for hosiery; 26 to 29 microns for hand knitting yarns and 30+ microns for hand knitting, interior textiles, very strong fiber and carpets". (Holt 12).

Not nearly enough work has been done on the many possible for uses of alpaca fiber. This is a whole new ares yet to be explored especially in the use of lower grades of alpaca and in textiles in and out of the home.
CONCLUSION OF TEST RESULTS

A summary of the test and experiment results attempted in this research that may add to the general body of knowledge about alpaca are:

The elastic tests show alpaca may have average elasticity and not poor elasticity as has been reported. Laboratory testing is needed for more accurate confirmation of this conclusion.

The napping experiment shows alpaca to have some innate ability to fluff. Fuzzing in alpaca has been previously attributed to yarn and construction design and not to the fiber itself. Further scientific tests are needed to document this find.

In general, the point at which it was found that alpaca becomes harsh with over twist was determined at twist angles of between 25 to 27 degrees. This test was done on a limited number of alpaca samples and could be done with a broader range by including all the average ranges of micron counts found in alpaca.

Blends with alpaca in amounts less than 70 to 75% lose the essential feel of alpaca. Blends are in the domain of personal preference so this finding is only a guide-line.

The stain tests showed alpaca has an excellent ability to resist and shed stains. A wider number of stains needs to be tested under controlled laboratory conditions used to confirm this ability.

The colorfast tests of common dyes available to hand spinners showed excellent resistance to sun and light. Controlled testing can be done to determine whether this is directly a property of the dyes or that of the alpaca or a combination of both.

The wash tests were inconclusive in that they were expected to show alpaca washes better than most wool fibers. They did proved alpaca does shrink and to more of a degree than is experienced with washing other alpaca garments.
TAXONOMY

Initial disagreement among scientists arose in deciding the zoological classification of camelids because it is not a true ruminant as their stomach lacks the omasum (the third division in the stomach of cud-chewing animals).

There is now common agreement to the following classification:

Order - Artiodactyla
Sub-order - Ruminantia
Infra-Order - Tylopoda
Family - Camelidae

In the family of camelidae are two genus:

Genus Camelus
Camelus Dromedary
Camelus Bactrianus

Genus Lama
Lama Glama (llama)
Lama Pacos (alpacas)
Lama Guanicoe (quanaco)
Lama Vicuna or Vicugna Vicuna (vicuna)

In the paco species there are two varieties:
Huacaya
Suri

As a group, camelids are, also, known as lamoids and lamas.
**LENGTH OF FIBRES**

**WOOL**
- Fine and medium wools 2" to 4"
- Crossbred wools 3" to 6"
- Lustrous longwools 5" to 14"
- Coarse wools 4" to 12"

**COTTON**
- Uplands 1" to 1-1/16"
- Pima 1-1/2" to 1-3/4"
- Sea Island 1-3/4" to 2"
- Natural brown 1/2" to 7/8"

**BAST FIBRES**
- Linen 15" to 30" (often cut in industrial processing.)
- Hemp & Jute 3" to 6" (often cut in industrial processing.)
- Ramie—combed tops 5" to 7" noil 1" to 4"

**SILK**
The single filament of one cocoon can measure up to a mile long. Reeled silk is considered functionally continuous.
- Cut silk 2" to 6"
- Noil silk 1/2" to 2"

**ALPACA**
- Combed tops 5" to 9" (in raw fleece length depends on frequency of shearing and can be 8" to 20")

**CAMEL**
- Down 1-1/2" to 2-1/2"
- Hair—combed tops 4" to 8" other 1-1/4" to 4"

**CASHMERE**
- Down 1-1/2" to 3"
- Hair 3" to 5"

**LLAMA**
- Combed Tops 5" to 9"

**MOHAI R**
- Kid 3" to 4"
- Older 8" to 12" (if allowed to grow). Combed tops 4" to 8"

**VICUNA**
- Down 1-1/2" to 3"

**GUANACO**
- Down 1-1/2" to 3-1/2"

**ANGORA RABBIT**
- Brushed or plucked 3" to 5"
- Shorn 2" to 4"

**MUSK OX**
- Down 1-1/2" to 3-1/2"

**GOAT HAIR**
- Combed tops 4" to 6"
- Other 1-1/2" to 6"

When measuring the length of fibres, the only problem is choosing a typical sample to be measured. For instance, an average Lincoln Longwool fleece has wool about 12 to 15 inches long, but one prize English ewe grew a fleece of 32 inches. Climate and growing conditions affect the length of plant fibres. And there is considerable natural variation. The fibres from a single cotton seed have shown a range of less than an eighth of an inch to two inches in length. These measurements represent the average range of length available, not the outer limits which can occur.

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**DIAMETER OF FIBRES**

The diameter of fibres is most commonly measured in microns (one micron equals a millionth of a meter). Knowing the measurement enables us to compare the thickness of fibres. The difference in volume can be very great. For instance, if one fibre measures 10 microns in diameter and another measures 30 microns in diameter, the total volume of the second fibre will be about nine times greater. Published results have varied dramatically because the fibre samples chosen for measurement have varied so greatly. The size of animal fibres depends on the age of the animal, and the part of the body from which they are shorn. The size of plant fibres is influenced by the strain and growing conditions (a single brown cotton fibre can be three times the volume of a single fibre of Sea Island cotton). And there is wool both finer and coarser than shown here. This chart represents a conservative average of fibre quality most often available.

**NOTE:** Measurements have been compiled from many sources, including A.S.T.M., British Wool Marketing Board, U.S.D.A., American Sheep Producers Council, Textile Institute, Natural Fiber Economic Research Center, Encyclopedia of Textiles, Werner von Bergen, E.E. Morton, G.R. Wray, Kenneth Ponting and others. The measurements given here represent an average of these figures.
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