EFFN news

Newsletter of the European Fine Fibre Network

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Contents :

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Editorial

(by Claire Souchet, project administrator, Macaulay Land Use Research Institute)

The European Fine Fibre Network has received new funding from the European Commission (FAIR3 CT96 1597). The new project is a Thematic Network entitled *''Increased competitiveness of high quality European animal textile fibres by improving fibre quality''* and will be in existence until January 2000.

At the last meeting of the previous EC Concerted Action, a need was identified to establish a European network of researchers, producers' organisations and textile manufacturers engaged in research and development on the production and processing of high quality animal textile fibres of European origin in order to improve the measurement of fibre traits in genetic improvement programmes and in the marketing of these fibres. This present network, which concerns cashmere, mohair, angora and fine wool fibres, will specifically:

1. Establish common methodology for the measurement of quality fibres traits by using OFDA fibre measurement technology and encouraging comparability between fibre analyses in different countries.

2. Increase European collaboration in fibre quality improvement through the establishment of common protocols for measuring fibre traits in breeding programmes for different fibre types.

3. Improve the competitiveness of European producers of speciality animal fibres by establishing clearly defined market-led quality objectives, grading and presentation standards and the creation of new information channels between producers, industry and research.

A key feature of the network will be the holding of four workshops which will allow all those involved in research and development of animal fibre production and processing to discuss, agree upon and implement common measurement methodologies to encourage the competitiveness of Europe in specialised fibres.

A round-trial of fibre quality measurements, using the OFDA methodology, will be undertaken this winter for cashmere and mohair fibres to assist in demonstrating the value of the methodology.

There are also funds available for training courses and technical exchange visits to other laboratories, to increase the use of OFDA technology. Details are given in page 3.

This first newsletter, one of two to be published this year, describes the network and the current stage of research on fibre measurements. The next newsletter will focus more on research on each fibre and the outcomes of the first workshop will be described. We would be also pleased to receive members' own ideas for the newsletter and the further development of the network.

The EFFN network has a homepage on the Internet. More details about its activities will be therefore available. It is accessible at the following address : **http://www.mluri.sari.ac.uk/~mi573/**

We look forward to hearing further from those who will receive this Newsletter and we would be pleased to meet them at the workshops during the coming years. We would also ask them to encourage others to join the Network.

Those who have not been yet contacted and who would wish to participate to this network should contact the network administrator, Miss Claire Souchet (see address below).

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WORKSHOPS

The organisation of workshops is an important part of the network's activities. The aim is to involve researchers, producers' groups and manufacturers. The objective is to further the introduction of OFDA measurement technology into fibre quality measurements on a pan-European basis for the specific areas of genetic selection and quality control schemes.

The first workshop on "*The development of European standards for the objective measurement of genetic selection parameters, based on quantity and quality fibre traits*" will take place in Villaviciosa in Spain, on 10 and 11 October 1997 by kind invitation of Dr Koldo Osoro, of the Centro de Investigacion Agraria y Tecnologia Agroalimentaria.

On 9-10 March 1998, the second workshop will be held on "*The establishment of common European protocols for the recording of genetic performance data for speciality fibre producing animals*", in Toulouse (France), co-organised with Dr Daniel Allain of the Institut National de la Recherche Agronomique.

The third workshop will be held in June 1998 in Aachen, Germany, on "*Quality assessment and the requirements of the fibre manufacturing industry*"; it will be co-organised with Dr Ho Phan of Deutsches Wollforschungsinstitute and der Technischen Hochschule.

The last workshop, on "*The development of breeding schemes for European-produced speciality animal fibres*", is planned for 1999, and will be held in Scotland.

A publication will be produced from each of these workshops as a mean of assisting in the dissemination of information.

Details of the first three workshops:

Workshop I (Villaviciosa, Spain): 10-11 October 1997

This workshop will involve those concerned in breeding programmes for the 4 species dealt with, that is, angora goats (mohair), angora rabbits (angora), cashmere goats and fine wool sheep.

The main objective of this workshop is to agree on a set of common fibre measurements for each species across Europe.

The workshop will start with two papers on measurement techniques. Two working sessions will be held in parallel; sessions for angora rabbits and cashmere goats, followed by sessions for fine wool and angora goats.

A reporting back session will allow a discussion of the outputs of each working group, and the drawing ups of action plans for the development of common fibre measurements for each fibre.

Workshop II (Toulouse, France): 9-10 March 1998

This workshop is likely to include predominantly the same participants as in Workshop I.

The objectives are 1) to agree on selection criteria and methods of measurement for a common set of fibre and non-fibre traits for each species, and 2) to agree on a database structure recording for these traits and its management.

As for the first workshop, two working sessions will be held in parallel; sessions for angora rabbits and cashmere goats, followed by sessions for fine wool and angora goats.

A reporting back session will allow a discussion of the outputs of each working group, and the drawing up of action plans.

Workshop III (Aachen, Germany): June 1998

Processors, manufacturers and producers' groups will be invited, as well as the scientific community, to the workshop. The objectives are 1) to discuss how their requirements can be met by the European fibre industry and how quality criteria can be standardised and 2) to outline a proposal to use OFDA methodology as a standard method for cashmere and mohair.

Anyone wishing further information about these workshops should contact the project administrator, Miss Claire Souchet (address page 2).

Training courses/technical exchange visits

The EFFN has funds for the provision of a limited number of training visits by Network members-or their staff and students- for the purpose of measuring, to institutions in others EC countries. These visits or courses are the use of the generic technology (fibre quality measurement) in research institutes, extension services, producers organisations and manufacturers. The grants are therefore intended for organisations who are using OFDA methodology to run courses and for visits by staff from organisations setting up the new technology to those organisations.

Proposals for funding should include:

1-date of the visits and the outline of the activities that are planned
2-the full address of the institute(s) to be visited and the contact name(s) there
3-a description of the applicant's background and current interests and what he/she hopes to gain from the visit
4-a budget showing all the expenses that will be claimed. The appropriate APEX air fare may be claimed for international travel. Within the destination country, reasonable travel expenses may be claimed. A subsistance allowance to cover hotels and meals may be charged at a rate of up to 75 ECU per day.
5-an acknowledgment from the host institution that they have been consulted and agree with the proposal.

Following the visit, a short report should be sent to the Project Co-ordinator.

Applications should be sent to "Dr John Milne, EFFN Co-ordinator, MLURI, Craigiebuckler, Aberdeen, AB15 8QH, Scotland, UK". They should arrive not later than 6 weeks before the proposed departure date.

Fleece and fibre measurements in angora goats and angora rabbits.

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1-Objectives fleece and fibre measurements for mohair.

The angora goat is primarily raised for textile fibre, known as mohair. Income from mohair is largely determined by the quantity and the quality of fibre produced by goats, that is, the weight of clean fibre, mean fibre diameter with fibre distribution and the rate of undesirable fibres (kemp and medullated fibres). Other fleece quality traits such as staple length, style, character and lustre have a slight effect on the value of mohair.

Except for greasy fleece weight, which can be easily determine directly on the farm by the grower with a weighing machine, the other fibre characteristics which determined fibre quality need to be objectively measured in the laboratory. The main quality criteria are the clean fleece content, mean fibre diameter, fibre diameter distribution and kemp, and medullated fibre content.

Clean fleece content

The standard method used for wool, and defined by the IWTO, can be extended to mohair. It is the amount of wool or mohair base adjusted to a standard ash plus alcohol content of 2.27 % and brought finally to a regain (due to moisture content) of 17 %. The method required to determine the mohair base, that is the content of fibre free of all impurities (water, ash, grease or alcohol ether extract and vegetable matter), is achieved with the washing yield, determination of ash content, alcohol-extractable matter, and vegetable matter con tent. However, this method used for trade and industrial purposes is time consuming and expensive. Thus it cannot be used to determine clean fleece content of one animal.
A derived methodology called "ITF-INRA washing yield method" has been developed in France. This method, using ultrasonic technology, is well correlated with the IWTO standard method and accurate enough for determining the clean fibre content of a fleece or a small fibre lot.

Mean fibre diameter, fibre distribution.

There are two main standard methods of obtaining information about the fibre diameter of a mohair or wool sample.
The first method (IWTO E1/71E) establishes mean fibre diameter by using instruments such as an airflow apparatus of the constant flow or constant pressure type. This method is not recommended for medullated fibres. However, no information on fibre distribution is obtained with this method.
The second method allows the calculation of mean fibre diameter and fibre distribution (standard deviation and coefficient of variation) using instruments, such as projection microscopes (IWTO B/66E) and OFDA (Optical Fibre Diameter Analyser). The latter apparatus allows the determination of fibre distribution by observing up to several thousands of fibre within a few minutes and is becoming more widely used.
Another recently method, but not yet standardised, is based on the measurement of the area, shape and dimensions of the fibre cross-section under a microscope with the help of a computerising image analysis system. This method correlates well with the OFDA method and can also be used for the determination of kemp and medullated fibre content (Allain & Thebault, 1995, Rasmussen, 1995).

Kemp and medullated fibre content

Up to now, kemp and medullated fibre content are determined by observing and counting under a microscope a large quantity of individual fibres. This method is time consuming.
There are other possible methods. The first is the cross-section method (Allain & Thebault, 1995, Rasmussen, 1995) that determines simultaneously mean fibre diameter, fibre distribution and medullated fibre content. The second is derived from the OFDA apparatus, which can be modified to differentiate medullated fibres from non-medullated fibres. It is based on fibre opacity (Brims, 1993; Peterson et al., 1994). However this method needs to be tested and improved.

2-Objectives fleece and fibre measurements for angora.

The angora rabbit produces a very fine fibre (from 12 to 16 µm) without grease or any vegetable contamination which can be processed without any cleaning treatment by the textile industry. There are different kinds of fibres within the fleece: guard hair or bristle, that is a coarse and long fibre, an intermediate fibre and the down, a short and fine fibre. However, conversely to other fibre-producing animals, all fibres are desirable. Furthermore, there are different grades of angora as the structure and the composition of the fleece vary over the body.

Thus the main criteria determining the quantity and the quality of angora produced by angora rabbits are: total fleece weight, the weight of different angora grades making up the fleece, the fibre diameter, fibre length and the rate of each fibre type within the fleece.

Total fleece weight and the weight of each angora grade can be easily determined directly on the farm by the grower with a weighing machine. Similarly, bristle length and down length within the fibre staple can be easily measured with a ruler, the French angora rabbit having a well-structured fleece. However, other fleece and fibre characteristics, as well as fibre length in the German angora rabbit, need to be measured in a laboratory.

Fleece composition and diameter of each fibre type

Up to now, an IWTO method (IWTO-8-89) is used for determining fibre diameter and percentage of medullated fibre in wool and other animal fibres, based on a projection microscope. Nevertheless, this method is time-consuming, not widely used for measuring fleece composition or fibre diameter in angora and not very precise, as most angora fibres are medullated and the fibre cross-sectional shape is not circular.

A recent method based on measurements of fibre cross section characteristics has been recently developed (Allain and Thebault, 1995). This method describes characteristics of the different fibre types of the angora rabbit fleece, determines the content of each fibre type and measures cross-sectional characteristics by using a new histology technique, combined with microscopic image analysis and computer techniques.

The new OFDA apparatus, which seems to be able to differentiate medullated fibres, could be an alternative for measuring fleece composition and diameter of each fibre type. However, the OFDA apparatus has to be tested for angora.

Fibre length

When the fibre staple is not well structured due to the harvest method by shearing, as it is very often in the German angora rabbit, the length of bristles and other angora fibres can be measured by determining bristle and height with a comb sorter.

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Objective measurement of cashmere and its role in breeding programmes

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The value of cashmere is determined by a whole range of characteristics which in the past were evaluated by the eye of an expert with many years of experience in the trade. The task was, and still is, to assess the amount of usable cashmere available in the undercoat, to determine the quality and the potential end use of cashmere and to estimate the cost of processing it into the finished product.

Characteristics of cashmere which are assessed include:

diameter
length
colour
lustre and crimp (style and handle)
strength
& yield (amount of cashmere after dehairing and scouring the raw fibre).

The variability in each of these components is also important as is the character of the guard hair which should be long and coarse for easy and effective removal and to protect the undercoat while in situ.

Objective measurements for many of these traits have been established and developed into IWTO (International Wool Testing Organisation) specifications (the main exceptions being colour and lustre) which buyers rely upon increasingly to purchase fibre. Objective measurements also provide the means by which the requirements of the trade can be translated into goals for the producer and breeder.

The differential in the price paid for cashmere is variable but is always in favour of fine white cashmere with high crimp and low lustre and the production of such high quality fibre must be the ultimate goal of European cashmere breeders. However, the breeder has the additional task of increasing annual production per head since financial returns are determined not only by price/kg, but also by weight produced. Fibre traits such as fibre diameter and annual production, in cashmere goats are very strongly inherited (Sumner and Bigham, 1993; Bishop and Russel, 1996) but there is, as in other fibre producing species, a positive relationship between fibre diameter and fibre weight which prevents concurrent improvement in annual production and fibre quality.

Devising a strategy to overcome this problem is the current challenge for researchers and breeders alike, but most breeders or even breeding groups in Europe currently operate on a small scale limiting the amount of information available and progress which can be made. One important aim of this Thematic Network, which is to be commended, is to establish common protocols for fibre analyses so that performance records from herds across Europe can be merged into a common database for the eventual benefit of all participants.

In any breeding programme, the rate of genetic progress is faster with selection for fewer traits in larger numbers of animals. In the past, the hand separation of patch samples to determine cashmere yield and estimate annual production, and the projection microscope technique for the measurement of fibre diameter, was expensive in terms of time and money. It limited not only the number of traits which could be measured but also the number of animals which could be tested. With the use of OFDA, we can not only measure fibre diameter more accurately, but we can also measure yield (Herrman and Wortmann, 1997) in a fraction of time, sparing resources to measure other traits such as length, colour and crimp, which can be included in the cashmere database.

With the best European cashmere goats, currently producing 250g of hosiery or 300g of weaving quality cashmere, and the average goat producing closer to 100g, selection for increased annual production of cashmere under 18.5 mm, using measurements of yield and diameter, is likely to be a priority for the foreseeable future. However, information in the database will enable us to develop efficient selection strategies for other traits, if these become important. The first step is to decide what we want to measure and to establish a common protocol and standard of measurement. The data is only as good as we make it.

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The measurement of fibre diameter- the potential of the OFDA measurement technique

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The production of fine fibres in Europe is of increasing importance. Among the criteria determining the market price of speciality fibres, the mean fibre diameter is the most important one. For example, a small difference of 2 µm in cashmere fineness (Chinese versus Iranian cashmere) can make the finer fibres 50% more valuable. However, there is a lack of an accurate, *standardized* method for the determination of the fineness of speciality fibres. For the same keratin fibre sample, a difference of 3-4 µm in the fineness of the fibre can be measured, depending upon the laboratory and the technique being used.

In 1995, a round trial was organised by the EFFN (European Fine Fibre Network) and the DWI (German Wool Research Institute, Aachen). The main aims were to check the uniformity in measuring cashmere fineness at different stages of processing (dehaired and non-dehaired samples) and to identify the most accurate and reliable tool among the measurement systems:

- Projection microscope
- Laserscan
- Cross section method and
- OFDA method (Optical Fibre Diameter Analyser).

It was shown that the results gained by measuring the mean fibre diameter of the samples varied considerably between laboratories, even when the techniques being applied were the same. Within the four techniques mentioned above, the OFDA allows a better differentiation between very similar samples. Compared to the traditional projection microscope, the OFDA technique is much less laborious: a measurement cycle on a clean, conditioned sample takes only about 2 minutes (when using a projection microscope, it would take about 90 - 100 min for measuring 600 fibres.).

Principally the OFDA is an automatic image analysis system: moving fibres of a sample (in form of snippets) are magnified by a microscope set above the sample holder. The images are captured by a video camera and then identified and measured by a computer system. After measurement, a histogram printout is produced, showing the fibre diameter distribution.

The mean fibre diameter, the standard deviation (SD) and the coefficient of variation (CV) are included in OFDA's histogram. Within 2 minutes, more than four thousand fibre snippets can be identified and measured. The accuracy of the OFDA method is therefore higher, compared to the traditional one.

The OFDA method has been accepted by the IWTO (International Wool Textile Organisation) as a standard test method for the measurement of the mean and distribution of fibre diameter of **sheep's wool** (IWTO-47-95). For calibration of this image analysis system, INTERWOOLLABS standard tops have been used, whereby the lowest threshold of the mean fibre diameter of the wool standard lies at 17 µm. The average mean fibre diameters of these standard tops had been determined in projection microscope round trials previously.

Dehaired, fine cashmere down has a mean fibre diameter range from approx. 13 - 18 µm. This is still a lack of fine fibre samples as standards when using the OFDA as a tool for measuring such small mean fibre diameters and this must be rectified. The same applied to mohair fibres. The round trial proposed will overcome this current deficiency.

The Round trial

(Dr Ho Phan, DWI, Germany)

Since the OFDA has been proposed by the EFFN as the preferred technique for testing cashmere fleeces, the Thematic Network is going to conduct a round trial on the measurement of the mean fibre diameter of fine cashmere down and of mohair in October this year.

The main aim of the round trial is to test the reliability of the OFDA method for the measurement of mean diameter and distribution of mohair and of fine cashmere down. Due to the fact that there is no standard for the diameter range among 13 - 17 µm for calibrating the OFDA, the conventional projection microscope method will also be used in the round trial for testing the fibre fineness. A comparison between the values gained by the OFDA and by the microprojection technique will be made. If the OFDA method exhibits a high precision in this trial, it is proposed to recommend it to be a standard method for cashmere down and mohair.

Organisers: K.-H. Phan (DWI) and C. Souchet (MLURI)

Participants: DWI will ask laboratories and institutes that have been working in fibre testing by means of the OFDA and/or the projection microscope to take part in such a round trial.

Date: the round trial will be started on 1 October 1997

Instruments: OFDA, projection microscope

Test specimens:

As requested by the European cashmere and mohair growers, only cleaned samples of dehaired, fine cashmere down and of mohair (without medullation) will be used. The cashmere test samples will be delivered to DWI by the MLURI (Macaulay Land Use Research Institute) and the mohair samples by INRA (Institut National de la Recherche Agronomique). DWI will distribute the subsamples to the participants of the round trial.

The participants will be asked to apply the OFDA and the projection microscope (or both of them, if available) techniques and to supply the mean fibre diameters and standard deviations of the samples.

The test results will be evaluated by the MLURI and reported in the newsletters of the Thematic Network as well as at meetings of IWTO.

Quality measurements in old and recent fine wool Merino breeds

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It is important to consider historical aspects to become reminded of our ancient roots and tradition and also to get better background information for evaluating existing developments.

The basis of this report is an old collection of wool samples at the former Agricultural University at Berlin and investigations published by Fischer and Leucht (1987, 1988).

1. History of German Merino strains

The basis of the German Merino gene pool was founded by limited importation of Merino stock from Spain about 240 years ago to the central German provinces of Saxon and Brandenburg in a temperate climate, with moderate precipitation ranging from 400 to 800 mm/y. The importation to the Electorate of Saxony, as a royal present of best Merinos, represents the nucleus of so-called Electoral sheep (Fig. 1). The appearance of the animals was fairly uniform. The live weight of a sheep was from 25 to 30 kg.

Fig. 1: Electoral Merino (photo: 1906)

The animals grew extremely fine carding wool with a very low clean weight of about 25 %. The thin skin was tight and without any folds. The sheep were known as difficult feeders and were sensitive to dampness and wet pastures. Therefore, the sheep were protected from the weather. They were housed at night and additionally stall fed with turnips and other on-farm available foodstuffs. The superfine wool produced considerably attracted the English wool market at this time. The achievement of German breeders over half a century resulted in a Saxon type of fine, low, dense and lustrous true grown wool, that was entirely free from coarse and silvery hair running through the fleece. However, the antagonistic result of the unique preference of fine wool selection was a change of the original hardy Spanish stock to a weak light-fleeced animal.

Another genetic source used in the German Merino breed consisted of the Austrian Merino strain named Negretti (Fig. 2).

Fig. 2: Negretti Merino (photo: 1892)

These sheep grew also a very fine wool but showed a low-set compact body. While great stress was laid on the quantity of greasy wool yield and dense wool growth, the tough skin finally developed heavy folds on the neck rump, haunches and tail. The fine wool produced was especially known for its high content of lower solving grease. At the beginning of the 19th century, breeding activities in the former Prussian provinces of Silesia and Brandenburg tended to overcome the disadvantage of overemphasized breeding developments of the Electorals and Negrettis. They tried to combine the adverse advantages of both breeds by combination. This resulted in a fine wool type called the "Eskurial" or "German Thoroughbred Sheep". In the middle of the last century, the production of superfine wool ceased, due to the requirement of longer, coarser and less crimped wool. Breeding of the former type of sheep became unprofitable through insufficient yield and falling prices for finest wool.

From different flocks of Electoral, Negrettis and Electoral-Negrettis, the breeding strategy in direction to the German Thoroughbred was continued with special emphasis on larger, heavier body type and faultless rumps covered with a dense and deep staple of equable fine wool. Differentiated breeding objectives finally lead to three different Merino types

- "Merino-Tuchwoll" sheep (Merino carding wool) : a special wool type, a medium-sized animal (40 kg) with very fine wool (AAA/AAAA) and a staple length up to 4 cm for the production of the finest cloths and felts (Fig. 3).

Fig. 3: Merino Carding Wool (photo: 1904)

- "Merino-Stoffwoll" sheep (Merino combing wool sheep) : a type equally bred for wool and meat with an increase of body weight, staple length and yield of clip. By crossing with the French Rambouillets, an above average body size type with more meat was developed. The wool quality (AA/AAA) was less than that of the carding wool sheep but the staple length was higher at 4 to 7 cm (Fig. 4).

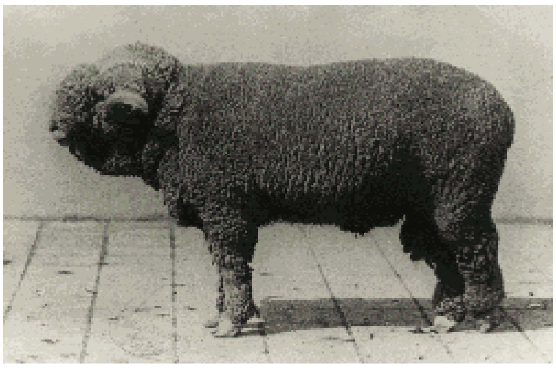


Fig. 4: Merino Combing Wool

- "Merino-Kammwoll" sheep (combing wool sheep) : bred for wool and meat, with a compact body densely covered with combing wool of high quality (A/AA), good regularity and of greater staple length (above 6 cm) (Fig. 5).

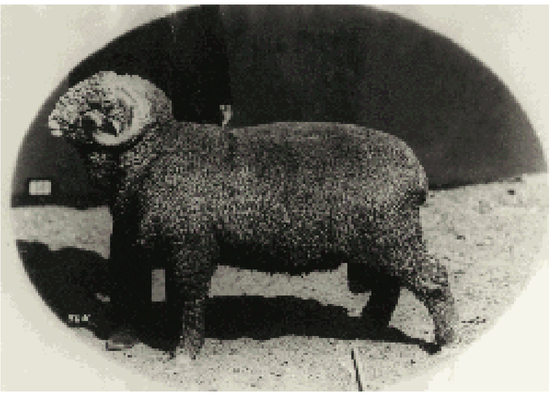


Fig. 5: Combing Wool Sheep (photo: 1891)

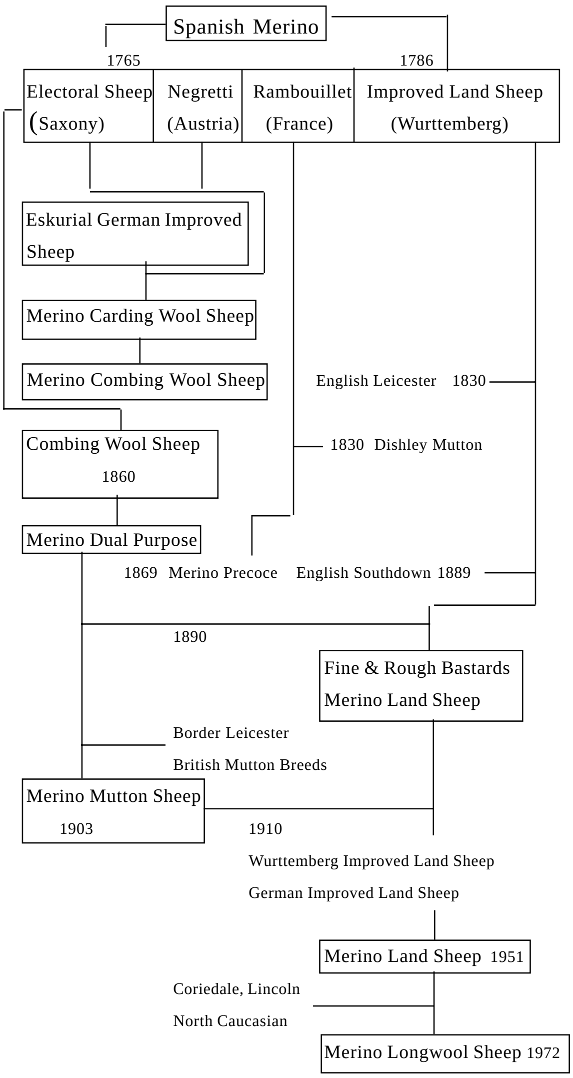
At the beginning of the 20th century, the emphasis on wool production made sheep production more and more unprofitable. By using then French mutton Merino type (Précoce Merino) and British Leicester types, the former combing wool sheep was converted to a mutton wool and finally to the German Merino Mutton sheep (Fig. 6). The aim was a fast-growing animal producing a regular, faultless wool (A/B) and combining low nutritional requirements with good fattening qualities.

Fig. 6: Hornless Merino Mutton-Dual Purpose (photo:1892)

Within the whole breeding process, a continuous recurrent use of Spanish Merino importation was the case, whereby strains with different genetic make up were selected for further breeding. However, superfine wool Merino from Germany highbred was exported to many countries in the world.

In Fig. 7, a schematic diagram shows the historic pathway of Merino sheep developments. Here is demonstrated another important use of original Merino genomes, with the development of the most important strain of the so-called "German Merino Land Sheep". The foundation of this breed happened in Southern Germany (especially in Württemberg), initially by crossing with local breeds, and later on with mutton sheep breeds. Merino Land Sheep has been acknowledged as a hardy breed of large body size which carry Merino-like wool with lower fineness (A/AB/B) but especially possess early maturity and aseasonality, as well as good walking and fattening characteristics. A special breeding strategy for more humid conditions has been recently performed in Eastern Germany, by crossing Merino-Land Sheep with American Merino mutton breeds and with Russian long-wool types (Fig. 7). This resulted in a new breed, named the "Merino Longwool Sheep".

Fig.7. History of Merino Breeds in Germany



Since the beginning of this decade, Merino mutton and Merino Longwool have mainly been displaced by the economically superior, mutton aligned, Merino Land Sheep, which is now the most important breed in Germany. This is reflected in the different proportions of Merino breeds found today; for example Merino Land Sheep (30.1 %), Merino Longwool Sheep (14.3 %) and Merino Mutton Sheep (3.8 %).

2.Quality measurements with ancient Merino wool probes

The source of wool probes used was a collection at the Humboldt University of Berlin (Fischer and Leucht, 1987, 1988). The wool was stored in glass and breed/ strain, year, sex and owner of the animals were also recorded.

To compare the quality of ancient and recent wool probes, the following criteria were taken: fineness, crimps and length, as main selection measures (Table 1), and tensile strength and tensile elasticity as valuable characteristics for the textile industry (Table 2).

From the first group of criteria, the known positive relationship between fineness and crimp on one hand, and the negative relation between these measures and length on the other hand, can be seen. Furthermore, it can be seen how much wool quality has improved after importation of original stock on one side, and on the other side how much wool fineness has deteriorated with decline of wool prices and the greater emphasis on meat selection and infusion of mutton breeds. The introduction of Russian Stavropol Merinos (descending from Australian origin) into the East-German type of mutton Merino did not have much effect on the Merino wool quality. Today, the strongest Merino wool is found in the Merino Longwool sheep.

Physical characteristics showed also a high negative correlation with fineness of wool; while tensile strength has been increased tremendously, tensile elasticity has remained nearly constant. The important effect of fineness on strength is also demonstrated by the index trait expressed as tensile strength in relation to fineness. From this relationship, it can also be concluded how little physical wool quality has been affected within a time period of 150 to 200 years.

3. Conclusions

- Quality measurements from sporadic collected samples of Merino strains in Germany covering a very long breeding time span of about 200 years have been made.
- The most significant quality trait, that is wool fineness, improved in the first phase of importation, but declined in later stages.
- This development reflects changing selection aims with respect to higher wool yields and later on selection for meat qualities.
- Synchronously, length of wool has been altered in the same way, whereas in the extreme form, the integration of Merino strains with higher wool growth during the recent period, resulted in a special German Longwool Merino type.
- Fineness and length of wool of the different Merino mutton types has remained nearly constant during the last hundred years.
- Tensile characteristics are very much dependent on wool fineness. Fibre elasticity has remained quite stable, whereas tensile strength measurements have increased significantly. Longwool Merinos displayed outstanding values, even after correcting for differences in wool fineness.
- Results show that the highest quality wool can be produced under variable climatic and ecological conditions of Central Europe, depending on genetic potential and additional management refinements.
- Qualities of the non-food commodity wool persist over long time periods demonstrating that wool belongs to one of the most durable quality products of animal production.
- Existing genetic variability of still available Merino strains in the world should be exploited for further developments of economical and environmentally adapted strains.

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Table 1: Wool quality traits of historic and recent Merino wool samples

Merino strains	Year	Fineness (microm)			Crimps (per cm)			Length (cm)		
		N	mean	CV%	N	mean	CV%	N	mean	CV%
Original Merinos (Spanish)	~1778	2	16.90	12.6	2	9.00	15.7	2	3.48	10.2
Electoral Merino	~1810	8	14.11	17.4	8	11.88	15.2	8	3.23	18.5
Negretti Merino Sheep*	~1823	7	18.17	15.0	7	8.86	13.7	7	3.77	14.5
Electoral Negretti Merino	~1840	8	16.75	15.1	8	9.50	8.0	8	3.47	11.1
Merino Carding Wool Sheep	1840/50	4	17.85	14.2	4	10.50	12.3	4	4.27	10.3
Merino Combing Wool Sheep	1850	5	18.62	14.8	5	8.20	18.1	5	5.28	8.0
Combing Wool Sheep	1865	8	20.47	15.0	8	7.00	13.2	8	6.85	13.1
Merino Dual purpose	1892	3	25.77	14.7	3	4.67	12.4	3	9.38	15.7
Merino Mutton Sheep	1983	865	24.96	12.8	162	4.02	16.3	831	9.52	10.9
Merino Mutton x Stavropol	1985	928	23.08	16.3	286	5.12	18.2	920	10.32	18.8
Merino Longwool Sheep	1985	481	29.92	22.2	---	---	---	465	12.92	19.2
Merino Mutton Sheep	1995	92	24.15	19.8	68	4.81	15.1	86	8.21	12.9

* Moeglin-flock owned by A. Thaer; N=number of samples; CV=coefficient of variation

Table 2: Physical characteristics of historic and recent Merino wool samples

Merino strains	year	N	tensile strength		t.s.related to fineness		tensile elasticity	
			mean (mN)	CV%	mean (mN)	CV%	mean (mN)	CV%
Original Merinos (Spanish)	~1778	2	40.03	17.0	136.40	30.8	35.77	30.8
Electoral Merino	~1810	8	27.58	17.7	133.60	12.6	37.95	12.6
Negretti Merino Sheep*	~1823	7	47.14	17.2	142.70	30.3	36.93	30.3
Electoral Negretti Merino	~1840	8	35.75	14.6	123.90	10.8	35.84	10.8
Merino Carding Wool Sheep	1840/50	4	39.21	22.8	119.20	5.7	40.22	15.7
Merino Combing Wool Sheep	1850	5	48.90	33.0	133.90	15.8	42.94	15.8
Combing Wool Sheep	1865	8	56.96	11.9	131.70	12.5	41.17	12.5
Merino Dual purpose	1892	3	85.98	12.5	124.80	11.5	40.90	11.5
Merino Mutton Sheep	1983	82	94.60	36.8	142.51	14.3	38.82	8.4
Merino Mutton x Stavropol	1985	68	88.20	42.2	131.38	22.8	36.68	12.6
Merino Longwool Sheep	1985	52	128.60	48.3	158.24	25.9	40.20	16.8

*Moeglin-flock owned by A. Thaer ; N=number of samples; CV=coefficient of variation

Fine Wool Initiatives

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Previous issues of *Fine Fibre News* have carried reports of developments to raise the profile of wool production in the EU. Leo Gallico wrote (FFN, No.4 , p.1) of the importance of wool, and other speciality fibres, for European rural development and outlined the first steps being taken to rectify the omission of wool, as an agricultural commodity, from the Treaty of Rome in 1957. Further action to remedy what must surely have been a serious oversight in the drafting of the Treaty was reported in 1995 (FFN, No.5, p.3). Later that year Jerry Laker presented an outline of the specific measures recommended by the Committee on Agriculture and Rural Development to develop wool production and processing in the EU (FFN, No.6, p.10).

These proposals dealt not only with the need for aid to sheep farmers in marginal areas and the establishment of wool grading and marketing structures, but also with the requirement to establish and disseminate superior fine and speciality wool genotypes of sheep throughout the EU. This article reviews recent progress in the development of two new fine-wool sheep breeds and one particular system of wool production, all of which could make significant contributions to the economic viability of European sheep enterprises.

Before discussing these recent developments mention must be made of the importance of wool quality in any attempt to derive significant income from this product. The main determinant of wool quality, and hence value, is fineness or, in technical terms, mean fibre diameter. The relationship between monetary value and fibre diameter is illustrated in Figure 1.

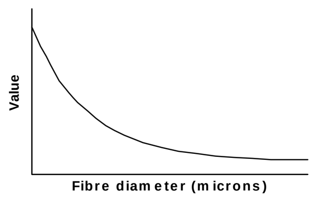

Fig. 1. The relationship between monetary value of wool and mean fibre diameter (adapted from Saul, Russel and Sibbald, 1993)

The point of inflection in the relationship generally lies around 22 mm. Above this point price is relatively insensitive to changes in fibre diameter, but at lower diameters each micron reduction results in an exponential increase in value.

In many European breeds the mean fibre diameter is greater than 25 mm. Any attempt to reduce fibre diameter by selective breeding will be unlikely to result in a sufficient improvement in fineness to attract a higher price per kilogram and, because there is a positive relationship between fibre diameter and fleece weight, would most probably produce a reduction in fleece weight. The consequence would be an overall reduction, rather than an increase, in the value of the fleece.

In breeds with mean fibre diameters of less than 22 mm, however, a small improvement of 1 - 2 mm in fineness will lead to a significant increase in price per kilogram which, in most cases, will more than offset any small reduction in fleece weight and will result in an increase in the value of the fleece. Such increases in monetary value can be quite dramatic where the reduction in fibre diameter is from, say, 18 mm to 16 mm.

In the UK, and notably in Scotland, there is currently an interest, albeit small, in fine wool production. This interest exists across all types of sheep farms from lowground to hill and mountain areas. The UK operates what is known as a "stratified" system of sheep production, with pure breeds maintained on the highest and poorest land resources being crossed with Leicester-type rams to supply crossbred ewes to upland and lowground farms, where they in turn are mated to terminal sires (e.g. Suffolk or Texel) to produce finished lambs for the meat market.

Scottish Fine Wool Producers - a group of some 30 sheep farmers from the south of Scotland to the Shetland Islands - have developed a breeding strategy which gives improved returns from wool at a number of points in the stratified production system. This strategy is based on a new breed of ram, the Lomond, developed from a French Est-à-Laine and Saxon Merino cross which has been selected for its wool characteristics. Lomond rams are used in the stratified production system, in place of the more usual Leicester-type sires, and are mated to ewes of one of the finer native British breeds, usually the Shetland.

The Lomond half-bred ewe and wether progeny are shorn as lambs (a practice which is not usual in the UK) and produce fleeces worth about £5.60 (approximately 8 ECU) per lamb. The female progeny are either kept for breeding on the farm on which they were born, or sold as breeding stock to a farm on lower ground. As adult ewes they produce fleeces averaging about 3.3 kg and worth some £6.50 (about 9 ECU).They, in turn, are mated to terminal sires and the fleeces of the resultant progeny are still sufficiently fine to command a premium and justify their being shorn prior to slaughter. It has been calculated that gross margins from this system are about £13 (about 19 ECU) per ewe greater than from a traditional crossbred ewe flock - an increase of more than 30%.

The additional income accruing from the use of the Lomond ram is attributable in part to an increase in the fleece weight of the crossbred ewe, but is principally a consequence of improvements in wool quality (i.e. fineness) which attract a higher price per kilogram and make worthwhile the shearing of lambs before slaughter. The fibre diameter of Lomond half-bred ewes and wethers is typically about 22 - 24 mm and that of their Suffolk or Texel cross lambs of the order of 24 -26 mm.

Whereas the Lomond half-bred ewe is essentially an upland or lowground sheep, the Bowmont ewe, recently developed by the Macaulay Land Use Research Institute, has been bred for a different sector of the sheep farming industry, *viz.* extensive hill farms.

The Bowmont's origins lie in a study of the potential to increase income from wool on hill and upland sheep flocks in the UK (Saul, Russel and Sibbald, 1992; 1993). This work suggested that a cross between the finest-woolled British breed, the Shetland, and the world's finest-woolled breed, the Saxon Merino, could theoretically produce a sufficient quantity of high quality wool to make it economically attractive to UK hill sheep farmers.

This theory was tested by mating Shetland ewes to Saxon Merino rams to establish the Bowmont breed, which has subsequently been subjected to selection for wool quality and the ability to survive under relatively harsh climatic and topographic conditions. Unlike the Lomond, the Bowmont is used principally as a pure breed and not as a source of sires for crossing with traditional hill breeds. It is a small sheep, ewes weighing not much more than 40 kg. Ewe fleece weights are between 2.5 and 3.0 kg and the current average fibre diameter of the flock at the Institute's Sourhope research station is just under 20 mm. Mature wethers have produced 5 kg fleeces and a few individuals in the flock have fibre diameters in the 16 - 17 mm range. With further rigorous selection there is every reason to believe that mean fibre diameter can be reduced by at least 2 mm within a few generations.

It is difficult at this stage to put a value on Bowmont wool; there are no classes in the current British Wool Marketing Board price schedule which cater for wool of such high quality. At world prices, however, individual ram and ewe hogg (yearling) fleeces have been valued at more than £35 (over 50 ECU). This compares with an average value of about £2 (3 ECU) for a typical hill ewe fleece.

Two major roles are envisaged for the Bowmont breed. The first is in regular-aged wether flocks managed extensively in low-input systems on the poorest hill land resources. These areas currently support flocks of breeding ewes which achieve only very low physical outputs (often between 55 and 75 lambs weaned per 100 ewes mated). These flocks would not be economically sustainable if the current high levels of EU and UK government support were reduced or withdrawn. Under the prevailing legislation wether sheep do not qualify for support. If in future the regulations are changed and subsidies are paid, for example, on an area or labour unit basis, as opposed to a per ewe basis, the farming - or perhaps the ranching - of wether sheep, which require little or no supplementary feeding and incur only minimal veterinary costs, could be economically viable and indeed financially attractive, provided that their wool is of a high quality and can be marketed at ruling world prices.

The second role for Bowmont sheep is on the less severe farms where breeding flocks could be maintained to supply wether sheep for the extensive, low-input system of management referred to above. Substantial benefits in terms of income from wool could again be expected without penalty to other sources of income. Experience with the Bowmont is still limited, but the indications are that lambing performance is of the order of 1.25 lambs per ewe, i.e. comparable to other hill breeds. Prices for wether lambs sold for slaughter have been very satisfactory. It is anticipated that prices of ewe lambs or yearlings sold for breeding, and of male lambs to replenish the wether flocks on the poorer land resources, would be similar to or greater than those of the traditional hill breeds.

A third fine wool project which is attracting interest in the UK is a "Sharlea" system of production operated by Border Fine Merinos, using purebred Saxon Merino wether sheep. In this system, pioneered in Australia, wether sheep, covered with canvas coats to protect the exceptionally high quality wool from contamination by feed or faeces, are kept in a slatted-floor building and fed rationed quantities of a specially formulated diet.

Fleece weights are about 3 kg and the quality of the wool comparable to the best produced anywhere in the world. The first bale of wool from this project averaged less than 17 mm and sold for £40 (58 ECU) per kg greasy fleece weight. The project is now in the process of fulfilling an order for 14.0 -14.5 mm wool for which it has been guaranteed a price of £80 (115 ECU) per kg greasy wool. This specialised wether flock is replenished from a small breeding flock which also produces exceptionally fine wool, but because these sheep are maintained outdoors and are subject to the vagaries of weather, endo- and ectoparasites and variations in nutrition, as well as the demands of pregnancy and lactation, their fleeces are more variable and worth some £35 - £40 (50 - 60 ECU) - which is still more than ten times that of most other breeds!

The three fine wool production systems outlined above are complementary to each other. The project based on the Lomond ram offers opportunities to the lowground sheep enterprises producing finished lambs for slaughter, and also to the upland and hill enterprises producing crossbred ewe stock. The Bowmont caters for the farmers on the poorer land resources supporting either extensively managed wether flocks or, where conditions are not too severe, breeding flocks producing female replacements and wethers for the more severe areas. The Sharlea enterprise is a very specialised system requiring continuous housing for the wether flock and relatively dry conditions for the breeding ewes, as well as a high degree of management skill and technical expertise.

All three projects can currently demonstrate significantly higher returns from wool than the traditional systems to which they offer alternatives. They are, however, relatively recent innovations and there is every reason to believe that, as they develop, wool quality will continue to improve further. The qualities of the wool from the three projects, although quite different from each other, all lie within the area of the price : quality relationship (Figure 1) where even a small improvement in fineness attracts a substantial increase in value.

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