

The distinction between wool and hair is rather arbitrary than natural, consisting in the greater or lesser degrees of fineness, softness, and pliability of the fibres. When they possess these properties so far as to admit of their being spun and woven into a texture sufficiently pliable to be used as an article of dress, they are called wool. The gradations between wool and hair on the skins of some animals are often too minute to admit of accurate distinction. The fleeces of many sheep contain fibres so hard and coarse, that they may most properly be called hair; and some hairy animals produce on part of their skins fibres possessing all the properties of wool; even in fleeces from the sheep, we may sometimes observe the very same fibre to be a coarse hair at one end, and at the other end a comparatively soft wool. The power of words, when inaccurately applied in retarding the progress of improvement, may frequently be traced in the most common occurrences of life, and we are persuaded it has had no inconsiderable effect in this instance, in preventing the cultivation of wool, in Europe, on the skins of other animals besides sheep. No one will deny that it is impossible to produce wool on the backs of the ox or the ass, if we restrict the term wool to the fleece of the sheep; but if by wool we mean a soft fine hair, possessing all the properties which render it suitable to be spun, woven, and fulled, to make cloth, the oxen of Thibet and the asses of Chili do produce and have for centuries produced such wool. Many of the asses and oxen even in this kingdom have soft woolly tufts of hair on some parts of their skins, and if such cattle were selected, and the breed cultivated, it is probable we might obtain from them a valuable addition to the materials on which national industry might be profitably employed.

Sheep's-wool appears to be the product of cultivation; we know of no wild animal which resembles the wool-bearing sheep. The argali, from which all the varieties of sheep are supposed to be derived, is covered with short hair, at the bottom of which, close to the skin, there is a softer hair, or down. (See ARGALI and SHEEP.) This is not peculiar to the argali; almost all quadrupeds inhabiting cold climates are covered in the same manner with a soft hair or down, which is protected by a coat of longer and coarser hair. By removal to a temperate climate, or when placed under the fostering care of man, and protected from the inclemencies of the weather, and supplied regularly with food, the coarse long hair falls off, and the animal retains only the softer and shorter hair, or wool. It is also observed that European sheep, removed to tropical climates and much exposed, soon become languid and sickly, and lose their fleece, which is succeeded by a covering of short coarse hair. Sheep in exposed situations in Europe often produce short coarse white hairs called kemps, intermixed with the finer wool; on removal to a warmer situation, and to a richer pasture, the coarse hairs fall off, and do not grow again. These facts are sufficient to prove the effect of cultivation on the fleece; and it must be observed that sheep's-wool of a good quality is never found but in those countries which have been the seats of the arts, and where a considerable degree of luxury or refinement exists, or has once prevailed. This is a strong presumptive proof that such wool has been originally obtained by a careful and long-continued attention to the selection of those sheep which produced the finest and most valued fleeces.

Angora, the ancient Ancyra, the former seat of arts and manufactures, still retains its breed of fine-woolled animals, among which the goat at the present time produces a fleece nearly equal to silk in lustre and fineness; and the cat and the rabbit of that district yet produce fine long wool. Damascus, and the other ancient cities of Asia Minor, preserve

WOOL, in *Natural History* and *Manufactures*, Latin *lana*, *lanicium*, Fr. *laine*, signifies soft hair or down, more particularly that of sheep, but is applied to the soft hair of other animals, as of the vicunna, commonly called Vigonia wool, that of the yak of Tartary, &c.; and also to fine vegetable fibres, as cotton. The Romans applied the term extensively to the soft hair or down of all quadrupeds, and even to that of birds, as *lana anserina*, the wool or down of the goose; *lana caprina*, goat's-wool.

They also applied the term to vegetable substances:

—“*Nemora Æthiopiæ molli canentia lana.*”

Virg. *Georg.* ii. 120.

“The trees of Ethiopia, white with soft wool, or cotton.”

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in their vicinity the traces of the former cultivation of fine-woolled animals. The Tarentine fine-woolled sheep, so much valued by the Greeks and Romans, were obtained from Asia Minor, and were on that account sometimes called *Asianæ*. It is highly probable that these sheep came originally from the more eastern seats of luxury, where the soft fleeces are now grown, of which the shawls and cloths of India are fabricated.

In countries where manufactures have once flourished, their effects continue for a long time visible in the race of sheep which still remain there. Even in the present condition of the fleeces from Barbary and the adjoining states, the experienced eye may perceive the vestiges of a fine-woolled race of sheep, degenerated by utter neglect, in a climate naturally unfavourable to the production of fine wool. In Sicily and the southern parts of Italy, the remains of the ancient Tarentine breed preserve to the present day a race of fine-woolled sheep, but greatly degenerated by neglect. In Portugal the fine-woolled sheep retain more of their original purity, but are still much neglected. In Spain attention to the growth of fine wool appears never to have been entirely lost sight of, and it is here that the race of fine-woolled sheep exist in the highest degree of perfection, though, as we shall afterwards state, probably inferior in some important qualities to the original Tarentine race. Some writers have asserted that fine wool is the result of climate and food; but this is not the fact, though we admit that both have some influence on the quality of wool. It is the breed alone that primarily determines the fineness of the fleece; this has been ably demonstrated by the experiments of lord Somerville, Dr. Parry of Bath, and others in this country, and by experiments on a larger scale in Sweden, Denmark, Saxony, and France.

It has been ascertained by Mr. Bakewell of Dishley, in Leicestershire, that the form of animals might be changed by selecting such as had any remarkable peculiarities, and continuing to breed from them for a few generations, when a new race is established, in which these peculiarities continue permanent. It has been ascertained by careful observations, both of cattle-breeders and physiologists, that in producing a new breed from two varieties of the same species, the female has more influence over the form of the progeny than the male; but with respect to wool the case is reversed, the quality of the fleece depending more on the sire than the dam. Beginning to breed from a coarse-woolled ewe and a pure fine-woolled ram, the produce of the first crosses will have a fleece approaching one-half to the fineness of that of the ram; and continuing to cross this progeny with a fine-woolled ram, equal to the first in quality, the fleece of the score and crosses will approach three-fourths to the fineness of the first, and in a few crosses more will be brought to an equal quality. If we state it numerically, and suppose the wool of the ewe to be twice as coarse as that of the ram, or as 320 to 160, the first crosses will have the fibre reduced to 240, the second to 200, the third to 180, the fourth to 170, the fifth to 165, the sixth to $162\frac{1}{2}$, which to all practical purposes may be regarded as equal to the first number. This ratio of approximation may be stated as correct on a large scale of experiment. If we breed with a fine-woolled ewe and a coarse-woolled ram, the series would be reversed, and in a few generations all vestiges of the fine-woolled race would be nearly, if not entirely, extinct. The ancient Romans, in the time of Columella, seem to have been fully aware of the effects of breed on the fineness of the wool, and as much as 200*l.* sterling was paid for a fine-woolled ram.

When a flock of fine-woolled sheep are once formed, they can only be kept pure by selecting and preserving the

finest-woolled rams, and most carefully avoiding all intermixture with sheep from coarser-woolled flocks that may exist in the country. Where this is neglected, the quality of the wool will soon be debased.

But supposing all the flocks in a country were of the fine-woolled race, accidental varieties of coarse-woolled sheep will occur among them, or of sheep having fleeces intermixed with coarse hair. If these be not carefully examined and removed, the wool will deteriorate, and more so where the climate is variable, and the sheep are exposed to great and sudden vicissitudes of temperature.

What has been stated may suffice to explain the circumstance of fine-woolled breeds of sheep being only found in the vicinity of present or ancient manufactures, or where they have been transported from such districts. Wherever fine-woolled sheep are neglected by man, the wool becomes either coarse, or intermixed with coarse hairs; the latter is the case in the Shetland isles, and in all countries where the arts and manufactures have been entirely destroyed, and ignorant barbarians have succeeded as the possessors of the soil.

Most ancient writers on wool, and even many moderns, seem not to be aware of any difference in wools, except the fineness or coarseness of the fibre; but the length of the fibre constitutes a far more important distinctive character. Long wool, or what is called combing-wool, differs more from short or clothing wool, in the uses to which it is applied, and the mode of manufacture, than flax from cotton.

Sheep's-wool may, therefore, be divided into two kinds. Short wool, or clothing-wool, and long or combing wool: each of these kinds may be subdivided into a variety of sorts, according to their degrees of fineness. This process is the proper labour of the wool-sorter.

Short wool, or clothing-wool, may vary in length from one to three or four inches; if it be longer it requires to be cut or broken, to prepare it for the further processes of the cloth manufacture. Short or clothing wool is always carded or broken upon an instrument with fine short teeth, by which the fibres are opened and spread in every direction, and the fabrics made from it are subjected to the process of felting, which we shall afterwards describe. By this process, the fibres become matted together, and the texture rendered more compact.

Long or combing wool may vary in length from three to eight or ten inches: it is prepared on a comb or instrument, with rows of long steel teeth, which open the fibres, and arrange them longitudinally: in the thread spun from combed wool, the fibres or filaments of the wool are arranged in the same manner, or similar to those of flax, and the pieces when woven are not subjected to the process of felting.

The shorter combing-wools are principally used for hose, and are spun softer than the longer combing-wools, the former being made into what is called hard worsted yarn, and the latter into soft worsted yarn.

Short Clothing-Wool.—The principal qualities deserving attention in clothing-wools are the regular fineness of the hair or pile, its softness and tendency to felt, the length and soundness of the staple, and the colour. The wool-buyer also regards as important the clean state of the fleece, and to the grower its weight is particularly deserving attention; for in fleeces equally fine, from sheep of the same size, some may be much heavier than others, the fibres of wool being grown closer to each other on the skin.

The fineness of the hair or fibre can only be estimated to any useful purpose, in the woollen manufacture, by the wool-sorter or wool dealer, accustomed by long habit to discern

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discern a minute difference, which is quite imperceptible to common observers, and scarcely appreciable by the most powerful microscopes. Of the various attempts that have been made to reduce the fineness of wool to a certain standard, by admeasurement with a micrometer, we shall afterwards speak. From some experiments we have made, as well as from those made by Mr. Luccock, Dr. Parry, and others, we may estimate the thickness of the hair of the finest Spanish and Saxony wool to be not more than the fifteen-hundredth part of an inch, and that of the finest native English to be from twelve to thirteen-hundredth parts, whilst the inferior sorts gradually increase to the six-hundredth part of an inch and more. A difference in the size of these fibres, too minute to be noticed by the common observer, may occasion a difference of 40 *per cent.* or more in the value of the wool. The fineness of the hair has been ever considered as an important quality since the clothing manufacture emerged from its rudest state. Fine wool was formerly valued because a finer thread could be spun from it, and a thinner fabric made, than from the coarser wools; but since recent mechanical improvements have been introduced into the woollen manufacture, it has been found practicable to spin coarse wools to the same length as the finer wools were formerly spun to. It is well known, however, to cloth-manufacturers, that whatever be the fineness of the yarn, unless the wool be fine, it is impossible to make a fine, compact, and even cloth, in which the thread shall be covered with a thick soft pile; nor would a thin cloth made from coarse wool have the same durability or appearance as one from fine wool of equal weight *per yard*. Fine wool will, therefore, always preserve a superior value to the coarse; indeed it was long considered as the principal and almost the only quality deserving the attention of the wool-grower, the wool-stapler, and the clothier.

The regular fineness of the fibre is also an object of considerable importance; the lower end of the staple, or that part of the fleece nearest the skin, will sometimes be very fine, and the upper part coarse. In some fine fleeces there will frequently be an intermixture of long, silvery, coarse hairs, and in other fine fleeces an intermixture of short, thick, opaque hairs, called kemps. When the wool is thus irregularly fine or intermixed, it is technically called not being *true grown*. The fine fleeces of Spain and Portugal, particularly of the latter country, are many of them injured by the intermixture of the long silvery hairs before-mentioned: whether this be owing to the original Tarentine breed having been crossed with the coarse-woolled native sheep of Spain, (see the article SHEEP,) and still preserving a tendency to revert to their first condition, or whether it be the effect of heat on the skin, is uncertain. The Saxony fleeces, from the same breed, removed to colder climates, are generally free from this defect. The coarse short hairs, or kemps, are not uncommon in some of the fine-woolled flocks of England and Wales, particularly those which are more exposed to the inclemencies of the weather, and have a scanty or irregular supply of food. It has been observed, in the first part of the article SHEEP, that in some flocks the proportion of fine wool in each fleece is much greater than in others, for in few or none is the wool grown uniformly fine over the whole body.

On the Merino sheep the fleece is more regular, whatever be the degree of fineness, than on any of our native English fine-woolled breeds. The Merino fleece admits of a division into four sorts, the *refina*, the *fina*, and the *tercera*, with a very minute portion of coarse from the shanks and head, which is not sent to market. The three sorts are distinguished in commerce by the marks R, F, and T.

On the average, there will be in each fleece nearly three-fourths of the best or R wool. The second and third sorts, or the F and T, will also contain a considerable portion as fine as the best; but being shorter and discoloured, or intermixed with coarse hairs, which require their locks to be separated from the best sort, or the refina.

In the native English fleeces, however fine some part may be, the proportion of the best sort rarely exceeds one-third part, and is frequently not more than one-sixth part of the whole fleece.

The value of the best part of a Spanish fleece, or the R wool, varies greatly in different flocks. When this sort, from the most esteemed flocks, may be worth six shillings and sixpence *per pound* in the English market, the R wool from another flock may not be worth more than three shillings and sixpence. The F and T wools are from 25 to 50 *per cent.* lower than the first sort: thus, the inferior sorts from the finest piles may be of greater value than the best sort or R wool of other piles; but they are never intermixed by the dealers, as they are applicable to different fabrics. In the English mode of wool-sorting, there will frequently be eight or ten sorts in a single fleece; and if the best wool of one fleece be not equal to the finest sort, it is thrown to a second, third, or fourth, or a still lower sort, which is of an equal degree of fineness with it. The best English short native fleeces, such as the fine Norfolk and South Down, are generally divided by the wool-sorter into the following sorts, varying in degree of fineness from each other, which are called,

Prime,
Choice,
Super,
Head,
Downrights,
Seconds,
Fine abb,
Coarse abb,
Livery,
Short coarse or breech wool.

Besides these sorts of white clothing wool, two and generally three sorts of grey wool are made, consisting of locks which may be black, or intermixed with grey hairs. Some wool-sorters also throw out any remarkably fine locks in the prime, and make a small quantity of a superior sort, which they call picklock. The origin of some of the above names is obscure, but the names of the finer sorts appear to indicate either a progressive improvement in the quality of the wool, or in the art of wool-sorting. The relative value of each sort varies considerably, according to the greater demand for coarse, fine, or middle cloths; and the variation during and since the late war in the Spanish peninsula has been much increased by temporary causes. Before that period, when the R wool of good Spanish piles sold at from five shillings and sixpence to six shillings *per pound*, the prime from Herefordshire fleeces was sold at about three shillings and sixpence, and that from the Norfolk and South Down from three shillings to three shillings and two-pence *per pound*. The higher price of the Herefordshire was in part owing to its being in a cleaner state. The Spanish wool is also cleaner than any of the English wools, being scoured after it is shorn; but the latter is only imperfectly washed on the sheep, previously to its being shorn. A pack of English clothing wool of 240 pounds weight, in its marketable state, will waste about 70 pounds in the process of the manufacture: the same quantity of Spanish wool, as sent to market, will not waste more than 48 pounds

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on the average. This contributes to enhance the difference between the prices of each, as well as the superior fineness of the latter.

Different wool-sorters make a considerable variation in their modes of sorting the same kind of fleeces: some divide them into more sorts than others; but the following table will shew what may be taken as the average relative value of each sort, when the prime is worth about three shillings and two-pence *per* pound, and may serve to shew the skill required to estimate the value of fine English wool in the fleece.

	<i>s.</i>	<i>d.</i>	to	<i>s.</i>	<i>d.</i>
Prime - - -	3	0	to	3	4
Choice - - -	2	4	to	2	8
Super - - -	2	0	to	2	2
Head - - -	1	8	to	1	10
Downrights - -	1	5	to	1	6
Seconds - - -	1	3	to	1	4
Fine abb - - -	1	0	to	1	1
Coarse ditto - -	0	9	to	0	10
Livery - - -	0	8	to	0	10
Short coarse - -	0	7	to	0	8

The demand for coarse woollen goods having greatly increased of late, the prices of the lower sorts are considerably advanced from the above-stated prices, and are at present as under:

	<i>s.</i>	<i>d.</i>	
Short coarse - -	1	4	} <i>per</i> pound in London.
Livery - - -	1	5	
Fine abb - - -	1	6	
Seconds - - -	1	7	
Downrights - -	1	8	
Head - - -	1	10	
Super - - -	2	0	
Choice - - -	2	2	
Prime - - -	2	6	
Picklock - - -	3	0	

The Softness of fine clothing Wool is next in importance to the fineness of the fibre, though it has been too little attended to in the culture of English wool. This quality is not dependent on the fineness of the fibre; it consists in the peculiar feel which approaches to that of silk or down, but in which the wool of all European sheep is inferior to that of Eastern Asia, or to the wool of the vicunna, or lama of Peru and Chili. In foreign European wools there are different degrees of this property, where the fibre is equally fine. In our native English wools, the like difference exists between the softness of wool possessing the same degree of fineness, but grown in different districts. In the harder wool, the fibre is elastic and hard to the touch, and cloth made from it has the same harsh feel; it is also more loose in its texture, and the surface of the thread is generally more bare. The difference in the value of cloth from two kinds of wool, equally fine, but one distinguished for its softness, and the other for the contrary quality, is such, that with the same process and expence of manufacture, the one will make a cloth more valuable than the other from twenty to twenty-five *per cent*.

Though the English woollen manufactures had been carried on for so long a period, the cause of this difference in cloths made from wool equally fine was but very imperfectly known till the present century. Mr. Robert Bakewell, then of Wakefield in Yorkshire, first directed the attention of wool-growers and manufacturers to this subject, in a work, entitled "Observations on the Influence of Soil and Climate

on Wool." The reason why the manufacturers remained so long ignorant respecting it arose, he observed, from the manner in which the woollen-trade had been carried on in Yorkshire, the great feat of the manufacture of English clothing-wool, the division of employment there not permitting the wool-dealer, or even the clothier, to witness the final result of the process. The wool-buyer in the distant counties, and the wool-sorter, who divided the fleece, were equally unacquainted with the cloth manufacture. The Yorkshire clothier sold his goods in an undressed, and often in an undyed state; they were bought and finished by the cloth merchant, who was formerly unacquainted with the previous processes of the manufacture, or the qualities of wool. In a promiscuous lot of undressed cloth bought at the same price, and apparently of the same quality in the rough state, if some pieces were finished much better and softer than others, it was attributed to lucky chance, the patron divinity of the ignorant. Mr. Bakewell proved that the hardness of English wools does not depend on the nature of the soil, or even entirely on the breed; it is the effect of the soil acting on the surface of the fleece. The wools from chalk districts, or light dry calcareous soils, have the natural yolk or moisture absorbed by the particles of calcareous earth that penetrate the fleece, and the wool is thereby rendered hard. The same effect is produced on a skin where lime is used; it may also be produced by keeping wool for a longer or shorter time in a dry hot temperature; and when wool has been so dried, no process will restore to it its primitive softness. On the contrary, wools grown on rich loamy argillaceous soils are always distinguished for their softness. The quantity of grease or yolk in the fleece has a considerable degree of influence on the softness of Merino wool, the pile being so close as in a considerable degree to prevent the earthy particles from penetrating the fleece; but in all English fleeces the wool is grown thinner on the skin, and admits the more easy access of the absorbent particles. Exposure to the direct rays of a summer sun has also a tendency to injure the soft quality of the wool. We shall have occasion to refer to the methods recommended by Mr. Bakewell to improve the softness of wool on soils naturally unfavourable to its growth.

Of fine European wools, the Saxony generally possesses a greater degree of softness than the Spanish, which we believe to be owing to the sheep being less exposed to the action of light and heat. The native fine Italian wool, before the introduction of the Merino race, possessed a considerable degree of softness, judging from wools which we have seen from thence, but they were deficient in soundness, and not *true grown*. The wools on the chalk soils in the southern and eastern side of England are generally hard, except, as in Kent, where the chalk is covered by thick argillaceous beds. Nottingham forest, Chamwood forest in Leicestershire, and some parts of Shropshire, produced not the finest, but some of the softest wools in England before the late inclosures. The Cheviot hills in Cumberland are not pastured by the finest-woolled English sheep, but their fleeces possess a degree of softness exceeding any from the other districts of England, and they are rendered soft by artificial means, which we shall describe. It is still somewhat uncertain, whether there are two distinct breeds of sheep, from which the fine shawl wool of India are grown; or whether one species of the animal which yields it is not to be classed with the goat. The fleeces from India, which we have seen, are grown on a very small sheep; close to the skin, there is a wool as soft as the softest fur; this is covered by long coarse hairs growing through it. When the wool is once shorn, the separation of these hairs from the soft

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Wool is a work of extreme difficulty; but on the back of the sheep we believe the separation can be made with great ease. The softness of the Indian wool is not even distantly approached in the very softest Merino fleeces from Saxony and Spain; this may be proved by comparing the finest cassimere cloth from Saxony wool, with the shawls or shawl-cloth of India. The ancient Tarentine sheep, called by way of excellence 'molles oves,' were treated with peculiar care by the Romans, and clothed in skins, which we believe was intended to preserve the softness of the wool, as it is still practised in some parts of Asia for that purpose. In Europe no experiments have been made directly to improve the softness of wool, though wool approaching in softness to that of India would be a most valuable acquisition to our manufactures. To be convinced of this, it need only be stated, that the yarn from Indian wool has been sold here at three guineas *per* pound, not on account of the superior fineness of the spinning, but for the softness of the wool. For coarse goods, indeed, such as blankets, carpets, and cloths called duffields, raised with a hairy pile, a considerable degree of hardness or elasticity of the fibre is an advantage; but in all the finer articles of the woollen or worsted manufacture, the opposite quality is of great value.

The felting property of wool is intimately connected with its softness, the softest wools having the greatest tendency to felt, and the hard wools are all defective in this respect. The felting property appears to depend on a peculiar structure of the surface of the fibres, by which they are disposed to move in one direction more easily than another. This is perceptible in drawing a hair through the fingers, first from the end to the point, and again from the point to the end; in one direction the hair feels perfectly smooth, in the other direction a peculiar roughness is felt. The cause of this is supposed to be owing to the surface of the fibres having laminæ, like the scales of fishes, with the edges laid over each other. Indeed in the furs of some animals we have observed with a powerful microscope, that the surface is composed of laminæ laid over each other, resembling the arrangement of the leaves of the artichoke. On this property the process of hat-making depends; the short fibres of the fur being repeatedly compressed, move and interlock with each other, so as to form a compact substance; this motion is further aided by heat and moisture. A similar process takes place to a certain degree in cloth subjected to the strokes of a fulling-mill; the fibres cohere, and the piece contracts in length and breadth, and its texture is rendered more compact and uniform. This process is essential to the beauty and strength of woollen cloth; and it is observed, that the softer wools felt in much less time than the harder, and form a closer pile on the surface of the cloth, on which account it is a common practice to mix a certain quantity of soft wool with the hard, to enable the former to felt with more facility.

The length and soundness of the staple of clothing wool is the quality next to be considered. By the staple of wool is meant the separate locks into which the fleece naturally divides in the skin, each lock consisting of a certain number of fibres, which collectively are called the staple.

The best length of staple for fine clothing-wool, if found, is from two to three inches. If it be longer it requires breaking down to prepare it for the process of carding. Saxony wool, being generally more tender than the Spanish, and more easily broken down, is sometimes four or five inches long; but as it works down easily, it is preferred, on account of the length of its staple, for such goods which

require fine spinning, as cassimeres, pelisse cloth, and shawls. Much of the English clothing-wool of a middle quality is grown longer than is desirable for the purpose of the clothier, and when found is thrown out for the hosiery trade, if the demand for the latter be great. As the grower could not shorten the length of the staple without diminishing the weight of the fleece, he has no motive to induce him to grow shorter wool; but the object might be obtained with much benefit to himself by shearing twice in the year, once the latter end of April, and again the latter end of August; the wool would then be grown of a suitable length for the card, and from experiments that have been made we believe the weight would exceed what can be obtained from one clip: the increase would not be less than fifteen *per cent.*, and the condition of the sheep thereby improved.

The soundness of the staple in clothing-wools is not so important as in combing-wools; but for some kinds of colours which injure the wool, it is particularly desirable that the fibre should be found and strong; this is judged of by drawing out the staple and pulling it by both ends. The soundness and strength of the staple depend primarily on the healthy state of the animal, and on a sufficient supply of food. The staple on some parts of the fleece will always be more tender than on other parts, but by mixture they tend to form a dense pile on the surface of the cloth.

The colour of the fleece should always approach as much as possible to the purest white, because such wool is not only necessary for cloths dressed white, but for all cloths to be dyed bright colours, for which a clear white ground is required, to give a due degree of richness and lustre. It is probable that all sheep's-wool was first of a black or reddish colour: the latter is often referred to by the ancients. Before the invention of dyeing, coloured wool must have had a preference to white; but after the act of communicating beautiful colours to the fleece, white wool would be in the greatest demand, and those sheep which had white fleeces would be selected to breed from. The most ancient flocks of sheep which we have any record of are those of Laban and Jacob, described in the book of Genesis. The fleeces appear to have been principally brown, or spotted and striped, which was in all probability the general colour of the flocks throughout that part of Asia. We learn that in the course of twenty years a great change was effected in the colour of a large portion of the sheep of Laban: though Jacob appears to have concealed from his father-in-law the method by which this change was effected, we are expressly told in the sequel that it was by crossing with rams which had fleeces of the colours required.

Dark-brown or black woolled sheep are not uncommon in many parts of the European flocks, but such wool being of less value than the white, these sheep ought always to be expelled. Some of the English fine-wooled sheep, as the Norfolk and South-Down, have black or grey faces and legs. In all such sheep there is a tendency to grow grey wool on some part of the body, or to produce some grey fibres intermixed with the fleece, which renders the wool unfit for many kinds of white goods; for though the black hairs may be too few or minute to be detected by the wool-sorter, yet when the cloth is stoved they will become visible, forming reddish spots, by which its appearance is much injured. The Herefordshire sheep, which have white faces, are entirely free from this defect, and yield a fleece without any admixture of grey hairs. We have no doubt that by carefully rejecting those sheep from the South-Down flocks, in which the grey is most apparent, this defect might be gradually removed. It is particularly desirable with respect

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to these sheep, as the wool grown on chalk soils, though less soft than on other soils, is generally whiter, and better suited to such goods which require the process of bleaching or stoving, and do not require to be so much fulled as many other cloths.

The ancients were so well aware of the necessity of expelling dark-coloured wool from their flocks, that in selecting the sheep to breed from, they did not trust to the colour of the fleece alone, but carefully examined the mouth and tongue of the ram, and if the least blackness or swarthiness appeared he was immediately rejected; and though some moderns have doubted the use of this precaution, we believe it was well founded.

“ Illum autem, quamvis aries fit candidus ipse,
Nigra subest udo tantum cui lingua palato,
Rejice, ne maculis infuscet vellera pullis
Nascentem.” Vir. Georg. iii.

Pliny also states, that particular attention was on this account had to the colour of the mouth. “Arietum maxime spectantur ora.” We are informed that this kind of inspection takes place in the Spanish flocks at present, a practice in all probability derived from the Roman shepherds, as we believe the flock to have been from those of Italy, or the Tarentine breed. The colour of the soil on which sheep graze, if very dark or red, communicates to the wool a tint more or less strong, which is indelible, and renders such wool less proper for cloths or hosiery goods that are to be finished white; for though the colour may be improved by stoving, yet on washing the cloths, they soon return to a brownish or yellowish tint. The tint from the soil is, however, rarely of sufficient strength to be regarded for dyed goods, excepting for exceedingly light colours.

The cleanness of wool is principally regarded by the purchaser, as it affects the weight. To the grower those fleeces are generally the most profitable that are well filled with the grease, or yolk as it is called, because it keeps the wool in a sound state, and improves its softness. It ought, however, to be washed out as much as possible before it is exposed to sale. The fleeces of the Merino sheep are more plentifully supplied with yolk than those of any of our native fine-woolled breeds; indeed it is so abundant, that the English mode of washing on the back of the sheep will scarcely produce any effect upon the fleece. The yolk or grease in the fleece appears, from the experiments made upon it by M. Vauquelin, to be a native soap, consisting principally of animal oil combined with potash. It is most copiously produced in those breeds which grow the finest and softest wool, and is always most abundant on those parts of the animal which yield the finest parts of the fleece. To this subject we shall again refer in treating of the improvement of wool. This yolk, though so beneficial to the wool in a growing state, becomes injurious to it when shorn; for if the fleeces remain piled in an unwashed state, a fermentation takes place, the yolk becomes hard, and the fibre is rendered hard and brittle. This effect takes place more rapidly in hot weather. The Spaniards remove this yolk in a great measure by washing the wool after it is shorn and sorted. In Saxony fine-woolled sheep of the same race are washed in tubs with warm water, soap-lees, and urine, and afterwards in clean water.

In England the wool is washed on the back of the sheep by immersing the animal in water, and squeezing the fleece with the hand. From these different modes of washing, the wool is left more or less pure. Mr. Bakewell, in his Ob-

servations on the Influence of Soil and Climate on Wool, has given the following table, containing a statement of the quantity of neat wool in every hundred pounds, taken on an average of each sort, and supposing each to be free from lumps of pitch employed in marking the wool, and cleared from what are called the *dog-locks*. The first column represents the average weight after the wool has been scoured perfectly clean with soap and water, and dried; the second the amount of waste.

	Pure Wool.	Waste.
100 lbs. of English wool washed on the sheep's back	75	25
Ditto Saxony fleece-wool	80	20
Ditto Spanish R, or refine	88	12
Ditto Spanish and Portugal unwashed	75	55
Ditto English fleeces unwashed	60	40
Ditto lightly greased wools of Northumberland washed on the sheep's back	65	35

Hence it is obvious, that the state of the fleece with respect to cleanness is an object of great importance to the wool-buyer. The English Merino sheep, from the difficulty of washing the wool on the sheep's back, have generally been shorn in an unwashed state, and the wool offered for sale in this state. The purchasers were frequently unacquainted with the great amount of the loss it would suffer by washing, and were much disappointed at the result. This circumstance, we conceive, more than any other, tended to prejudice the manufacturer against the Anglo-Merino wool. The wool is also injured by remaining in the grease, as we have before stated, and though this has been contradicted, we have no hesitation in asserting the fact from our own experience. Indeed the French manufacturers of fine cloth assert, that the best wools from Spain, though cleared in a great measure from the yolk, yet still retain sufficient to injure the wool if it be suffered to grow old when it is packed, the yolk becoming rancid and hard, and communicating the latter property to the wool. We have frequently observed this effect in the wools from Portugal, that retain a greater portion of the yolk than those from Spain.

After wool has been washed in the usual manner practiced in England, and piled or packed, a certain process takes place in eight or nine weeks, called *sweating*. This is well known to wool-dealers and manufacturers, but has not been before noticed by any writer that we are acquainted with. It is evidently an incipient fermentation of the remaining yolk; and the inner part of the pack or pile becomes sensibly warm. This process produces a certain change in the wool, whereby it becomes in a better condition for manufacturing, being what is called in the north of England less *fuzzy*. This effect results from a diminution of the natural elasticity of the fibre.

When this fermentation takes place in unwashed wool, it proceeds farther, and injures the colour and soundness of the staple or fibre. A similar effect is produced in wool or cloth which has been oiled, and remains some time in an unscoured state. Instances of spontaneous combustion from heaps of refuse wool remaining in a greasy state have been known to occur, and occasion the most serious accidents in woollen factories.

The weight of the fleece is an object of great importance to the grower. It is generally supposed by the English wool-dealers, that an increase of weight implied an increase of coarseness; indeed the words coarse and heavy are considered by them as synonymous, but this is not absolutely

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the case ; a fleece grown upon the same animal may be increased in weight either by the fibres becoming coarser, or by their being grown longer, or by a greater number of fibres being grown in the same skin. To the wool-grower it can never answer to increase the weight of the fleece on small fine-woolled sheep, by growing the wool coarser ; if this be his object, the long-woolled breeds of sheep are to be preferred. He may produce wool somewhat longer by increasing the quantity of food ; but it generally loses something of its fineness, and is less suitable for the cloth trade. He may, however, increase the weight considerably by selecting such breeds as grow the wool close upon the skin, and are thickly covered with wool over every part of the body. In this respect, the Merino sheep have greatly the advantage over any of the native breeds of English sheep ; many of them yielding from three to four pounds of pure wool, whilst the finest English fleeces rarely exceed two pounds, and would lose one-fourth of this weight when brought to a pure state by scouring. It has been doubted whether all sheep's-wool, when clean, possesses the same specific gravity ; but admitting there may be some variation in the wool from different piles, we conceive that it is too minute to deserve the attention of the wool-grower or manufacturer.

The filaments of fine wool being so minute, it requires an eye habituated by long experience to appreciate the relative fineness of two piles, which may differ in value as much as twenty-five *per cent.* Even those who have been long practised in such examinations find it difficult to form immediately a correct opinion of the fineness, if they are removed for a few weeks from all opportunity of viewing wool. It is not surprising then that the wool-grower, who only directs his attention to the subject during one part of the year, should often be unable to judge whether his wool has improved or not since the preceding summer. On this account it would be highly desirable that some easy and correct method of admeasurement by the micrometer could be invented, which might enable the observer to decide this with certainty. Mr. Daubenton employed a graduated scale, adapting it to the eye-piece of a compound microscope ; but his method does not admit of accuracy. Mr. Luccock made use of a more simple instrument, which we have seen ; it consisted of a lens about half an inch in focal length, adjusted to a graduated scale. On this scale a number of fibres were stretched and compressed by a slider and screw into a given space ; the filaments covering this space were then counted by the aid of the lens, and a number of admeasurements being taken of the same sort, the mean of the whole was supposed to give the correct diameter of the filament. In this method, however, some of the filaments must unavoidably overlap part of the others, on which account a greater number will be seen in a given space than there would be were the whole diameter of each fibre visible. The error resulting from this may be stated at one-fifth. Thus Mr. Luccock makes the best English wool to measure the fourteen-hundredth part of an inch, which is finer than the best Spanish, as measured by Dr. Parry, by a more accurate but more laborious method. According to Mr. Luccock, a sample of moderately fine Spanish wool reached to the sixteen-hundredth part of an inch ; according to Dr. Parry, the very best Spanish is not smaller than the fourteen-hundredth part of an inch.

With the above deduction of one-fifth, which we believe to be a near approximation to correctness, the diameter of the fibres of the best English wool, as sorted in the usual method, will be nearly as follows :

	Parts of an Inch.
Prime - - -	$\frac{1}{1120}$
Choice - - -	$\frac{1}{1074}$
Super - - -	$\frac{1}{928}$
Head - - -	$\frac{1}{800}$
Downrights - - -	$\frac{1}{740}$
Seconds - - -	$\frac{1}{640}$
Abb - - -	$\frac{1}{560}$
Fine livery (variable) -	$\frac{1}{480}$

The method of measurement adopted by Mr. Luccock might be sufficiently correct with the deduction of one-fifth, were the instrument always used by the same person, and a similar degree of pressure given in each experiment ; but as this is required, it becomes uncertain in its results, and inadequate to practical purposes.

Dr. Parry's method of measurement is effected with an instrument similar in principle to the lamp micrometer of Dr. Herschel, of which an account is published in the Philosophical Transactions for 1782. (See MICROMETER.) An object of a known diameter being placed in the focus of a compound microscope, and strongly illuminated, a piece of white paper is placed horizontally at some distance beneath it ; then looking through the microscope with one eye, and keeping the other steadily open, you will see the object apparently projected on the paper, which is to be measured, whilst viewing it, with a pair of compasses. Divide the length of the image so measured with the known diameter of the object, which will give the magnifying power of the microscope. This being found, place the object you wish to measure in the focus, and projecting its image on the paper as before, measure it with the compasses, and divide the result by the magnifying power, which will be the real magnitude of the object required.

The light of a lamp is to be preferred to day-light, and the fibres to be measured are to be stretched on a glass, and waxed down at both ends. The under side of the glass should be blackened with Indian ink, except in three parts, the middle, and near the two ends. The unblackened spaces being placed in the focus of the microscope, ten or more filaments may be examined and measured successively, both in the middle part of the glass, and near the ends, which will give the diameter of the filament at the upper and lower end of the staple, and in the middle. Each lock of ten filaments being thus examined in three different parts, the mean of the three measurements must be taken for the mean diameter of each filament, and the mean diameter of the ten filaments may be taken for the fineness of the whole lock.

In place of the blackened glass, we would recommend a thin slide of ivory or brass, about five inches in length, and half an inch in breadth, with three transverse slits or openings, one in the middle, and the two others about three-fourths of an inch from each end. On this slide the filaments may be stretched, it will not be liable to break, and the edges of the filaments will be more correctly defined than when a plate of glass is placed under them.

The farther the paper is removed from the eye, the larger will be the apparent space covered by the image of the object, but it must not be too far for the hand to measure it with compasses. But if in place of the compasses we have a sheet of pasteboard graduated into minute divisions from a black line upwards, and a sliding index be adjusted, the pasteboard may be placed at a much greater distance, the observer adjusting the slide, until the edge of it and the black line coincide with both edges of the filament. A

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horizontal position for the microscope will be the most convenient, illuminating the object with a lamp and lens. In this way, the apparent diameter may be greatly increased, and we think the observations might be made with greater ease and accuracy.

By the above method the diameter of very minute filaments may be ascertained, and minute differences detected, which the unassisted eye is unable to detect. We are aware, however, that it requires some address and time to enable the observer to manage the instrument, on which account it cannot, we fear, be made generally useful.

The following admeasurements of different fine wools were taken with Dr. Parry's instrument; the first column represents the outward end of the filament, the second the middle, and the third the bottom, in fractional parts of an inch; the latter column the mean of ten filaments of the same wool.

TABLE of comparative Diameters of the Filaments of various Clothing Wools, by Dr. Parry.

	Outward End.	Middle.	Inner End.	Mean.
Spanish Ewe - -	$\frac{1}{1237}$	$\frac{1}{1233}$	$\frac{1}{1238}$	$\frac{1}{1230}$
Lafteria Pile - -	$\frac{1}{1146}$	$\frac{1}{1144}$	$\frac{1}{1142}$	$\frac{1}{1144}$
Ewe - - -	$\frac{1}{1048}$	$\frac{1}{1287}$	$\frac{1}{1278}$	$\frac{1}{1257}$
Coronet Pile - -	$\frac{1}{1271}$	$\frac{1}{1270}$	$\frac{1}{1277}$	$\frac{1}{1273}$
Native Merino Ram -	$\frac{1}{1146}$	$\frac{1}{1234}$	$\frac{1}{1235}$	$\frac{1}{1234}$
Saxon - - -	$\frac{1}{1270}$	$\frac{1}{1161}$	$\frac{1}{1164}$	$\frac{1}{1202}$
Pictet's Merino Ram	$\frac{1}{1183}$	$\frac{1}{1224}$	$\frac{1}{1176}$	$\frac{1}{1195}$
Best Negrette Pile -	$\frac{1}{1173}$	$\frac{1}{1172}$	$\frac{1}{1177}$	$\frac{1}{1179}$
Alva Pile - - -	$\frac{1}{1085}$	$\frac{1}{1234}$	$\frac{1}{1276}$	$\frac{1}{1178}$
Rambouillet Ewe - -	$\frac{1}{1067}$	$\frac{1}{1134}$	$\frac{1}{1278}$	$\frac{1}{1139}$
Imperial Pile - - -	$\frac{1}{1116}$	$\frac{1}{1037}$	$\frac{1}{1257}$	$\frac{1}{1137}$
Morre - - -	$\frac{1}{1140}$	$\frac{1}{1071}$	$\frac{1}{1200}$	$\frac{1}{1137}$
Ryeland - - -	$\frac{1}{1037}$	$\frac{1}{1166}$	$\frac{1}{1137}$	$\frac{1}{1144}$
South Down - - -	$\frac{1}{1076}$	$\frac{1}{1141}$	$\frac{1}{1174}$	$\frac{1}{1160}$
Anglo Negrette Ram	$\frac{1}{1014}$	$\frac{1}{1019}$	$\frac{1}{1134}$	$\frac{1}{1037}$
Negrette Ram, Marquis of Bath } }	$\frac{1}{993}$	$\frac{1}{973}$	$\frac{1}{1217}$	$\frac{1}{1057}$
Charenton Ram - -	$\frac{1}{1007}$	$\frac{1}{974}$	$\frac{1}{1090}$	$\frac{1}{1003}$
Ryeland Ram - - -	$\frac{1}{933}$	$\frac{1}{950}$	$\frac{1}{1086}$	$\frac{1}{989}$
Cape, 4th Cross - -	$\frac{1}{827}$	$\frac{1}{906}$	$\frac{1}{970}$	$\frac{1}{897}$
Wilts Ewe - - -	$\frac{1}{873}$	$\frac{1}{771}$	$\frac{1}{880}$	$\frac{1}{800}$

Long Wool, or Combing Wool, being prepared for spinning by a process entirely different from that of short or clothing wool, and the pieces made from it being finished in a very different manner, the qualities most required in this kind of wool are length and soundness of the staple, without which the fleece is unfitted for the comb. The fineness of the hair is a secondary quality, required only in certain kinds of goods. The wool-comb is an instrument of simple construction, consisting of a wooden handle, with a transverse piece or head, in which are inserted three rows of long steel teeth. The wool, which is to be combed after being clean scoured, dried, and oiled, is first drawn upon these teeth with the hand, until the comb is sufficiently loaded. It is then placed on the knee of the comber, and another comb of a similar kind is drawn through it, and the operation is repeated till all the hairs or fibres are combed smooth in one direction. This operation requires considerable strength, but the comb being previously heated, and the wool thoroughly oiled, facilitates the process. When completed the

combed wool is drawn off with the fingers, forming what is called a *staple*; the shorter part of the wool sticks in the teeth of the comb, and is called the *noyl*: this is sold to the clothiers.

From the above description, it is evident that if the staple of the wool be not found, the greater part of it will be broken by the process of combing, and form noyls. The staple must also have a sufficient degree of length for the combs to operate upon it. Length and soundness of the staple are therefore the most essential and characteristic qualities of combing-wools.

Long wools may be classed into two kinds: first, those suited for the manufacture of hard yarn for worsted pieces; and second, those suited for the manufacture of soft yarn used for hosiery. The former require a greater length of staple than the latter. The first may therefore be called long combing-wool, and the latter short combing-wool; between these there are gradations of wool, which may be applied to either purpose.

Long combing-wool should have the staple from six inches to eight, ten, or even twelve, in length. Before the recent improvements in spinning by machinery, a very great length of staple was considered as an excellence in long combing-wools; and on this account the hog-wool, or the first fleeces from sheep which had not been shorn when lambs, was more valuable than the wether wool from the same flock, and bore a higher price than the former, by at least fifteen *per cent.* Since that time the wether wool has risen in relative value on account of the evenness of the staple, each lock being nearly equally thick at both ends; but the staple of hog-wool is pointed, or what is technically called *spirey*. Eight inches, if the wool be found, may be regarded as a very proper length for heavy combing-wools. The longer stapled wool was formerly worked by itself, and used for the finer spun yarn, or mixed in small quantities with the wether wool, to improve the spinning. It is found that an equal length of staple contributes to the evenness of the thread when spun by machinery, and a very great length of staple is rather injurious than otherwise in the process of machine spinning. To the wool-grower, however, it must always be desirable to increase the length of his heavy combing fleeces, as he thereby materially increases the weight; and we have not yet learned that the price has ever been reduced on this account, for if the wool be too long for some branches of the worsted manufacture, there are others in which it may be worked with advantage.

The length of the staple may be increased by a plentiful supply of nutritious food. The same effect may also be produced by letting the wool remain a longer time on the sheep before it is shorn. We have seen a staple of Lincolnshire wool which was twenty inches in length: it had grown two years without shearing. This, however, would be unattended with any advantage to the grower. The more frequently sheep are shorn, provided the wool is sufficiently long, the greater will be the weight grown in a given time on the same animal; for, from observations which we have made, we are satisfied that wool is grown more rapidly immediately after the sheep are shorn than at any other time. Length of staple in wool depends primarily on the breed, but may be more affected by culture than many other qualities of the fleece. The soundness of the staple may be easily judged of by pulling both ends of it with the fingers with considerable force. In weak or unfound wool the staple easily breaks in one or more parts, and on observing it, it will be seen that the fibres are much thinner in the part which breaks. This is occasioned either by a deficient supply

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ply of food, by disease, or by inclement seasons, which cause a stoppage in the growth of the fleece. This goes on to a greater or less degree. In some instances, the stoppage has been so entire that the upper part of the staple is nearly separated from the lower, and is only connected with it by a few filaments: in such cases, the stoppage has continued for a considerable time, and the bottom part of the staple may be considered as a new fleece, protruding the old one from the skin. Connected with the soundness of wool, there is another property required; this is, that the staple be free and open, or that the fibres shall not be matted or felted together; an effect which takes place frequently when the wool is unsound. It is in fact a natural felting of the wool on the back of the animal, when by any cause it has ceased to grow. Sometimes the lower part of the fleece next the skin will be so completely matted as to form a substance nearly as hard as a hat, and will hold to the skin by a few hairs only. These are called cotted fleeces; all approach to this state is peculiarly injurious to combing-wools. The wool-buyers generally throw out the cotted and unsound fleeces when they pack the wool from the grower, and buy them at a very reduced price. The softness of combing-wool, though of less importance than in clothing-wool, yet enhances its value, as it is found that such wool makes a clover and softer thread, and in every process of the manufacture finishes more *kindly*. Combing-wools grown on light calcareous soils are deficient in this respect; such are the combing-wools of Oxfordshire and the Cotswold hills, which are formed of that species of lime-stone called oolite, or roe-stone. A copious supply of the yolk is necessary to the healthy condition of the fleece, and as this in many flocks is nearly equal in weight to the wool, the fleeces contain from six to eight pounds or more of it before they are washed, for in the unwashed state they often weigh eighteen pounds in many of the long-woolled flocks in England.

The whiteness of the fleece is less important in the long combing than in clothing wool, provided it be free from grey hairs. The latter circumstance does not frequently occur in combing-wools. There is, however, a peculiar colour communicated by the soil, which is sometimes so deep as to injure the wool for particular uses, and what is of more importance, there is a dingy-brown colour given to the fleece by impoverished keeping or disease, which is called a *winter stain*; it is a sure indication that the wool is not in a thoroughly sound state, and such fleeces are carefully thrown out by the wool-sorter, being only suited for those goods which are to be dyed dark colours.

The fineness of heavy combing-wool is of less importance than the other qualities. In every fleece of this kind there will be a certain small portion of short clothing-wool on the flanks, the belly, the throat, and the buttocks. The clothing-wool from such fleeces is not often divided into more than two or three low sorts, and the combing-wool is seldom thrown into more than four sorts, that is, two sorts of the hog-wool, and two sorts of the wether-wool, of which three-fourths, if the fleece be good, will form the best sort in each.

There is, however, a fine long combing-wool which is required for bombazines and the finer kinds of worsted goods; this is most frequently selected from the longer parts of clothing fleeces, and admits a division into four or five sorts, the finest being equal in hair to that of the head or super in clothing-wool; whereas the best sort of the common heavy combing-wools seldom ranges higher in point of fineness than the coarsest sort of clothing-wool above the breech locks; *viz.* the low abb and the livery.

Short combing or hosiery wool requires a different length of staple, according to its fineness: for the better sorts, the staple should not be shorter than four or five inches; the lower sorts may range as high as eight inches. A greater length than this is not desirable for any kind of soft worsted. What has been said of the soundness and fineness of staple required for long combing-wool, applies equally to the hosiery wool, but in this the fineness of the hair and softness are of more importance. Most of the fleeces which yield fine combing-wool produce nearly an equal quantity of short wool, which is thrown in the same manner as the regular clothing sorts. The combing sorts for the hosiery are generally called,

Super matching,
Fine matching,
Fine drawing,
Altered drawing,
Brown drawing,
Saycraft.

The names of these sorts derive their origin from ancient processes of the manufacture, with which we are unacquainted at present. The lower sort, or saycraft, was probably at first the long coarse combing-wool, thrown out for the manufacture of lays, of which we have frequent mention in the earliest history of the woollen trade in England. The relative value of these sorts, compared with each other, varies according to the demand for the finer or coarser kinds of hosiery, and is also affected by the clothing trade. When any clothing sort which ranges in fineness with one of the combing sorts is in great demand, the wool-sorter will break down the shorter combing-wool of this sort, and throw it to the clothing-wool, which enhances the price of the former by making it scarce. The fineness of these sorts out of the best combing-wools, stated numerically, as compared with clothing sorts, will be nearly as under, in the fractional parts of an inch.

Super matching	-	-	$\frac{1}{2800}$
Fine matching	-	-	$\frac{1}{7700}$
Fine drawing	-	-	$\frac{1}{7000}$
Altered drawing	-	-	$\frac{1}{4000}$
Brown drawing	-	-	$\frac{1}{3200}$
Saycraft	-	-	$\frac{1}{2800}$

Most of the best sorters throw out the hog combing-wool from the best sorts, making a superfine hog for the bombazine trade, hog-wool being less suitable for the hosiery, which does not require yarn so finely spun as for hard yarn.

As all the different sorts of short combing-wool, together with several sorts of clothing-wool, will frequently occur in one English fleece, it is obviously the interest of the grower that his fleece should produce as great a proportion of the best sorts as can be done without materially diminishing the weight.

Skin Wool, or Pelt Wool, is the wool separated from the skins of slaughtered sheep by the fellmonger. The quantity of this wool, in a country like England, where so much animal food is consumed, is very considerable, and has been estimated at near 50,000 packs of 240lbs. *per annum*, for England and Wales. Soon after shearing, the skin-wool is too short to be worked by itself, and is generally kept and mixed in with the longer wools. The process by which wool is separated from the skins has a tendency to make it hard, and destroy or injure its felting or milling property, on which account short-skin wools are seldom used for the manufacture of cloth, but more generally for flannels, serges, and those kinds of goods which require little or no milling;

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the finest kinds are much used for stockings made of yarn from carded wool. In the spring, when the wool on the skins has acquired a considerable length, it is thrown into combing forts; the finer kinds are used for knitting hosiery yarn, and the coarser for hard yarn for the warps of serges and other goods, having a warp of combed and a weft of carded wool. The value of skin-wool is seldom equal to that of fleece-wool of the same degree of length and fineness, owing to the felting property being injured, which renders it more unfit for the manufacture of woollen cloth.

Lamb's Wool.—The wool of the lamb is, with certain exceptions, softer than that of sheep's-wool, from the same flocks. It possesses the property of felting in a remarkable degree, and on this account is principally manufactured into hats, except skin lamb's-wool, which losing its felting property in a great degree, is employed in the manufacture of flannels and woollen yarn for lamb's-wool hosiery. In the northern parts of Europe, the lambs of some of the breeds of sheep possess a fleece so delicately soft, that it constitutes a most valuable fur, being dressed on the skin, and used as a costly article of attire. According to Pallas, the inhabitants of the Ukraïn and Podoli, as soon as the lamb is dropped, (which comes into the world with a pretty wavy skin, even without the assistance of art,) to augment its beauty, and make it bring a higher price, sew it up in a sort of coarse linen shirt, so as to keep up a constant gentle pressure on the wool, pouring warm water over it every day to make it soft and sleek; only letting out the bandage a little from time to time as the animal increases in size, but still keeping it tight enough to effect their purpose, which is to lay the wool in beautiful glossy ringlets, and thereby produce a delicate species of fur in great request for lining clothes and morning-gowns. By this treatment, the staple of the fine soft wool which rises in the infancy of the lamb takes a handsome arrangement; and the animal is killed younger or older according to the species of fur intended to be produced; from a short glossy nap, like satin, only fit from its thinness for the purpose mentioned above, to a warm thick fur for a winter great-coat. The first of these furs in estimation and price is a fine black, that looks like silk damask; an inferior black fur comes next, much thicker, used for *pelisses*, or *skubes*, as the upper winter garb worn out of doors is called; and the least in estimation is the whitest, except it be of a very pure colour and silky appearance, where it is a rival to the first; especially for night-gowns, a very common dress both morning and evening amongst the Russians; particularly in the interior parts of the empire.

The Bucharian sheep, as described by Pallas, grows a compact, soft, and elastic wool, which is elegantly formed into frizzled ringlets. In the lamb, the wool is formed into delicate little circular waves, as if pressed close to the skin by art; but when taken from the mother, or killed immediately after birth, they are still more beautiful, and often elegantly marbled with feathered waves, like silk damask. These three furs are the finest and most precious of the kind known to Europe and the East; they are brought to us by the Bucharian Tartars and Persians, who sell them dear. The most prized are, the *blue*, the black, and the silver grey; but of the *unborn lamb-skins*, as the fine glossy thin furs are called, which so much resemble silk damask, the fine black is dearest and most esteemed. To obtain these valuable furs, the Bucharian Tartars purchase whole flocks of male lambs just dropped from their mothers: as to kill a female till past the age of breeding is held as a kind of crime by all Tartar hordes; such is their reverence for an animal which constitutes their greatest riches, and the propagation and care of

which are the great business of their lives; so that all the fur we see of this species sold by the Tartars are from young rams. The Bucharians are of opinion, that art is necessary to preserve these furs in their greatest beauty; and under that idea, keep the lambs under shades, &c. during the meridian ardour of the sun; but Dr. Pallas has reason to think, that these precautions are useless, as he observed that the same variety of sheep produced the same fine hues equal in every respect, without any sort of care, in the hands of the Kirguite Tartars.

It is very remarkable that the lamb's-wool, in many of the Merino flocks, is coarser than the sheep's-wool. In some of the flocks, the lambs are at first covered with coarse hair, which falls off afterwards, and they produce the finest wool.

Wool from other animals besides the sheep is employed in manufactures, and spun and woven into fabrics of different kinds, either unmixed or mixed with sheep's-wool. The goats of Thibet, which grow the fine shawl wool, produce it as a fine down at the bottom of the long coarse hair, with which the animals are covered. Many of the common goats in Europe grow a similar down, which, by cultivation, might become a valuable article of commerce. It is not, however, yet clearly ascertained, whether the shawls and shawl cloth of India are all manufactured from goat's-wool; part of it appears to be made from sheep's-wool peculiarly soft and fine. The Angora goat grows a hair extremely fine and silky, which is much used in some of the French worsted goods mixed with silk. This goat is properly a long-woolled animal. Dr. Anderson says, that the Angora goat will prosper and preserve its peculiarities in France and Sweden. The wool of the vicunna, called Vigonia wool, is generally of a reddish-fawn colour; it is peculiarly soft and silky, but intermixed with long coarse hairs, which are very difficult to separate. (See VICUNNA.) From the lama and pacos of Peru a stronger and longer stapled wool is obtained, which is sometimes white. Under a liberal government which protected and encouraged commerce, we have no doubt the fleeces of these animals might be greatly improved, and would become an article of great value. The wool from the yak of Tartary, and the musk ox of Hudson's bay, has yet received little attention. We have seen stockings made of the latter, and which are worn in that country; the wool was soft but not fine, and much intermixed with long coarse hairs.

The quantity of sheep's-wool annually grown in England and Wales was estimated, by persons in the wool trade examined before the house of commons in the year 1800, at six hundred thousand packs. Mr. Luccock, in his Treatise on Wool, seems to consider this estimate as greatly exceeding the real amount, and has given an estimate founded on the supposed extent of surface pastured by sheep, and the quantity of sheep *per* acre in each county. This table we subjoin, as the only attempt that we know of to determine the question on certain data; though we consider it only as an approximation to truth, and are inclined to believe that the quantity is under the real amount. Such is also the opinion of the most intelligent persons in the wool trade, whom we have had an opportunity of consulting.

From this table, it will appear that the total amount, including skin-wool and lamb's-wool, is somewhat short of four hundred thousand packs, which is probably one-fourth below the true quantity, could it be ascertained. Mr. Luccock is inclined to believe that the flocks of sheep in England and Wales are not so numerous as formerly, but he says those of Ireland and Scotland are rapidly increasing. Even in England and Wales, he says, we have
more

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more than three millions of acres capable of being improved, and carrying a more numerous flock. We have two millions of sheep whose fleeces are scarcely wool, and which might be brought to contribute their share to support the woollen manufacture, and to increase the wealth of the country.

It may be proper to remark, that the quantity of wool grown annually in England is more variable than is generally supposed, owing to the variable temperature of our climate. In long-continued and severe winters, the sheep not obtaining the same quantity of food, and being also rendered less vigorous by the cold, do not grow so much wool as in milder seasons. The difference between the weight of the fleeces grown in severe and in very mild seasons, may be stated at one-fifth of the whole annual clip: indeed we believe it exceeds that proportion. About the year 1700, the annual value of English wool was estimated at two millions sterling. If we suppose the average price at that time to have been eight-pence *per* pound, or eight pounds *per* pack, this will make the total weight of wool two hundred and fifty thousand packs. Indeed when

we consider the improved state of our agriculture, the great increase of our population, and of our woollen exports, we may fairly state the present weight of wool grown to be double the amount of what it was at the period referred to. In a subsequent part of this article, it will be seen that the cloth manufactures of Yorkshire, principally from English wools, have increased eight-fold in the last eighty years; and though the woollen manufactures have removed from some other situations, yet the great increase on the whole in England cannot be doubted. Since the date of Mr. Luccock's table in 1805, in consequence of the high price of long combing-wool, the growers have paid more attention to the weight of their fleeces; and many who had rendered their fleeces lighter by exchanging the Lincolnshire for the Leicester breeds of sheep, have since been reverting to the former breed, or rather to a mixed breed, endeavouring to combine the improved form of the Leicester sheep with the heavy fleece of the Lincoln. The quantity of long combing-wool grown annually is greater than it was even ten years since; the high and increasing price and demand operating naturally as a premium for its cultivation.

TABLE I.—Shewing the Produce of English Long Wool.

District.	County.	No. of Acres.	No. of Sheep.	Weight of Fleece.	No. of Packs.
Teefwater -	{ Durham - - - - -	100800	67200	9	2520
	{ Yorkshire - - - - -	61250	14310	8	477
	{ Holderness - - - - -	127680	84000	8	2800
Lincoln -	{ Lincoln rich land - - - - -	413875	1241625	9	46561
	{ marshes - - - - -	175000	87500	8	2916
	{ miscellaneous land - - - - -	758485	505657	8	16855
	{ Norfolk - - - - -	55428	38500	7	1223
	{ Cambridge - - - - -	187600	41688	8	1390
Leicester -	{ Huntingdon - - - - -	87500	87500	7	2552
	{ Leicester - - - - -	398650	380528	7	11100
	{ Northampton - - - - -	560000	640000	6	16000
	{ Rutland - - - - -	117000	114000	5	2370
	{ Warwick - - - - -	182875	160000	5	3333
	{ Stafford - - - - -	14000	3720	7	113
Kent -	{ Romney Marsh - - - - -	46920	185000	7	5400
	{ Other Marshes - - - - -	65000	108330	7	3160
Devonshire -	{ South Hams - - - - -	387500	193750	8	6458
Cotswold -	{ Gloucester - - - - -	200000	200000	8	6666
		3939563	4153308		131794
Slaughtered		1176770 Sheep			
		196128 Producing long-skin wool		5720 Packs.	
				Carrion wool 286	
				5434	
Neat Total -				137228	

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TABLE II.—English Short Wool.

District.	County.	No. of Acres.	No. of Sheep.	Weight of Fleece.	No. of Packs.
Norfolk	Norfolk	1260572	683704	2	5697
	Suffolk	817000	497000	2½	5176
	Cambridge	817600	67744	4	1128
	Huntingdon	144000	108000	4½	2000
	Bedford	268800	204000	5	4250
	Essex	778400	519000	3	6486
	Suffex Downs	211200	316800	2	2640
	Low Land	623840	547000	3	6837
	Kent	728000	524475	3¼	7000
	Hampshire	774900	516600	3	6457
	Isle of Wight	87500	61000	3¼	800
	Wiltshire	Surrey	327600	283000	3
Wiltshire Downs		437000	583500	2¾	6684
Pasture		235000	117500	3	1460
Berkshire		408800	306600	3¼	4151
Oxford		380730	304584	Various.	5303
Bucks		408800	222968	3	2787
Herts		369600	277000	4½	5297
Middlesex		76000	45000	4	750
Dorset		700000	632240	3¼	9880
Devon		873700	436850	4	7280
Western	Cornwall	812000	203000	4	3382
	Somerfet	851200	500700	4½	9338
	Gloucester	528000	355000	Various.	5400
	Hereford	672000	500000	2	4200
	Monmouth	322625	177619	Various.	1431
	Worcester	369600	330504	3½	4820
	Shropshire	739200	422034	2½	4397
	Stafford	549360	183120	2	1526
	Warwick	365925	182962	3	2287
	Leicester	50000	20000	3½	291
Hereford	Lincoln	309120	123648	5½	2833
	Nottingham	435680	255147	Various.	4112
	Derby	553280	362400	3	4530
	Chester	588000	65000	Various.	926
	Lancaster	952000	310000	3½	4522
	York West Riding	1429250	383122	Various.	6678
	East Riding	454720	306240	5	6380
	North Riding	1200000	365326	Various.	5939
	Westmoreland	431200	378400	3½	3262
	Cumberland	856800	378400	3¼	5915
Heath	Durham	414400	159385	5	3320
	Northumberland	1108800	538162	5½	12333
	North Wales	2035200	683040	2	5692
	South Wales	2284800	571200	1½	3570
	Isle of Man				
		28412202	14854299		202737
Packs Skin Wool.					
Slaughtered		4221748	sheep	$\frac{3 \cdot 25}{2}$	28580
Carrion		211087			1429
Slaughter of long-wool sheep		980642		3	12258
Carrion of ditto brought forward					286
					42553
Total of short wool					245290
Ditto long ditto					137228
Wool from lambs slaughtered					2918
Ditto shorn					7800
					10718
Grand total					393236

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N.B.—The average fleece of England, } nearly - - - - - }	lbs.	oz.		
Do. ————— short wool	4	8		
Do. ————— long wool	3	4		
Do. ————— stock <i>per acre</i> in } England - - - - - }	7	10		
Do. ————— do. long wool - - -			$\frac{10}{32}$	sh.
Do. ————— do. short wool - - -			$\frac{20}{100}$	sh.
Do. ————— produce <i>per acre</i> } long fleece wool - - - }	8	0		
Do. ————— do. short do. - - -	1	5		
Do. ————— do. long skin wool - - -	0	5		
Do. ————— do. short do. - - -	0	4		
Do. ————— do. skin wool of } the kingdom, nearly - - - }	0	5		

The wool of Scotland may, perhaps, be estimated at 70,000 packs, of which the greater part, particularly that grown in the Highlands, is of the very coarsest kind. Of the quantity of wool grown in Ireland, we can form no correct estimate, but it cannot be great. From the returns at the Custom-house, it appears that the quantity of wool imported from Ireland and the Isle of Man in 1816 amounted to about 2600 packs; whilst the value of woollens imported from England was upwards of 500,000*l.* sterling. The woollen and worsted manufactures in Ireland are no where on an extensive scale; perhaps 60,000 packs are the full amount of the wool annually shorn in Ireland: this was the amount stated about a century since.

The quantity of wool imported into England may be seen from the following return at the Custom-house for the year 1817, amounting to about thirty thousand packs. The qualities we have annexed in the last column.

An Account of the Quantity of Sheep and Lamb's Wool imported into Great Britain, in the Year ending 5th January 1817; distinguishing the Countries from whence imported.

Countries from whence imported.	Year ending 5th Jan. 1817.	Quality.
	lbs.	
Russia - - - - -	228,673	Coarse.
Denmark - - - - -	80,646	Principally coarse.
Iceland and Feröe - - -	33,395	Coarse.
Prussia - - - - -	16,712	Fine clothing-wool.
Germany - - - - -	2,816,655	Principally ditto.
Holland - - - - -	143,390	Ditto.
Flanders - - - - -	77,625	Ditto.
France - - - - -	221,595	Ditto.
Portugal, &c. - - - -	493,277	Ditto.
Spain - - - - -	2,958,607	Ditto.
Gibraltar - - - - -	25,692	Coarse.
Italy - - - - -	108,234	Principally fine.
Turkey - - - - -	26,821	Fine.
Ireland and Isle of } Man (produce) - - - - - }	600,377	} Various, none } very fine.
——— (foreign) - - - - -	1,171	
New Holland - - - - -	13,611	Fine Merino.
Cape of Good Hope - - -	9,623	Ditto.
United States of Ame- } rica - - - - - }	43,465	} Various.
Spanish colonies in } South America - - - - }	206,454	
Brazil - - - - -	5,512	Ditto.
British West Indies - - -	6,329	Ditto.
Total - - - - -	8,117,864	

The whole of the imported wool, with scarcely an exception, is worked on the card, none of it being suited for the comb. The coarser kinds are principally employed for carpets, &c.; and the fine from Spain, Germany, Portugal, and France, supply our manufactures of superfine broad cloths, cassimeres, &c. So large a portion being of the finer kinds, the total value cannot be less than one million and a half pounds sterling.

Wool of New Holland.—The annual value and amount of the fine wool imported into England for our own manufactures being so great, we must surely applaud the meritorious exertions of those who attempt to supply the demand with the produce of our own country, or of our dependent colonies, and more particularly if they can raise this supply from parts where no wool was before grown. In this view, it cannot fail to be highly interesting to learn, that the exertions of one enlightened agriculturist have been eminently successful in spreading over an immense region dependent on England the very finest-woolled sheep, where the soil had never before yielded any produce serviceable to civilized man.

John Macarthur, esq. descended from an ancient family in Argyleshire, captain in a regiment then commanded by general Grose, went to New Holland in 1789. Fortunately for the future prosperity of the colony, his active spirit of inquiry and enterprise led him to direct his attention to the natural advantages which the soil and climate presented to the agriculturist, and having by purchase and grants obtained a considerable tract of country, he quitted the service in 1793, and commenced his farming operations. His stock at first consisted only of a few oxen and thirty Bengal ewes, growing a coarse kind of wool or hair. About the year 1795, he obtained from captain Kent, of the Royal Navy, one Merino ram and two ewes, purchased from the Dutch governor of the Cape of Good Hope. With these he began to cross his coarse-haired sheep, and to select the finest-woolled progeny to breed from. Having occasion to return to England in 1802, he brought over specimens of his wool, which were shewn to a body of the clothiers from the west of England, then in London on public business, who were so sensible of the advantages which might result from encouraging the growth of fine wool in the colony, that they presented a petition to the privy council, by whom Mr. Macarthur was examined. His plans being approved, the privy council recommended the secretary of state for the colonies to give him an additional grant of land, in a tract of country, from its fertility, called the cow-pastures, forming part of Camden county. On his return he took with him three Merino rams and two ewes, purchased from his majesty's flocks; and thus encouraged, he proceeded with rapid steps in the increase and improvement of his flocks, the climate being every way suited to secure the healthy condition of the sheep, and preserve the fineness of the wool.

The numbers increase four-fold every five years, so that his flocks already amounted to about four thousand sheep and lambs, including the fine and mixed breeds, when the unfortunate disputes with governor Blight, and the subsequent arrest of the latter, obliged Mr. Macarthur once more to return to England, and in some degree interrupted the progress of improvement. In 1817 his flocks had increased to about seven thousand, and the wool which has been sent to this country at different times, is become an important source of profit, the better sort being equal to the best Merino piles from Spain or Saxony. What we have seen more nearly resembles the latter, and were they both in the same state of cleanness, the most experienced eye could not discern any difference between them in fineness of the hair, length of staple, soundness, colour, or other properties.

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The wool has been hitherto washed on the sheep's back in the English method, by which it is not rendered so clean as by the Spanish or German mode; but making allowance for the additional waste, its value is equal to that of the very best Merino wool imported from any part of Europe.

The quantity imported this year is about eighteen thousand pounds weight, and a farther arrival is expected. The laudable example of Mr. Macarthur has been followed by other persons in the colony, and the total amount of wool sent from thence this year is about fifty thousand pounds weight; and such is the spirit of agricultural improvement, that at the annual sales of sheep established by Mr. Macarthur, rams and ewes have been sold at from ten to thirty guineas each. Though the absence of Mr. Macarthur impeded the progress of improvement, yet this will be more than compensated by the valuable information he has obtained with respect to the management and improvement of his flocks, from observations made on the continent; and he has further benefited the colony by taking back with him a selection of olive-trees, vines, and oranges. The dryness and mildness of the climate of New Holland, and the almost total absence of briars and underwood, are extremely favourable to sheep. His stock is divided into flocks of about four hundred, with shepherds and Spanish dogs to each. Under these propitious circumstances, and as the flocks double in number every thirty months, we may anticipate, that in the course of twenty or twenty-five years, the importation of fine wool from this colony will be fully equal to the total amount at present imported into England from all the different countries of Europe. It might repay the exertions of this enlightened agriculturist, and of the British government, could they procure from India the animals, whether sheep or goats, which yield the peculiarly soft wool for shawls. This would be a most valuable article, and is much wanted by our manufacturers.

There can scarcely be a doubt, that under the favourable climate of the British settlements in New Holland, all the Asiatic wool-bearing animals, particularly those of Cashmere and Thibet, might be introduced with every prospect of success. The coarse wool grown in the colony is chiefly manufactured in the country for domestic use. It is estimated that there are at present sixty thousand sheep in the colony, and a little perseverance and attention would suffice to change the coarse-woolled breeds into finer ones; a change which is at present rapidly taking place, and deserves the greatest encouragement, as wool is the only article of produce which the colonists have at present to export in exchange for British manufactured goods.

The Improvement of Wool depends primarily on attention to the breed of sheep, but there are various circumstances of soil, climate, and food, which are important to be regarded. The experiments that have been made in various parts of Europe within the last half century, have sufficiently removed the prejudice that long prevailed, respecting the impossibility of growing the finest clothing-wool in almost every part of the globe where sheep will subsist and thrive. It is different with the long combing-wools, to grow which in perfection, luxuriant pastures seem absolutely requisite, and these cannot be obtained under a parching sun, nor could the animal subsist in tropical climates, covered with such a load of wool as is grown on our sheep in Lincolnshire. Under such circumstances, an entire change seems to take place in the animal system; the long-woolled sheep become diseased and feverish, and only recover by casting the fleece, which is replaced by a coat of short hair. The rich pasture in England, and the opposite coasts of Flanders, seem more favourable to the growth of heavy combing

fleeces, than any other country in the known world; and the Leicestershire and Lincolnshire sheep seem every way well suited to these pastures, and the prices of the wool obtained at present are sufficient to secure attention to its cultivation. At one period, indeed, during the American revolution, the price of long combing-wool not being more than about three-pence *per* pound, the growers turned their attention principally to the improvement of the carcass, and neglected the weight of the fleece. At present the price is about eighteen-pence, and the average weight being about eight pounds, the wool forms an important object, and the growers are endeavouring to increase the weight of their fleeces. For the common purposes of the worsted manufactures, this wool is so well suited as to leave nothing further to be desired; and it is this kind which foreign manufacturers are so desirous to obtain from us. In many situations, however, where heavy long-woolled sheep are introduced, and where the soil is not sufficiently rich to grow it in perfection, it would be possible to grow a fleece weighing five or six pounds of very fine combing-wool, by crossing the long-woolled ewes with the Anglo-Merino rams. The increasing demand for finer goods, and the great improvement made in the spinning of combing-wool by machinery, make such a change desirable where the pastures are not sufficiently rich to bear the heavy long-woolled breeds of Leicester and Lincoln.

In many cold and exposed situations it would be desirable to provide better shelter for the flocks; and the practice of *greasing*, hereafter described, might be introduced with great advantage, and would tend to preserve the sheep and improve the quality of the wool.

The experiments made on the fine-woolled sheep on a large scale in different parts of Europe, prove that the peculiarities of food and climate have comparatively small influence on the quality of clothing-wool, and that it may be grown equally fine in situations where the sheep are confined and kept on dry meat a great part of the year, as in Saxony, Sweden, and Denmark. It may also be grown in the richest pastures, provided the pastures be over-stocked, to keep the herbage bare. There cannot, however, be a doubt, that a dry light soil, particularly in the moist climate of England, is most favourable to the health of the sheep, and to the quality of the wool.

The experiments that have been made in England on the Merino sheep have not been so successful as in other countries, principally arising from two causes.

In the first place, the demand for meat in England will always make the wool but a secondary object with the grazier, and no cross of the Merino sheep with the English has yet produced a race that equal in symmetry of form the South Down sheep, or that will produce the same quantity of meat to the butcher in the same space of time, and with the same food. In the second place, the mode of washing the Merino and Anglo-Merino wool in England will, so long as it is practised, prevent the wool from obtaining its proper value in the market. From the great quantity of natural yolk or grease in the Merino fleece, it is impossible to wash the wool on the sheep's back by mere immersion in water. In Spain no attempts are made to wash the wool upon the sheep's back, but all the fleeces of a pile are regularly sorted, and the different sorts scoured and dried before the wool is packed. But where the quantity of wool which any one grower possesses is small, as in England, it would not answer to send for wool-sorters from a distance; and to wash the wool before it is sorted, would so intermingle the fine with the coarse locks, as to render the regular sorting extremely difficult and expensive. In Saxony

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Saxony and Sweden the wool is washed on the sheep's backs. The following account of the process is thus described by baron Schulz. The sheep are first washed with one part clear ley, and two parts lukewarm water, and then in another tub with less ley in the water; after which the sheep are washed, laying them always on their backs, with their heads up, in a tub with clean water; and lastly, there is poured on the sheep, when standing on the ground, a sufficient quantity of water, which is as much as possible squeezed out of the wool. The sheep are afterwards driven into an unpastured meadow adjoining, and remain there, to prevent their soiling themselves in the sheep-house. They remain there a day and a night, or longer, till the wool be dry, which in fine weather will be in three days. Some persons wash their sheep twice, but the wool becomes harder in consequence of it, and has a greyer appearance.

The great quantity of grease which the finest Spanish wool contains at the first washing mixes with the ley-water, and makes it quite foamy; but this grease is wanting in the second washing, so that the water is not in the least softened. Some mode of washing like the above must be introduced in England, before the manufacturer will encourage the Anglo-Merino wool; for after his purchase, when he thinks he has obtained sufficient allowance in the price to cover the waste, he is generally much disappointed in finding the loss in the manufacture so greatly to exceed his expectation, and he is deterred from making a second trial.

In the northern counties of England, and in Scotland, a practice has long prevailed of greasing the sheep with a mixture of tar and butter, to preserve the animal from the effects of moisture, and the inclemency of the weather in hilly and exposed situations. This practice seems at present peculiar to Britain, but the ancients evidently made use of mixtures of the dregs of olive wax, tar, wine, and other ingredients, to protect the skin of sheep after shearing, and to soften and improve the wool. Such was the practice of the Italian shepherds, as described by Virgil:

“ Aut tonsum trifti contingunt corpus amurca,
Et spumas miscunt argenti vivaque sulfura,
Idæaque pices et pingues unguine ceras
Scyllamque helleborofque graves nigrumque bitumen.”
Georg. lib. iii.

That this practice was extremely beneficial in warm climates, by protecting the skin of the sheep from insects after shearing, and by keeping the wool in a soft state, cannot be doubted.

The practice of greasing the sheep in Scotland, and the northern counties of England, with a mixture of tar and butter, seems to have been introduced merely to preserve the sheep, and was generally supposed to be injurious to the wool. Indeed the great proportion of tar, too frequently employed, gave some ground for entertaining this opinion; and the breed of sheep, on which this mixture was most generally applied, is naturally the worst which exists in Britain for the production of wool, the fleeces more nearly resembling coarse hair than wool; but Mr. Bakewell, in his *Treatise on Wool*, observes, that “in Northumberland, where the fine-wooled sheep have received the benefit of greasing with a mixture in which the proportion of tar was merely sufficient to give it due tenacity, the wool is greatly improved by the process, but the ignorance or selfishness of the wool-buyers for a long time prevented the acknowledgment of the fact.” Many were afraid to purchase the wool on account of its dirty appearance, but its value is now better understood in the Yorkshire markets, and it is purchased by the manufacturers of coloured cloth in preference to the ungreased wool

of the same degree of fineness. The same preference is also given to the cloths in the halls, where they are sold in an ungreased state. When these cloths are finished, their superiority is more apparent, possessing a degree of softness far beyond the ungreased wool. These wools appear to improve in every process of the manufacture, and yield a cloth of greater value by twenty or thirty *per cent.* than the ungreased hard wools, though the latter may be equally fine.

But even in Northumberland, where the wool is so greatly improved by the practice, its good effects in this respect are not sufficiently known, and the operation is delayed till the approach of winter. By this delay, the upper part of the staple which is first grown, is deprived of the advantage of being kept in a moist soft state during the summer heat. When the operation has taken place, a perceptible improvement may be observed in the wool which is afterwards grown. The line of distinction is clearly marked by the stain which the unguent leaves in the staple, the bottom part of which, where it is applied, is finer and softer than the upper part which was grown before its application. This difference is so great, that a careful examination of the fine-greased wools of Northumberland might alone be sufficient to demonstrate the advantage of the practice, and the inconvenience of delaying the operation to the end of the year. To derive the most advantage from the ointment both to the wool and the sheep, it should be applied immediately after shearing, and again at the approach of winter. By the first greasing, the wool will be kept soft and moist during the sultry heats of July and August, and the top of the staple would not become harsh and discoloured, which is frequently the case with English wool. One acknowledged advantage of greasing immediately after shearing should not be overlooked; it destroys the sheep-tick, and has a tendency to prevent cutaneous distempers, and to protect the skin from the bite of the fly. The manner of preparing the ointment in Northumberland is as follows:—From sixteen to twenty pounds of butter are placed over a gentle fire, and melted; a gallon of tar is then added, and the mixture stirred with a stick until the tar and butter are well combined, and form a soft tenacious ointment. Some skill is required in its application, the want of which has prevented the practice from prevailing more generally. If the ointment be rubbed on the wool, it collects on the top of the staple, where it detains the loose soil, and becomes hard, and is injurious to the wool. The proper method is to divide the staples or locks with one hand, and apply the ointment with the finger immediately upon the skin; it is thus kept constantly soft by the warmth of the animal, and is equally diffused through the fleece. Attention to this circumstance is of the greatest importance to the success of the practice. The quantity laid on each animal varies in different districts. In the lighter mode of greasing, one gallon of tar and twenty pounds of butter will be sufficient for fifty sheep. In Scotland, where greasing is applied merely to preserve the animal against the inclemency of the climate, a much larger portion of tar is used: this would be very injurious to the wool, were it of any other than the very coarsest kind.

Could a cheap substitute for tar be found, which would possess equal tenacity, the ointment might be applied with great advantage to all our native breeds of English sheep, both for the preservation of the animal and the improvement of the wool. Mr. Bakewell states, that long combing-wools, which have been greased in this manner, produce a softer and superior yarn to any ever made from wool of the native English breeds which have not undergone the pro-

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cefs. On all chalk and light calcareous soils, the wool is always much harsher than wools of the same degree of fineness grown on argillaceous or siliceous soils; and this arises from the calcareous earth penetrating the fleece, and absorbing the natural greafe, and thus rendering the fibres hard and elastic. These soils cover a large portion of the south-eastern counties of England, and of some of the midland counties; and it is well known to cloth manufacturers that the wool from these districts do not work so well, nor make so soft a cloth, as wool on siliceous or argillaceous soils. Nor will this wool felt in the fulling-mill like the softer wools. The practice of greasing would be of undoubted advantage in calcareous districts, applying the ointment more sparingly than in the northern counties. Perhaps twenty-five pounds of butter, and one of tar, or two of bees'-wax, might be sufficient for one hundred South-Down sheep; and if the mixture were applied once after shearing, and again in October, the expence would be abundantly compensated by the improved condition both of the sheep and wool. The softness of wool appears to be essentially connected with the property of felting, and depends partly on the structure of the surface of the fibre, and partly on its possessing but a moderate degree of elasticity. The process of felting is best illustrated in the hat manufacture, where the fibres of wool or fur are brought into contact by pressure and warmth, and form a compact substance without the aid of spinning and weaving. In some parts of Tartary, coarse cloth for tents is manufactured by spreading the wool on the ground, and pressing it in warm water with the feet; this was probably the first mode of making cloth. All good woollen cloth is still woven comparatively loose, and is made firm and close in the fulling-mill. The fibres of wool or fur have a tendency to move more easily in one direction when pressed, than in the opposite direction. This motion has been compared to that of an ear of barley placed under the coat-sleeve, with the points of the beards downwards; by the action of the arm the ear is moved in a retrograde direction, until it has advanced from the wrist to the shoulder. When we draw a hair of wool or fur through the fingers in a direction from the points to the root, we can feel a sensible degree of roughness, which is not felt if the hair be drawn from the root to the point. Hence we may suppose, that the surface is covered with a number of points or rings, which are too minute to be observed by the microscope, except in some kinds of fur, as in that from the South-sea seal, in which, with a powerful microscope, we have seen the surface covered with distinct leaves or points, shaped like those of the artichoke. We have a striking illustration of this tendency of the fibre to move in one direction in that particular process of hat-making, where it is intended to cover the felt or substance of the hat with fur of a superior kind. The felt on which this fur is to be laid being finished, the hair of the beaver is uniformly spread upon the surface, and being covered with a cloth, it is pressed and agitated by the hand for a certain time. The fibres of beaver-hair introduce themselves by their roots into the felt, and proceed to a certain depth, and become firmly fixed in it. If the pressure were continued for a longer time, the hairs would pass entirely through the felt, going out at the under surface, as each hair follows the direction it acquired at the beginning of the process.

As the felting property, therefore, seems to depend on the minute structure of the surface of the fibre, it is easy to conceive how this may be injured by a dry calcareous soil, and how this property is best preserved in those furs

which are grown under a covering of coarse hair, and protected from external injury. The process of greasing is in some respects a substitute for such a covering, and not only defends the surface, but prevents the fibre from becoming dry, harsh, and elastic. The ancient Greeks and Romans were in the practice of covering their soft-woolled sheep, called *molles oves*, with skins: this has been supposed to have been intended merely as a protection from briars and underwood; but we have no doubt that wool so covered would be much softer than wool exposed to the action of light, and of the soil. That the rays of the summer sun have a tendency to make wool both coarser and harsher, may be seen in the effect produced on sheep that are exposed to it without shelter immediately after shearing. The top point of the staple which was grown at that time is almost always coarser and harder than the bottom of the staple which has been grown under the cover of the upper part of the fleece, and consequently more protected from light. An analogous effect is produced on the skins of horses kept in coal-mines, which become sleek and soft. These facts may suggest to wool-growers desirous of improving their wool, the advantage of providing shade for their flocks during the sultry heats of summer. The natural instincts of sheep might teach them the impropriety, not to speak of the cruelty, of keeping their sheep in summer inclosed in pens, and unsheltered, upon a dry soil, where the animals are almost roasted alive; a practice not less injurious to the health of sheep than to all the best qualities of the wool. Next to a regular supply of food, protection from the effects of heat and wet are objects of the first importance in the management of sheep; and it may be stated as an undoubted truth, that whatever contributes to the comfort of the animal, will enable it to fatten with a smaller quantity of food, will tend to preserve it in a healthy state, and will also increase the quantity and improve the quality of the wool.

Wool, Chemical Examination of. The chemical properties of wool are very similar to those of hair, and as we omitted to speak of these in their proper place, we shall introduce them here.

From the experiments of Achard and Hatchett, it appears that hair contains gelatine, to which it owes its suppleness and toughness. When hair is boiled in water, this principle is separated, and the hair becomes much more brittle than before. Indeed, if the process be continued long enough, the hair crumbles to pieces between the fingers. The portion insoluble in water possesses, according to Mr. Hatchett, the properties of coagulated albumen.

Mr. Hatchett has concluded, from his experiments, that the hair which loses its curl in moist weather, and which is softest and most flexible, is that which yields its gelatine most readily; whereas strong and elastic hair yields it with the greatest difficulty, and in the smallest proportion. This conclusion has been confirmed by a very considerable hair merchant in London, who assured him that the first kind of hair was much more injured by boiling than the second.

Vauquelin has published a curious set of experiments on human hair of different colours. He found it completely soluble in a Papin's digester. During this process, sulphuretted hydrogen was evolved. The solution thus obtained contains a kind of bituminous oil, which is deposited very slowly. This oil was black when the hair was black, but yellowish-red when red hair was the subject of experiment. When this oil was removed, nut-galls and chlorine produced copious precipitates. Silver was blackened, and acetate of lead precipitated brown. When concentrated by evaporation, it did not concrete into a jelly.

Water

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Water containing only four *per cent.* of potash dissolves hair, while hydro-sulphuret of ammonia is evolved. If the hair be black, a thick dark-coloured oil, with some sulphur and iron, remain undissolved. If the hair be red, this oil is yellowish. Acids throw down from this solution a precipitate, soluble in excess of acid.

Sulphuric and muriatic acids become red when first poured on hair, and gradually dissolve it. Nitric acid turns hair yellow, and dissolves it, while an oil separates, varying in colour, as before-mentioned, according to the colour of the hair employed. The solution contains a great deal of oxalic acid, besides bitter principle, iron, and sulphuric acid. Chlorine reduces it to a substance of the consistence of turpentine, partly soluble in alcohol.

Alcohol, digested on black hair, extracts from it two kinds of oil. The first, which is white, subsides in white shining scales as the liquor cools; the second is obtained by evaporating the alcohol. It has a greyish-green colour, and at last becomes solid. From red hair alcohol also extracts two oils, one white, as above, the other red as blood. After this latter has been extracted, the hair becomes chefnut. Hence its red colour appears to depend upon this oil.

Hair on incineration yields iron and manganese, sulphate and carbonate of lime, muriate of soda, and a considerable proportion of silica. The ashes of red hair contain less iron and manganese. Those of white hair still less; but in those we find magnesia, which is wanting in the ashes of other hair. The ashes of hair do not exceed .015 of the hair.

Hence, according to this analysis, hair consists of

1. Animal matters constituting the greatest part.
2. A white solid oil, small in quantity.
3. A greyish-green oil, more abundant.
4. Iron, state unknown.
5. Oxyd of manganese.
6. Phosphate of lime.
7. Carbonate of lime, very scanty.
8. Silica.
9. Sulphur.

Vauquelin infers from these experiments, that hair depends for its colour upon a kind of oil, which varies according to the colour of the hair in which it is found. He also supposes, that sulphuret of iron contributes to the colour of black hair. The sudden change of colour in hair from grief, he thinks, is owing to the evolution of an acid. Bichat, however, attributes this change, perhaps with greater probability, to the absorption of the colouring principle. To whatever cause it be owing, the fact appears undoubted; and it shews a closer connection between the living powers and the hair, than many physiologists are inclined to admit.

Wool appears, according to the experiments of Berthollet, to coincide almost exactly in its chemical properties with those of hair above-mentioned. When growing on the back of the animal, it is enveloped in a greasy matter, called the *yolk*, and which appears to be a kind of soap; or, more properly speaking, according to the experiments of Vauquelin, who has examined it, of

1. A soap of potash.
2. Carbonate of potash.
3. A little acetate of potash.
4. Lime.
5. A little muriate of potash.
6. An animal matter.

This substance appears to have the property of protecting the animal from insects to a certain degree, and of preserving

the softness of the wool, which are perhaps its chief uses. It is removed from the wool before it is manufactured, by the process termed *scouring*. The affinity of the animal matter of wool for all colouring principles is very great, and in general far exceeds that of the different vegetable fibres, as cotton, flax, &c. for such principles. There is one kind of coarse wool, however, which, according to Dr. Bancroft, does not possess this property, and receives colours with great difficulty. See DYEING, and the preceding article.

WOOL, *Laws relating to.* The jealousy entertained on the subject of our wools, may be learnt from the legal restriction which has been made in relation thereto; as also with the view that as much employment as is possible may be found for the labouring classes. This is effected by the prohibition of the exportation of wool in an unmanufactured state, as will be seen below. It must be obvious, however, that it would be to little purpose to be thus strict respecting the article itself, if that which produced it was not equally guarded; therefore as early as 13 & 14 Ch. II. c. 18. it was made felony to export sheep from England or Ireland, or even to Scotland: now however the penalty is forfeiture of every ram, sheep, or lamb, and the vessel in which such is shipped with intent to exportation from Great Britain and the islands belonging thereto; and offenders are to forfeit 3*l.* for every sheep, &c. so shipped, and to suffer three months solitary imprisonment, and till the forfeiture be paid, but not to exceed twelve months; and for any second offence 5*l.* for each ram, &c. and six months imprisonment, and till the fine is paid, but not to exceed two years. 28 Geo. III. c. 38. § 2.

By the 9th and 37th sections, no wool, woolfells, mortlings, yarn, or worsted made of wool, woolflocks, coverings, cruels, waddings, or other manufactures, or pretended manufactures slightly wrought up so that it may be reduced to wool again, or mattresses, or beds stuffed with wool combed or fit for combing or carding, may be shipped or exported, or carried or moved for that purpose, from Great Britain, or Guernsey, Jersey, Alderney, Sark, or Man, to any foreign place, on forfeiture of the wool, with the carriage, ship, or cattle on which it is laden or removed; but 300 sheep may be sent annually from Liverpool or Whitehaven to the Isle of Man (51 Geo. III. c. 50.); and the person offending to forfeit 3*s.* for every pound weight, or 50*l.* in the whole, and to be imprisoned three months, and till the penalty is paid, but not to exceed six months; but for a second offence he is to forfeit the like sums, and to be imprisoned for six months, and till such fine be paid, not exceeding two years; but this is not to extend to lambskins dressed for furs and linings.

And persons qualified by the governors of the following islands may export the respective qualities set against them from Southampton to those places in every year:

	Tods.
To Jersey - -	4000
To Guernsey - -	2000
To Alderney - -	400
To Sark - - -	200

28 Geo. III. c. 38. § 16, 17. And 20,000 pounds weight of worsted and woollen yarn may be exported annually from London to Lower Canada, by permission of his majesty in council. 47 Geo. III. c. 9. 52 Geo. III. c. 55.

By the 48 Geo. III. c. 44. wool may be shipped in England for exportation to Ireland, on being duly entered and bond given for its true exportation there; and upon obtaining a licence under the hands of the commissioners of the customs to allow it.

No wool shipped to be sent coastwise from one part of Great Britain to another, until due notice be given and bond entered into, and a licence obtained under the hand of three commissioners of the customs. Penalty, forfeiture. 28 Geo. III. c. 38. § 34. And wool must also be shipped coastwise in British ship, British owned and manned, the owner of which does not reside out of Great Britain. § 19. and 12 Car. II. c. 18. Formerly there were penalties and forfeitures for keeping or removing wool in Kent and Suffex within certain distances of the sea (ten and fifteen miles), without entry and bond, and procuring certificates or permits, and also for removing wool within five miles of the sea-coast of Great Britain before sun-rising and after sun-set; but by the 54 Geo. III. c. 78. all the regulations formerly required *antecedent to the removal* of wool on land throughout England are repealed.

Wool to be packed in packs, or trusses of leather, or canvas, called 'Pack-cloths,' or in linen or woollen, and to be marked 'Wool,' in letters three inches long, on forfeiture of the wool, and 1s. *per* pound. 28 Geo. III. c. 38. § 28.

Persons packing wool, &c. into boxes, barrels, casks, or chests, and other than as above, or pressing or steaming the same, to forfeit the goods, and 3s. *per* pound. *Ibid.* § 30, 31.

Insurances for the conveyance of wool contrary to this act void, and the parties may be punished. § 45, 46, 47, 48.

King's ships empowered and required to search ships for wool shipped without licence. § 49, 50, 51.

No person can seize wool unlawfully removing but officers of customs, excise, and salt-duties, or persons accompanied by a constable (§ 52.); and persons neglecting their duty to forfeit 20*l.*, and making collusive seizures or agreements to be subject to like penalties as exporters. (§ 53. 55.) Hindering, obstructing, or beating officers, subjects offenders to transportation; and bribery of them, whether accepted or not, to the penalty of 300*l.* § 56, 57.

If any question arises upon the growth of the wool, the *onus probandi* is to lie upon the owners. § 60.

Informations may be laid in any court of record, and penalties, &c. under 200*l.* may be determined before two justices of the peace; and justices at quarter-sessions may direct ships, goods, wool, &c. to be sold. § 62, 63.

Prosecutions to be commenced within three years. § 77.

Wool the growth of Ireland may be exported to England, and no where else. 1 W. & M. c. 32. 7 & 8 W. III. c. 28. 10 & 11 W. III. c. 10. 26 Geo. III. c. 11.

And the Admiralty is to appoint three ships of the sixth rate, and eight or more armed sloops, to prevent the exportation of wool from Ireland to foreign ports. 5 Geo. II. c. 21.

Wool the produce of any of the colonies, &c. in America, or countries on the continent of America, subject to any foreign European states, imported into certain British West India islands, may be imported into Great Britain under the regulations of the 12 Car. II. c. 18.

Those places are, Jamaica, Granada, Dominica, Antigua, Trinidad, Tobago, New Providence, Crooked island, St. Vincent, Bermuda, Caicos, Tortola, Curacao, and the Bahamas. 27 Geo. III. c. 27. 45 Geo. III. c. 57. 47 Geo. III. sess. 2. c. 34.

British hare or coney wool may not be exported, (except to Ireland, 39 & 40 Geo. III. c. 67.) on penalty of forfeiture. The owner or shipper to pay 100*l.*, and the master of the ship 40*l.* 24 Geo. III. c. 21.