VOL. XII **TEXTILE RESEARCH** NO. 9

Outstanding Features in

This Month's Issue

Spinning Twists

An accurate method of twist determination with formulas for compensating for yarn contraction and errors in winding. (See page 3.)

Elasticity of Wool

A discussion of the elasticity of wool and a comparison of the effect of rupturing the molecular cross-links with the elasticity after rebuilding the linkages. (See page 11.)

Textile Unit

Description of the textile manufacturing unit for applied research at American Viscose Corp. (See page 21.)

The Structure of Flax

Microscopic studies show cellular structure. (See page 26.)

World Economics

An outline of the need of research and coordination of effort as a preliminary to plans for post-war reconstruction. (See page 30.)

What About Wool

More research is needed if the wool fiber is to maintain its supremacy among competing fibers. (See page 18.)

Report by Textile Foundation gives present status of

Mildewproofing

The following is a topic abstract of report prepared by Charles W. Hock, Research Associate of the Textile Foundation.

The Cause of Mildew: The molds causing mildew are disseminated by means of tiny spores the growth of which depends on temperature, moisture and available food supply.

Compounds Used: A list of requirements for a satisfactory compound is given. The most widely used being copper naphthenate. Since the stock piles of scrap copper are running low, substitute agents are being sought.

Application of Agents: Present difficulty chiefly encountered in the application is uneven penetration of the fiber.

Toxicity: The mildewproofed fabric must not be toxic to the user. The copper compounds while satisfactory for sand bags and mechanical fabrics are not suitable for clothing and blankets.

Tests for Mildewproofing: Present tests consume time and shorter tests are desirable. The principal tests at present consist of innoculation by Chaetomium Globosum, the soil innoculation, and the burial test.

Laboratories now carrying on investigations are the various bureaus of the Department of Agriculture and various industrial laboratories.

References are given to the principal published literature on the subject of mildewproofing.

New Method Permits More Accurate

Twist Determination

By MALCOLM E. CAMPBELL*

For determining the amount of twist inserted in cotton yarn during spinning, the usual method gives a rough approximation to the true twist and is probably adequate for most purposes. It is, however, subject to two sources of error, which if not accounted for may be large enough to upset the more precise calculations needed in checking twist counters, or for investigations of twist-strength relationships, and other subjects of research. It is the purpose of this article to suggest a practical method of handling these two sources of error so that an accurate determination of the twist inserted during spinning can be made.

In ordinary mill practice the amount of twist that is put into a yarn is calculated by determining the ratio of the spindle speed, in revolutions per minute, to the surface speed of the front drawing roll in inches per minute. This is usually done simply by dividing the twist constant of the spinning frame by the number of teeth in the twist change gear. Or it may be done with slightly greater accuracy by taking tachometer readings of spindle and front roll speeds. Neither of these methods takes into consideration the effects of yarn contraction during spinning, which may result in an error of as much as 20 per

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cent or more in high-twist crepe yarns. Moreover, except in the case of certain rule-of-thumb methods no cognizance is taken of the effects of winding, which may inject an error as large as 5 per cent. It is true that these two errors are in opposite directions and are thus compensating to some degree, but it is important to eliminate them altogether for certain purposes, as mentioned.

Fig. 1 shows the relationship of the "nominal" twist multiplier, as calculated by the usual method, and the true multiplier after corrections have been made for contraction and winding. It is seen that in the range of ordinary warp twists (at an nominal multiplier of 4.50, for example) the actual twist is 6 or 7 per cent higher than that calculated in the usual manner, and at a nominal twist multiplier of 8.00, the actual twist multiplier is 9.95, or 24 per cent higher. This undoubtedly accounts for some of the difficulties encountered in attempting to make the results obtained with a twist counter agree with the nominal twist in a yarn.

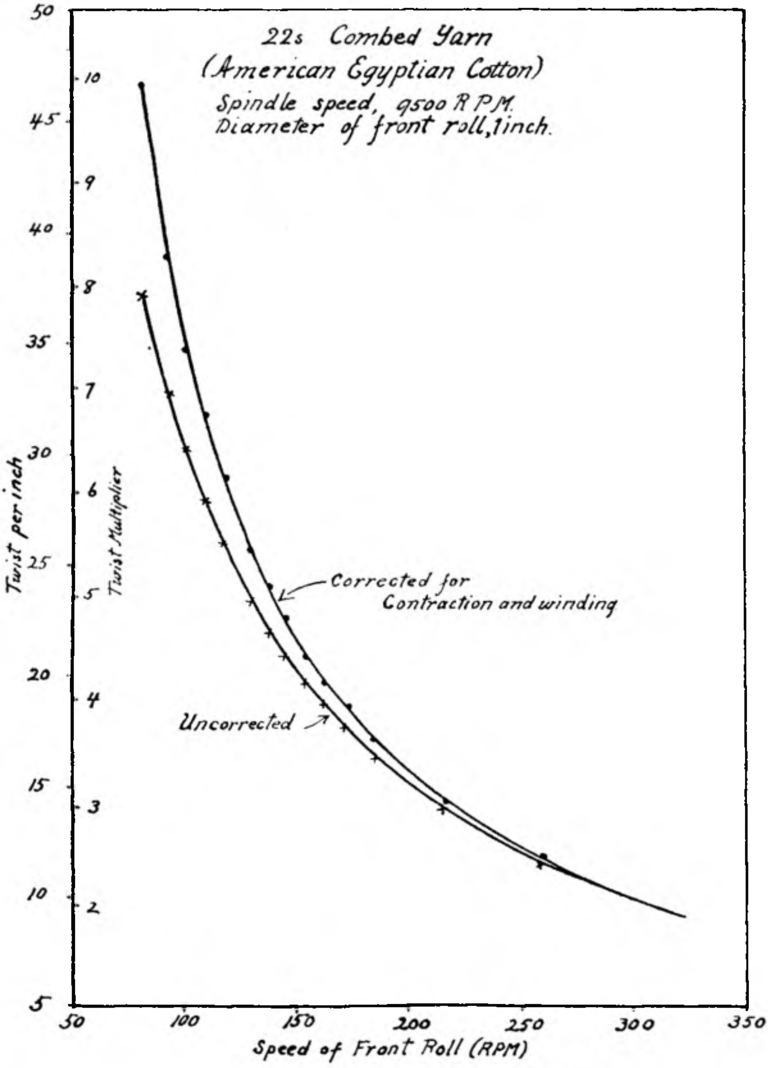
At the present time, cotton fiber and spinning research has not progressed far enough to permit yarn contraction to be accurately pre-determined from the physical properties of the fibers. For a given yarn count and degree of twist, the contraction is evidently influenced by the fineness and rigidity, and possibly by the cross-sectional shapes of the fibers. Different cottons behave quite differently with respect to yarn contraction, and at present the only safe method to employ is one that includes the twist-contraction characteristics of the particular cotton under consideration.

An accurate measure of the contraction can be obtained by reeling and weighing a sufficient quantity of yarn and of roving for a given spindle, and applying the following equation: $L = \frac{2YG}{HK}$ (Equation No. 1) in which,

L is the length of twisted yarn per inch of untwisted yarn.

Y is the actual count of the yarn.

Fig. 1. At low degrees of twist the net effect of contraction and winding is quite small, but with higher twists an important error is introduced if contraction is ignored



G is the draft change gear used.
H is the actual size of roving.
K is the gearing draft constant.

(When single roving is used, the factor 2 should be omitted.) The percentage of contraction can then be determined, if desired, by the calculation, $C = 100\ (1–L)$. (Equation No. 2.)

The first equation gives, in effect, the ratio between the actual draft determined from the sizes of roving and contracted yarn, and the theoretical draft from the roll gearing. The second, of course, merely converts this ratio to percentage of contraction, based on the length of the untwisted yarn.

Although it is sometimes important to know the percentage of contraction, the length ratio, L, is used in the final equation, which will be discussed presently. In the meantime, we shall consider the error caused by winding. Each revolution of the traveler around the spindle inserts one turn of twist. The speed of the traveler is somewhat variable, however, and cannot be measured with a tachometer, and so it is customary to use the speed of the spindle. (It is possible to measure the speed of the traveler fairly accurately with a stroboscope, but these instruments are usually not graduated to give precise R.P.M. measurements.) The speed of the traveler lags behind that of the spindle just enough to permit the yarn to be wound on to the bobbin. The larger the package, the fewer the turns required to wind a given length of yarn, and the closer the speed of the traveler approaches that of the spindle. It can be shown that the decrease in twist per inch of yarn that is due to the lag in traveler speed is proportional to the reciprocal of the circumference of the bobbin or package at the point of winding. Thus the correction in turns of twist per inch attributable to winding amounts simply to deducting this reciprocal. That is, the correction for winding equals $\frac{1}{\pi b}$ (Equation No. 3) in which b is the diameter in inches of the bobbin or package at the point of winding. The correct measure of twist per inch can be obtained from the formula

$$T = \frac{S}{\pi R r L} - \frac{1}{\pi b}$$ (Equation No. 4) in which,

T is the twist in turns per inch of yarn.
S is the speed of the spindle in R.P.M.
L is the length of twisted yarn per inch of untwisted yarn. (From equation No. 1.)
r is the diameter of the front roll in inches.
b is the diameter of the bobbin in inches.

It will be noted that this formula is simply the common spindle-roll speed equation, with the addition of the factor L to correct for contraction, and the factor $\frac{1}{\pi b}$ which takes care of the effects of winding.

To illustrate the use of these equations, let us calculate the actual twist per inch in a yarn from the following information, which was obtained from an actual laboratory test: Average size of yarn spun, 29.35s. Spindle speed, 9500 R.P.M. Average size of roving, 5.67 hk. Front roll speed, 113 R.P.M. Draft gear used, 39 teeth. Diameter of front roll, 1 inch. Draft constant from gearing, 441.6. Diameter of bobbin, .875 inches.

$$L = \frac{(2)\ (29.35)\ (39)}{(5.67)\ (441.6)} = 0.914$$ inches of twisted yarn per inch of untwisted yarn (from Equation No. 1).

$$T = \frac{9500}{(\pi)\ (113)\ (1)\ (.914)} - \frac{1}{(\pi)\ (.875)}.$$
$$= 29.28 - 0.36 = 28.92$$ turns per inch (from Equation No. 4).

As calculated in the usual way, without allowing for contraction and winding, the result would be 26.76 T.P.I., which is 2.16 turns, or about 7.5 per cent less than the actual twist as determined by equation No. 4. Or, stated in another way, instead of a twist multiplier of 4.94 as given by the usual calculations, the yarn actually was spun with a twist multiplier of 5.34.

RESEARCH ACTIVITIES

The Textile Research Institute and Textile Foundation in concentrating their activities on war problems following the organizing of the *Research War Council*, have undertaken a number of military problems which are being actively worked on at present. A survey has been completed giving the status to date of the mildewproofing of fabrics for military use. A brief outline of this report is given on page 2 of this issue of *Textile Research*. Mimeographed copies of the complete report are available and can be had by writing to the Textile Research Institute, 10 East 40th St., New York. A study has also been made of the equipment and methods used for the accelerated ageing of fabrics essential for military needs, such as duck, burlap, etc.

Need of vast research organization for post-war planning was stressed by Walter Hoving, president of Lord and Taylor in an address at a recent Salvation Army Association luncheon. Mr. Hoving stated that good intentions for the post-war world must be translated into deeds, adding that unless "we have the proper facilities to tackle the problems of the peace and work them out our intentions will be wrecked on the rocks of planless impracticability."

The American Association of Textile Technologists met Wednesday evening, June 3, for dinner and discussion of the problems in connection with the use of rayon yarns in the manufacture of full fashioned hosiery. Papers were read by Edmund Lauber, of American Viscose Corp. Textile Unit, Marcus Hook, Pa., by Thomas Johnson, of American Bemberg Corp., by Erb N. Ditton, of Gotham Silk Hosiery Co., and by E. J. Schellenberger, Jr., of the Atwood Division of Hess-Goldsmith & Co., Inc. Among the subjects discussed were the types of yarn available, the selection of proper twists, the question of proper sizing, and luster, and the progress made to date.

Major S. J. Kennedy recently testified before the subcommittee of the House Appropriations Committee to the fact that manufacturers who have not previously had experience in the manufacture of blended fabrics always have great difficulty at first in changing over to blends and cited the case of one mill that tried to make blends for two years without obtaining a single satisfactory fabric. Major Kennedy praised the program adopted by the WPB of encouraging the mills by offering a bonus to mills that will successfully produce these fabrics.

An "OEM Handbook" issued by the War Production Board is a 72 page directory of personnel and organization of the WPB, OPA and the other constituent agencies of the OEM. This is the long needed directory of War Agencies but if changes continue as past record would seem to indicate, it will require frequent revision. Copies of the booklet may be obtained at room 1501, New Social Security Building and from the Supt. of Documents, Washington, D. C. and at OEM field offices.

Celanese rayon blended with wool is called for in recent specifications for the kersey overcoating employed for pea jackets and blankets by both the Coast

Guard and Maritime Commission. It is pointed out that the rather low moisture absorption makes this fiber more desirable for this blending than either rayon staple fiber or cotton.

The War Production Board has stated that because of the critical shortage of scientific equipment, university and other private laboratories engaged in research work unrelated to the production of materials, or in other research not directly connected with the war effort, will be unable to secure laboratory equipment unless the particular use is approved by the Director of Industry Operations. Details are given in Limitation Order L–144 issued June 12, 1942.

Urging American industry to continue long range research projects if at all possible, Dr. Donald Price, newly-elected vice president of the American Institute of Chemists, maintained that such policies will contribute much to the war effort, in addition to providing products and processes which will "carry" industry after the war. Dr. Price, who is technical director of National Oil Products Co., Harrison, N. J., speaking at the twentieth annual meeting of the American Institute of Chemists, contended it would be "highly unwise to abandon all long range research, even under the stress of war."

The American Association of Textile Technologists had four representatives at the meeting of the Research War Council held May 19th in New York. The report of this meeting was given in the June issue of Textile Research.

The Elasticity of Wool As Related to Fiber Structure

By MILTON HARRIS, LOUIS R. MIZELL, AND LYMAN FOURT

Fundamental research in the chemical structure of fibers has received increasing attention in recent years. This research has gone hand in hand with the improvement of regenerated and synthetic fibers, that has brought rayon to its present commanding position among textile fibers.

The unique structure of the wool fiber, namely, flexible chains linked together by cross-linkages, and the fact that these cross-links can be ruptured and then re-built, with the effect of making the wool fiber more stable and resistant to the action of alkalies and attacks by moths, was outlined in TEXTILE RESEARCH, *November, 1941. The following is a condensed report of further investigations, by Dr. Harris and associates at the Textile Foundation Laboratories. The complete report will be found in the July issue of* Journal of Research, *National Bureau of Standards;* Ind. and Eng. Chemistry; *and in* American Dyestuff Reporter.

THE RESULTS of the earlier investigations by Astbury and others lead to the concept that fibrous materials, in spite of their lack of homogeneity and their high molecular weights, are not necessarily "amorphous" but show a definite "crystallizing" tendency, in that portions of the fiber apparently consist of compact bundles of long-chain molecules in a parallel arrangement. On the basis of this concept, it has been possible to explain many facts concerning the structure and strength of high-polymers in general and of the fibers in particular. For example it has been frequently shown that the more highly oriented the crystallites of the fiber the higher the strength. While it is recognized that other factors, such as molecular chain length and the nature of the inter-molecular forces, also have a profound influence on the strength of fibers, it can be shown that in a general way the strengths of entirely different classes of fibers are comparable on the same basis. The data in the accompanying table illustrate this point.

Having achieved considerable success with respect to the production of fibers of high strength, many investigators have shifted their attention to the problem of trying to improve other mechanical properties of fibers, and especially to make fibers having "wool-like" properties. One of the properties which makes wool fiber unique among other fibers is its long range elasticity; that is, its ability to recover from deformations of magnitudes considerably greater than those permitted by other types of fibers. The purpose of this paper is to examine certain aspects of the molecular structure of wool from the point of view of their relations to long range elasticity as well as to strength.

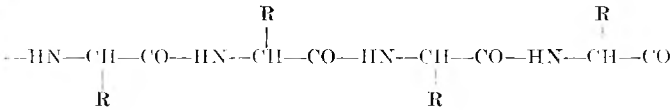
Wool is composed principally of protein substances. Proteins being poly-condensation products in which the

Comparison of Different Classes of Fibers

	Relative Degree of "Crystallinity"	Breaking Strength lbs./ sq. in.
Flax	very high	up to 156,000
Ramie	very high	129,000 to 135,000
Nylon	high	72,500 to 100,000
Cotton	medium	40,000 to 111,000
Rayons *	low to high	22,000 to 110,000
Silks	medium	46,000 to 74,000
Wool	low	17,000 to 25,000

* Value depends on degree to which the rayon is oriented during manufacture.

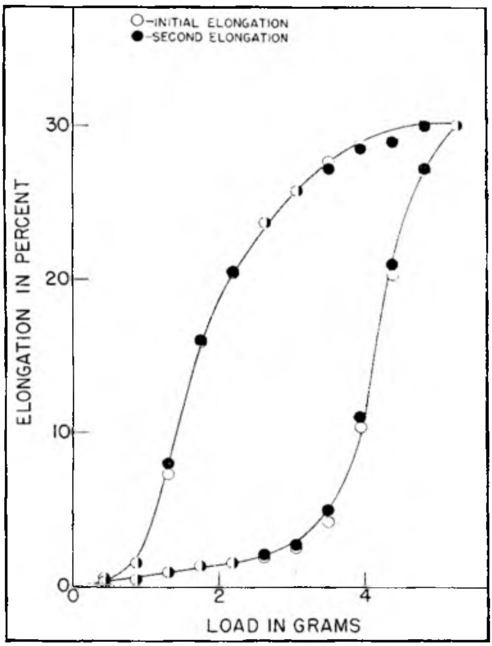
different amino acids are linked together to form the poly-peptide chain, shown in the following scheme:



The mechanical properties of such chains can be considered, in general, to depend on the following four factors.

(1) They exhibit great flexibility. This enables the protein molecule to assume a great number of configurations which could be either of the folded or spiral type. The earlier investigators ascribed the long range extensibility of wool to the straightening of specific types of folds in the more or less "crystalline" regions. However, since studies of X-ray diffraction patterns reveal that these regions account for a relatively small proportion of the total wool fiber and that the bulk of the fiber consists of the "amorphous" regions, more attention should be given to the less organized regions of the fiber. (2) They have a large number of highly polar peptide linkages which can give rise to inter- and intra-molecular bonding. A preponderance of polar groups in synthetic materials renders linear polymers non flexible and brittle. This would be the case with wool were it not for another factor discussed in a following section of

Fig. 1. Untreated wool fiber



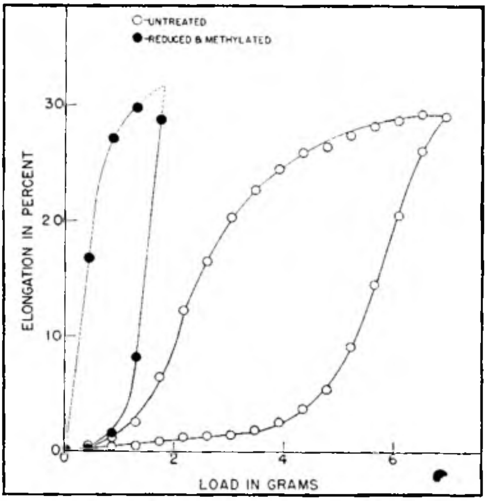


Figure 2 illustrates the effect of rupturing 5/6ths of the cross-linkages by a reduction process. Much less energy is required to elongate the fiber. However the recovery is complete and rapid.

Fig. 2. Comparison with methylated

this report. (3) They contain relatively large side chains (R groups in the polypeptide chain) which prevent close packing of the protein molecules, thus decreasing the extent of possible inter-molecular bonding. In wool, nearly all of the constituent amino acids are of the type

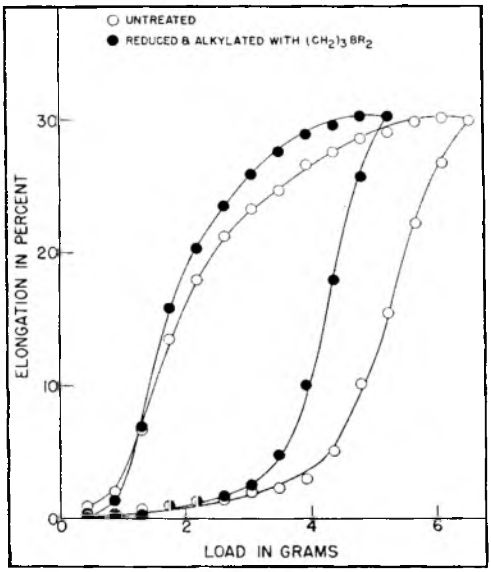


Fig. 3. Reduced and rebuilt by alkylation. Gives the effect on the stress-strain cycle of rebuilding 5/6ths of the cross-linkages as *bis*-thioethers by reduction and alkylation with trimethylene bromide.

having large side chains and from data obtained it can be estimated that close to 50 per cent of the weight of wool is in the side chains. Therefore it would be expected that wool fibers would exhibit relatively low tensile strengths, an expectation which is borne out by experiment (see table). It should be pointed out that wool fibers would exhibit even lower tensile strengths were it not for the presence of covalent cross links between the molecular chains.

(4) They exhibit association forms other than those contributed by hydrogen bonds. In this discussion only those contributed by the amino acid cystine which is found in unusually large amounts in wool and other mammalian hair fibers will be considered. Evidence thus far indicates that wool may be considered a network of polypeptide chains linked together by the disulphide groups of the amino acid, cystine.

The function of the cross-links is to strengthen the materials and suppress plastic flow. However, the introduction of a higher proportion of cross-links would

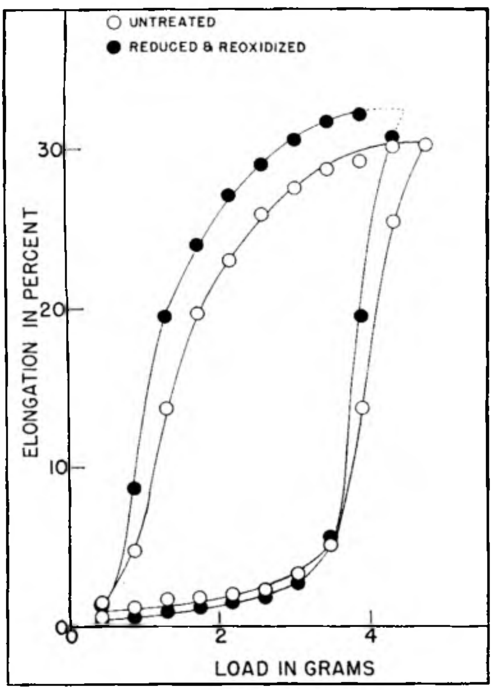


Fig. 4. Reduced and rebuilt by oxygen. Shows the effect of reduction of one half the cross linkages, followed by a rebuilding by oxidation with oxygen.

decrease the flexibility and reduce the range of elasticity. It is interesting to note that the absence of covalent cross-linkage undoubtedly accounts for the low tensile strength particularly when wet, in regenerated protein fibers made from cassein, soybean protein, etc. On the other hand silk fibers which do not apparently contain any covalent cross-linking exhibit very high tensile strengths. However, while in wool the chain weight is to the side chain weight as 1 to 1, in silk this ratio is nearly 2 to 1. The poly-peptide chains of silk may be considered to be significantly more bare than those of wool, making possible a considerable amount of close packing and interchain hydrogen bonding, which would account for the high observed strengths. Comparison of the X-ray diagram of silk and wool shows a much higher "degree of crystallization" in the silk.

Since in wool the cross-links can be quantitatively ruptured and rebuilt at will it may serve as an excellent model for many other high-polymeric systems.

The Analogy Between Wool and Rubber

The results of the present investigation suggest that in many ways wool is quite analagous to rubber, and indeed in some respects may serve as a useful model for explaining certain properties of the latter.

Probably the most interesting analogy is found in comparing the properties of raw rubber to those of wool after treatment of the latter to rupture its disulphide groups, and in comparing the properties of vulcanized rubber to those of raw wool.

This gives considerable support to the hypothesis of cross-linking in vulcanized rubber. For example, modified wool fibers in which the cross links have been ruptured may be stretched in water more than 100 per cent before breaking, whereas untreated wool fibers show extensibilities of only 50 to 60 per cent. A representative sample of unvulcanized rubber had an elongation of 1200 per cent at break, whereas after vulcanization the elongation at break of a similar sample was only 700 per cent.

The solubility and swelling properties of both wool and rubber serve to emphasize their similarity in physical structure. Untreated wool fibers swell appreciably in aqueous solutions but are definitely insoluble in the usual protein solvents. Rupture of the disulphide cross-links yields a product which is readily soluble, for example in alkaline solutions, but the original insolubility is restored after re-formation of these links. Similarly it can be shown that whereas vulcanization makes rubber insoluble in a variety of organic solvents, the raw rubber is soluble in the same solvents.

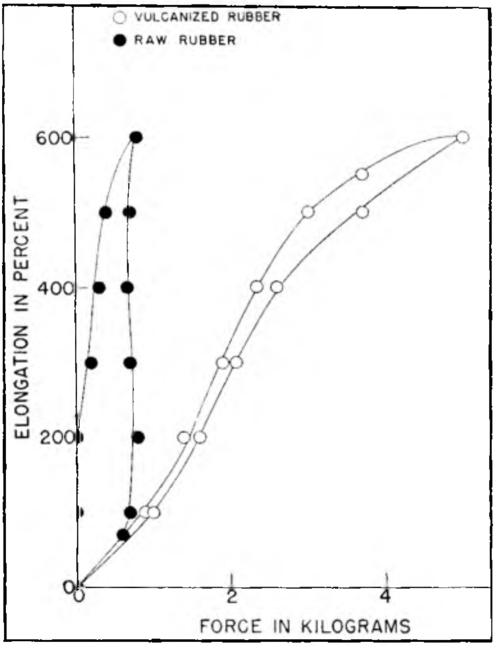


Fig. 5. Comparison of raw and vulcanized rubber

There is, however, one principal difference between the two types of molecules. Rubber is practically entirely hydrocarbon and accordingly exhibits only low-order molecular cohesion or interactions, whereas wool contains a large proportion of highly polar groups capable of forming relatively strong molecular interactions. For this reason, the sensitivity of rubber to temperature is not shared by dry wool. On the other hand, the mechanical properties of the latter are greatly affected by moisture, which swells the protein and presumably decreases intermolecular cohesion. Thus, it is found that the influence of heat on the mechanical behavior of rubber is very similar to the influence of moisture on the behavior of wool.

What About Wool?

AN EDITORIAL

► Occasionally there is proclaimed a new fiber expected to de-throne wool, a fiber said to possess the essential virtues of wool and with some superiority.

► It is true that man's natural inquisitiveness together with the help of modern technical aids has already led to the disclosure of fiber structure, and is now leading to investigation of the physical behavior of fibers; for example, research is comparing the effect, under controlled conditions of temperature and humidity, of shock load vs. load gradually applied and the effect of repeated loadings, as well as the recovery in each case when the load has been removed.

► It is also true that chemists are progressing rapidly in their ability to build molecular structures. So that it is not safe to assume the impossibility of building a fiber that will approximate wool in the aspects in which the wool fiber now excels.

► Synthetics *are* being developed with sufficient wool-like properties to lead to the likelihood of an increasing percentage being used in connection with wool. Furthermore the war necessity of limiting the use of wool to a minimum admixture in fabrics is not only stimulating the accumulation of knowledge as to what that minimum is, but is forcing manufacturers to adapt their machinery and processes to accommodate the use of fibers they were not always equipped to handle. Then with the future resumption of manufacture of civilian textiles, the competitive requirements of style, appearance, serviceability, and cost, will continue the demand for an infinite variation in the selection and blending of staple synthetics along with natural fibers.

► Therefore the net result is likely to be an ultimate decrease in the proportionate consumption of wool as compared to other fibers.

► All of this leads to the suggestion that the wool and woolen manufacturing interests should more actively participate in research into the properties and use of fibers in general, and of wool in particular. This suggestion merits consideration, for if wool is to maintain the proportionate use its economic value entitles it to hold, it will be necessary to add to the present knowledge through research and applied tests.

The Future Textile Industry

► One trend is becoming more apparent every day and that is the disappearance of the old line of demarcation between a Woolen, a Cotton, a Silk, and a Rayon industry, as such, and the merging of all these interests into one TEXTILE INDUSTRY.

► This unification of interests, logically including manufacturers of textile machinery, the dye and chemical manufacturers, and the marketing interests, offers a rare opportunity for a pooling of resources and for cooperative effort: cooperation in research into all processes from the production of raw material, through manufacturing to marketing, and cooperation with the end result always in view of better serving the complex requirements of modern civilization.

► Difficult? Yes. But it is a challenge to American resourcefulness and leadership that will be accepted.

Julian S. Jacobs

RESEARCH AIDS

Working With the Microscope

Designed for the amateur, hobbyist, and student—anyone except the advanced professional, "Working with the Microscope" * is designed as a complete guide and reference work for those who wish to learn microscopy and micro-technique. Complete instructions are given on the preparation of slides, or specimens, of every degree of difficulty from the simplest to the highly technical. Every process is clearly explained and by following these directions, the amateur can train himself without outside guidance. Full directions on the preparation and use of reagents, a list of sources of supplies, a bibliography, and reference tables are included. The book is illustrated with over one hundred photographs and line drawings.

* WORKING WITH THE MICROSCOPE—by Julian D. Carrington. McGraw-Hill Book Co., Inc., 330 West 42nd Street, New York City, $3.00.

Statistical Technique

"Industrial Statistics" * gives examples of the uses of elementary statistical methods in the design and analysis of experiments carried out in industrial plants and scientific laboratories. Laboratory, mill and field experiments do not in themselves furnish sufficient information to determine economic policy. Mathematical formulas are necessary in order to give proper weight to variable factors involved and to eliminate errors in sampling. The manuscript of this book has, for the past several years, formed the basis of a one-semester course in industrial statistics, Economics 38, at the Massachusetts Institute of Technology. The book should be useful to research workers in the textile field.

* INDUSTRIAL STATISTICS—by H. A. Freeman. John Wiley & Sons, New York City, 178 p., $2.50.

Textile Unit at American Viscose Set Up for Large Scale

Applied Research

This organization, which extends its assistance to any textile manufacturer in his problem of selection, blending and use of fibers and yarns, is unique in the textile industry. It is a fine example of industrial research for the common good. To be sure it was established with a view of promoting company sales; nevertheless its direct benefit to the entire rayon industry through broadening the market for regenerated and synthetic fibers is obvious. (EDITOR.)

AMERICAN VISCOSE CORP. established late in 1939 in its plant in Marcus Hook, Pa., a complete textile manufacturing unit as a division of the sales development department, in order to keep pace with its own expansion and also for the purpose of meeting industry-wide needs for greater textile research and technical service.

This textile unit is equipped with standard cotton, woolen, worsted and knitting machinery and is laid out in divisions permitting separate humidification and temperature control. Whenever possible there is a duplication of both older and newer types of machinery. This set up permits a duplication on an adequate volume production basis, of existing outside trade conditions, producing yarns and fabrics, as desired by a choice of the cotton, woolen or worsted systems.

The staff of this department, headed by E. S. Kennedy has been drawn from industry and is composed of men especially skilled in the technique and procedures of each of the textile fields represented. New fields have been added in accordance with expansion of the corporation's products in such fields, and at this writing, the following industries are represented, in each case by a staff member or several staff members of the department: cotton spinning; woolen spinning; worsted spinning; the knitting industry in each field of general volume, such as full-fashioned hosiery, seamless hosiery, circular underwear and outerwear, warp knitting; the weaving industry in its various operations and branches; the throwing industry; and the dyeing and finishing. All of these men are at the service of the textile industry, not only for the solution of trade problems, but also for insurance of customer satisfaction in the use of corporation products, as well as for general research and development in textile procedures.

The objectives of the textile unit are as follows:

1. The checking of all products of American Viscose Corp., according to customer procedures for maintenance and improvement of quality.

Bradford drawing at textile unit of American Viscose Co.

Section of warping at textile unit of American Viscose Co.

2. The development of new fabrics in cooperation with the fabric development department in New York City. This department designs new fabrics of all types and kinds, and the textile unit puts them into practical operation.

3. Development of new textile equipment and procedure. This is perhaps one of the most difficult goals to reach. In the development of such equipment it is necessary to reach a point of excellence so that the equipment or procedure will have merit in the judgment of the veteran textile men in the trade. This work is frequently done by cooperation with textile machinery builders, dye manufacturers and supply houses in general. For the furtherance of this work the textile unit is offered as a proving ground to these sources for the perfection and development of new equipment and new textile ideas.

4. Development of new products for the company as well as new uses for standard products. This involves inter-

Section of weave room at textile unit of American Viscose Co.

change of ideas and specifications for such products with the chemical and mechanical research laboratories of the corporation. The products arising out of such interchange are brought to the point of commercial and practical condition by volume runs on the textile unit equipment before being offered to the trade. For example, in cooperation with the research laboratories of American Viscose Corp., the Aveonit finish for application to high-twist rayon yarns for hosiery was developed. It has been a means of helping the full-fashioned hosiery industry over the transition period from silk to rayon occasioned by the elimination of silk from this field and has enabled the hosiery trade to reduce press-offs from as high as 20 per cent down to a normal 2½ per cent by use of this finish. The finish is not limited to customers of the American Viscose Corp., but is available to the entire industry insofar as production will permit.

5. Making available to each member of the technical staff a complete operating unit in the particular field which he

represents. By so doing, it affords him virtually unlimited means of obtaining up-to-the-minute textile and technical information.

In view of the fact that conditions occasioned by the war have made it necessary for mills to use increasing amounts of rayon with other fibers, this textile unit can be of special assistance at this time. For example WPB is bending every effort to have mills blend a percentage of other fibers with wool. But mill organizations who have specialized in virgin wool fabrics always experience great difficulty at first in changing over.

Results of the applied research carried out at the textile unit are made available to customers of the company and to the industry as a whole by means of papers presented by members of the staff at meetings of various trade associations and by articles contributed to textile publications and by personal visits to mills by members of the staff. Members of the industry are invited to bring their problems to the textile unit.

Full fashioned hosiery knitting at textile unit of American Viscose Co.

Microscopic Studies Reveal

Structure of Flax

ABSTRACT OF REPORT by—C. W. HOCK

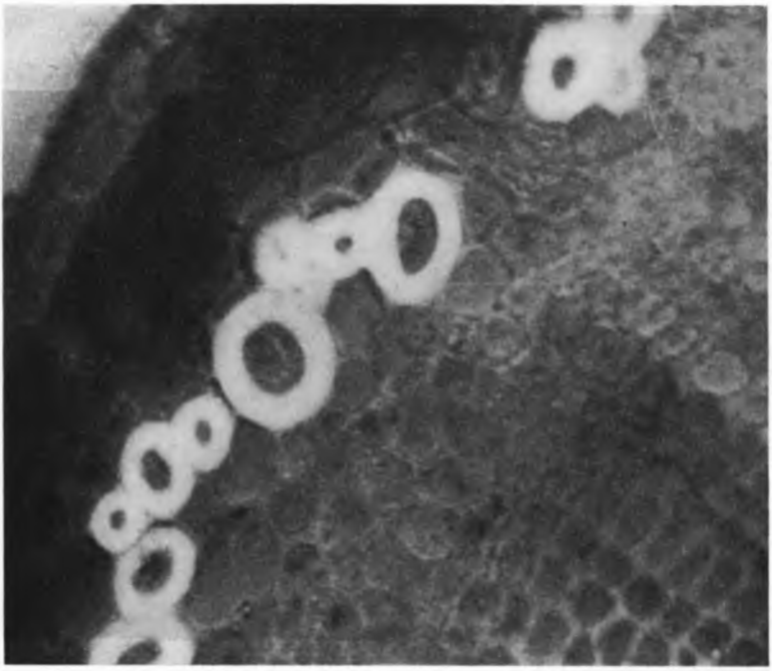
WITH THE LOSS OF EUROPEAN SOURCES OF SUPPLY of flax fiber, a renewed interest in all aspects of the flax problem has been manifested, and accordingly, an investigation of the microscopic structure of flax and related bast fibers was undertaken as a research project of the Textile Foundation at the National Bureau of Standards.

The stem of the flax plant consists of two main parts, a central woody core, and a surrounding cortex which contains the bast fibers. The cambium layer lies between these regions. Retting, which is one of the procedures carried out during the freeing of the fibers from the stem, involves essentially a softening of the tissues, usually by bacterial action, to permit separation of the fibers from the other parts of the stem. The cambium layer is attacked first during this treatment, followed later by attack on other thin walled cells in the cortex.

Flax fibers are obtained from the stem in the form of long filaments which vary in length from several inches to more than a yard. Each fiber is made up of cells, which are usually about one inch long and one one-thousandth of an inch in diameter. Other bast fibers such as hemp, jute, and ramie have a similar origin and structure. Although the bast fibers have many structural details like those in cotton, they differ from it in one important respect. Whereas a cotton fiber is a single plant cell, a bast fiber is made up of a group of cells.

A flax cell has a primary and a secondary wall. The former constitutes the surface of each cell and consists largely of wax and other material, much of which has generally been assumed to be of a pectic nature. The secondary wall, which comprises the bulk of the fiber, is made up of innumerable cellulose fibrils, the outermost layer of which winds in one direction, whereas the majority of the fibrils beneath this layer wind in the opposite direction. These fibrils, which are similar to those found in many other plant cell walls, are grouped so as to give the wall a layered pattern. There is a greater number of these layers in the walls of the flax cells at the base of the stem than in the cells from the growing tip. A corresponding increase in thickness of the wall, from the tip of the stem where the cells originate to the base where they mature, also prevails. All the

Fig. 1. Cross section of growing flax fiber. Mag. × 500.



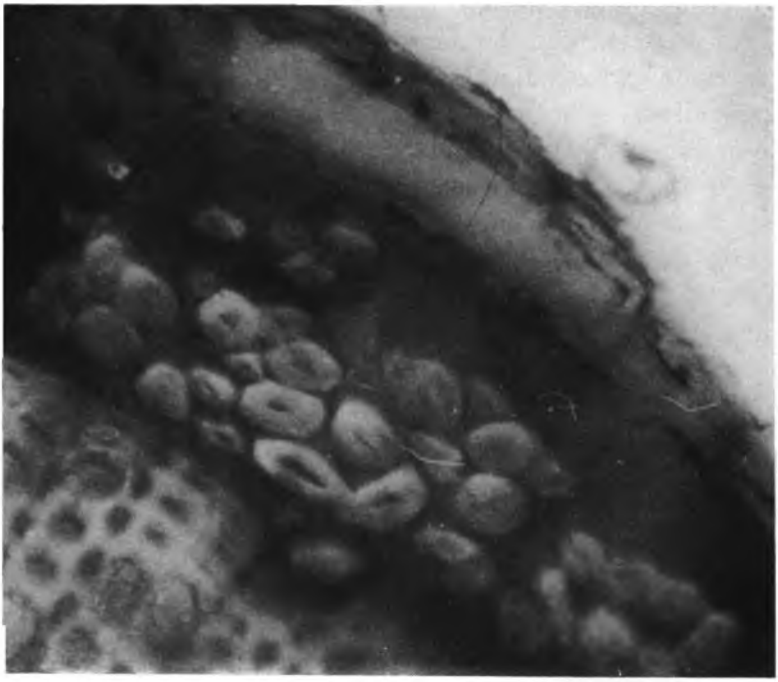


Fig. 2. Part of a cross section of a retted flax stem showing the break down of the cells surrounding the fibers and in this case the separation of the fiber cells from each other because of over-retting. Compare with Fig. 1. Mag. × 500.

bast fibers have essentially similar structures. Flax and ramie, however, differ from hemp and jute in the directions of fibrillar orientation, and this accounts for some of the differences in the physical properties of the two groups.

In the study of the flax fiber cuprammonium reagent was used. This reagent dissolves the cellulose in a relatively short time. In suitable dilutions of the reagent, however, complete dissolution does not occur; instead the fibers swell considerably and thereby reveal many details of structure. When single cells or small groups of flax cells were placed in cuprammonium hydroxide diluted with three to four volumes of concentrated ammonium

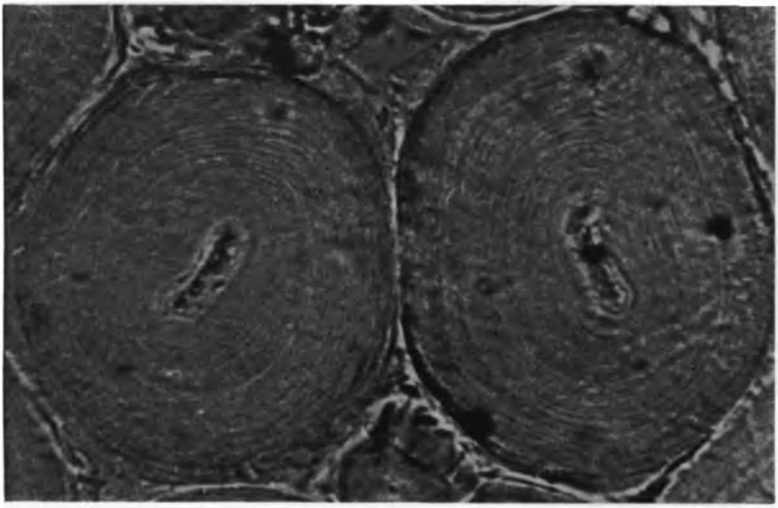
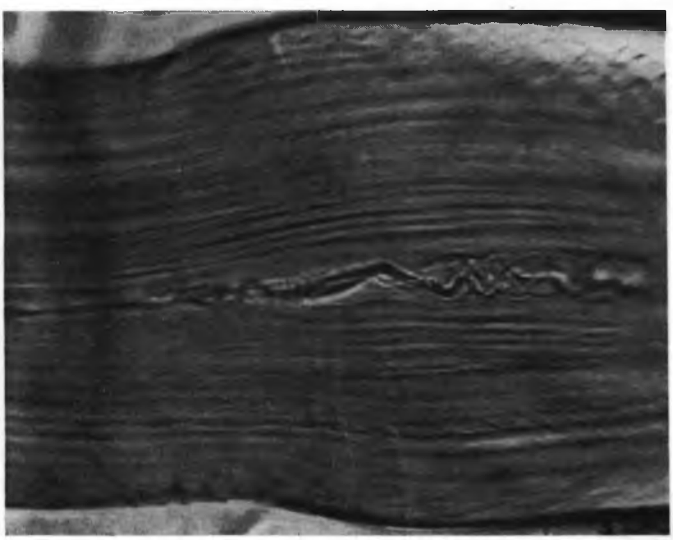


Fig. 3. Cross section of flax cells. Mag. × 500.

hydroxide, they swelled to several times their original diameter and the concentric layers or lamellae, could be observed.

Fig. 4. Longitudinal view of single flax cell. Mag. × 500.



Economic Research Should Precede Plans for

Post War Reconstruction

The economics of reconstruction to follow the cessation of hostilities is very much in the limelight just now. Most economic groups are studying the subject and it is conceded that the problem of discovering the forms in which the ideal of the classical economist can be reconciled with the realities of modern technological development is the major economic problem of our time. This presents a challenge to economics that will require the mustering of all its forces of research in an effort of economic analysis as a guide to constructive thinking and planning.

One group, recently organized, whose activities may lead to a major contribution to the effort is the Institute of World Economics, 429 W. 117th St., New York. The following article is a brief statement of the purpose of the Institute and an abstract of its published analysis of the problems.

The Institute of World Economics has been formed to study the problems arising out of changes in the economic relations between nations, to examine the place of the United States in the emerging world economy, and to bring together organizations and individuals concerned with regional and special problems for the purpose of integrating their studies and programs.

The main problem ahead is the establishment of a new world economy which can serve the social needs of the people in all countries. Despite the nationalistic trends of thought which have held the stage, the need for strengthening the economic ties between countries and peoples has been felt ever more keenly.

Two features which characterized the international economy before 1939 are of particular importance. One was the decline in the technical dominance of western Europe. The other was the tendency of the industrially advanced countries to use the growth of economic power for exclusive or monopolistic ends. The international economy could not continue on such a basis. Technical knowledge was spreading beyond western Europe and the United States to all corners of the globe, and the peoples of all continents are today in possession of the secrets of Western economic supremacy.

Economic Nationalism Fails

The experience of the past two decades has thus shown beyond any further doubt that neither economic imperialism nor economic nationalism can master our expanding technology and use our growing knowledge of materials and resources in the most effective way in the common interest of mankind. Economic imperialism fails because it cannot meet the demand for freedom and greater equality of opportunity for all. Neither can economic nationalism succeed in its objectives whether as a defensive movement against imperialism or as a method of building up new great imperial systems. As a defensive weapon, it fails because it slows up the industrial development of its advocates and brings them into conflict with their own national purposes. As an offensive weapon, it leads to wars which destroy economic achievements and social values.

In the light of current events, the United States is the logical base for a new approach to world economic problems. The migration of the Technical Sections of the League of Nations and of the International Labor Office to North America is symbolic of the new world role of the Western Hemisphere. The United States, especially, is becoming not only the haven of free world inquiry and thought but also the center for growth of a new world consciousness in which East and West and the civilizations of the Atlantic and the Pacific may meet in reconciliation.

At the same time, no other country in the world possesses such wealth of the raw materials and data for economic research, much of which remains unutilized. Also, no other country is equipped with so many research organizations specializing in one or another economic area whose work could be made so much more effective and fruitful if it could be integrated from the point of view of a developing world economy.

What Is Needed

The Institute of World Economics is not proposing to construct plans but to coordinate and analyze knowledge being gathered, and to stimulate the accumulation of further knowledge along the lines indicated above.

What is wanted is, first of all, a realistic survey of the world's resources, natural and technical, from the point of view of their dynamic possibilities. On the basis of such a survey, it should be possible to investigate further the division of the world into natural economic zones or belts, which may form the basis for the territorial division of labor. Technical surveys, including surveys of world energy developments and of changing means and routes of communication, should give us a clearer picture of the further needs and possibilities of agriculture and of the movement of the industrial frontier in relation to resources, people and capital.

In the midst of a tragic war situation, individuals or research groups cannot hope to influence much the course of the struggle as it develops from day to day. But they may help to clarify thinking for the day when the struggle ends and when new foundations will have to be laid for the future. Whatever can be done now to clarify economic trends and any suggestions that can be made in advance to indicate the forms upon which a new world economy may be built will facilitate the task of construction which lies ahead.

Further Studies Shed More Light on Effect of

Higher Card Speeds

INCREASED FLAT AND LICKER-IN SPEEDS ON THE CARD is an abstract of the third published preliminary report in a series of card tests conducted by cooperating mills and sponsored by The Textile Foundation, The Arkwrights, and Southern Textile Association. The complete report is available for distribution and may be had by writing TEXTILE RESEARCH. The tests here reported were conducted with a view to producing data for a study of increased licker-in and flat speeds as compared to regular speeds. These data are indicative only since definite conclusions cannot be drawn from any one test. The data shown indicate that with the higher speeds, (1) waste in

Item	Speed of Flats (inches per min.)		
	2.96	4.31	5.91
Cord waste:			
Flat strips (percent)	3.07	3.91	4.71
Cyl. and doffer strips (percent)	.22	.25	.24
Motes and fly (percent)	1.46	1.74	1.40
Sliver:			
Av. grains per yd.	59.15	57.52	57.02
Standard deviation	2.96	3.24	3.95
Condition of web:			
Appearance	Good	Fair	Poor
Neps	Normal	Few more	Excessive
Yarn count 12s:			
Actual yarn count	11.78	11.97	12.11
Actual yarn strength (lbs.)	189.10	186.70	184.10
Corrected yarn strength (lbs.)	185.60	186.20	185.80

the form of flat strips increased, (2) card sliver became less uniform, (3) the appearance of the web deteriorated, and (4) neps were more numerous. The yarn skein strength was not affected materially. Increasing the licker-in speeds from 438.5 revolutions per minute to 486.5 and 524.8 revolutions per minute, respectively, had no significant effect on carding or yarn quality.

All lots were processed on the same drawing frame and the same roving frame. Careful and accurate recordings were made of all speeds relating to the test. In these tests the percentage of card waste is based on the net weight of cotton fed to the card. The average weight of the card sliver is based on 100 sizings of one yard each. The average tensile strength and average yarn sizes respectively are based on 100 breaks each. The single-strand data represent the average of 200 observations. No creeling was done during the period in which the ends down per thousand spindles per hour were checked.

Research on increasing card speeds continues

RESEARCH BRIEFS

THE REACTIONS OF CELLULOSE is the fourth in a series of articles dealing with the chemical processes involved in the production of rayon. This article discusses the effect of conditions obtaining during the ripening process upon the colloidal and micellar condition of the product in the manufacture of acetate rayon. Details are given in the June, 1942, issue of *Silk and Rayon,* p. 350.

A STUDY OF THE GROWTH OF MILDEW FORMING BACTERIA gives the rate of oxygen absorption by sea island cotton fiber and yarn after innoculation with Chaetomium Globosum. Measurements were taken by means of the Warburg apparatus. *Journal of Bacteriology,* Vol. 43, No. 2, Feb., 1942.

THE MISCROSOPICAL EXAMINATION of cross-sections made from materials dyed with various dyes and dyeing procedures clarifies some of the factors which enter into making union dyeing one of the most difficult of the dyeing processes. This article, by H. E. Millson and G. L. Royer of Calco division, American Cyanamid Company, entitled "Microscopical Observations of Union Dyeing" and illustrated by photomicrographs, appears in *American Dyestuff Reporter* June 8, 1942, p. 278.

A PRACTICAL METHOD OF MAKING WOOL NON-FELTING has been developed, resulting in the exclusive adoption of non-felting wool by the British armed forces. Garments made from materials so treated are finding favor also with the consuming public. It is claimed that non-felting wool overcomes some of the objectionable features encountered in mixtures of wool with cotton or rayon, and that it should give longer service than ordinary wool. Details of processing are given in an article by George Abrahamson appearing in the June, 1942, issue of *Textile World,* p. 82.

RAYON WARP SIZING is discussed in an article giving typical temperature schedules for acetate and viscose warps in their five and seven drying cylinder sizing machines. Temperature schedules in relation to sizing speeds are given. This article is the ninth of a series and appears in *Textile Manufacturer,* June 1942, p. 233.

COMPARISON OF WOOL GRADES with denier and micron systems of measurement are given to assist manufacturers in blending rayon with wool. The effect of specific gravity upon calculations also error due to paralax are discussed. The inherent stiffness of the fiber is important. For example the denier of acetate should be somewhat heavier than viscose or cotton because it is inherently softer. The article, entitled "Blending Wool and Rayon Staple Fibers," appears in *Rayon Textile Monthly,* June 1942, p. 28 (314).

THE SWELLING OF TEXTILE FIBERS IN LIQUIDS is studied and the importance of the degree of swelling on absorption of dyes emphasized in an article by J. W. Illingworth in *Textile Recorder,* May 1942, p. 26.

DURABILITY OF DISH TOWELS composed of 45 per cent spun rayon, 38 per cent cotton, and 17 per cent linen under different conditions of consumer use is discussed by Margaret B. Hays and Ruth Elmquist Royers, of the U. S. Bureau of Home Economics, in a research report "The Serviceability of a Dish Towel Fabric," in *Rayon Textile Monthly,* May 1942, p. 83 (289).