A STUDY OF THE DEVELOPMENT AND PRESENT STATUS OF CERTAIN SYNTHETIC FIBERS AS APPLIED TO HOUSEHOLD USE

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PREFACE

Scientific research, with particular emphasis on chemical developments, has had a profound influence upon our daily pattern of living. There is evidence at every hand to show how greatly scientific research has contributed to the improvement of living conditions for man. Materials have been created that contribute to our comfort and health and that aid in the conservation of our natural resources. Synthetic fibers which tend to make Americans independent of foreign sources of supply for certain materials such as silk and wool have been produced.

Year after year a new product or process has been developed by inventors until synthetic fibers have become in themselves a basic industry rich in potentialities. Many of the synthetic fibers are relatively young and many of them are predicted to have long and useful lives. There is evidence that more important developments are to come and that much improvement in the present products is to take place.

In this particular study we are concerned only with those synthetic fibers which are spinable and weavable and have present or potential use in the textile field. The publicity that accompanied the developments in the synthetic fiber field has created much interest and some confusion about the nature and importance of the test tube fiber; therefore, an attempt will be made to present a picture of the present status of the synthetic fibers as revealed by various authorities in the field.

With the conviction foremost in mind that synthetic fibers are to play an important part in the textile industry of the future, this study will be devoted to the characteristics, properties, present uses, and possible future uses of the fibers. The development of the synthetic fibers will be traced up to the present time, and some predictions will be made for the future.

The information for this study has been obtained directly from manufacturers of the fibers, namely: E. I. du Pont de Nemours and Company, Owens-Corning Fiberglas Corporation, United States Rubber Company, American Bemberg Corporation, and the United States Department of Agriculture, Bureau of Dairy Industry, and from trade and industrial magazines.

CONTENTS

CHAPTER I

STATUS OF THE SYNTHETIC FIBERS

Synthetic fibers are fibers made by synthesis or the process of making a compound by combining ingredients.[1] There is a difference between the so-called synthetic fibers and the true synthetic fibers. For example, rayon is not classed as a true synthetic fiber because the fiber is derived from cellulose and remains a cellulose product after the fiber is developed. The true synthetic fibers such as Vinyon and Nylon are entirely different products than the minerals from which they are made. The term synthetic fibers will be used in this paper to include both of these classes of fibers. The most common of the basic ingredients used for these fibers are minerals, cotton, wood pulp, glass, milk, soybeans, cornmeal, and fish.

At the present time, there are synthetic fibers at various stages in their development. While one of the fibers has been used extensively for some time, some of the fibers are just beginning to be used commercially, others are ready to be presented to the consumer, and a number are still products of the laboratory. Many beautiful and serviceable products made from the synthetic fibers are now being offered to the public. In a short time, the fibers now in the experimental stage will be ready for the use of the consumer.

According to Douglas G. Woolf, editor of the Textile World, the

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[1] "Pioneers in Synthetic Fibers," Textile World, LXXVI (September, 1939), p. 1743.

synthetic fibers are now entering the third stage of their existence. The first stage might be identified as the infancy stage, as for example when artificial silk was employed in the making of soluble neckties and sweaters. The second stage might denote the rapid growth of rayon from 1920 to 1938, when the textile field was invaded through practically all branches by the synthetic fiber with the cellulose base. Synthetic fibers have been spotlighted in their third stage during the last two years. During the third stage fibers are being made with a non-cellulose base. The latter period could be defined as starting in 1938, although experiments with several products were carried on before that date. During the last year results have been published of fibers being produced completely by synthetic methods. Mr. Woolf believes that this great discovery will result in an industrial revolution in the textile field.[2]

There is evidence to support the belief that eventually the synthetic fibers may hold a place of more importance than the natural fibers. There is a possibility that the synthetic fibers may repeat the process of eliminating the natural fibers as the synthetic dyes eliminated the natural dyes. This belief may be verified by the fact that the synthetic fibers can be modified at the will of the chemist to meet a specified need. Such fibers can be produced under the control of man, and need not be dependent upon the conditions of nature.[3]

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[2] Woolf, Douglas G., "Synthetics Enter Their Third Stage," Textile World, LXXXIX (September, 1939), p. 73.

[3] Ibid.

Many predictions have been made for the synthetic fibers during the next decade. It is thought that by the year 1950 the synthetic fibers may contribute as much as one-fourth of the raw materials consumed in the textile industry. In 1939 the synthetic fibers furnished 8 per cent of the total fibers utilized in the textile field.[4] It has been said that, "The synthetic fiber will not have reached its zenith a decade from now; it will be its way to complete dominion of the textile field--say certainly by the year 2000."[5]

In the manufacturing processes synthetic fibers have an advantage over the natural fibers in regard to uniformity and complete absence of impurities and foreign matters, which must be removed from the natural fibers. The weather conditions, the types of soil, the health and age of the animals, and the methods employed by man will affect the production of natural fibers, making it impossible for the manufacturer to secure the same grade of raw materials each time. At the present time the prices of some of the synthetic fibers are higher than those of the natural fibers, but it is believed that with larger scale production and wider usage the prices will tend to be lowered.

There is a need for the consumer to familiarize herself with the different types of synthetic yarns and fabrics as well as the individual uses and care. Knowledge in this field will contribute toward a more satisfactory use of the synthetic fibers, since certain yarns are

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4 Woolf, Douglas G., "Textiles in 1950," Textile World, XC (February, 1940), p. 95.

5 Ibid.

better adapted to certain purposes than others. A broader understanding on this point would help both the consumer and industry as a whole.

CHAPTER II

MINERAL FIBERS

The mineral kingdom has given to us two of the newer synthetic fibers; namely, Nylon and Vinyon. The properties of these two fibers indicate that they have a number of uses in various types of household and industrial fabrics. They have both passed through the experimental stage and are at the present time being produced commercially.

Vinyon

Vinyon is outstanding in the field of synthetic fibers due to the fact that it is derived from an entirely different source than heretofore used for synthetic fibers. The Vinyon fiber has developed rapidly and is being established as suitable for a steadily widening range of uses. It was developed by the Carbide and Carbon Chemical Corporation, South Charleston, West Virginia, and has been produced by the American Viscose Corporation, Meadville, Pennsylvania, since October 31, 1939.[1]

The discovery of the Vinyon fiber was the result of many years of experimentation. However, mention was made of obtaining textile fibers from gums and resins as early as 1664 by Dr. Robert Hooke.[2] Vinyon is derived from a vinylite resin which is in turn derived from natural gas (or coal), salt, water, and air. In its first stage the

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1 "Vinyon Plans Completed," Textile World, LXXXIX (November, 1939), p. 68.

2 "The Story of Vinyon," American Viscose Corporation.

fiber is in the form of a fluffy white powder, which is converted into a textile by modification of the dry spinning process. The white powder is dissolved in acetone and filtered. The resulting product, a heavy syrup solution, is stored in tanks. This solution is spun on standard acetate rayon spinning equipment. Higher air pressures and temperatures are used in the Vinyon process than in the spinning of acetate rayon. The yarns are then stretched to increase the tensile strength. The regularity of denier, elongation, and elasticity also depend upon the temperature, pressure, and speed of the stretching process. The yarns are next oiled and twisted, then redrawn on cones and spools ready for shipment.[3]

This new fiber may be made in two general forms, continuous filament and staple fiber. It may be purchased either stretched or unstretched. The unstretched yarn is preferred for certain purposes. Shrinkage of these unstretched yarns may be utilized to tighten the stitch in knitted or woven fabrics. The staple fiber of Vinyon blended with natural fibers like cotton, wool, or rayon are many times incorporated into fabrics to help retain a pressed fold, shape, or crease.[4]

Vinyon fiber possess a number of unusual characteristics and properties, indicating its adaptability to many textile fields. Up to the present time the yarn has been spun in three deniers and the producer is said to be prepared to spin other counts, if such should be desired. These fibers may be knitted, woven, or braided on the

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3 "Vinyon--Its Story to Date," Textile World, XC (February, 1940), p. 113.

4 "Vinyon Plans Completed," op. cit.

conventional types of textile machinery. The fibers also lend themselves to processing which makes possible the production of yarns with a wide range of tensile strengths and elastic properties. Vinyon has an unusually high resistance to mineral acids and alkalis, and the yarns are said to possess a great resistance to deterioration. Other desirable properties credited to this new fiber are: water resistancy, waterproofness, resiliency, crease resistancy, and non-conductivity.[5]

The producers report that great progress has been made in regard to the dyeing of Vinyon. At present, one manufacturer of dyestuffs is prepared to dye samples of Vinyon yarn and fabrics in a wide range of colors.[6]

As a first step in its development, Vinyon is already being used in an important group of industrial fabrics, including filter cloths (Plate I), pressed felts, sewing threads, and twines of various constructions. It is expected in the near future that the Vinyon fiber will be winning acceptance in various apparel and other textile fields. Some of the possibilities for its future use are: bathing suits, shoe fabrics, glass curtains, upholstery, a variety of braided and knit goods, electrical insulation, chemical-resistant clothing, shower curtains, and awnings. Experimentation is being directed toward the development of a Vinyon yarn to be used in the manufacture of full-fashioned hosiery.[7]

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5 Ibid.

6 "Putting the Spotlight on the New Synthetic Fibers," Textile World, LXXXIX (September, 1939), p. 75.

7 "Vinyon--A New Textile Fiber," American Viscose Corporation, January, 1940.

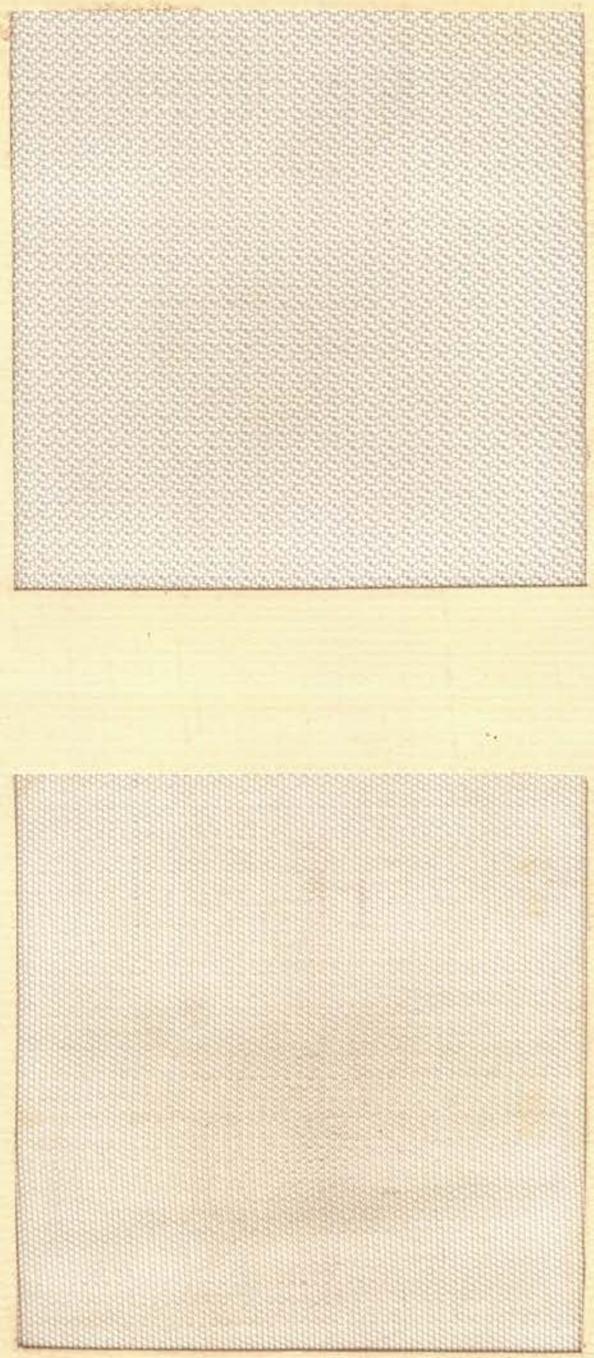

Plate I

One of the most striking uses in the production of Vinyon is the development of felt materials which contain no hair, fur, or wool. They are said to look like, feel and wear like ordinary kinds of felt. This product is being made from cotton which is held together by the binding properties of Vinyon resins.[8]

Work is progressing rapidly toward determining what new uses may prove suitable for the Vinyon fiber. In the development of Vinyon for textile application, the producers are said to have adapted a program of thorough experimentation to be sure the new fiber will be used under those conditions which may be warranted by its special characteristics and qualities. The producers announced that the market interest and demand has materially increased since early in January.[9]

Nylon

Nylon, one of the newest synthetic fibers, was developed by the E. I. du Pont de Nemours & Company. As far as can be determined, Nylon is one of the first wholly synthetic textile fibers produced by man from the mineral kingdom. Late in 1938, Du Pont announced the discovery of this product that the industrial chemists look to as one of the most important developments of the last decade.[10]

The name "Nylon", Du Pont officials explain, is a generic term applying to the synthetic fiber-forming polymeric amides. It is not a registered name or trademark. This name was chosen because it would

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8 Ibid.

9 "The Story of Vinyon," op. cit.

10 Hackett, Charles M., "New Era on the Naticoke," The Du Pont Magazine, (December, 1939), p. 4.

be easy to pronounce, as the ending "on" was common to rayon and cotton, the most widely used textile fibers. The fiber was first presented to the public as Fiber 66. Nylon fiber differs from rayon in that it contains no cellulose. In its chemical composition Nylon has a closer resemblance to silk than to any of the other natural fibers. However, the Nylon fiber cannot properly be termed synthetic silk as it is a protein-like chemical product.[11]

Nylon may be described as a polyamide, derivable from coal, air, or water. Coal is used principally because it is abundant and cheap. Many steps in manufacture must be taken between bituminous coal and a pair of Nylon hosiery or some of the other Nylon products. The polyamides can be melted and extruded through tiny holes to form cobwebby filaments. The filaments solidify in the air and then are wound onto spools. To strengthen the filaments they are stretched to the desired diameter.[12]

The Nylon fiber has been used to a great extent for hosiery up to the present time. In the process of making Nylon hosiery the yarn is knitted on the conventional type of textile machinery. The hosiery is given a permanent set immediately after knitting by a hot wet treatment known as pre-boarding. Pre-boarding determines to a large degree the permanent shape and smoothness of the stocking. The above treatment renders the stocking immune to any wrinkle or set during

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11 Wharton, Don, "Nylon--A Triumph of Research," Textile World, XC (January, 1940), p. 50.

12 Ibid, p. 52.

the processes that are to follow. Steaming the yarns moistened with a solution of sodium sulphite increases the elastic recovery, crimp, and crease resistance. Lastly, the hosiery is scoured, dyed, and rinsed.[13]

According to the experiments up to date, neutral dyeing acid colors have proved the most satisfactory type of dye for Nylon. Most of the dyes used for silk, wool, and acetate rayon have been used successfully.[14]

Many reports have been made concerning the length of life of a pair of Nylon hosiery, some of them quite exaggerated. According to the authorities on the subject they are not runproof, but are less likely to develop runs from punctures than the silk hosiery. Observers believe that the Nylon hosiery will last twice as long as the silk ones. Nylon hosiery can be washed in hot water without damaging the fiber, and can be dried in ten minutes. Due to the pre-boarding treatment Nylon stockings hold their shape after laundering. Other desirable qualities possessed by the Nylon hosiery are: stronger and more elastic than silk, high tensile strength when wet, not affected by ironing or drying, will not burn when exposed to a flame, are water and stain resistant, and can be produced in filaments of cobwebby size.[15]

The Nylon hosiery made their appearance generally in the commercial market May 15, 1940, although they were shown and sold at the World's Fairs in New York and San Francisco in 1939. They were

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13 "Putting the Spotlight on the New Synthetic Fibers," Textile World, LXXXIX (September, 1939), p. 76.

14 Ibid.

15 Ibid.

obtainable in all colors and shades that have no unusual tendency to fade. The first prices quoted on the extra-sheer three thread hosiery were \$1.15, \$1.25, \$1.35, according to the gauge and thread of the hosiery. A sample of the \$1.15 hosiery will be found (Plate II). The prices are expected to be lowered when the volume grows.[16]

It is safe to say the hosiery were an unqualified success judging from the reports from the larger stores in New York, Chicago, and San Francisco. It was stated that the crowds gathered at the hosiery counters after the Nylon hosiery went on sale were reminiscent of the Christmas rush. In the larger cities the only curb on sales was the supply and not demand. The arrangement was made to enable the big stores to receive no more than 25 dozen pairs from any mill at the opening of the sale of Nylon. Many of the smaller stores possibly received no delivery. The early sales were accomplished with a minimum of advertising. It will be wise to wait for some time to judge the relative importance of Nylon hosiery. Women are buying them experimentally now, but for some time to come supply and not demand will be the problem.[17]

Hosiery is not the only field to be invaded by this new fiber. It will find other uses in the manufacture of apparel, household, and industrial fabrics. At the present time, Nylon sewing thread and tooth brushes with Nylon bristles are offered on the market to the consumer. Tooth brush bristles developed from coal, air, and water are said to

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16 "Nylon Goes to Town," Business Week, (May 25, 1940), p. 45.

17 Ibid.

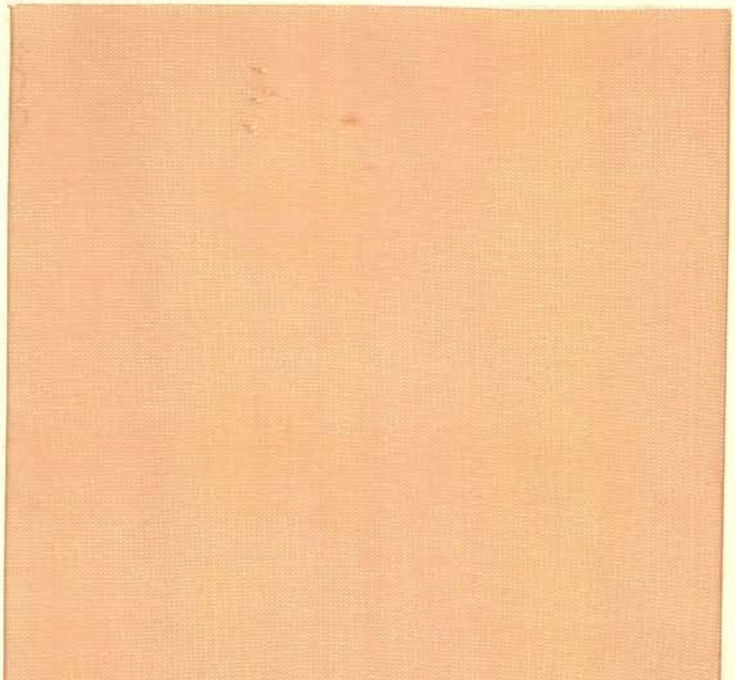

Plate II

absorb moisture more slowly and absorb only one-fifth as much as the hog bristles. The Nylon bristles have a long life, do not shed, and retain their firmness. Hair brushes containing the Nylon bristles are also on the market.[18]

According to the latest developments, Nylon is likely to become a competitor of the wool fiber. A new patent has been issued to John Blanchard Milles, Jr., scientist of E. I. du Pont de Nemours and Company, covering the production of a wool-like fiber from Nylon. This new wool-like fiber is described as almost an equal to wool in its insulating properties. It has also been said that it is superior to the wool fiber in many ways, namely: strength, heat stability, dyeing characteristics, elasticity, moth proofness, and immunity to damage from common cleaning fluids and processes. Mechanical methods of crimping are used either before, during, or following the cold drawing process in the making of the yarn. The patent states that at least four crimps to the inch will be required. E. K. Gladding, Manager of the Nylon Division of Du Pont, states there will be no immediate commercial production of the wool-like fiber. New types of manufacturing equipment must be designed and built before this is possible.[19]

Other uses suggested for the Nylon synthetic fiber are: drapery material, filter cloth, bolting cloth, felt, flame-proof awnings, woven dress fabrics, lace, and linings for men's suits.[20]

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18 "Du Pont Announces Nylon," The Du Pont Magazine, December, 1938, p. 1.

19 "Nylon, Rival of Silk, May Soon Compete With Wool," Science News Letter, XXXVII (May 11, 1940), p. 303.

20 "How to Make More and More Money Through Synthetics," Textile World, LXXXVIII (February, 1940), p. 102.

The Nylon hosiery are taking the place of importance just now in the uses of the synthetic fiber, but there is a bright outlook for its use in the making of other apparel fabrics since the materials when produced are light in weight, strong, elastic, non-deformable, non-shrinkable, and self-ironing. It appears probable that Nylon may threaten both the rayon, wool and silk industries.[21]

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21 Wharton, Don, "Nylon, A Triumph of Research," op. cit.

CHAPTER III

FIBERGLAS

The dreams of scientists for many centuries have been realized through the production of Fiberglas. Glass, one of the most perfect of all materials, can now be formed into flexible fibers instead of being brittle and flat. The Venetians used glass of this type as a decoration for their glassware, but it was left to the modern chemists to develop a flexible glass fiber to be utilized for many purposes.[1]

By 1893 Edward Drummond Libbey used glass strands in combination with silk to make lamp shades, which he displayed at the World's Fair in Chicago. A celebrated actress, after seeing the lamp shades, had enough of the spun glass produced to make her a dress. The actress paid twenty-five dollars a yard for the material and had the dress carefully lined with silk.[2]

During the World War when it was impossible for Germany to secure the needed supply of asbestos for sound and heat insulation, a method was devised to produce glass fibers for that use. With the process of manufacture slightly modified the same method is still in use today.[3]

For the last few years the attention of chemists of the United States has been directed toward producing glass filaments of a smaller

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[1] "Can This be Glass?", Owens-Corning Fiberglas Corporation, 1940.

[2] Ibid.

[3] "Report on the Development and Use of Rayon and Other Synthetic Fibers," Bureau of Agricultural Economics, and Bureau of Chemistry and Soils, 1938, p. 48.

diameter and this has met with marked success. After years of experimentation, in 1931 a machine was developed by the Owens-Corning Glass Corporation that would produce coarse fibers of glass to be used as an air filtering material. The experimentation continued and with it came finer, more flexible fibers to be used against heat and cold. By 1935 very fine, soft glass fibers which were flexible enough to be woven into cloth that would bend without splitting were developed. The process of development did not stop there. Machinery is steadily improving and formulas are being developed to make the glass suitable for many new and different uses.[4]

Today, the process has been developed to the stage that the glass woven fabrics can be bent in the same manner as rubber and even tied in knots like a string. The improved glass fiber can be put on a loom and woven as if it were silk.[5]

The basic material used in the production of Fiberglas is the same as that for other types of glass. Scientifically worked out formulas are used for the simple combinations of sand, limestone, soda ash, and a few other ingredients. Accuracy is an important feature in the making of this sensitive product. The mixture of ingredients named above is placed in the furnace and melted. From the Fiberglas basic material two types of products are made, Fiberglas wool and Fiberglas textile fiber.[6]

The glass is extruded through fine openings at the base of the furnace and caught by jets of high pressure steam to form the Fiberglas

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4 "Can This Be Glass?", op. cit.

5 Ibid.

6 "Putting the Spotlight on the Newer Synthetic Fibers," op. cit. p. 76.

wool. The force of the steam pulls the threads into thread-like fibers that are finer than a human hair and from an inch to a foot in length. The fibers falling from a belt form a soft woolly blanket. These fibers are interlaced as they fall from the furnace. They are light, clean, and pure white in color. These fine fibers are used as insulation against heat and cold, while the coarser ones are used as a filtering medium for air and chemicals.[7]

In the process of making the Fiberglas textile fiber the glass is molded into small green marbles, placed into a special electric furnace and melted. The hot liquid flows through tiny holes at the bottom of the furnace coming out in a form comparable to a spider's web. These minute strands are said to be as strong as steel and can be wound onto spools at the rate of more than a mile a minute. This process yields the continuous Fiberglas filament, sometimes being drawn to a length of five thousand miles. The Fiberglas yarn is formed by drawing together approximately one hundred of these fine filaments to make a strand; the combination of at least two strands forms the yarns. Staple length fibers can be formed from the same raw material. The steam draws the fibers into eight to fourteen inches average length.[8]

The continuous yarn corresponds to silk as the yarn is smooth and can be woven into hard finished fabrics. The staple length yarn has greater bulk and resembles wool. This type of Fiberglas yarn is rather fuzzy, giving a softer finish when woven. Fiberglas yarns may be woven, braided or knitted on the usual type of textile equipment. A small

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7 Ibid.

8 Ibid.

amount of lubricant is added to the yarn during the manufacturing process. Sizing, prepared by special formulas, is used until the fabric is completed, then washed off, leaving pure glass.[9]

Fiberglas fibers are produced in various colors. Experiments are being made to determine satisfactory types of dye to be used for these fibers since they cannot be dyed by the usual processes. The fibers are not affected by heat, light, mildew, microorganisms, and weathering. Fiberglas has the ability to stand high temperatures with little or no damage, to resist the effect of acids, and to offer good thermal insulating qualities. The high tensile strength of Fiberglas may be changed by varying the glass formula. Generally, the finer yarns have a greater tensile strength than the coarser ones.[10]

Although Fiberglas has many desirable qualities, there are some undesirable ones that tend to limit its use. There is a lack of resiliency, lack of elasticity, and a lack of softness to the touch. When subjected to a great deal of bending, Fiberglas lacks the durability of many fibers. At the present stage in production, Fiberglas is definitely not suitable for clothing, mainly due to the undesirable features cited above.[11]

Fiberglas is now used for various household and industrial purposes. Among the household uses are fabrics for table cloths, bedspreads, lamp shades, tapestries, curtains, shower curtains, draperies, upholstery, wall coverings, awnings, rugs, and carpets. These fabrics are proving

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9 Ibid.

10 Shayter, Games, "Glass Fibers," il Rayon, XVIII (May, 1937), p. 302.

11 "Report on the Development and Use of Rayon and Other Synthetic Fibers," op. cit.

especially desirable for use in public buildings since they are durable and fireproof. Tapes of great tensile strength are made for commercial purposes, of which an example may be found on Plate III. Fiberglas filters may be used to purify the air circulated from warm air furnaces. Insulation against heat and cold is used in refrigerators, warm heater and pipes, ovens of stoves, and walls of buildings. In addition to the uses listed above, there are many important industrial uses for the Fiberglas fiber.[12]

Only the future can tell whether or not dress fabrics and wearing apparel made of the Fiberglas fiber will be used extensively. Many uses have been found for these thread-like glass fibers and an important future may be safely predicted for them.

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12 "Putting The Spotlight on the Newer Synthetic Fibers," op. cit.

Plate III

CHAPTER IV

PROTEIN FIBERS

In seeking wool-like fibers, chemists have turned to protein materials since wool is a protein substance. The protein materials have been supplied by milk, soybeans, cornmeal, and fish for this unusual group of textiles. These new fibers are known as Lanital, soybean fibers, cornmeal fibers, and fish fibers.

Lanital

Lanital, a synthetic fiber obtained from casein in milk, has been developed for the past six years in Italy. The name Lanital means "Ital-wool." Many experiments have been performed relating to this product during the last forty years, but they did not prove successful until 1934. All types of Lanital prior to 1934 were not very strong, but those made at present appear quite satisfactory in respect to strength.[1] Lanital was first discovered by Antonio Ferritti and produced by the Snia Viscosa Company. During the first two years of its life, Lanital was received with much criticism. In considering the fiber the merits and possibilities of the product were forgotten; instead the criticism was directed toward its deficiencies as a good substitute for wool.[2]

There has been some research carried on with the casein fiber in the United States. At least three companies have made the fiber on a

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[1] Borghetty, H. C., "In Defense of Lanital," American Dyestuff Reporter, XIX (March, 1938), p. 158.

[2] Ibid.

semi-plant scale. Generally speaking, Lanital is in the experimental stage in this country. A patent was granted in December, 1938, to two chemists, Stephen P. Gould and Earl O. Whittier, connected with the United States Department of Agriculture for the production of a casein fiber by a somewhat different method than that employed in the making of Lanital in Italy. One of the largest dairy companies in this country is experimenting with the casein fiber, but at the present time is not producing it commercially. Small quantities of the casein fiber are being imported into the United States from Italy.[3]

Since Lanital has been produced primarily as a substitute for wool, there appears to be a need for distinguishing between the two fibers. They are somewhat alike in color due to the sulfur present in the molecule. In the comparison of wool and Lanital it will be noticed that the casein fiber is inferior in some respects and superior in others. One distinct advantage for Lanital is that the fiber can be produced which is extremely regular. On the other hand wool differs with its location on the sheep's body, the age of the sheep, the season of the year, and the health of the sheep. Lanital lacks the characteristic scales of wool. The casein fiber is not so firm as wool, but it does possess a resilient woolly feel. Practically the same odor is said to be noticed when the two fibers are burned. Lanital is said to be about 85 per cent as strong as wool, with elongation about the same for the two fibers. The true elasticity of the casein fiber is less than that of wool. The main difference in the two fibers appears to lie in the lower sulfur content of Lanital as shown in the following table:[4]

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[3] "Casein Fiber," United States Department of Agriculture, 1939.

[4] "Putting the Spotlight on the Newer Synthetic Fibers," op. cit., p. 77.

	Lanital	Wool
Carbon	53.00%	48.25%
Hydrogen	7.00	7.57
Oxygen	23.00	23.66
Nitrogen	15.50	15.86
Sulphur	0.70	3.66

Lanital is produced by precipitating casein from skim milk, leaving about one-tenth of one per cent of the fat in the dry casein. The casein is then dissolved in an alkaline solution and allowed to age. The spinning process is accomplished by extrusion through a spinneret into an acid bath. The continuous filaments may be used or cut into desired staple lengths. The filaments are washed and treated with dilute formaldehyde solution and dried.[5]

The procedure used in the manufacture of the casein fiber in the United States by the two chemists of the Bureau of Dairy Industry differs from the Italian process. The following procedure, as explained by the United States Department of Agriculture, is the one used by the two American chemists. The casein is softened in water, then placed in a caustic alkali solution. The resultant sticky mass is allowed to age until the proper consistency is obtained. A modifying agent is added, then the mass is forced through spinnerets of the kind used in rayon manufacture. The next step is the separation of the fibers and passing them through a hardening acid bath.[6]

> "Dr. Whittier, American chemist, says of Lanital, 'It is unsafe to predict the future of casein fiber in this country; but there appears to be a real need for an inexpensive fiber to be used as a diluent or extender of wool so that our inadequate supply

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5 Ibid.

6 "Casein Fiber," op. cit.

of wool may be made to satisfy our needs at a lower cost.
'We have a potential supply of skim milk of 40 billion pounds annually over and above that now converted into manufactured products. This is equivalent to one billion pounds of casein fiber. It is equal to world production of rayon and is twice the consumption of wool in the United States. The economics of the textile situation will determine how far we go with the casein fiber.'"[7]

Lanital manufactured by the process developed by the American chemists is said to have an almost identical chemical composition with wool except for a lower sulfur content. The fiber is yellow in color and may be compared to a good grade of Merino wool. It possesses the fine kink of wool and may be used in fabric mixtures with wool. As the product is still in the experimental stage, costs have not been estimated.[8]

Lanital fibers can be spun to a fine count on the same set of machinery used for wool. The carding machine is used to loosen, pick, and straighten the fiber. The fiber is given a twist to prevent breaking, then follows the doubling and twisting process. The Lanital fibers differ in characteristics depending upon the processes of manufacture and are being continually improved in certain aspects. If stretched, twisted, or compressed the casein fiber will return to the original state when dried. Lanital is damaged by alkalis. The casein fibers are not susceptible to moth attacks, and it is said that textiles made from these fibers do not shrink.[9]

The Lanital fiber can be dyed according to the same procedures as those used in the dyeing of wool fibers. The casein fibers take up

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7 Simpich, Fredrick, "Chemists Make a New World," The National Geographic Magazine, LXXVI (November, 1939), pp. 620-2.

8 "Casein Fiber," op. cit.

9 "Lanital and Wool Compared," Rayon, Textile Monthly, XIX (January, 1938), p. 34.

acid dyes much faster than wool. The low sulfur content of Lanital makes it more easily and more evenly dyed than wool. Dyestuffs of outstanding wash fastness are desirable for the dyeing of Lanital, as there is a tendency for the casein fiber to lose some of its color.[10]

Lanital is said to be especially suited for knitted fabrics because the fibers are all of the same diameter, do not irritate the skin, and do not shrink. The casein fiber is also being employed in the manufacture of coating, suiting, uniform fabrics, dress goods, hosiery, blankets, bathing suits, underwear, sweaters, and other apparel fabrics. Lanital may be used alone or in combination with wool or viscose rayon. It promises to play an important part in mixed fabrics, giving an economical advantage when the costs are lowered and acting as a beautifying component. Experiments are being made to determine the degree of mixture of Lanital and wool to insure a good cloth. A variation of from 30 per cent to 60 per cent Lanital has been used in connection with mixed fabrics. After careful investigation a mixture of 30 per cent Lanital and 70 per cent raw wool has been used by the Italian government for uniforms in the army.[11]

An agreement was made between the Snia Viscosa Company and a Japanese industrial group under which Japan may have the right to manufacture Lanital in its country. Japan's deficiency in the milk supply will possibly retard the manufacture of Lanital in that country. Due to Italy's successful experiments with the casein fiber, Hungary, Poland, France, Germany, Belgium, and Holland have acquired licenses to produce Lanital.

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[10] Ibid.

[11] Giordano, Antonio, "Lanital, The Synthetic Wool from Milk," Rayon, Textile Monthly, XX (September, 1939), p. 502.

Casein fibers are produced under various names in the several countries. It is developed under the name Lactofil in Holland, as casein fiber in Great Britain, as Tiolan in Germany, and as Cargau in Belgium. In January, 1938, Meyer & Marks Yarn Company, Inc., New York, was appointed as the United States distributors of the casein synthetic fiber.[12]

The development and the use of Lanital in the past six years may be compared to the earlier stages in the development of rayon, which implies that the casein fiber will probably come to its own unique position among the textile fibers. This fiber has been greatly improved and shortly will be sought among the fabrics the consumer is purchasing.

Soybean Fiber

The soybean is not only an excellent food and one of the best sources of oil, but its protein can be converted into fibrous form. The soybean plant is grown widely in northern Asia and is of increasing importance throughout the rest of the world.

To extract the protein from the beans, they are crushed and the oil removed. The meal is then treated with a saline solution which extracts the protein. By a chemical process the protein is made into a viscous solution, which is extruded through a spinneret into a coagulating bath. The filaments are wound on a spool ready for bleaching and dyeing. In order to give a wool-like appearance to the filaments, they are cut into short staples to resemble wool. The production of the fiber from the

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12 Bodenhender, H. G., "Casein Fiber," Textile Colorist, XX (July, 1938), pp. 451-2.

soybean solution requires from two to three hours.[13]

The soybean fiber closely resembles Lanital in color, luster, touch and crimp, and has about the same tensile strength that Lanital had in 1935. This fiber is approximately four times weaker than wool in the dry state and eight times weaker in the wet state. The high uniformity of the diameter of the fiber closely resembles the Nylon filament. Microscopically, the fiber has a smooth surface with fine dots probably caused by air bubbles. In the crosswise section, the fibers are nearly circular and highly uniform in diameter. Chemically, there are traces of sulfur present, and the odor is similar to wool. The fiber shows a high affinity for the acid colors. When held in an open flame the fiber does not burn, but forms charred globules. The fibers are moth-resistant, and possess good thermal insulating properties.[14]

The soybean fibers are now being produced on a laboratory scale by two companies. Some fabrics have been woven from the fiber experimentally. The United States Department of Agriculture now maintains a soybean experimental station at the University of Illinois.[15]

The Glidden Company of Cleveland, Ohio, is preparing to set up a pilot plant. Much improvement is expected with the machinery and equipment that is to be used in this plant. Mr. O'Brien, vice-president of the Glidden Company, estimated the price to be from 25 to 40 cents per pound when produced commercially.[16] The soybean fiber is just in

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[13] "Putting the Spotlight on the New Synthetic Fibers," op. cit., p. 77.

[14] Ibid, p. 78.

[15] Ibid.

[16] Bergen, W. Von, "Soybean Fiber and its Identification," Rayon, Textile Monthly, XX (November, 1939), p. 634.

its infancy; much more research will probably be directed toward the strength deficiency of the fiber before it will meet with general approval.

Cornmeal Fiber

One of the newest fibers now being produced is the one made from zein, a protein found in cornmeal. The work being done on this fiber is still in the laboratory stage. A patent was issued in May, 1939, granting the manufacture of this fiber.[17]

The zein solution is extruded through spinnerets into a coagulating bath of an aldehyde. The filaments are then subjected to a high temperature. According to the specifications of the patent, the cornmeal fibers have a satisfactory elasticity and resiliency. In a wet stage the cornmeal fibers are superior to the synthetic fibers made from cellulose in elastic recovery and abrasion resistance.[18]

There appears to be many possibilities for these fibers once they are produced commercially.

Fish Fiber

While very little is known concerning the fiber derived from fish, many experiments with fish albumen have been reported from Germany. Professor Otto Mecheels, outstanding German textile expert, has reported the development of a process for making textile fibers from fish albumen. It is said that Russia is attempting to form some sort of combination between fish albumen and cellulose which might be described as an

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17 "Putting the Spotlight on the New Synthetic Fibers," op. cit, p. 78.

18 Ibid.

animalized staple that will have similar characteristics to wool.[19] It is believed that a mixture of 20 per cent fish wool and 80 per cent cellulose fibers may present an economical advantage as a substitute for wool.[20]

These fish fibers are said to be similar to Lanital, the Italian casein fiber. In several respects the fish fibers are claimed to be advantageous over the Lanital fiber. Partly on account of the large size of the molecule, the initiators believe the fish fiber to be the better. The spinning characteristics of the fiber made from fish are supposed to be better than those of Lanital.[21]

19 Brown, J. S., "New Fibers from Nitrogenous Products," Textile Colorist, LX (June, 1938), p. 371.

20 "Plan Sea Synthetics," Business Week, LX (January 22, 1938), p. 46.

21 Ibid.

CHAPTER V

CELLOPHANE

Cellophane, another of man's test tube fibers, is manufactured from wood pulp or purified cellulose in the form of square sheets. These sheets are then soaked in caustic soda, dampened and shredded, and aged for two or three days. The resulting product, alkali cellulose, is treated with carbon disulfide and then dissolved in caustic soda. The viscose is then extruded through a slit in a spinnerette in the form of sheets of thin weak cellophane which is strengthened by acid baths. The sheets are washed, bleached, dyed, and passed through a glycerine and water bath. As the film passes through the glycerine and water bath enough of the glycerine is absorbed to make the film pliable. To remove the excess moisture the sheet is placed between heavy squeeze rollers.[22]

The cellophane is cut into lengths and wrapped for use. The film may be embossed in any design by the use of pressure rollers. To make cellophane moisture proof the film is passed through a special moisture proofing solution which treats both sides of the sheet.[23]

Cellophane is not as flexible as other fibers, but it can be woven or knitted. The narrower and thinner the strip the more flexible the fiber will be. If the cellophane is woven or knitted it is washable; but cannot be washed in the sheet form. The transparency of the product is one of its most desirable qualities.

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[22] Peck, A. P., "Cellophane," Scientific American, CLIX (May, 1938), p. 274.

[23] Ibid.

Cellophane is usually used in combination with another fiber. It is chiefly used for novelty effects (Plate IV, Figure A), quite often mixed with rayon in velvet to give a lustrous, metallic appearance. Some uses that have been found for the flat-shaped fiber are: shower curtains (Plate IV, Figure B), costumes, and evening wear. This fiber has not been employed extensively in the manufacture of clothing for general use, but rather has been used for effect in costume and clothes for evening wear.[24]

[24] Ibid, p. 275.

Figure A

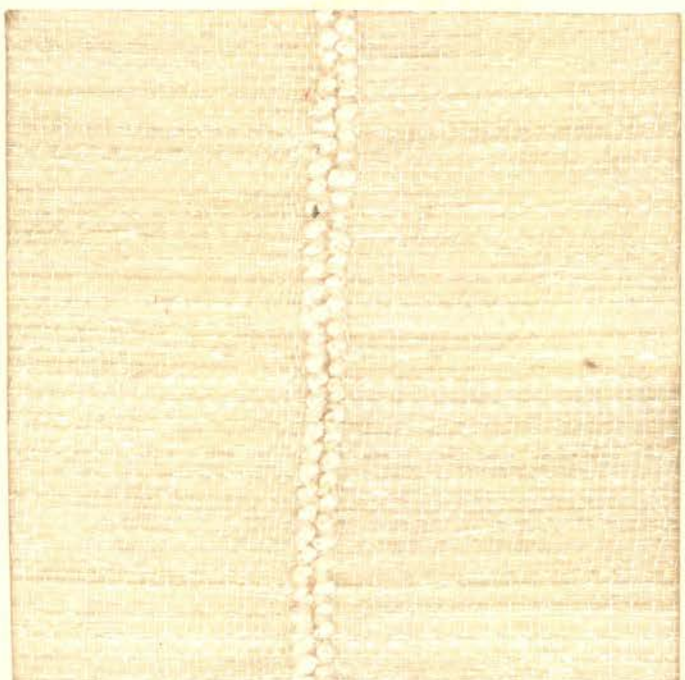

Figure B

Plate IV

CHAPTER VI

LASTEX

For almost a century the consuming public has been acquainted with rubber and with the older type of elastic, but it was not until 1930 that the newer type of elastic, Lastex, was invented. The Lastex fibers are making great progress in practically every branch of the textile industry. There appears to be no limit to the uses of the more than three hundred types of yarn manufactured. Manufacturers are making various uses of this newer type of elastic in apparel for men, women, and children.[1]

Lastex is made from latex, a milky emulsion obtained by tapping the bark of rubber trees. In the manufacture of the Lastex fiber, latex is chemically treated under high pressure and forced through small holes to form filaments which in turn are called lactrons. After this process the fiber is in the form of a solid, round thread which is vulcanized to prevent oxidation. The filaments may be spun in any diameter and given any degree of elasticity. The lactron is then covered with wool, cotton, silk, or rayon to add to the durability of the fiber. The winding of the other yarns around the fiber improves the appearance as the Lastex acquires the characteristics of the textile fiber used in the winding process. The Lastex yarn is said to take any color known to the modern chemist.[2]

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1 "Figures and Fashions in Lastex," United States Rubber Company, 1939, p. 2.

2 Ibid, p. 8.

According to Mr. Arthur Cote, Chemist in charge of the Laboratory of Canadian Lastex Limited, natural ageing of elastic fibers is brought about by oxidation. The period of time which Lastex will resist oxidation is determined in advance by a process called the Oxygen Bomb Test. The samples of yarn or fabric to be tested are placed in a steel pressure apparatus and oxygen is introduced. The bomb is then placed in an oven or in a water bath, and the temperature remains constant through the testing period. An elastic yarn or fiber that will resist 72 hours of this test will have one year shelf life before deteriorating, that is, the yarn may be kept one year without losing any of its properties. In the application of this test to Lastex, it resisted the treatment anywhere from 35 to 42 days, thus proving that the Lastex yarn is permanent to a high degree.[3]

Lastex yarns may be woven or knitted, with or without other non-elastic yarns into fabrics of all kinds. The elasticity which Lastex gives to fabrics may be defined as one-way stretch or as two-way stretch. That is, the Lastex yarns may run in the direction of the warp or the filling or in both directions. Frequently the one-way stretch fabric is combined in the same garment with a fabric having a two-way stretch. This process is said to result in a garment that gives greater comfort, fit, and control.[4]

Garments incorporating Lastex stretch to fit the body and then come back to their original state. The stretch is considered to be permanent as it is known to usually outlast the garment itself. The Lastex yarn

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3 Ibid.

4 Ibid.

does not change the general characteristics of the material; nor the reactions of the material to washing, pressing, cleaning, ironing, mending, or darning.[5]

Some of the older type of elastic was made by wrapping cotton, wool, and silk yarns around threads cut from sheets of rubber. This type of elastic was and still is useful in many ways. Lastex is known to possess many attributes such as adaptability to many types of fabrics and garments, washability, and others that the older type of elastic does not have. Lastex is not damaged by ordinary methods of applying heat. Fabrics made of Lastex may be ironed or pressed in the same manner as any other fabric. The cleaning characteristic of Lastex is one of its most desirable properties. It may be cleaned or laundered without any appreciable damage. The Lastex yarn is light in weight and is adaptable to many uses. Unlike the other type of elastic, Lastex is suitable for weaving, knitting, or shirring processes in the manufacture of fabrics.[6]

The hit or miss fit of the average ready-made clothing in many instances has been improved by the production of garments that mold to the figure. Longer wear, greater comfort, and more convenience are said to be the attributes of these fabrics. The long lasting quality of material containing Lastex is due to the great flexibility of the fabrics. They offer less resistance to wear and tear than do the more rigid fabrics.[7]

Lastex is chiefly employed to insure comfort and fit in apparel, but it is also used to add texture interest to fabrics in the form of shirring or embroidering. The shirring effect may be seen in Plate V,

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5 "Figures and Fashions in Lastex," p. 8.

6 Ibid.

7 "Lastex, The Miracle Yarn that Makes Things Fit," The United States Rubber Company, p. 7.

Figure A

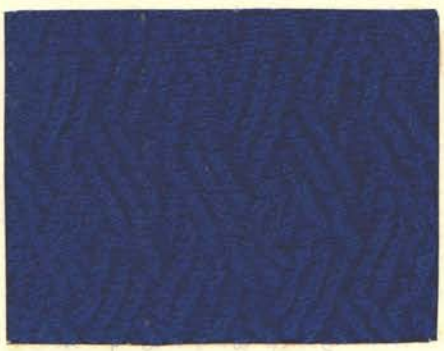

Figure B

Figure C

Plate V

Figure A. This effect may be accomplished on an ordinary home sewing machine by the use of a special Lastex thread. In the beginning, Lastex was emphasized by the manufacturers of corsets, swim suits, hosiery, and underwear, but since that time many uses have been added.

For over four years, Lastex has been employed in fabric shoes as a style factor. In the last two years it has been used in leather and patent leather, imparting stretch to the leather as a whole through a finely woven backing of fabric made with Lastex yarn. The Lastex is usually placed over the instep in women's shoes, thus simplifying the style lines. It has been said that the shoes tend to conform to the shape of the foot after much wear, causing the shoe to lose its original shape.[8]

In women's wear the following uses have been found for the Lastex yarn: corsets and pantie girdles, examples of fabrics used for such purposes are on Plate VI, Figure B and C, brassieres, underwear, hosiery, surgical stockings, shoes, daytime, sport, and evening dresses, knitted sports wear, maternity dresses, blouses, housecoats, gloves, bags, belts, trimmings, bathing suits, an example of this fabric is on Plate VI, Figure A, beach clogs, playsuits, and notions.

Manufacturers are now offering the following types of men's apparel containing the Lastex fiber: underwear, hosiery, athletic goods, caps, vest backs, sports wear, sweaters, and bathing trunks. Lastex yarn may be inserted in the weaving of men's dress and sport suits to make a fabric which allows for more movement yet provides a close fit in the garment. On Plate VI, Figure A, is shown one type of this fabric

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[8] Ibid.

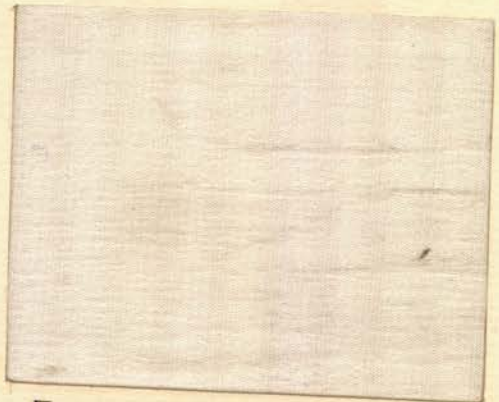

Figure A

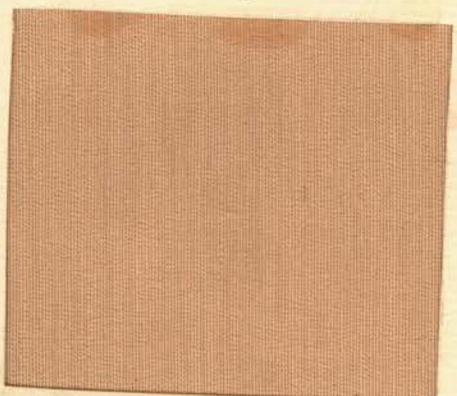

Figure B

Figure C

Plate VI

that might be incorporated in men's sports wear.

Lastex fibers are employed in the following children's wear: underwear, sleeping garments, diapers, knitted bottle covers, garterless hose, caps, berets, dresses, knit suits for boys, and bathing suits.

New uses for the Lastex fiber are constantly being suggested and tried; thus the steady growth of the Lastex fiber in the past seven years can be realized. It is possible that many other uses will be developed to influence the wearing apparel of men, women, and children.

CHAPTER VII

RAYON

Since rayon is the oldest of the synthetic fibers and most people are more or less familiar with its history and production, only the recent developments and the present status of the fiber will be dealt with in this study.

Recently there have been many important changes made in the quality and the nature of the cellulose yarns produced. More economical processes have been discovered to take the place of the original Chardonnet process.[1] It has been said, "Turning to Rayon one finds that the development of special strong viscose yarns, the reduced cost of producing acetate yarn, and the development of the new uses for Rayon staple are leading to greatly expanded consumption of the fibers derived from cellulose."[2] The fine multifilament yarns of high strength produced today are certainly a great improvement over the earlier rayon with its coarse fibers and low strength. This increase in the strength is said to be due to the stretching of the filaments during the process of their plastic formation and fixation.[3]

Regenerated cellulose fibers are now being produced commercially in this country by the cuprammonium process and the viscose process. Most of the cuprammonium rayon is produced by the stretch spinning

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1 Bonnet, F., "Recent Developments in Rayon and Some of the Newer Manufactured Textile Fibers," Rayon Textile Monthly, XXI (February, 1940), p. 82.

2 "How to Make Money Make More Money Through Synthetic Fibers," op. cit., p. 102.

3 "Recent Developments in Rayon and Some of the Newer Manufactured Textile Fibers," op. cit., p. 83.

process. Rayon spun by this method is said to be characterized by the exceptional fineness of filaments which can be obtained. Continuous filament cuprammonium rayon is being used in a variety of woven and knitted fabrics where the fineness of yarn make it desirable. Small amounts of cuprammonium staple have been developed in this country, but it is not considered as important from a volume standpoint.[4]

The viscose type of yarn and fibers is at present the most important of any of the synthetic fibers from the standpoint of volume consumption. Recent developments in the production of viscose continuous-filament rayon have been the improvements in tensile strength, elasticity, uniformity, and fineness. Other developments worthy of mention are the so-called thick-and-thin yarn used to produce shantung effects in woven fabrics and abraded filament yarns.[5]

By a modification of the spinning process of the viscose rayon, yarns may be obtained that have a higher strength both wet and dry. Cordura, Tenasco, and Rayflex are the high strength viscose yarns produced in this country. A strong viscose rayon staple, Strong Fibro, is being produced by a similar method to the one described for the continuous-filament fiscose rayon.[6]

An important trend in the rayon field is the broadening market for various types of rayon staple. The consumption of rayon staple rose from 53,000,000 pounds in 1938 to 100,000,000 pounds in 1939.

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[4] "Putting the Spotlight on the New Synthetic Fibers," Textile World, LXXVI (September, 1939), p. 78.

[5] Ibid.

[6] Ibid, p. 79.

Predictions have been made that by the end of the decade it will be at least five times that figure.[7] This type of fiber was first developed as a direct substitute for the natural fibers, cotton and wool; later as the true qualities of the fiber became evident it was used for the purpose of obtaining a much greater variety in fabric design. The staple fiber is nothing more than the continuous yarn cut into suitable lengths to be handled on cotton, woolen, and worsted machinery. This type of fiber can be blended with natural fibers such as wool, cotton, or linen to produce very striking fabrics.[8]

Rayon staple has been developed for use as dress goods, draperies, slacks, and sportswear. There is now a tendency to employ the staple fibers alone or in combination with other fibers in the manufacture of suitings and overcoatings. Large manufacturers of rugs and carpets are experimenting with the rayon staple, and at least one company is offering rugs containing this fiber commercially. Still other possibilities which are being considered for the use of this fiber are blankets, upholstery, and towelings.[9]

A modified viscose staple is being produced in Europe in which a synthetic resin or casein is incorporated in the spinning solution. This type of staple is said to be more wool-like in appearance and handle than that of the ordinary viscose staple. Cisalfa, a product

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7 "How to Make Money Make More Money Through Synthetic Fibers," op. cit.

8 "Recent Developments in Rayon and Some of the Newer Textile Fibers," op. cit.

9 "How to Make Money Make More Money Through Synthetic Fibers," op. cit.

of this nature, is imported in this country in small quantities.[10]

A wool imitation fiber is being commercially produced in Japan, and equipment for its production has been recently made available in this country. This type of fiber resembles wool in luster, handle, and crimp.[11]

Acetate yarns of a high tensile strength may be obtained by the special stretch-spinning process. Teca is a new type of acetate rayon produced in this country which is characterized by having a crimp or waviness. The Teca yarn is used for a wide variety of weaves from light weight sheers to heavy worsted types. Acele, another brand recently announced, also has the crinkled appearance.[12]

The beauty and durability of rayon yarns have been steadily improved and many new uses have been found for the yarns, as a result of which garments made from this synthetic fiber are found in stores throughout the world.

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10 "Putting the Spotlight on the New Synthetic Fibers," op. cit.

11 Ibid.

12 Ibid.

CHAPTER VIII

CONCLUSION

In considering the synthetic fibers that have been enthusiastically received by the general public for the past few years and the progress they have made in this brief time, it seems safe to say that the test tube fibers are rapidly rising to a significant place in the textile world.

It has become increasingly apparent that in the textile field a change of revolutionary character is occuring, partially due to the expansion and use of the newer fibers. There is much controversy as to the future status of the natural fibers, but it may be said that as a result of the intensified drive of chemists, the synthetic fibers will be employed in an ever-widening variety of fabrics and will replace the natural fibers for certain purposes. It seems reasonable that the use of certain synthetic fibers will permit production of more uniform products or products which can be sold at lower prices.

Possibly as larger quantities of synthetic fibers are made available and as the prices are reduced, they will be employed more and more in styles for the middle and lower income groups. Many other synthetic fibers not produced at the present time are expected to be available in the next few years. Our country is now in need of a substitute fiber for the natural linen fiber since at the present most of the linen must be imported.

The rapidly expanding uses of the synthetic fibers expected in the next decade will bring new problems as well as new opportunities.

No one can safely predict with certainty what the future holds for these fibers, but it is hoped that the information presented in this paper of the current developments and future possibilities will enable the reader to get a better vision of the progress being made in this field, and to arouse an increased interest in the production and the use of the test tube fibers.

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Cleo Calderhead
Typist

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[24] Ibid., p. 275.