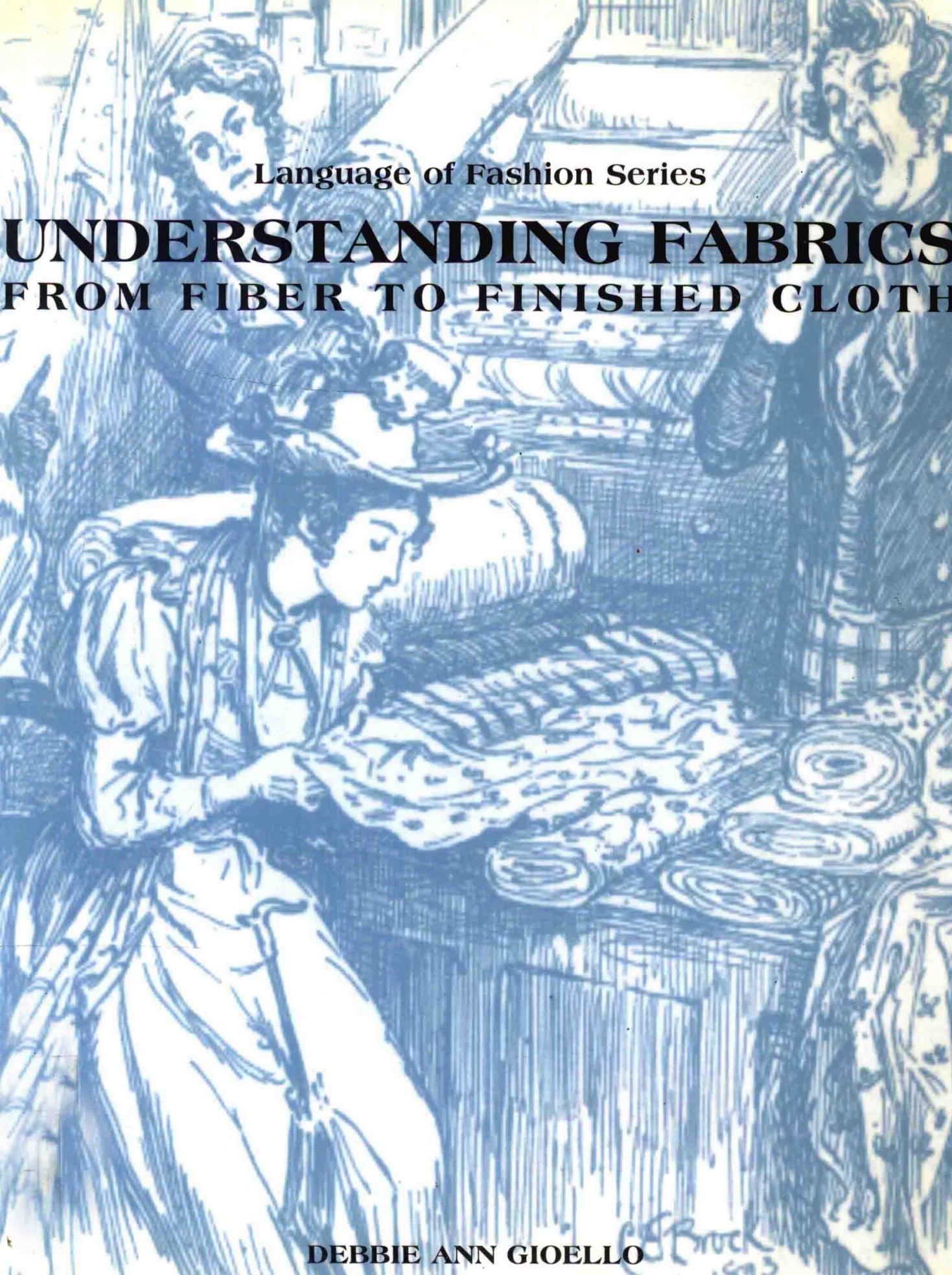
Language of Fashion Series

UNDERSTANDING FABRICS

FROM FIBER TO FINISHED CLOTH



DEBBIE ANN GIOELLO

Language of Fashion Series

Understanding Fabrics:
From Fiber to Finished Cloth

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Fairchild Publications
New York

Janet Solgaard, book designer
Barbara Scholey, cover illustration
Unless otherwise noted, photography by author

Second Printing 1996

Standard Book Number: 87005-377-9

Library of Congress Catalog Card Number: 82-071553

Printed in the United States of America

Understanding Fabrics

Preface

The development and expansion of the textile industry is reflected in the development of raw materials into natural and man-made fibers, advances in processing and engineering technology, new machinery and methods of manufacturing, changes in apparel production, and consumer's needs.

The advances and changes in the textile industry have resulted in the production of a variety of fabrics with different and complex characteristics and properties. This complexity necessitates clarification of existing terms, identification of newly emerging textile products, and clarification of product information.

Understanding Fabrics: from Fiber to Finished Cloth covers product facts including:

- Language and terms of textiles
- Usage of current technology
- Functional and technical aspects of fabrics
- Materials and methods of textile production
- Interrelationship of fiber, yarn, fabric structure, and finish
- Performance expectations and behavior of fabric
- Relationship of fiber properties to fabric behavior

This text is arranged and presented in an order that relates the definite parts of a textile fabric and the usual evolution in the manufacturing process from fiber to structure. Definite parts and components of a textile fabric include:

- Fiber content—fiber used
- Yarn construction—arrangement of fibers
- Fabric structure—arrangement of fibers or yarns
- Finishes—type, durability and method of application
- Color and/or surface design—type, durability and method of application

Arrangement of the definite parts and components affect, alter or modify the fabric's:

- Appearance
- Texture
- Hand
- Weight
- Drapability qualities
- Performance expectations/behavior

These interrelated factors influence the fabric's and garment's:

- End use
- Selection
- Durability
- Comfort
- Care factors

Understanding Fabrics, fourth in a series entitled *Language of Fashion*, is intended to be used by the textile designer, manufacturer, converter; in the textile showroom by management, sales force, purchasing agent; by the fashion designer, stylist, showroom staff, production room technician; by the retail merchandiser of textiles, textile products, and apparel; by the educator and student involved with textiles and textile-related fields; by the consumer and layperson who wish more knowledge and understanding of fabrics.

Information has been compiled from my personal experience as a designer and educator; through research of trade journals and publications; by communication with textile designers, manufacturers, converters and textile-related personnel; through personal contact with technicians, individuals and educators knowledgeable in the various fields of textiles. Accuracy has been of great importance, but new works are rarely free from error. I hope that the reader will call attention to errors of commission or omission.

Due to lack of space, some judgment regarding information to be included was required. For detailed information regarding the relationship of fibers, yarns, fabric structure, finishing processes, color and surface design application, performance expectation, width, weight, hand, texture, opacity, drapability qualities, and care factors of specific fabrics, refer to the third text in this series, *Profiling Fabrics: Properties, Performance & Construction Techniques*. Individual fabrics are analyzed, discussed and photographed. It is hoped that the

presentation of these combined texts dealing with individual fabrics and related terms will supply background knowledge of fabric terms and an understanding of fabric usage.

Other books in the *Language of Fashion* series include *Fashion Production Terms* and *Figure Types and Size Ranges*. The next volume will cover *Working with Fabrics*. Another future work in this continuing series will give extensive coverage to *silhouettes*, including parts of the garment and design details.

1982

Debbie Ann Gioello
New York

Acknowledgments

A pictorial encyclopedia as inclusive as *Understanding Fabrics: from Fiber to Finished Cloth* required the assistance of many people. Without their continued cooperation, generosity and encouragement, the monumental task of compiling all the information relating to the understanding of fabrics would have been impossible.

The author wishes to acknowledge the following people and companies for technical information and photographs regarding fiber and yarn specifications and fabric structure procedures: James Adshead Jr., E.I. du Pont de Nemours & Company; James P. Allen, Celanese Corporation; Walter J. Bartlett, American Cyanamid Company; Walter C. Caudle, Allied Chemical Corporation; Libby Clark, Cotton Inc.; Donald R. Clark and Harold W. Young, American Enka Company; Wanda H. Coffen, Badische Corporation; R.D. Colman, Eastman Chemical Products, Inc.; Elizabeth Dagget, Avtex Fibers Inc.; James Donovan, American Textiles Manufacturing Institute (ATMI); F.C. Flint, Monsanto Textiles Company; Dee Graper, American Hoechst Corporation; Thomas C. Haas, The Wool Bureau, Inc.; International Silk Association; Francesca Joelion, Mohair Council of America; Frank McNeirney, International Nonwoven & Disposables Association (INDA); Linda Muller, U.S. Department of Agriculture; National Knitted Outerwear Association; Julie Rlymes, Man-made Fiber Producers Association, Inc.; Lynn Sanders, Belgian Linen Association; Maria Sciandra, Courtaulds North America, Inc.

The following people and companies supplied technical information, specifications and photographs related to coloring, printing and finishing processes of fabrics and information related to care of specific fabrics; David W. Adams, Pellerin Milnor Corp; Jeffrey R. Allen, Com-Tex Corp.; L.B. Arnold Jr., Vikon Chemical Co. Inc.; Vincent Baldassari, Lembo Corp.; Martha Barker, Wise Industries Inc.; Richard Bennett, Bruckner Machinery Corp.; Dieter H. Bailek, American Artos Corp.; Broad Street Machine Company; H.S. Bultman Jr., Custom Scientific Instruments Inc.; H.L. Cauffman, Simco Co. Inc.; A.C. Chapman, Albright & Wilson Ltd.; T.F. Devlin Jr., James Hunter Machine Co. Inc.; Robyn Dowling, C.S.I.R.O. Division of Textile Industries, Wool Research Lab.; Joseph D. Dyer, Tubular Textile Machinery; Glenn Fabbri, Temac Inc.; Murry Firman and William Nathan, Hartford Corp.; Vlastimil Filous, Elitex Concern Research Industries; G.R. Goettelman, Proctor and Schwartz Inc.; Alan Goldburg, Krantz American Inc.; Leonard E. Herrmann, Precision Screen Machines Inc.; Robert C. Honour, Bently Machinery Inc.; Leon E. Hotz, Saurer Corporation Textile Machinery; Robert M. Humphreys, Tuftco Corp.; Maureen Jacolucci, Frank G.W. McKittrick Co.; Craig Jensen, Proctor and Gamble Co.; Joyce L. Johnson, Cobble Tufting Equipment; Paul Kelso, Chomolox Instruments & Control; Jan Laundau and Janice Liverance, Embroidery Council of America; Penny Lempenau and Mario Putzrath, Springs Mills Inc.; Joil Levitt, Custom Fabrics Finishing Mills; Reiner Liebscher, Zangs Corporation; W.R. Litzler, C.A. Litzler Co. Inc.; A.S. Mafilios, Surplice Chemical Co. Inc; Yves Mahe, Sublistatic Corporation of America; Honora Maresco, Spellman High Voltage Electronics Corp.; Kathleen A. Marshall, Hollingsworth Vose Co.; Eugene R. Massey, David Gessner Co.; I. May, American Hoechst Corporation; Karl Mayer, Karl Mayer Textilmaschinen Fabric GMBH; McCoy-Ellison Inc.; Joel T. Merritt, Ahiba-Mathis Inc.; Erik B. Nagel, Edda Textile Machine Inc.; John A. Pasquale III, Liberty Machine Co. Inc.; Siegfried W. Posner, Greenville Machinery Corp.; Nance Presson, Keiltex Corp.; William Quinn, Bouligny Co.; Jean T. Rednick, Thies Corporation.; Joseph B. Resch Jr., Melton Corporation; James S. Robinson, C.G. Sargent's Sons Corp.; Helmut Ruef, Fleissner Corp.; Saueressig Gmbh Intra Inc.; Albert A. Scala, ABC Industries Inc.; Joachim Schreiba, BASF Wyandotte Corp.; Joanne Shaw and Laura Skolar, Orphalese Designs; D.B. Stafford, Rice Barton Corp.; Richard Steele, Consolidated Engravers Corp.; H.B. Sturtevant Jr. E.I. du Pont de Nemours & Co. Inc.; Tekmatex Inc.; Mike Thompson and Steve Little, Gaston Country Sales & Service Corp.; Charles L. Tighe, Mega Marketing Inc.; H.W. Todd, Herbert Products Inc.; Dorothy B. von Steinberg, The Arkansas Co. Inc.; Charles B. Warren, Markem USA; John M. White, Morrison Machine Co.; Arno H. Wirth, Arno H. Wirth Company.

Special thanks and appreciation are extended to the following members of the faculty and staff of the Fashion Institute of Technology for their invaluable assistance: Marvin Feldman, President; Beverly Berke and Nurie Relis, Fashion Design Department; Arthur Price (chairman), George Tay, and Joseph Samuales, Textile Science Department; Robert Riley (director), Laura Sinderbrand, Dom Petrillo and staff, Design Laboratory; Marjorie Miller and Pete Smith, Library Media Service.

My personal gratitude to my daughter Donna Gioello; my friends Josephine DeCaro, Sherri Mannuzza, Gail Monteforte, and Ken Falber for their assistance and William Brown for his assistance for the art work.

Contents

1 ~ Fibers

Fibers are the basic units or the basic components in textiles. They are the smallest particles that make up yarn. Yarns used in the production of fabrics use different types of fibers as their raw material.

Textile fibers are found in natural sources or may be manufactured from remains of natural sources or synthesized from chemicals.

All fibers have innate or inherent characteristics and multiple properties. Each textile fiber has its own distinctive structural shape, marking and size. Properties or inherent characteristics of fibers are determined by the fiber's:

- Composition and Origin
- Length and diameter
- Shape/Cross-section Form
- Contour/Longitudinal Form
- Spinnability/Cohesiveness
- Light-reflecting Qualities
- Dyeability

Multiple properties and inherent characteristics of the fiber will affect the fabric's:

- Performance Expectation
- Hand or Feel
- Body or Weight
- Appearance
- Surface Texture
- Luster
- Care
- End Use

Factors influencing the development and utilization of natural or man-made fibers include the:

- Desirability of fiber properties
- Ability to spin fiber
- Availability in sufficient quantities

- Cost and economy of production
- Performance expectation of fiber and fabric
- End use of fabric
- Life and care factors of fabrics

The innate or inherent properties of a fiber can be altered or modified at the stages of raw fiber, yarn or fabric structure.

Fibers can be texturized to produce bulk, crimp or stretch or may be modified to change the hand of the fiber, thereby changing the performance of the yarn and the finished cloth. The ultimate behavior, performance expectation, drapability quality, care and end use of the fiber are not dependent on fiber characteristics or fiber properties alone. These properties are also influenced by the methods used to transfer fibers into yarns, yarns into finished cloth as well as finish and color applications.

Fiber, yarn, fabric structure and finishes are interdependent in the production of fabric. When one or more of the components in the production of fabric is modified or changed, the finished fabric is changed.

Selecting one fiber over the other to produce yarn or fabric depends on:

- Fiber's individual characteristics
- Positive qualities vs negative qualities
- Performance expectations required
- Appearance, feel, hand and texture desired
- Drapability qualities
- Finishing processes
- Weight or opacity
- Care performance
- End use
- Fiber's availability
- Cost

Fiber Composition/Fiber Origin

Fibers are derived from natural and man-made (or synthetic) materials.

Natural Fibers Natural fibers are materials that grow in nature such as cotton, flax, silk and wool. Utilizing various processes of harvesting, sorting, cleaning and milling, natural fibers are made ready for spinning.

Man-made Fibers Man-made fibers are fibers created by man through technology. The fiber-forming ingredients of man-made fibers are extruded, twisted or spun to form a long chain polymer.

Man-made fibers are divided into two groups:

- Regenerated Man-made fibers
- "True" Man-made Fibers

Regenerated man-made fibers are made from cellulosic substances or natural materials such as petrified wood, cotton linters, corn protein, milk or seaweed. The substances are reformed or generated by chemical treatment or may be processed into usable fibers.

"True" Man-made Fibers are synthesized completely from noncellulosic substances or chemical substances such as petroleum derivatives, nitrogen, hydrogen and carbon.

Natural or man-made textile fibers can be classified according to their origin and their chemical constitution.

- Cotton fibers for cotton fabrics and cotton-blended fabrics
- Flax fibers for linen fabrics and linen-blended fabrics
- Jute fibers for burlap fabrics and burlap-type fabrics
- Silk fibers for silk fabrics and silk-type fabrics
- Wool fibers for wool and worsted fabrics and wool and worsted-type fabrics
- Specialty hair fibers/Animal fur fibers
- Man-made fibers (regenerated cellulose fibers or 100% synthetic fibers)

Man-made fibers may be manipulated and finished to simulate natural fibers of cotton, linen, burlap, silk, wool or worsted fabrics. The texture, look, feel and structure that are important parts of any natural-fiber fabric may be copied.

The Federal Trade Commission, under the rules and regulations of the Textile Products Identification Act, has assigned *generic names* and definitions for the various types of man-made fibers according to the chemical composition of the fiber-forming substance. The *generic name* and definition of the fibers are listed according to section 7(c) of the Act. All fibers with the same *generic name* have similar chemical structure, compounds and characteristics. However, characteristics of individual generic fibers differ. Not all fibers possess the same properties.

Composition/Origin of Natural Fibers

	Fiber Type	Origin
Cellulosic/Vegetable Fibers	Cotton	Cotton boll/Seed hair
	Kopak	Kopak tree/Seed hair
	Hemp	Hemp or Abaca stalk/Bast fiber
	Jute	Jute stalk/Bast fiber
	Flax	Flax stalk/Bast fiber
	Ramie	Rhea or China Grass/Bast fiber
	Pina	Pineapple leaf/Leaf fiber
	Sisal	Agava leaf/Leaf fiber
	Coir	Coconut husk/Nut husk fiber
Animal/Protein Fibers	Silk	Cultivated, doupioni or wild silkworms
	Specialty Fur Fibers	Selected fur bearing animals
	Specialty Hair Fibers	Camel and goat family animals
	Wool	Sheep
Mineral Fibers	Asbestos	Varieties of rock Silicate of magnesium and calcium
Rubber Fibers	Natural Rubber	Rubber plant

Composition/Origin of Man-Made Fibers

	Fiber Type	Origin
Cellulosic/Vegetable Fibers	Acetate Rayon Triacetate	Cotton Linters or Wood Cotton Linters or Wood Cotton Linters or Wood
Man-Made/Synthetic Long-Chain Polymer Fibers	Anidex Acrylic Modacrylic Nylon Nytril Olefin Polyester Saran Spandex Vinal Vinyon	Monohydic Alcohol/Acrylic Acid Acrylonitrile (85%) Acrylonitrile (35%–84%) Polyamide Vinylidene Dinitrile (85%) Ethylene or Propylene (85%) Dihydic Alcohol-Terephthalic Acid Vinylidene Chloride (80%) Polyurethane (85%) Vinyl Chloride (50%) Vinyl Alcohol (85%)
Protein Fibers	Azlon	Corn or Soybean
Mineral Fibers	Ceramic Glass Graphite	Minerals Silica, Sand, Limestone Carbon
Metal Fibers	Metallic	Aluminum, Silver, Gold, Stainless Steel
Rubber Fibers	Rubber	Man-made/Synthetic

The Production of Man-made Fibers

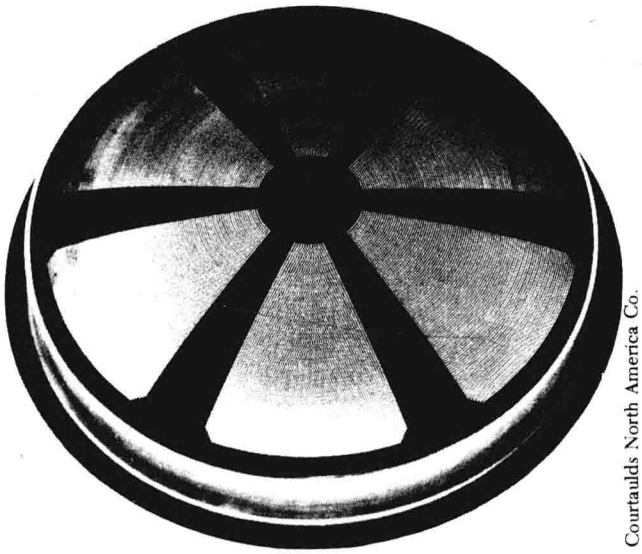
The fiber-forming ingredients of man-made fibers are extruded, twisted or spun to form a long chain polymer. The liquid substance, forced through a spinnerette (or spinning jet), hardens to produce a long continuous filament fiber. There are three processes used to produce man-made fibers:

- Dry Spinning Process
- Wet Spinning Process
- Melt Spinning Process

Dry Spinning Process Filaments emerge from the spinnerette and are solidified by being dried by warm air. Process is applicable for producing: acetate, acrylic, modacrylic, triacetate, and vinyon.

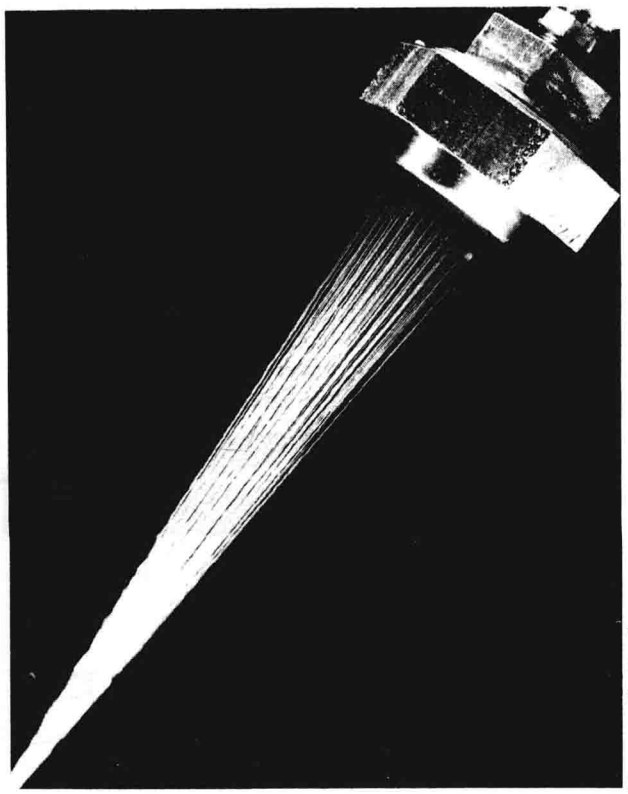
Wet Spinning Process Filaments emerge from the spinnerette and are passed directly into a chemical bath where they are solidified or regenerated. Process is applicable for producing: acrylic, rayon, and anidex.

Melt Spinning Process Fiber-forming substance is melted for extrusion and hardened by cool air. Process is applicable for producing: nylon, polyester, olefin, aramid, and glass.



Courtaulds North America Co.

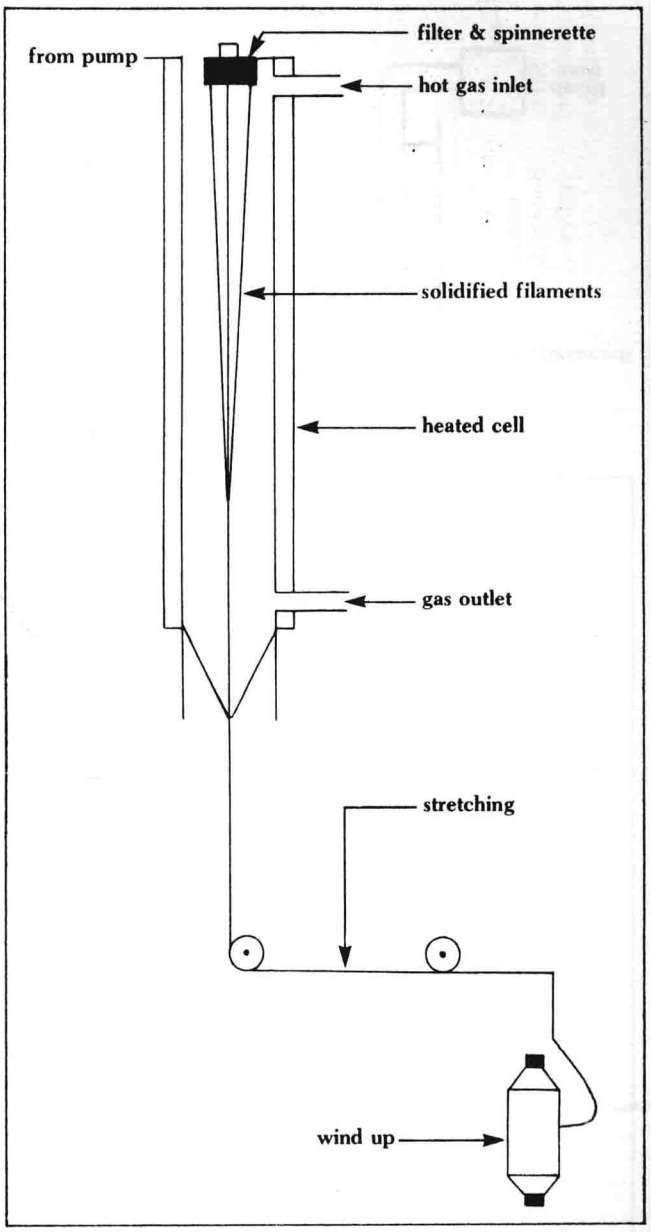
spinnerette/spinning jet



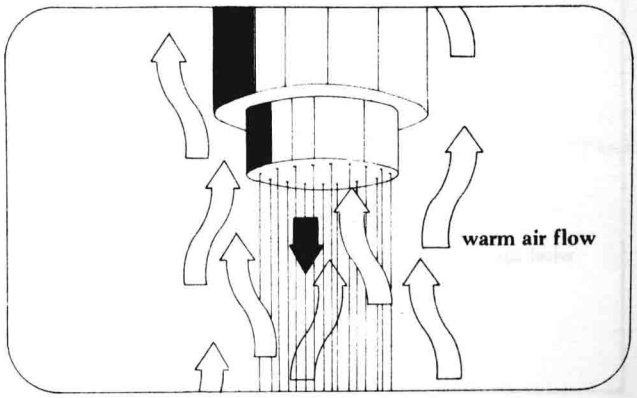
Monsanto Textile Co.

solution emerging from spinnerette to form filament yarns

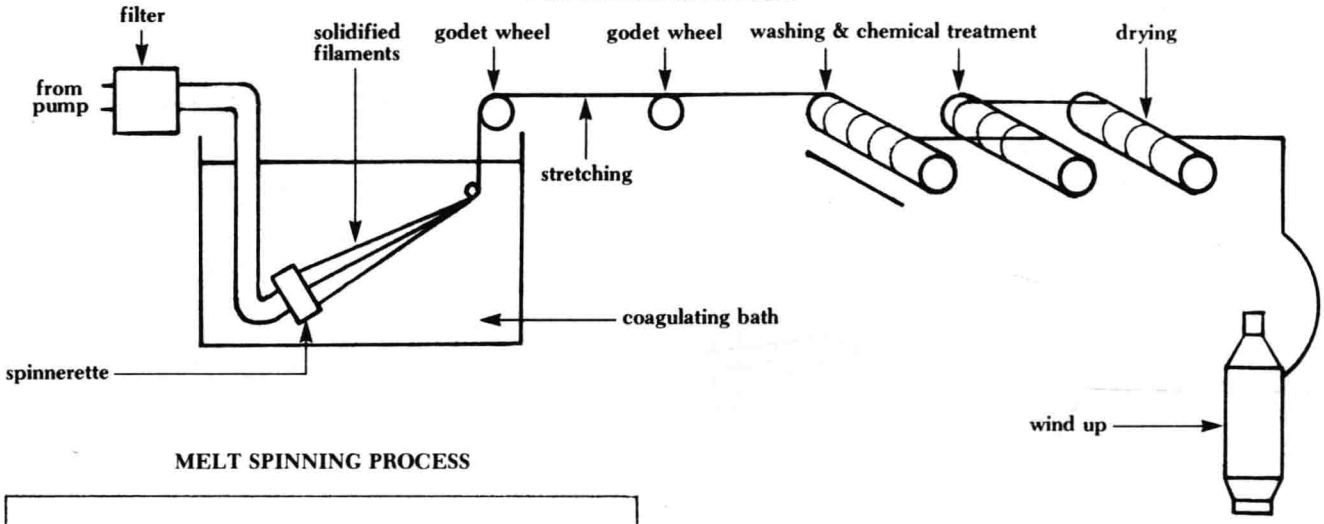
DRY SPINNING PROCESS



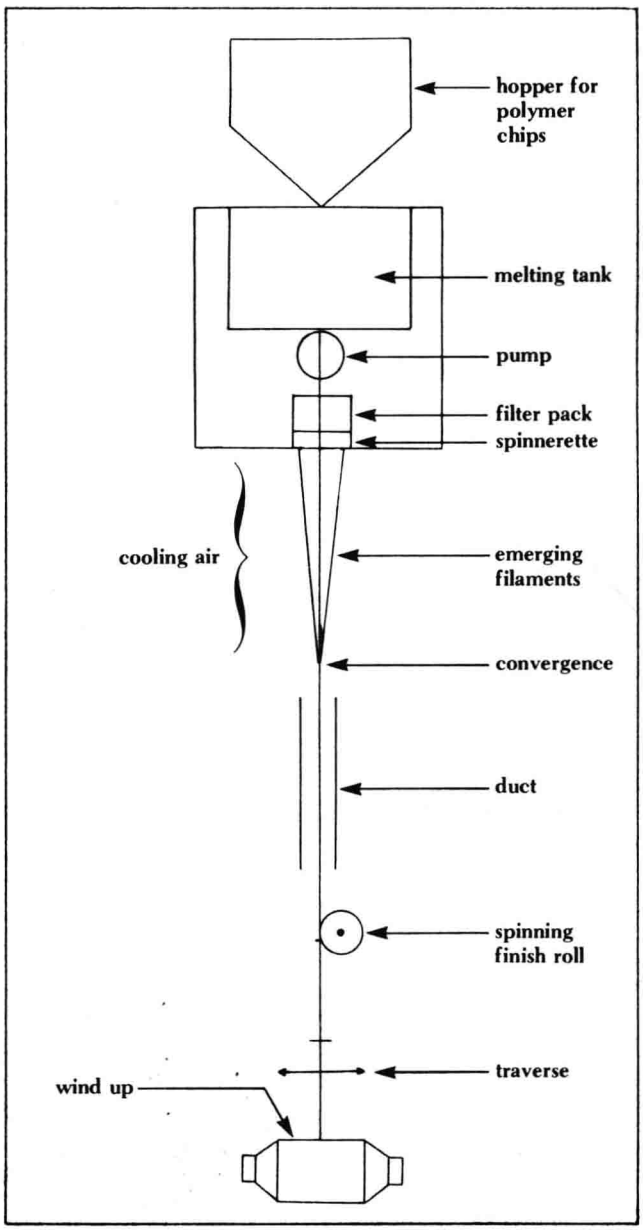
CLOSE-UP OF SPINNERETTE IN DRY SPINNING PROCESS



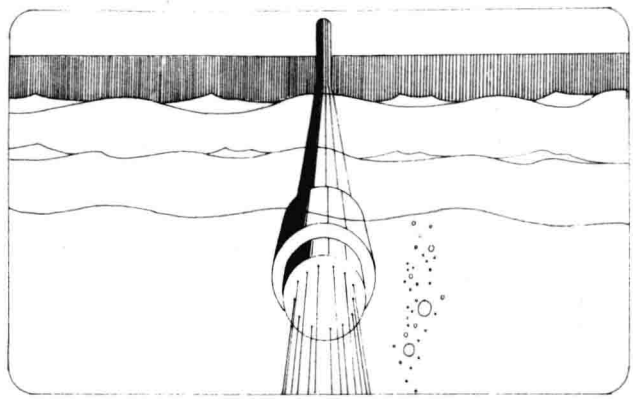
WET SPINNING PROCESS



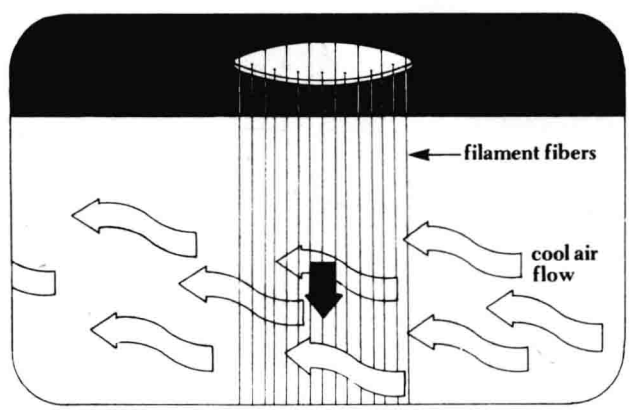
MELT SPINNING PROCESS

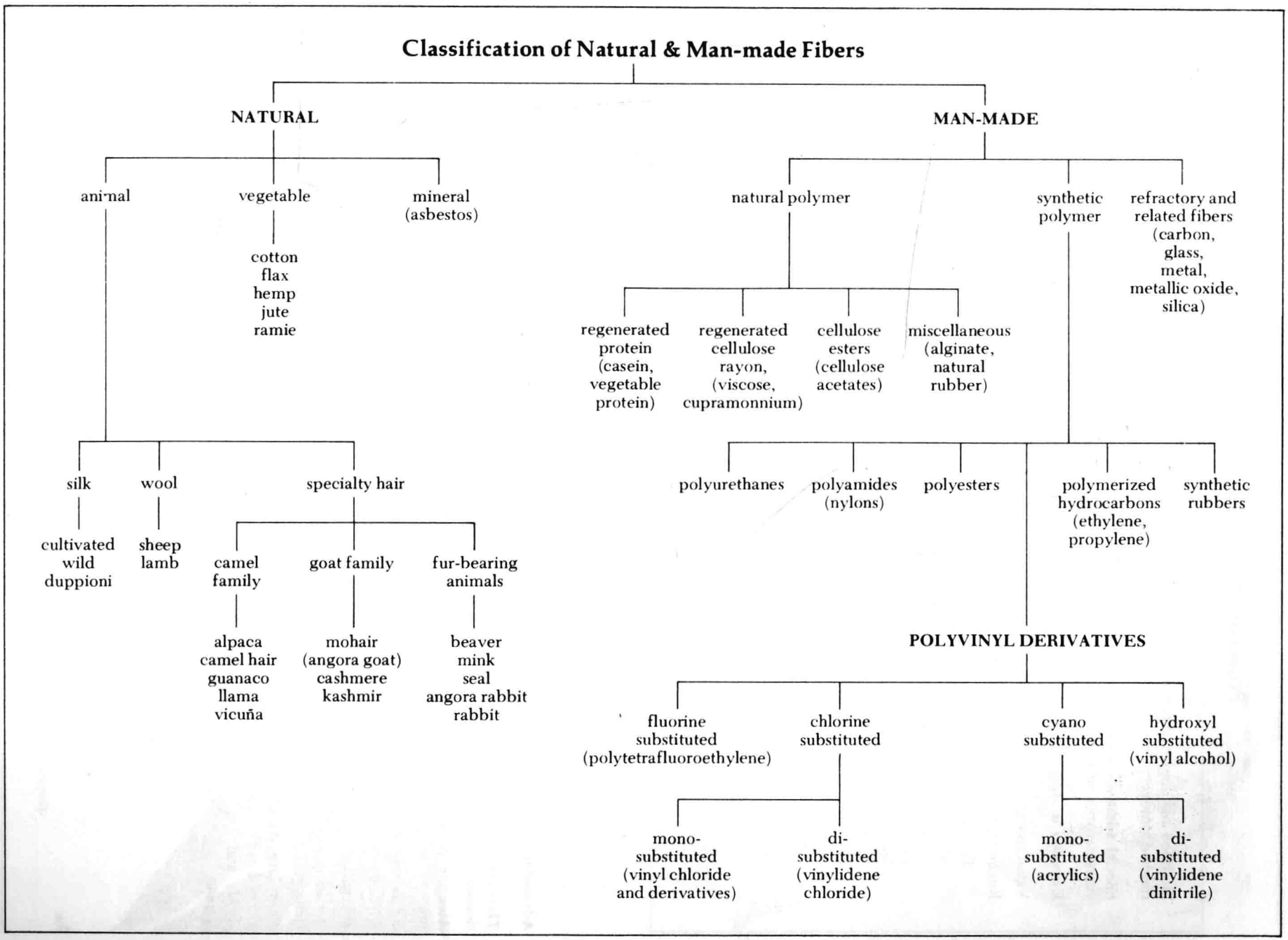


CLOSE-UP OF SPINNERETTE AND COAGULATING BATH IN WET SPINNING PROCESS



CLOSE-UP OF SPINNERETTE IN MELT SPINNING PROCESS




Classification of Natural & Man-made Fibers
NATURAL
MAN-MADE
animal
vegetable
mineral (asbestos)
cotton
flax
hemp
jute
ramie
silk
wool
specialty hair
cultivated wild duppioni
sheep lamb
camel family
goat family
fur-bearing animals
alpaca
camel hair
guanaco
llama
vicuña
mohair (angora goat)
cashmere
kashmir
beaver
mink
seal
angora rabbit
rabbit
natural polymer
synthetic polymer
refractory and related fibers (carbon, glass, metal, metallic oxide, silica)
regenerated protein (casein, vegetable protein)
regenerated cellulose rayon, (viscose, cupramonnium)
cellulose esters (cellulose acetates)
miscellaneous (alginate, natural rubber)
polyurethanes
polyamides (nylons)
polyesters
polymerized hydrocarbons (ethylene, propylene)
synthetic rubbers
POLYVINYL DERIVATIVES
fluorine substituted (polytetrafluoroethylene)
chlorine substituted
cyano substituted
hydroxyl substituted (vinyl alcohol)
mono-substituted (vinyl chloride and derivatives)
di-substituted (vinylidene chloride)
mono-substituted (acrylics)
di-substituted (vinylidene dinitrile)

Properties & Characteristics of Man-made Fibers

Modified and improved to build desirable characteristics and eliminate or modify the undesirable characteristics in the finished product.

Special additives mixed into the basic liquid fiber solution may impart special qualities or change one or more characteristics of fiber.

Extruded in different sizes, shapes, and thicknesses to meet special needs of the finished products.

Variations in textiles products.

Engineered and produced to provide specific needs or functions such as:

Fit a variety of end uses
Absorb like cotton
Look like natural-fiber fabrics
From fine and sheer to thick, strong and opaque
Stretchy or bulky without additional weight
Hold pleats permanently
Flame-retardant
Mildew and moth resistant
Formed into filament fibers of any length or cut staple fibers
Formed into film fiber form
Monofilament or multifilament yarns
Tow yarns

Man-made yarns may be texturized to produce bulk, stretch or various surface interests; cut into different lengths; spun, blended or combined.

Advantages & Disadvantages of Man-made Fibers

Advantages

Thermoplasticity. Fiber can be molded or shaped to a desired form. Permanent setting of pleats by heat setting.

Abrasion Resistant. Withstands surface wear; shows minimum wear.

Resiliency. When crushed, springs back quickly; inherent wrinkle resistance.

Strength. A strong fiber; high dry and high wet strength.

Resistance. Resistant to damage by mildew, moths and sunlight.

Easy Care. Washes easily and dries quickly. Surface may be cleaned with damp sponge. Water stains penetrate fiber slowly and can be easily removed. Requires little or no ironing.

Disadvantages

Absorbency. Poor absorbency due to inability of fiber to absorb moisture. Perspiration condenses between body and garment. Fabric feels either cold and clammy or hot and uncomfortable on the body.

Staining. Oil-base stains such as grease, butter or animal fats penetrate the fiber and become difficult or impossible to remove.

Static Electricity. Builds up static electricity causing electric shocks. Fabric clings to body.

Thermoplasticity. Overdrying or high heat sets undesirable creases and wrinkles. High ironing temperatures will melt fabric.

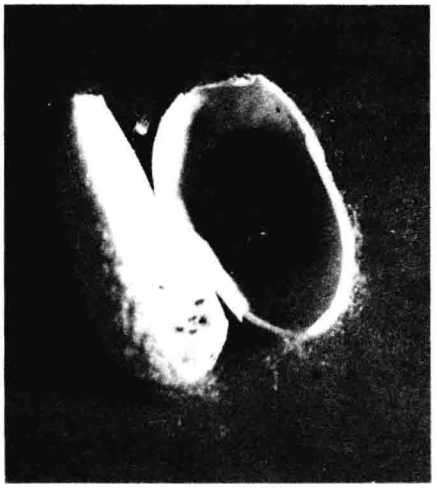
cotton bolls

U.S.D.A., Southern Regional Research Center

bundles of flax fibers

Belgian Linen Association

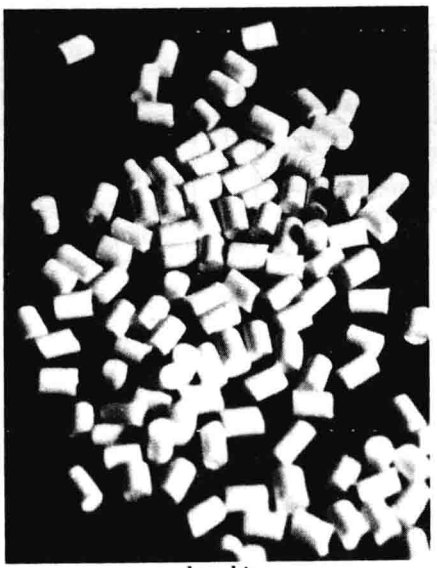
silk cocoon



opened silk cocoon

Rambouillet sheep

polyester chips



nylon chips

rayon pulp