A STUDY OF CONSUMER RESEARCH IN CLOTHING AND TEXTILES

by

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CORRECTION

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PRECEDING IMAGE HAS BEEN REFILMED TO ASSURE LEGIBILITY OR TO CORRECT A POSSIBLE ERROR

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PART I

A REVIEW OF THE HISTORY AND DEVELOPMENT OF CONSUMER RESEARCH IN CLOTHING AND TEXTILES

CHAPTER I

THE HISTORICAL BACKGROUND OF THE CONSUMER MOVEMENT

It has been recognized from Adam Smith to Keynes that, "Consumption is the sole end and purpose of all production; and the interest of the producer ought to be attended to only insofar as it may be necessary for promoting that of the consumer."[1]

This basic economic principle of production might well be considered the beginning of the consumer movement.

> The Consumer movement in the widest sense of the term consists of all the efforts, organized and unorganized, to make the consumer a wiser buyer and user of those products and services which she acquires in her capacity as a consumer.[2]

The purpose of the consumer movement has been to help the consumer identify more clearly her desires and wants, to supply her with information which will help her to satisfactorily meet these wants, to thereby increase her buying power and raise her standard of living. These efforts have taken two directions:

1. Toward the consumer - to teach her what to look for in selecting certain goods and services, and how to use them.
2. Toward business - to encourage producers to provide complete and accurate information about the merchandise and services offered on the markets of the nation.

Both directions have given rise to a new type of research work - consumer research. This is the aspect of the Consumer Movement with which this paper shall deal. Consumer research is a research of a

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[1]Helen Sorenson, The Consumer Movement (New York: Harper and Brothers, 1941), p. xii.

[2]Werner K. Gabler, Labeling the Consumer Movement, An Analysis from the retailer's point of view of organizations and agencies engaged in consumer activities (Washington, D.C.: American Retail Federation, 1939), p. 14.

chemical and physical nature applied to finished goods. Its purpose is three-fold:

1. To make goods safe for human consumption.
2. To notify the consumer of the character of service to be expected from goods purchased.
3. To give information which makes possible maximum use benefits.

There have been in the United States a number of fundamental social and economic changes which have caused the consumer movement to take on major importance in the worlds of both the producer and the consumer.

1. The United States has changed from a rapidly expanding to a more stable economic system. As a young nation there were home frontiers to be explored, so that the economy grew as did the size of the nation. When home expansion came to an end, foreign frontiers of an economic nature were explored. The United States shifted from a debtor to a creditor nation. With foreign expansion closed, attention turned once again to the consumer market at home. But this market crashed in 1929. Goods and services could be produced in quantity, but to maintain a stable economic system, there needed to be created a home consumer's market with high purchasing power and a willingness to buy.[3]

2. The economic system also changed in another respect - from a producer to an exchange economy. In the early days of settlement, home productions was the basic goods-producing method. As the country grew, industry was born and grew with the nation. The economy shifted to an exchange economy. Buying assumed greater importance for the consumer. Her primary concern came to be to get the highest value for the money spent for finished goods. But technological progress moved quickly, and the producer's knowledge of new devices and goods moved ahead of the consumer's knowledge. The consumer became compelled to rely completely on commercial resources for knowledge about the quality and prices of goods and resources. Consumers tended to have their choices on price and emotional appeal, rather than real value. They had no way of telling how good or bad an article was in relation to other goods, or of how to realize maximum goods.[4]

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[3]*Ibid.*, pp. 17-18.

[4]*Ibid.*, pp. 18-19.

3. Modern marketing methods have done little to help the consumer make good value judgments. High production costs has resulted in expensive sales promotion and high-powered sales techniques. The result has been skepticism on the part of the consumer.[5]

4. The depression of the 1930's brought psychological changes in the buying public. Those of lower income groups became concerned not so much with raising their income as with maintaining a steady income. To them, getting their money's worth assumed great importance. Those in middle income groups became concerned with maintaining their standard of living, shifting in attitude from that of producer to that of consumer and a consciousness of pennypinching. As the people became more conscious of the economic condition of themselves as consumers, the Government began to think in terms of policies that would benefit the consumer . . . .[6]

But before the Federal Government entered the picture, individuals and groups across the country literally made economic history as they fought for the cause of the consumer, the victim of rapid technological progress and a rapidly expanding economy. The background history of the Consumer Movement is an impressive one.

1830 - The first consumer cooperatives appeared in this country. Outstanding among them was the Granger movement. Toward the turn of the century, these groups almost completely disappeared.

1890 - The Sherman Anti-trust Act offered the consumer new protection by forbidding monopolies, combinations, or conspirating in restraint of trade.

1899 - The Consumers League was organized. This group used its purchasing power to improve labor's working conditions.

1906 - The first food and drug law was enacted, offering protection against poisonous drugs and foods.

1908 - The American Home Economics Association was founded. This organization has known its greatest influence in cooperating with other organized groups in promoting and campaigning for the consumer and better goods and services.

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[5] Ibid., p. 20.

[6] Ibid., pp. 18-20.

1912 - Good Housekeeping established a certification service.

1914 - The Federal Trade Commission Act, which created the Federal Trade Commission, offered indirect protection to the consumer by protecting manufacturers and tradesmen from unfair practices. The Clayton Anti-trust Act enlarged upon the 1890 law by defining specific illegal or unfair practices.

1918 - The American Home Economics Association launched a campaign for labels and quality specifications on staple fibers.[7]

1921 - The AHEA, in cooperation with the U. S. Bureau of Standards and manufacturers of silk petticoats, compiled facts from wear and laboratory tests which gave the AHEA a start toward further cooperation with business and which therefore contributed to consumer knowledge.[8]

1923 - The Department of Agriculture established a Bureau of Home Economics in Washington.

1927 - The first "debunking" book attacking advertised merchandise was published, Your Money's Worth, by Chase and Schlink.

1929 - Dr. J. F. Schlink, due to the success of Your Money's Worth established the first independent testing and approving service.

The Silk Association of America, the National Retail Dry Goods Association, and the AHEA cooperated in efforts to establish standards for weighted silk.[9]

The AHEA and Bureau of Home Economics cooperated in an anthropometric study to establish standard and correct garment sizes.[10]

1930 - The growing depression made consumers more conscious of the need for standardization if they were to get their money's worth. A desire for organized action grew.[11]

1933 - The NRA set up a Consumers' Advisory Board, making consumers partners in establishing the nation's economic policy. The Consumers' Council was set up by the Agricultural Adjustment Administration, and was destined to become one of the most important consumer agencies in the government.

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[7] Ibid.

[8] Keturah E. Baldwin, The AHEA Saga (Washington, D.C.: American Economics Association, 1949), pp. 45-46.

[9] Baldwin, op. cit., p. 47.

[10] Ibid., p. 48.

[11] Sorenson, op. cit., pp. 9-10.

1933 - Schlink and Kallet's 100,000,000 Guinea Pigs made the best seller list.

The "Lynd Report" - the most effective accomplishment of the Consumers' Advisory Board of the NRA. The report was a "Proposal to Develop Standards for Consumer Goods by Establishing a Consumer Standards Board and Funds for Basic Testing." This was the first of a series of proposals to establish a government standardization agency.[12]

1934 - As an outgrowth of the NRA's Consumer Advisory Board and the Consumer's Division of the National Emergency Council, consumer groups sprang up all over the country. These groups were to be two-way channels through which administrative policies could be interpreted and from which consumer reaction could be obtained.[13]

Skin Deep, another of the "debunking" books, made its appearance.

1935 - NRA was declared unconstitutional, and governmental consumer activities were shifted to the Department of Labor as The Consumer Project.

Labor troubles in Consumer's Research gave rise to the forming of the Consumers' Union.[14]

1936 - This was a year in which consumer interests received much attention. Another influential book appeared, Marquis Childs' Sweden, The Middle Way. Edward A. Filene of Boston set up the Consumer Distribution Corporation. Its purpose - to promote consumer cooperatives in the United States.

The American Standards Association organized an Advisory Committee for Ultimate Consumer Goods as the first step in establishing consumer goods standards.

Wisconsin made the teaching of consumer cooperation in its high schools compulsory by law.[15]

The Administration sent a commission to Europe for the purpose of studying consumer cooperatives.

Commercial firms, for the first time, put on the market sheets, blankets, and rugs with grade or specification labels.[16]

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[12]Sorenson, op. cit., p. 20.

[13]Ibid., p. 17.

[14]Gabler, loc. cit.

[15]Ibid.

[16]Baldwin, op. cit., p. 48.

1936 - The AHEA began publication of "Consumer Education Service," a bulletin citing recent developments in standardization and labeling.[17]

Rayon first appeared and was sold under false names, so that in

1937 - The FTC brought into being the rayon rules, the first mandatory fiber identification regulations, largely as a result of pressure from women's organizations.

A coordinating agency for all organizations interested in consumer activities was founded - the Consumers' National Federation.

Congress set up the Consumers' Council of the Bituminous Coal Commission. This was the first such body to be formed by Congressional action directly responsible to Congress and independent of the National Coal Commission.[18]

The National Consumer - Retailer Council was established as the communication organ between consumer and retailer who were considered equals. Its program was to include the following functions:
(1) Standard requirements for staple and semi-staple goods.
(2) Informative labeling, including grade.
(3) Testing of standardized and labeled goods.
(4) Publicity - to include disclosure of methods of testing and grading.
(5) Standardization of terminology for all publicity - including labels.[19]

1938 - Another very active year for consumer interests.
A new Food, Drug, and Cosmetic Act of 1938 - the result of the working together of many groups in a five-year battle.

The Wheeler - Lea Act gave the FTC control of tradepractices and advertising - awakening of industry to the importance of organized consumer activity.

The Alfred P. Sloan Foundation founded the Institute for Consumer Education.

Michigan set up the first state consumer department.

Women's clubs increased consumer activities. Business showed increasing "rapprochement" toward the consumer movement, a fact

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[17]Ibid., p. 49.

[18]Gabler, op. cit., pp. 15-16.

[19]Grace S. M. Zorbaugh, The Consumer Movement and Business (The Consumer Conference of Greater Cincinnati, 1941), p. 6.

to become significant in future business - consumer relations.[20]

General trends toward informative labeling were noted on the part of:
(1) Retail department stores.
(2) Manufactuers of textiles, blankets, and hosiery.
(3) Testing labs awarding respected seals of approval were organized by: National Dry Goods Association
National Gasoline Association
National Board of Fire Underwriters
American Institute of Laundering
National Association of Dyers and Cleaners[21]

There was organized a Committee on Consumer Relations in advertising by various advertising agencies.

1939 - The first National Conference for Consumer Education met at the Institute for Consumer Education at Columbia, Missouri, with 400 representatives in attendance from all phases of consumer interest.

Representative Boren introduced into the House two bills setting up machinery and allocating funds for the establishment and promulgation of performance standards for consumer goods.

The Business - Consumer Relations Conference, organized by the National Association of Better Business Bureaus of Buffalo, was the first important business organized conference devoted entirely to the discussion of Business - Consumer Relations.[22]

The Wool Products Labeling Act was passed to protect consumers against the mishandling of wool products and to prevent the use on non-wool products of terms associated with wool products. Fiber content labels must accompany woolen products through all the stages of production to the consumer.

1940 - The President established a consumer division in the National Defense Advisory Commission to promote standardization and labeling of consumer goods.

1941 - Fair trade rules were introduced for fabric identification of silk, rayon, linen, and woven cotten materials as to shrinkage.

1944 - A survey was conducted by the AHEA in 40 states to determine critical needs in yard goods and school and work clothes - due

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[20]Gabler, loc. cit.

[21]Zorbaugh, op. cit., p. 7.

[22]Gabler, loc. cit.

to the flood of new luxury goods and shoddy but expensive goods and clothes for service wear.[23]

1947 - The AHEA made efforts to achieve better standards for sizing children's and adults' clothing. This group also made new efforts toward research in laundry and dry cleaning of fabrics and clothing.

1952 - Fur Products Labeling Act was passed. This act provides consumer protection against false invoicing and advertising of fur products. The true English name of the animal that produced the fur, its origin (if imported), and whether the fur product is composed of used, damaged, or scrap fur, or fur that has been bleached or dyed are facts that must appear on the label.

1954 - The Flammable Fabrics Act passed Congress to protect the public against the hazards surrounding the use and marketing of flammable fabrics and articles of wearing apparel. Standards are set forth by the statute.

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[23]Baldwin, op. cit., pp. 49-50.

CHAPTER II

A BRIEF SUMMARY OF THE ACCOMPLISHMENTS OF CONSUMER RESEARCH IN THE CLOTHING AND TEXTILE FIELD

Since 1830, the government, agricultural experiment stations, universities, commercial and private laboratories, chemists, engineers, consumers, business men, and the clothing and textile industries have combined their efforts to produce a system of testing and research methods which has contributed to consumer well-being. Along with the development of textile producing machinery has come the development of equipment designed to test the fabrics of industry so that their performance value might be judged prior to consumer purchase.

Standards for many of the characteristics tested for have been adopted either through government regulation or through the mutual cooperation of the members of the industry itself. Today, therefore, research which can be called consumer research is carried on by a variety of agencies. Government agencies include the National Bureau of Standards, the Navy Department, the Department of Agriculture and its many branches, the Federal Trade Commission, the Public Health Service, and state and municipal governments. Private agencies include technical societies (medical, dental, and engineering), trade associations (the United States Chamber of Commerce), consumer associations and laboratories (Consumers' Research, Consumers' Union of United States, Intermountain Consumers' Service), professional laboratories (United States Testing Company, Better Fabrics Testing Bureau, American Institute of Laundering, American Society for Testing Materials, American Association of Textile Chemists and Colorists, American Standards Association, National Consumer - Retailer Council, Inc., National Institute of Cleaning and Dyeing), and private businesses (Macy's, J. C. Penney Company, and Sears, Roebuck and Company). Each of these agencies makes its information available to business and consumer in the form of regular bulletins or other publications. The American Home Economics Association and Household Finance Corporation are two other organizations whose purpose is to obtain greater benefits for the consumer through surveys, encouraging research, and making pertinent information available to the consumer. Consumers and home economists are perhaps more familiar with agricultural experiment stations and university research centers as sources of valid information about the products available to them over the counter. Consumers are advised not to rely too heavily on the seal of approval granted products by magazine institutes as always valid, since it is difficult for these organizations to be completely objective.[1]

The names which stand out as leaders in the consumer research movement come from a variety of fields. For example, Frederick John Schlink, author of the "debunking" books Your Money's Worth and 100,000,000 Guinea Pigs, was originally a mechanical engineer - physicist and assistant secretary of the American Engineering Standards Committee. As a staff member of the National Bureau of Standards for six years, he

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[1]Arch W. Trolestrup, Consumer Problems (New York: McGraw - Hill Book Company, Inc., 1952), offers an excellent discussion of this topic.

developed an even greater concern for the plight of the consumer. After the success of his "debunking" books, and due to public demand, he organized and is President and technical director of Consumers' Research. His philosophy is that there are six standards required to control mass production if useful goods are to result: quality, size and form, length (mass, time, and temperature), ratings, practices, and nomenclature. Consumers' Research makes its findings known to the public through its publication, Consumers' Digest.

From the industrial and business world come two other outstanding names - Alfred P. Sloan and Edward A. Filene. Alfred P. Sloan, one-time President of General Motors, made a valuable contribution to the consumer and the business world alike through the establishing of the Alfred P. Sloan Foundation. This foundation gives assistance to educational institutions and students for the study of economic principles and national policies for ". . . more things for more people everywhere - an opportunity for achievement and greater security and stability as well."[2]

Edward A. Filene, "social technician," also made his imprint on the consumer movement through the organization which he helped found. He was instrumental in establishing both the United States and International Chambers of Commerce. The credit union movement in this country was begun by him. A keen interest in and belief in the cooperative movement led him to found The Twentieth Century Fund and the Edward A. Filene Good Will Fund. Both these funds are used for fact finding and

[2]Paul F. Douglas, Six Upon the World (Boston: Little, Brown and Company, 1954), p. 178.

and experimental action in the field of cooperatives, and the findings are made available to those who request them.

From the area of scientific and home economics research comes the name Pauline Berry Mack, professor of textile chemistry and director of home economics research at Pennsylvania State College. Dr. Mack has directed and participated in hundreds of research projects. She cooperated with Consumers' Research for their cosmetic research project as reported in Skin Deep, a book by Mary Phillips. One of the most massive research problems under her direction was an eight-year consumer study of silk and rayon, completed in 1939. As a result of this project, a standard method of calculating and reporting silk weighting was established.[3] Other of her research projects have included a Northeastern Regional Experiment Station Co-operative Textile Project on the "Colorfastness of Women's and Children's Wearing-Apparel Fabrics" and a study of fabrics available for consumer consumption during World War II as compared to pre-war fabrics.

Consumer research is recognized today as a valuable part of our production of textile products. However, consumers must remain alert and continue the fight for getting their money's worth.

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[3]Pauline Berry Mack, and others, Resume of an Eight-Year Series of Consumer Studies on Silk and Rayon (Pennsylvania State College Bulletin, vol. XXXIII, No. 42, 1939), p. 214.

CHAPTER III

A BRIEF SUMMARY OF THE TESTING METHODS AND

TECHNIQUES APPLICABLE TO CONSUMER PROBLEMS

The testing of textiles is a vital function both for the textile industry and for the consumer, though the latter does not always recognize or understand its importance.

There are three basic types of testing:

1. Developmental research - which gives the consumer new products from industry.

2. Quality control testing - through which industry seeks to meet high standards of quality and performance.

3. Performance testing.

Performance testing may be conducted by manufacturers, but it is into this area of testing that consumer research falls. Each type of testing requires laboratory facilities of some kind. In performance testing, there are three classes of tests:

1. Visual tests. These tests require accuracy of the eye in judging quality and performance, and may demand magnification.

2. Physical tests are used to determine the physical characteristics of fibers and fabrics, and to predict the behavior of fabrics in end-use.

3. Chemical tests indicate the effect of chemicals and other factors which might affect the performance of fibers and fabrics.

Fiber analysis. The consumer usually classifies fibers according to their chemical content. Before the days of test tube fabrics, she could, with a little practice, identify the fabrics available to her by their appearance and feel. Today, however, the new organic fibers and the adaptations possible with the natural fibers have made such visual identification very difficult.

One of the simplest identification tests that can be performed is the burning test. In this test the speed and nature of burning, the odor resulting, and the remaining residue may give some conclusive indication of the fiber's nature. This test may be used by the consumer. However, because of the great variety of fibers now available and their varying characteristics, this is not a positive method. The most certain identification of textile fibers is by means of the microscope used in conjunction with chemical tests.[1] The American Association of Textile Chemists and Colorists publish each year a Technical Manual and Year Book which contains full instructions for carrying out recognized standard or tentative test methods and techniques for identifying fibers and for determining other physical and chemical properties of fibers and fabrics which affect their performance. These test methods and techniques are recognized by both the textile industry and those engaged in consumer research in clothing and textiles. Most of the tests referred to in this section are those set up by the AATCC.

Yarn analysis. Yarns are of two fundamental types - simple yarns or ply yarns (those made up of more than one simple yarn). Since

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[1]American Association of Textile Chemists and Colorists, 1935 Technical Manual and Yearbook of the AATCC, XXXI (New York: Howe Publishing Company, 1955), p. 88.

fibers or filaments are used to make yarns, it is important to know something of their physical structure. The manufacturer is interested in the characteristics of the individual fibers or filaments so that he can spin them into yarns suited to the product he is making. Those in consumer research are interested in knowing the nature of the fibers used in making yarns as an indication of what might be expected from the final product in performance.

Tests made on yarns include staple length measurement in which the actual length of the fiber making up the yarn is measured and recorded to the nearest hundredth of an inch. Filament count is another important test in which a count is taken of the number of filaments in a filament yarn. This test is used only on those yarns made from filament staple (the synthetic fibers).

The yarn number or size of all common spun-yarns is based upon the length contained in a specific weight of yarn. There are several systems for calculating yarn number - the cotton system, the worsted system, and the woolen system. The denier or size of all continuous filament yarns is based upon the weight of a standard length of yarn of that type. The Suter Yarn Numbering Balance is an instrument now being used which makes it possible to determine quickly the yarn number or denier of a yarn.

Yarn twist may be determined by the use of a twist counter. Procedures will vary with the instrument used, but the principle of all instruments consists of counting the number of turns necessary to untwist the yarn. Twists may be inserted into yarn in two directions, S or Z. Determination of the direction of twist must be made before an accurate count is achieved. Twist is recorded in number of twists per inch.

Yarn strength may be determined by testing a single yarn or a skein of yarn in a suitable machine. A Scott Tester is the most common one used.

Yarn analysis tests alone cannot give conclusive information concerning the behavior of fabrics in performance. Other tests are necessary, but a background knowledge of the yarns making up the fabrics is essential to a true understanding of fabric analysis data.

Fabric structure analysis. The tests used to determine fabric structure are understood more readily by the retailer and the consumer than are the previous tests, for they relate to the texture and quality of the fabric. An understanding of the proper use of these terms is helpful in selecting fabrics.

The weave of a fabric is determined by examining the interlacing of warp and filling yarns and comparing it with a known weave. Magnification may or may not be necessary for maximum satisfaction. Consumers may learn to identify weaves through experience or by referring to a variety of art, textile, and clothing books. Many fabrics are identified by the name of a weave, for example, silk crepe, cotton twill, and silk satin.

Thread count is the number of warp and filling threads used in making one inch of fabric. This count indicates the balance of the cloth. Good balance may be achieved by using the same number of yarns in both warp and filling or by using yarns of different size. Count is determined by the use of a micrometer. It is usually expressed by placing the warp count before the filling count - i.e., 80 x 70.

Fabric weight is important as an indication of performance. The weight of a fabric may be determined and expressed in different ways, but weight (ounces) per square yard is the more commonly used standard.

Fabric thickness may be of importance to the consumer, especially in heavy duty fabrics. Thickness can now be determined to the nearest thousandth of an inch by means of a thickness gauge tester.

The textile technician, by combining the data from yarn and fabric analysis tests might be able to make some predictions about the performance of a fabric. But additional and more accurate conclusions can be drawn if fabric serviceability tests are made.

Serviceability tests. These tests are usually performed by the manufacturer and the results are passed on to the consumer through promotional material. However, these tests are used rather successfully by consumer research laboratories in conjunction with actual wear tests.

Serviceability tests can duplicate the effect of one force at the time. But in actual use the fabric may be subjected to a number of varied forces at the same time. Wear tests are the most accurate method but are difficult to standardize. For maximum satisfaction, sampling must be large. The full cooperation of those participating in the tests is essential. A big disadvantage is that wear tests take time to complete properly, and the retailer or consumer may want quick results. Therefore, the following serviceability tests are used as a basis for judging performance.

The bursting strength test is a measure of the force necessary to rupture a circular specimen of material.[2] The primary use of this test is to determine strength characteristics of non-directional materials and to verify tearing strength tests on woven fabrics. Several testers are available. The Mullen Tester uses a hydraulic system with pressure exerted on the specimen by a rubber diaphragm measured in lbs./square inch. The Scott Ball Burst Machine is a mechanical system which forces a steel ball through the material and is measured in pounds of force on the ball which is one inch in diameter.

The tearing or breaking or tensile strength test is used to indicate the durability and resistance to wear of the fabric. The test indicates the number of pounds required to break a given amount of fabric, and is generally performed on a Scott Pendulum Tester, though several other methods may be used.

Dimensional stability is a feature consumers find most necessary in textile products. Few fabrics are sold today without first receiving some treatment to give greater dimensional control. Test results are expressed in terms of percentage change in each direction (warp and filling). Fabrics undergo considerable strain in wear and cleaning and are likely to show some change in size. Much time has been devoted to the study of dimensional changes in fabrics. As a result the following percentages have been established as criteria for judging satisfactory performance:

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[2] Textiles and Testing Course of Study, Consumer Service Group, U. S. Testing Company, Inc., Hoboken, N. J., 1955, p. 51.

> "1% change (about 3/8" per yard) is the maximum amount of residual shrinkage desired for greatest satisfaction in use.
> 2% change is not likely to be objectionable in consumer use although it is more than desired.
> 5% changes are exorbitant. Fabrics with this amount of shrinkage would have little value in consumer use."[3]

Standard methods of testing for dimensional change on all fabrics have been set up by the AATCC.

Abrasion resistance tests, which indicate the fabric's resistance to rubbing on the kind of wear the elbow of a sleeve receives, have not been standardized as to testing device or procedure. The value of the present tests rests in the comparison possible between fabrics rather than as an indication of the individual fabric's qualities - though it may be helpful when dealing with a single fabric.

Because color is such an important consideration today in textile products, colorfastness has become important as a serviceability test. Standards for testing and evaluating the colorfastness of textiles to a variety of conditions have been established by the AATCC. "Colorfastness to Commercial Laundering and to Domestic Washing" is a test in which ". . . color loss similar to that produced by commercial and domestic washing is reproduced on a laboratory scale (. . .) applicable to textiles made of cotton, linen, and manufactured organic fibers, and mixtures thereof, in the form of yarns and fabrics whether dyed, printed, or otherwise colored."[4] A standard test has been set for silk, and tentative test

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[3]"Textile Testing for Home Economists", Textile Research, School of Home Economics, The Woman's College, University of North Carolina, September, 1955.

[4]American Association of Textile Chemists and Colorists, op. cit., p. 56.

procedures for wool and organic fibers. Standard equipment and methods have been established for colorfastness to perspiration and rubbing (cracking). Tentative test methods now being used and perfected include tests to determine a fabric's colorfastness to dry and wet heat (hot pressing), pleating, dry cleaning, water (sea water and chlorinated pool water), and sunlight. Various simplified rapid control tests have been developed in many of these areas and are being perfected along with the more detailed test procedures. One of the more common "speeded-up" tests is the carbon-arc lamp test which is a laboratory method for the rapid evaluation of colorfastness to sunlight. However, evaluation of results has been difficult to standardize.

Miscellaneous performance tests. Other tests are often desired to indicate certain performance features.

With the advent of the new miracle fibers, crease resistance became an important feature. Tentative standard procedures have been established by the AATCC for the determination of crease recovery and wrinkle resistance. The Monsanto wrinkle recovery tester is most common but offers much chance of error. The Roller Pressure Crease Recovery Tester has a precision of + or - 1 degree, which for most materials results in an error of 1 or 2 per cent.

A standardized test for determining the flammability of clothing textiles was established in 1952. However, since the passage of the Flammable Fabrics Act in 1954, additional work is being done to raise standards so that at the present time, there is no recognized standard, only a tentative test.

The AATCC has established tests to cover biological procedures for determining resistance to insect pests of textiles that contain wool or other susceptible fibers. Other tests cover procedures for the evaluation of compounds designed to protect fibers and fabrics from damage by insect pests and mildew.

Water absorbency tests are important to the towel and diaper industry and their consumers. On the other hand, water resistance (the ability of a fabric to resist wetting and penetration of water) and water repellency (the ability of a fiber, yarn, or fabric to resist wetting) are features often demanded by consumers. Various kinds of water repellency tests exist. Immersion tests, rain test, impact test, spray test, and tests to determine the effect of finishes applied to the fabric are some commonly used. Most of these tests are applicable to any fabric. Some can be used to determine probable rain penetration resistance of fabrics, others cannot.

Little has been said concerning chemical testing methods. Most of the chemical testing used in consumer research is used for qualitative and quantitative examination of fabric content. Most serviceability and performance tests are physical tests, since they most nearly reproduce the treatment textile products usually receive in use. Though laboratory tests cannot reproduce in every detail the treatment fabrics receive in wear and use, nevertheless, these tests have been successfully used as means for predicting expected performance.

Many of the tests mentioned in this chapter were used in the study of Acrilan as reported in the second part of this paper. In Chapters III and IV of Part II, these tests are described in more detail.

CHAPTER IV

PRESENT-DAY TRENDS AND NEEDS IN CONSUMER RESEARCH

Household Finance Corporation states that the eleventh "better buymanship principle" is "Give due emphasis to spiritual and psychological values."[1] The sociological and psychological aspects of consumer motivation are receiving a great deal of attention from both business and consumer research.

In the area of consumer research the matter of informative labeling is still a problem. One writer has said, ". . . the question which is raised in connection with the problem of informative advertising and the factual, product-information approach to buying, is that it is not certain as yet to what extent the consumer really wants, will use or can use, specific product information."[2] Business has long recognized the need for some degree of standardization in advertising terms. As a result, many industries and advertising agencies have organized consumer advisory panels as a means of getting consumer information and reactions.

Professional research people in clothing and textiles have begun to give attention to the psychological and sociological effects of clothing. A number of such studies have been published since 1950. One of the most extensive of these was that carried out by Mary S. Ryan at the Cornell University Agricultural Experiment Station. This was a

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[1] "George Clark's Cartoons on Better Buymanship," Edited by the Department of Research, Household Finance Corporation, Chicago: 1942.

[2] Information in Advertising, Committee on Consumer Relations in Advertising, Inc. (New York: 1941), p. 51.

study in four parts of the psychological effects of clothing, the social and aesthetic aspects, on young people of college and high school age. Another new and very interesting study, published in 1955, was made by William H. Form and Gregory P. Stone of Michigan State College in the form of an inquiry. Their problem was the study of the social significance of clothing in occupational life as the men of the working world see it. General clothing importance, preferences for work clothes, and violations of clothing norms were among the questions included in the study.

Practices followed by consumers in buying "large expenditure" items of clothing, furniture, and equipment was the focal point of a recent study under the direction of Calla van Syckle at Michigan State College Agricultural Station. Other new studies sponsored by the U. S. Department of Agriculture have included studies of women's preferences among selected textile products (with particular emphasis on cotton as compared with other fibers), mothers' opinions of fibers in selected items of children's clothing, and a study of men's preferences among wool suits, coats, and jackets.

One of the most fascinating trends noted in the business world today is the emphasis on researching the consumer. Does the consumer know his own mind? A new type of research is being developed by business and industry which will have a direct influence on the consumer. That is motivation research. Its technique is still so new that its effectiveness is not yet known. Its theory is that "consumers' opinions are often so boxed in by emotional blocks or are so deeply buried in the subconscious that people are either unwilling or unable to tell the ordinary pollster the truth."[3] Yes and No answers are not used, rather the "depth interview" is being developed. The consumer is carefully selected as to age, income, and geographical location. There are no set questions, rather just long talks while the interviewer looks for psychological clues. Another source calls this "phenomenological psychology" or ". . . the study of individual subjective evaluation, rather than of mass behavior patterns."[4]

Clinical and social psychologists, sociologists, anthropologists, even hypnotists have gravitated to market studies.[5] There is, therefore, confusion among the disciples of this new research. Multisyllabic scientific jargon, the doubtful qualifications of some of the researchers, the weird reports resulting, and the squabbles among the researchers themselves are problems to be overcome. Two opposing camps have formed. Those who rely on statistical research vs. those in motivation research. Among those investigating motivation research loom two controversial figures - Alfred Politz and Ernest Dichter.

Politz, head of the Institute for Research in Mass Motivation, Croton-on-Hudson, New York, says that what people call motivation research is not research at all, though he admits its value, and uses

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[3] Sandford Brown, "Inside the Consumer," Newsweek, 46 (October 10, 1955), p. 89.

[4] "Will Customers Take a Chance?" Business Week (April 30, 1955), p. 82.

[5] Sandford Brown, op. cit., p. 90.

it, to generate ideas and suggest lines of inquiry for his opinion polls. "It is pointless to concentrate on basic motives in consumers when the only important task is to find motives which can be controlled to commercial advantage . . . basic or not."[6]

Dichter's theory is that all consumer buying motives are grounded in one or more of four basic human drives - sustenance, sex, security, and status.[7] Therefore, once a businessman proves where his product falls in relation to these four S's, he can better gauge his selling appeals. Dichter claims that his method eliminates the need for large-scale samplings common to standard research, because once universal psychological patterns are established, repetition is needless and expensive. However, the cost of his method is about equal to other types of surveys due to the intensive interviewing used. As yet, sales results from this type of research have not been announced.

Other middle-roaders exist, of course, and are developing their own techniques. Among them are Nowland and Company, Greenwich, Connecticut; James M. Vicary Company, New York; Social Research, Incorporated, Chicago; and Elms Roper, New York. In 1952, Consumer Behavior, Incorporated, was established by Consumers' Union for the purpose of promoting research into how a consumer behaves and why. Psychologists, anthropologists, sociologists, economists, market research experts, and business have pooled their resources to establish

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[6] Ibid., p. 93.

[7] Ibid., p. 91.

a true science of consumer behavior.[8]

Motivation research is therefore a research of the consumer herself. However, the findings of this new research will have much influence on the products industry turns out. Therefore, it behooves the consumer to keep up with this new frontier of the business world.

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[8] "How Consumers Take to Newness," Business Week (September 24, 1955), p. 41.

CHAPTER V

FUTURITY

The United States today has a population of over 161 million people. Consumer expenditures for clothing in 1953 totaled 17 billion dollars, or 6.9% of total consumer income. The long-term outlook for textiles, as well as other consumer goods, is associated with the dynamic elements in the economy[1] - population growth, mobility of population, and more money to spend. The men's wear market is expected to increase from about 55 millions in 1950 to 70 millions in 1970. The women's wear market is expected to increase by 18.2 million women - from 56.1 to 74.3 millions.[2] These figures indicate that clothing and textiles will continue to be an important part of both our business' world and our consumer's world. If this be true, then business will continue to research its customers in an effort primarily to achieve the greatest profits possible and still meet consumer demands. Once the fad aspects of motivation research have simmered down, businessmen will have a clearer idea of what it is and what it can do.

The ultimate consumer stands to benefit from industry's research. However, the same movement toward motivation research needs to be continued by professional researchers outside of industry, and there is every evidence that this kind of study is being explored by colleges, universities, experiment stations, the Department of Agriculture,

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[1]Ruth Jackendoff, "What's Ahead for Clothing Markets," (The Wool Bureau, Inc.,(New York: 1954), p. 4.

[2]Ibid., pp. 5,7.

and independent agencies. Social class norms, the new middle-income group, new suburbs, the urban Negro market, changing family relationships, personality attitudes, the feminine market, community leadership, and their effects on economic behavior are areas which surely deserve exploration in the future. A new kind of researcher trained in both market research and the social sciences is needed for most effective results. Here is opening a new professional field.

In the field of clothing and textiles itself, as long as new products and variations of the old are introduced, the consumer will need the aid of unbiased, objective research to acquaint her with the truth about these products. Consumers must continue to demand consumer research if they are to meet industry's efforts to maintain effective production and comfortable profits and still command respect as consumers with rational judgment and reasonable intelligence. Consumer research then is essential to a continued high standard of living in an economy such as ours.

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PART II

A STUDY OF THE SERVICEABILITY OF SELECTED ACRILAN FABRICS

CHAPTER I

INTRODUCTION

I. The Importance of Synthetic Fibers Today

The first man-made fiber of commercial value was produced from pulp of mulberry leaves in 1864 by Count Hilaire de Chardonnet. "Artificial silk," or rayon as it was named in 1924, has long been accepted by consumers. Successful development of the rayons has provided incentive for the development of other man-made fibers.

The success of Nylon, the first fully synthetic fiber, provided added incentive to the textile world to develop fibers by chemical synthesis and controlled polymerization. The trade recognized the demand for other fibers with unusual properties, and since the advent of Nylon on the consumer market in 1937, synthetics have increased in number and importance. Economic conditions have favored the synthetics since 1940. Population has increased. Consumers have had more dollars to spend so that there has been an increase in actual dollars spent for clothing.[1]

"If we assume (. . .) that the growth potentials of the economy will continue to be effective, we can reasonably expect a further gain in clothing expenditures by 1965 of about 52 per cent."[2] Man-made fibers have shown a steady increase in per capita consumption

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[1]Robert C. Shook, "You Can Expect Big Future Gains For Man-Made Fibers," Modern Textiles, XXXVI (April, 1955), p. 39.

[2]Ibid., p. 54.

since 1920 and represent "the most rigorous and rapidly growing section of the industry. About 30 per cent of all fibers consumed in 1965 will be man-made fibers, as compared with 24 per cent in 1953 and 11 per cent in 1939.[3]

In a recent article, Frank J. Soday[4] has stated that the basic principles underlying the production of fibers as outlined by Robert Hooke in 1664 are applicable to the synthetics. These principles are:

1. The provision of a composition having the desired physical and chemical properties.

2. Shaping the composition into filaments of the required size and shape.

Mr. Soday also states that the "chief function of the new synthetic fibers is to supplement, rather than to displace, the natural fibers."[5] Synthetic fibers can meet uniform, rigid specifications more readily than the natural fibers. They are also claimed to have a stabilizing influence on the prices of other fibers because their production is based on readily available chemical raw materials.[6]

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[3] Ibid., p. 40.

[4] Frank J. Soday, "Acrilan Claimed to Possess Outstanding Properties for Apparel," Knitted Outwear Times, 21:9 (March 2, 1953), p. 5.

[5] Ibid.

[6] Ibid., p. 29.

"In researches carried out in this country and abroad for the past several years, it has been demonstrated that polymers of acrylonitrile are outstanding fibers forming materials, from both Robert Hooke's point of view and the trade's point of view. Acrilan is the newest of the acrylic (acrylonitrile polymer) fibers."[7]

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[7]M. I. Kahn, Jr., "A is for Acrilan," Textile Forum, 10:2 (April, 1953), p. 12.

II. The Problem

Statement of the problem. The purpose of this study was: (1) to compare the construction of selected fabrics of Acrilan and Acrilan - Rayon blends, (2) to test the performance of these fabrics under controlled laundering conditions, and (3) to test their resistance to a selected group of common spots and stains.

Importance of the study. The manufacturers of Acrilan are making outstanding claims of unusual properties. During the past twelve months, an intensive advertising campaign has placed the big red "A" before consumers all over the country.

Acrilan sweaters are advertised as washable, fast drying, and needing no blocking to insure shape retention. The buyer is told to relax when she stores her Acrilan sweater, for it is safe from moths and mildew.

Acrilan fabrics by the yard are advertised as "rich to the touch, fresh and luxurious to see." "Wrinkles that do creep in . . . simply hang right out!" They are said to be washable by hand or machine and dry cleanable. "The shape, the color, the touch stay in the dress." Little or no ironing is required. Spots and stains wash right out. "Pleats and creases will stay put."

Particular emphasis has been placed on Acrilan's great dimensional stability through many washings by hand or machine. The idea of little or no ironing has been stressed, as has the claim that spots wash out with no extra effort. Warmth without weight is also claimed.

Garments and yard goods of 100% Acrilan and Acrilan blended in various proportions with other fabrics are appearing in consumer markets in increasing volume - in sweaters, sportshirts, suits, dresses, blouses, skirts, slacks, children's wear, work clothes, blankets, and deep pile coats. Acrilan is appearing with varying faces - soft, crisp, smooth, deep piles, flannels, light-weights, sheers, knits, and crepes. Acrilan fabrics are appearing in an unusually broad range of colors and values. All these facts make Acrilan seem highly desirable. But unbiased research is needed to acquaint the consumer with the true character and serviceability of this new fiber which is less than four years old.

Are the new Acrilan fabrics available in local stores? How do they respond to pleating? Wearability and good appearance with a minimum amount of care is important to today's consumer. Can Acrilan fabrics be laundered or dry cleaned and restored to their original appearance as well as the promotional claims would lead one to believe? Does Acrilan exhibit static qualities as do so many of the other synthetics? Do the dyes used retain their life through many washings and cleanings? How resistant are these fabrics to spots, moths, and mildew?

Limitations. Men's and women's sweaters have been the most popular outlets for Acrilan since its debut in 1952. Manufacturers, however, have been advertising a wide selection of goods-by-the-yard for home sewing. The present study was limited to light weight fabrics suitable for blouses, dresses, and suits.

The fabrics available were a limiting factor. In spite of the voluminous promotional material, almost no fabrics were available on yard goods counters of retail stores. It was therefore necessary to obtain the fabrics used in the present study from fabric manufacturers and wholesale houses. Even so, the choice of fabrics was limited to those of plain weave blends, crepe weave in blends and 100% Acrilan, and all-Acrilan jerseys. This limitation is thought to be due to the fact that Acrilan as a woven fabric has yet to prove itself in competition with the older, more well-established fibers. It is believed that the present study includes fabrics representative of the types now available to consumers, and is therefore a valid study.

III. Organization of the Study

Chapter II presents a review of literature dealing with the development, manufacture, properties, and uses of Acrilan. Chapter III presents the methods used in securing the test fabrics, procedures for laboratory analyses, serviceability tests of fabrics, and the laboratory laundering procedures. Data from the laboratory tests is presented and discussed in Chapter IV. A summary of the findings, conclusions, and recommendations for further study are included in Chapter V. Illustrative material showing Acrilan at various stages of production is presented in the appendix.

CHAPTER II

REVIEW OF LITERATURE ON ACRILAN

Development and Manufacture of Acrilan. On May 16, 1949, at Wilmington, Delaware, the Chemstrand Corporation was chartered to engage in research, development, and production of synthetic fibers.[1] After twelve years of research, Chemstrand Corporation of Decatur, Alabama, launched its new fiber "Acrilan" on August 27, 1952, with a showing at the Hotel Pierre in New York. More than 75 styles, ranging from beachwear to ball gowns, from more than fifty manufacturers were included in the line of Acrilan merchandise unveiled at the fashion show. The fabrics included 100% Acrilan or blends such as 80% Acrilan and 20% wool, 50% Acrilan and 50% cotton, 50% Acrilan and 50% rayon. This new acrylic fiber made its debut in the consumer market on September 8, 1952.

Pilot plant production has been underway since 1950. "Acrilan is derived almost entirely from natural gas and air . . . Basic chemicals are manufactured in Texas. Natural gas and air are combined to form ammonia, then natural gas and ammonia are combined to form hydrocyanic acid. Natural gas itself is elevated in temperature and pressure to form acetylene. Finally acetylene and hydrocyanic acid are combined to form acrylonitrile (. . .). The liquid acrylonitrile is shipped to the Chemstrand Acrilan plant where it is polymerized, that is, the individual molecules are combined to form very much larger linear molecules, and this polymer is then reduced to a white powder having the appearance of talc. This powder is dissolved to form the spinning solution. Forced or extruded through the spinnerettes, the fiber emerges in the form of continuous filaments. These filaments are dried, crimped for greater bulk, cut into shreds,

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[1]"Acrilan Acrylic Fiber Makes Its Debut," Textile Bulletin, 78:9 (September, 1952), p. 137.

dried again, and then packed into 400 pound bales for shipment to textile mills."[2]

Physical and chemical properties. From industry's point of view, the major characteristics of Acrilan are: (1) ready processability on conventional textile machinery, (2) a characteristic good hand, (3) warmth without weight, and (4) dyeability.[3]

Acrilan is being produced in 3 to 5 denier sizes ranging in staple length from 1½ inches to 5 inches. It is available in two staple forms: regular staple having normal strength and shrinkage of 2 per cent or less in single filament, and high-bulk staple[4] having shrinkage of 20 per cent in single filament.[5] An important property of Acrilan for industry is the ease with which it can be processed into yarns and fabrics on standard cotton and woolen machinery. No static problems are encountered in processing due to the development of a satisfactory finish. Acrilan can also be knit on all types of knitting machines - full-fashioned jersey, circular transfer jersey, and fine gauge.[6]

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[2] M. I. Kahn, Jr., "A is for Acrilan," Textile Forum, 10:2 (April, 1953), p. 12.

[3] Frank J. Soday, "Acrilan Claimed to Possess Outstanding Properties for Apparel," Knitted Outerwear Times, 21:9 (March 2, 1953), p. 29.

[4] Hibulk Acrilan is discussed in the section "Outlook for Acrilan."

[5] "More Facts About Acrilan," Textile Mercury and Argus, 134:3491 (March 2, 1956), p. 360.

[6] Ibid., p. 363.

Acrilan with a specific gravity of 1.135 is the lightest textile fiber. It offers great bulk and coverage in low-weight fabrics.

Mr. Walter Hindle of Chemstrand Corporation quoted recently on the dyeability of Acrilan, saying:

> "Today Acrilan is the most dyeable synthetic fiber on the market (. . .) all classes of dyes may be applied to it without the necessity of carriers, pressure, or other techniques (Usually necessary for synthetics)."[7]

Acrilan can be dyed at normal temperatures and in a full range of shades. All forms of acid dyes, many acetate dyes, basic dyes, and sulfuric acid esters of vat dyes may be used depending on the fastness required and depth of shade desired.[8] Dispersed acetate dyestuffs are most satisfactory when good fastness is desired. Basic dyestuffs give brightness.[9]

From the consumer's standpoint, Acrilan is offering "carefree" properties of wrinkle resistance, crease retention, washability and quick drying properties, "aversion" to spots, warmth without weight, dimensional stability, and resistance to degradation by micro-organisms and sunlight.

Acrilan's great affinity for dyes offers the consumer protection from cleaning and light fading. Its low specific gravity and high bulk

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[7] "Acrilan Said to be Most Dyeable of All Synthetics," America's Textile Reporter, 69:43 (October 27, 1955), p. 17.

[8] J. A. Woodruff, "Dyeing the New Acrylic Fiber Acrilan," Textile Age, 16:10 (October, 1952), p. 52.

[9] "Acrilan's Dyeability Appealing to Knitters," America's Textile Reporter, 69:15 (April 14, 1955), p. 73.

make possible "warmth without weight." Acrilan is hydrophobic, or moisture insensitive, so that fabrics and garments made of Acrilan will resist wrinkling and mussing and retain pleatings and creases. Because the fiber is thermoplastic, pleats can be set in at high temperatures. Only reheating at a higher temperature should remove such pleats. Like other synthetic fabrics, it resists damage from mildew, mold, and moths. Maximum appearance with a minimum of upkeep is the basis of appeal to the consumer market.

Use with other fabrics. "In 100 percent adaptations of Acrilan, the fabric will support (these) functional claims (made for it by the manufacturer). When Acrilan is blended with other fabrics, the percentage content and the type of fiber with which it is blended virtually dictates the degree to which these Acrilan properties can be claimed for the particular garment. To assure proper handling and care of each garment in the Acrilan debut, a manufacturer's hand tag identifies the fiber content with recommendations for cleaning procedures."[10]

Acrilan is being blended with other synthetics and with the natural fibers. Blends of 50% Acrilan - 50% rayon, 25% Acrilan - 75% rayon, 80% Acrilan - 20% wool, and 50% Acrilan - 50% cotton are available.

The dyeing of blends is not a problem so long as fastness requirements are not very stringent. With viscose and Acrilan, it is possible to dye both fibers using direct viscose dyes for the viscose and acetate dyes for the Acrilan. Better fastness is obtained by dyeing the Acrilan and then direct dyeing the viscose. With

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[10]"Acrilan Acrylic Fiber Makes Its Debut," Textile Bulletin, op. cit., p. 137.

acetate, the Acrilan is dyed with acid dyeing techniques followed by careful acetate dye application.[11] Blends with wool are more difficult in union shades since wool will rob Acrilan by more rapid exhaustion of dye.[12] The dyeing of blends in piece goods is an area needing more research in the development of Acrilan blends.

Outlook for Acrilan. On November 1, 1955, the price of Acrilan acrybic was reduced 32 cents per pound by its manufacturer. According to Robert C. Shook of Modern Textiles Magazine, price declines for new fibers are natural. Much of the initial fabric development carried out is based on the assumption that new fabrics, which are first limited by their high price to the higher price retail brackets for finished goods, will eventually be available for distribution in greater volume.[13]

A more recent development in Acrilan is the Hibulking process. "Acrilan acrybic fiber has (. . .) the ability to assume a temporary set which is stable at ordinary temperatures and humidities for a prolonged period of time. To all appearances, this metastable fiber is in no way different from the stable fiber except, perhaps, for a difference in crimp and slight difference in denier . . . the process consists of stretching a heated fiber and cooling of the fiber under tension, followed by release of the tension . . . Upon treatment with relaxing conditions, the yarn would shorten and become heavier (. . .) (increasing the) yarn diameter . . . If, however, we choose to place it in an oven, or preferably in boiling water or steam, this fiber immediately shrinks to its original

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[11]"The Processing of Acrilan," Textile Bulletin, 78:9 (September, 1952), p. 140.

[12]Woodruff, op. cit., p. 54.

[13]Robert C. Shook, "Outlook for Textiles," Modern Textiles, XXXVI, No. 12 (December, 1955), p. 30.

dimension, and no further . . . The Hibulking principle (. . .), therefore, relates to the production of a voluminous textile yarn resulting from the differential shrinkage of shrinking and non-shrinking modifications of the fiber in an intimate blend."[14]

The most extensive use of Hibulk blends today is in knit goods. However, when the Hibulk principle is applied to woven goods, it is possible to achieve unique effects through puckers, crepes, novelties, and fabrics with unusual hand. These Hibulk blends have the same "minimum care" advantages as regular Acrilan fabrics.

The Templon Spinning Mills of Mooresville, North Carolina, announced recently a process similar to Hibulking which produces an Acrilan fiber of cashmere-like softness. The acrylic filament is stretched under high temperatures and then broken into spinnable form. The new fiber has been named "Alana" and is to be used in the production of sweaters.[15]

The acrylic fibers have achieved most success volume-wise in products which utilize their esthetic qualities and performance properties judged by consumers to be superior to wool. Many of the gains of acrylic fibers have been at the expense of wool.

"Acrylic fibers, in short, have reached a point where they must begin to look for new fields. . . If there are new fields to conquer, in woven fabrics, the competition will be stiffer. The recent price reduction should encourage some expansion for acrylic fibers in the vast array of woven fabrics."[16]

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[14]S. Jack Davis, "Hibulk Acrilan" (Charlotte, N. C.: Piedmont Section of the American Association of Textile Chemists and Colorists, October 29, 1955) (Mimeographed).

[15]"Cashmere-Like Softness Imparted to Acrylics," Modern Textiles, XXXVI, No. 2 (April, 1955), p. 69.

[16]Shook, *loc. cit.*

CHAPTER III

METHOD OF PROCEDURE

Selection of fabrics. The fabrics included in this study were 100 per cent Acrilan and Acrilan and rayon blended fabrics of the types suitable for dresses, light-weight suits, and blouses.

The fabrics selected were obtained by contacting retail stores, wholesale houses, fabric manufacturers, and fiber manufacturers. Since Acrilan is a relatively new fabric to the consumer market and is therefore still limited as to availability, it is believed that the fabrics included in this study are representative of all those types now available to the consumer.

One and one-half yards of each fabric were purchased for laboratory testing.

Two fabrics of jersey were selected as suitable for dresses and blouses. Three light-weight crepe fabrics were selected as suitable for dresses and light-weight suits. One heavier fabric was selected as suitable for suits. The fabrics were purchased between October, 1955, and January, 1956.

ANALYSIS OF FABRIC CONSTRUCTION

Fiber content. No technical method of identification was used on those fabrics designated by the manufacturer's labels as 100% Acrilan.

The fiber content of the Acrilan and rayon blended fabrics was given by the fabric supplier and verified in the laboratory by the qualitative procedures recommended by the American Association for Textile

Chemists and Colorists.[1]

The oven-dry clean weight of the fabrics was obtained. The samples were then treated with 60 per cent sulfuric acid to remove the rayon from the blend. After thorough washing and neutralization, the samples were again oven-dried and weighed.

The per cent Acrilan content in the fabric was calculated using the formula $\frac{B}{A} \times 100$. Where A is the oven-dry clean weight of the sample, B is the oven-dry weight of the Acrilan after the rayon was removed. The per cent rayon content was calculated by subtracting the per cent of Acrilan from 100. Five samples were tested in this manner and averaged to give the mean fiber content.

Weave. The weaves were determined by observation and verified by use of the pick glass counter.

Weight per square yard. The procedure used was based on the test method recommended by Skinkle.[2]

Five samples, two inches square, were cut from non-adjacent areas of the fabrics. The oven-dried samples were weighed in an analytical balance. The weight per square yard was calculated by the formula: $S = \frac{36 \times 36}{A} \times \frac{G}{28.35}$. Where S in the formula is the ounces per square yard, A is the area of the sample in square inches, and G is the weight of the sample in grams.

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[1]American Association of Textile Chemists and Colorists, 1955 Technical Manual and Year Book of the American Association of Textile Chemists and Colorists (New York: Howe Publishing Co., 1955), Vol. XXXI, pp. 90, 91.

[2]John Skinkle, Textile Testing (Brooklyn, New York: Chemical Publishing Company, Inc., 1949), pp. 77-80.

The weights of the five squares were averaged to give the mean weight in ounces per square yard of the fabric.

Thread count. The test method used was that established by the American Society for Testing Materials.[3]

The fabric was spread smoothly on a flat surface with the Suter-counter, and the number of warp yarns in a linear inch was counted at five different places in the fabric. No two places counted included the same yarns, and no count was made nearer the selvedge than one tenth the width of the fabric. The average of the five counts was recorded as the number of warp yarns per linear inch.

The number of filling yarns per linear inch was determined in the same manner.

Fabric thickness. The compressometer type thickness gauge was used, and the tests were those recommended by the American Society for Testing Materials, Committee D-13.[4]

The fabric was placed on the anvil of the gauge and smoothed to free from wrinkles but was held under no tension. The pressurefoot was lowered on the fabric without impact and allowed to rest ten seconds before the dial was read. The dial readings indicated to a thousandth of an inch the distance between the pressurefoot and the anvil.

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[3]American Society for Testing Textile Materials Committee D-13 on Textile Materials, American Society for Testing Materials Standards on Textile Materials (Philadelphia, American Society for Testing Materials, 1954), p. 147.

[4]Loc. cit.

Five measurements were made over the surface of the fabric with none closer to the selvedge than one tenth the width of the fabric. The five readings were averaged to obtain the mean thickness of the fabric.

Staple length. The procedure used for determining staple length was based upon the test procedure for hand stapling of cotton fibers recommended by Skinkle[5] and modified so that yarns could be used instead of the unwoven tufts.

A warp yarn was removed from the fabric and untwisted. Fibers were pulled from the yarn and placed upon a slightly soiled ember. One of the fibers was smoothed and aligned on the scale of the ruler. The length was measured and recorded to the nearest sixteenth of an inch. Five warp fibers were measured in this manner, averaged, and recorded as the warp staple length.

The same procedure was used to determine the average filling staple length.

Yarn number. The yarn count or number, representing the number of units of length in a unit of weight, was calculated with the Universal Yarn Balance according to the recommendations supplied with the instrument.[6]

The procedure was based on the cotton system with 840 yards per number per pound. One yard length was used and the yarn number read directly on the balance. Three warp threads in 12-inch lengths were drawn from the material and weighed on the balance. The index pointer was then read to give the correct yarn number. The same procedure was carried out five

[5]Skinkle, op. cit., p. 35.

[6]Roller-Smith Precision Balance, Alfred Suter, Universal Yarn Numbering Balance, Instruction Sheet.

times and the results averaged to give the mean warp yarn number.

The same procedure was used to determine the filling yarn number.

Twist. The test procedure used to determine twist was that recommended by Skinkle.[7]

A scott twist counter was used. The gauge length was set at five inches, and the indicator set at zero. The single warp yarn was unravelled from the fabric to allow enough yarn to be clamped in the two jaws. The rotating jaw was revolved until enough twist was added to break the yarn. The dial and indicator were read and the direction of twist recorded. Another warp sample was drawn from the fabric and clamped in the jaws in the same manner. The rotating jaw was then turned in the opposite direction so as to first untwist the yarn and then to retwist it in the opposite direction until broken. The dial reading for twist and direction was again recorded.

This procedure was followed for five warp threads in each direction. The turns per inch were calculated using the formula:

$$T.P.I. = \frac{N_2}{2L_2} - \frac{N_1}{2L_1} \quad .$$

Where N_1 is the number of turns necessary to break a thread by adding twist, N_2 is the number of turns necessary to break a yarn that is first untwisted and then broken by adding twist. L_1 is the gauge length for N_1 and L_2 is the gauge length for N_2. The total warp turns per inch were added and the sum divided by five to give the average turns per inch.

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[7]Skinkle, op. cit., pp. 60, 64-65.

The same procedure was used to determine the twist of the filling yarns.

To determine the amount of twist in a ply yarn, the yarn was placed in the twist counter in the same manner used for single yarns. The rotating jaw was revolved until all the ply twist was removed. This point was reached when the strands were parallel and a needle could be passed from one jaw to the other. The direction and amount of twist were recorded. Five recordings of twist in one inch were averaged to give the mean amount of twist in the ply yarn. All the strands but one were broken off at the jaws and the twist in a single strand determined by the procedure used for single yarn.

PROCEDURES FOR LABORATORY ANALYSIS OF FABRIC SERVICEABILITY

Tests to determine dimensional change, breaking strength, bursting strength, and colorfastness were used to indicate the durability of the fabrics, and to help predict the serviceability in consumer use after laundering.

Preparation of test pieces. Six swatches eighteen inches in width and fifteen inches in length were cut from each yardage of fabric so that tests for dimensional change, breaking strength, bursting strength, and crease resistance might be determined on an original and after the first, second, fifth, tenth, and twentieth launderings. A ten-inch square following warp and filling threads was marked with a basting thread in the swatch to be laundered twenty times. In this way the same square might be measured throughout for dimensional change.

Following laundering and the determination of dimensional change, the swatches were cut to form the test pieces required for the breaking strength, bursting strength, and crease resistance tests.

Laundering procedure. The procedure used was adapted from a method recommended for home laundering fabrics of this type.[8]

A hand washing procedure was adopted due to the presence of the two knit fabrics selected. The swatches were washed two to three minutes at 100°F with a soap concentration of 10 g of a neutral flake soap to approximately 5 gallons of water. They were immersed and water squeezed through them or rubbed gently. Wash water was squeezed out rather than wrung out. Swatches were rinsed twice, swishing up and down through two fresh, lukewarm waters (90°F).

The last three steps of the recommended method, which called for the drying of the fabric by rolling in an absorbent towel and pressing while still damp, were altered to allow for the characteristics of these fabrics for developing and holding wrinkles if subjected to any pressure while wet. Therefore, the test samples were taken directly from the second rinse tub without squeezing and hung to drip dry in order to be judged for appearance. They were then pressed - as necessary - on a flat bed press at low temperatures.

Appearance. After the test swatches were allowed to drip dry, they were judged for wrinkle resistance to washing. The following criteria were set up to rate them for suitability in use with respect

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[8] Ruud Manufacturing Company, "Hand Washing Method Number 2 . . . Quick Time," All About Modern Home Laundering (Pittsburgh: Ruud Manufacturing Company, 1953), p. 47.

to the amount of pressing necessary:

Class 1 - No pressing necessary (surface free from wrinkles, usable in present state).

Class 2 - Small amount of pressing necessary (superficial wrinkles, easily removed; only moisture, heat and hand pressure required.).

Class 3 - Greater amount of pressing necessary (multiple wrinkles, not deeply set, however, but require heat, moisture, and pressure for optimum appearance).

Dimensional change. A ten inch square was marked in basting thread on the test swatch to be laundered 20 times. The square was measured after the first, second, fifth, tenth, and twentieth launderings to determine dimensional changes. The fabrics were laid on a flat surface without tension. Five measurements were taken uniformly over the square in both warp and filling directions. The five warp measurements were recorded to the nearest hundredth of an inch.

The warp measurements were averaged and the percentage of dimensional change determined using the following formula:

$$\frac{A - B}{A} \times 100 = C.$$

Where A is the original warp measurement, B is the warp measurement after laundering, and C is the percentage of dimensional change of the warp.

The same procedure was used in determining the percentage of dimensional change of the filling.

Breaking strength. Dry and wet breaking strength were determined by the raveled-strip method using the pendulum type testing machine specified by the American Society for Testing Materials.[9]

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[9]American Society for Testing Materials, op. cit., pp. 148-149.

Five specimens for testing dry strength were cut in the filling and warp directions each one and one-half inches wide and six inches long. Each strip was then raveled to one inch in width by removing approximately the same number of threads from each side. Due to limited yardage wet strength was determined from two to five specimens.

The tests were performed on the original fabric and after the first, second, fifth, tenth, and twentieth launderings. All tests for dry strength were performed on specimens conditioned for at least 8 hours at 65 per cent relative humidity and 70 degrees F within a tolerance of 2 per cent humidity and two degrees. Test specimens for determining wet strength were immersed in tap water for at least two hours before testing.

Tests were performed on a Scott tester and readings taken on the dial scale for light weight fabrics. The five dry warp readings were averaged for the mean dry warp breaking strength.

The same procedure was used to determine the average wet warp breaking strength, and dry and wet filling breaking strength.

Bursting strength. The diaphragm tester and procedure used were those specified by the American Society for Testing Materials.[10]

Dry specimens were tested under standard conditions of temperature and humidity as in the breaking strength tests. The specimens for determining wet bursting strength were immersed in tap water for at least two hours before testing. Tests were performed on the original fabric and after the first, second, fifth, tenth, and twentieth launderings.

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[10] Ibid., p. 158.

The dry test specimens were cut approximately five inches square. Five readings were taken on each specimen and averaged to give the mean dry bursting strength.

The same procedure was used to determine wet bursting strength. Due to limited yardage of the materials tested, mean wet strength was determined from two to five readings.

Light fastness test. An FDA-R type Fade-Ometer and the standards set up by The American Association of Textile Chemists and Colorists[11] were used to determine the relative colorfastness to light.

A three inch test specimen was placed in the holder. One third of the fabric was controlled throughout the testing. One third was exposed to 40 hours of light and the other third to 20 hours. Two specimens of each fabric were exposed.

At the end of the exposure periods, the color changes were rated by a scale[12] devised for consumer use in laboratory tests as follows:

Class I - No Color Change
Class II - Little change from the original
Class III - Definite change from the original but could still be worn
Class IV - Very evident change, could not be used again.

Colorfastness to laundering. Measurement of the amount of color difference due to laundering was determined by the use of a Photoelectric Twistimulus Colorimeter with three filters (reflectometer)

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[11]American Association of Textile Chemists and Colorists, op. cit., pp. 79-81.

[12]Helen Barton and Mina Dutz, et. al., "Colorfastness of Women's and Children's Wearing Apparel Fabrics," Journal of Home Economics, 34:539 (October, 1942).

according to the standards set up by the National Bureau of Standards.[13]

The percentage reflectancy of the surface color of each fabric was measured with blue, green, and amber filters on the original fabric and after the first, second, fifth, tenth, and twentieth launderings. Five readings were taken on each specimen and averaged to get the mean reading for each filter.

The unit of color difference from the original was calculated from the reflectancy readings of the washed fabrics. The formula used to measure the differences was devised by D. B. Judd and revised by the National Bureau of Standards and is shown in Illustration I.

Crease recovery. The Monsanto Wrinkle Recovery Tester was used to determine crease recovery in each fabric in the original and after the first, second, fifth, tenth, and twentieth launderings. The standards used were those established by the American Association of Textile Chemists and Colorists.[14]

All tests were made on flat and wrinkle-free fabrics conditioned at 65 + 2% relative humidity and 70° + 2°F for at least 8 hours.

Five warp specimens were creased and compressed under controlled conditions of time and weight. The specimen was suspended in the test instrument and allowed to recover. The recovery angle was measured at

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[13] Richard S. Hunter, Photoelectric Tristimulus Cholorimetry With Three Filters, National Bureau of Standards, United States Department of Commerce, Circular C 429 (Washington: Government Printing Office, 1942).

[14] American Association of Textile Chemists and Colorists, op. cit., pp. 136-137.

ILLUSTRATION I

MEASUREMENT OF AMOUNT OF COLOR DIFFERENCE

$$E = Fg \left\{ \left[7Y^{\frac{1}{4}} \sqrt{\Delta\alpha^2 + \Delta\beta^2}\, 10^2 \right]^2 - \left[K_1 \; (Y^{\frac{1}{2}}) \right]^2 \right\}^{\frac{1}{2}}$$

$K_1 = 100$ $\qquad$ $Fg = 1.00$

Fabric	original				
Corrected Blue Average Amber Average Green Average (Y)					
A – G G – B 0.4 (G – B) Denominator = B + A + 2G					
α = (A-G) /denominator β = 0.4(G-B)/ denominator					
$\Delta\alpha = \alpha - \alpha$ original $\Delta\beta = \beta - \beta$ original $\sqrt{\Delta\alpha^2 + \Delta\beta^2}\ .10^2$					
$Y^{\frac{1}{2}}$ $7\ (Y^{\frac{1}{4}})$* $\Delta C = 7(Y^{\frac{1}{4}} \sqrt{\Delta\alpha^2 + \Delta\beta^2}$					
$\Delta Y^{\frac{1}{2}}$ $\Delta L = K_1\ (\Delta Y^{\frac{1}{2}})$					
$\Delta E = \sqrt{\Delta C^2 + \Delta L^2}$					

*Compute $7(Y^{\frac{1}{4}})$ for standard and for any samples for which the value of Y differs from that of the standard by more than 10 per cent. For the latter samples, use the mean of the two values of $7\ (Y^{\frac{1}{4}})$; for others, use the value for the standard.

the end of a controlled time period with the degree scale in the "A" position on $0^\circ - 180^\circ$ line horizontal.

The percentage of crease recovery was calculated by dividing the crease recovery angle by 180° and multiplying by 100. The five warp measurements of percentage of crease recovery were averaged to give the mean percentage.

The same procedure was used for the filling direction.

RESISTANCE TO SPOTS AND STAINS

Preparation of test pieces and spots and stains reproduced. Two swatches of each fabric nine by eleven inches were marked off in twenty $2\frac{1}{4}$ inch squares. Each square was numbered and coded for a certain stain. The two swatches were duplicates of each other - one used as an original and one used as the washed swatch.

The stains were imparted to the fabrics as rapidly as possible and during the same time period. They were allowed to set 63 to 72 hours.

The set of swatches to be washed were laundered according to the same hand washing procedure used in laundering the swatches to be tested for colorfastness and dimensional change. The hand action in washing was a little more vigorous for the stained pieces than for the unstained pieces, as it would naturally be in a home laundering procedure.

The spots and stains reproduced were selected as being twenty of the most common stains likely to occur on clothing of the types that would be made of fabrics of the kind we used in the study. The stains, listed according to the code numbers used on the test square, are as follows:

1. Machinery grease
2. Mayonnaise
3. Tea - without cream
4. Tea - with cream
5. Coffee - without cream
6. Coffee - with cream
7. Cocoa
8. Jelly
9. Orange juice
10. Egg
11. Chocolate ice cream
12. Coca Cola
13. Blood
14. Ink - washable black
15. Pencil mark
16. Shoe polish
17. Fingernail polish
18. Lipstick
19. Mercurochrome
20. Red clay mud

CHAPTER IV

PRESENTATION OF DATA

DESCRIPTION OF FABRICS TESTED

Three 100% Acrilan and three Acrilan and rayon blended fabrics were selected for this study. They were collected over a period of four months - October, 1955, to January, 1956. Since very few of the Acrilan fabrics were available in the retail stores of Greensboro, it was necessary to purchase most of the fabrics elsewhere.

The prices of the fabrics ranged from $.99 to $2.97 per yard. The cost of each fabric is given in Table I.

The fabrics used are shown in Illustration II. They have been grouped according to fiber content.

Group A	100% Acrilan fabrics
Group RA	Acrilan-rayon blended fabrics

CONSTRUCTION OF FABRICS

All the fabrics in Group A were woven of yarns containing one fiber, Acrilan. Two of these fabrics were knit jerseys, so that many of the construction tests could not be run including filling staple length, filling yarn number, and filling twist count.

All the fabrics in Group RA were woven of yarns containing Rayon and Acrilan.

The data relating to the construction of the fabrics is shown in Table I and summarized in the following paragraphs.

Weave. Two of the fabrics, A-1 and A-3, were knit fabrics. Three of the fabrics, A-2, RA-1, and RA-3, were of a crepe weave. The other fabric, RA-2, was of the plain weave.

Weight. The weight of the 100 Acrilan fabrics ranged from 3.2 to 3.8 ounces per square yard and averaged 3.5 ounces per square yard.

The rayon and Acrilan blended fabrics ranged in weight from 5.0 to 5.3 ounces per square yard and averaged 5.1 ounces per square yard.

Thread count. Thread count did not vary greatly within groups or between groups.

The warp thread count of the 100% Acrilan fabrics ranged from 40 to 50 and the filling count ranged from 27 to 66.

In the rayon and Acrilan blended fabrics, the warp count ranged from 69 to 80 and the filling count from 56 to 63.

The average warp and filling thread count of the Acrilan fabrics was 44 x 44 as compared with an average count of 73 x 60 for the rayon and Acrilan fabrics. The loose construction of the yarns in the 100% Acrilan fabrics accounted for the difference in count.

Thickness. The Acrilan fabrics ranged in thickness from .016 to .023 inch with an average of .021 inch. The rayon and Acrilan fabrics ranged from .014 to .019 inch with an average of .017 inch.

The crepe weave fabrics of both groups ranged from .016 to .019, indicating that Acrilan fibers can be modified and used successfully in weaves characteristic to rayon.

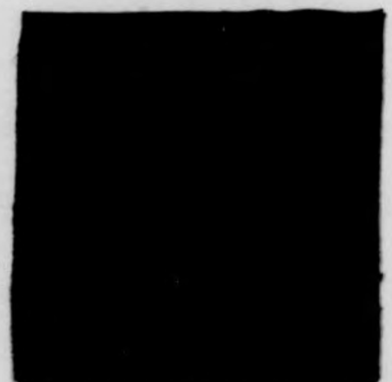
ILLUSTRATION II

FABRICS USED IN THE STUDY

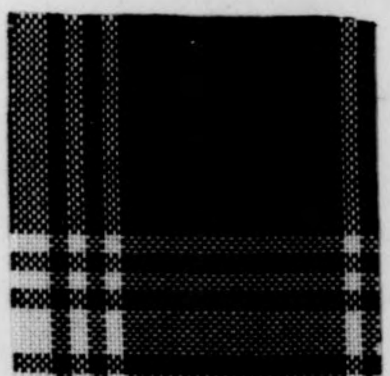
Fabric A-1

Fabric A-2

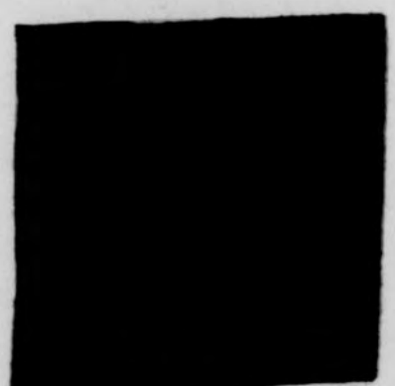
Fabric A-3



RA-1



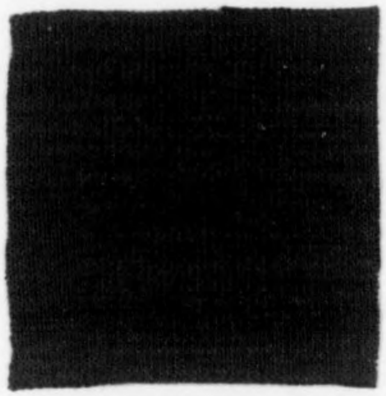
RA-2



RA-3

ILLUSTRATION II

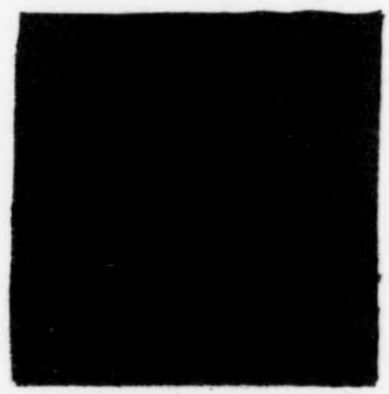
FABRICS USED IN THE STUDY



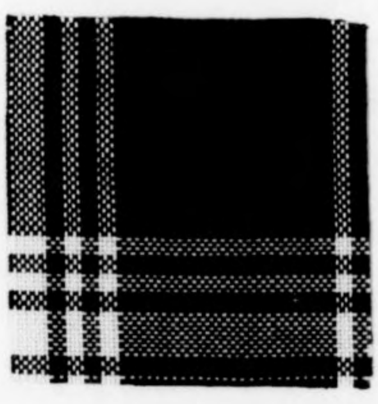
Fabric A-1

Fabric A-2

Fabric A-3



RA-1



RA-2

RA-3

TABLE 1

DATA PERTAINING TO THE CONSTRUCTION AND COST OF THE FABRICS

Fabric Number	Fiber	Content (Per cent)	Staple length (inches)		Yarn number (TYPP)		Twist Count and Direction of Twist				Thread Count		Weight (oz./ sq. yd	Thickness (inches)	Weave	Cost (per yd.)
			Warp	Filling	Warp	Filling	Warp	(Ply)	Filling	(Ply)	Warp	Filling				
GROUP A																
*1	Acrilan	100	2.0	—	16.2	—	18.3s	—	—	—	50	66	3.8	.023	knit	$1.60
2	Acrilan	100	2.7	2.6	29.0	28.4	45.0s	—	46.9s	—	42	39	3.2	.016	crepe	1.10
*3	Acrilan	100	1.4	—	18.2	—	22.4s	—	—	—	40	27	3.4	.023	knit	2.97
GROUP RA																
1	Acrilan Rayon	24.6 75.4	2.7	1.7	16.2	16.9	44.8s	—	48.8s	—	70	63	5.3	.018	crepe	1.29
2	Acrilan Rayon	51.0 49.0	2.5	2.4	10.4	10.6	36.4s	11.7s	36.2s	12.2s	80	60	5.0	.014	plain	.99
3	Acrilan Rayon	25.8 74.2	2.0	1.6	18.4	16.8	43.2s	--	49.2s	--	69	56	5.1	.019	crepe	1.10

*These were knit fabrics; many construction tests could not be run.

The two knit fabrics of all-Acrilan measured the same thickness although there was a notable difference in the number of wales and courses (A-1) 50 x 66 as compared with (A-3) 40 x 27. This would indicate that the latter (A-3) fabric was made of a fiber having more bulk than the former (A-1).

Staple length. The staple length for the all-Acrilan fabrics ranged from 1.4 to 2.7 inches in the warp. The Acrilan crepe measured 2.6 inches in the filling. The two knit fabrics had no filling threads.

The staple length for the rayon and Acrilan fabrics ranged from 2.0 to 2.7 inches in the warp and from 1.6 to 2.4 inches in the filling. The fibers were so fine that it was not possible to separate the Acrilan and rayon staple. Therefore the length recorded represents both fibers.

The average warp staple length for the all-Acrilan fabrics was 2.0 inches as compared with 2.4 inches in the rayon and Acrilan fabrics. However, the Acrilan crepe measured 2.6 inches in filling staple length compared with an average of 1.6+ inches for the filling staple of the blended crepes and 2.4 inches in the blended plain weave fabric.

Yarn number. The yarn number in the All-Acrilan fabrics ranged from 16.2 to 29.0 in the warp. The yarn number of the Acrilan crepe filling was 28.4. The rayon and Acrilan fabrics showed a range of 10.4 to 18.4 in the warp and 10.6 to 16.9 in the filling.

In each woven fabric, the warp and filling yarns differed only slightly in yarn number, indicating evenness of construction.

The all-Acrilan crepe contained finer yarns than those of rayon and Acrilan - 29.0 x 28.4 as compared with an average of 17.3 x 16.9 for the latter. The Acrilan crepe also had a lower thread count but in thickness averaged only slightly less than the blended crepes, indicating a looser weave.

Twist. The only fabric having a ply yarn was RA-2. The warp yarn had an S twist ply of 11.7 turns per inch and the filling yarn had an S twist ply of 12.2 turns per inch.

All other fabrics had S twist in both warp and filling yarns, including the individual yarns making up the two-ply yarns of fabric RA-2.

The amount of twist in the all-Acrilan fabrics ranged from 18.3 to 22.4 for the knitted jerseys. The Acrilan crepe measured 45.0 turns in the warp and 46.9 in the filling as compared with the rayon and Acrilan fabrics which ranged from 36.4 to 44.8 in the warp, with an average of 41.5 and from 36.2 to 49.2 in the filling, with an average of 44.7 turns per inch.

The one woven all-Acrilan fabric showed similarities to the woven rayon-Acrilan blended fabrics in yarn staple length and twist count and fabric thickness. Differences appeared in yarn number, where the Acrilan yarns measured finer than the blended yarns; in the thread count, where the Acrilan crepe showed a looser weave than the blended fabrics; and therefore in fabric weight, where the all-Acrilan fabric weighed an average of 2.0 ounces per square yard lighter than the blended fabrics.

RESULTS OF LABORATORY TESTS

Fabric appearance. The all-Acrilan and the blended fabrics generally retained their attractive appearance, color, and texture. Both groups, however, lost much of their crispness and liveliness of hand. Both groups compared favorably in appearance showing little advantage of one group over another.

The appearance of each fabric was judged after each testing period. The evaluation was based upon apparent resistance to wrinkling after being hung to drip dry. They were rated according to the following criteria set up for the study:

Class 1 - No pressing necessary (surface free from wrinkles, usable in present state).

Class 2 - Small amount of pressing necessary (superficial wrinkles, easily removed; only moisture and heat and hand pressure required).

Class 3 - Greater amount of pressing necessary (multiple wrinkles, not deeply set, however, but require heat, moisture, and pressure for optimum appearance).

The classifications of fabric appearance after laundering are presented in Table II.

TABLE II

Rating of Fabric Appearance After Laundering

Fabric Number	Number of Times Laundered 1	2	5	10	20
Group A - All-Acrilan Fabrics					
1	3	3	2	1	1
2	3	3	3	2	1
3	1	1	1	1	1
Group RA - Acrilan-Rayon Blended Fabrics					
1	3	3	2	3	1
2	2	2	1	1	1
3	2	1	3	1	1

Fabrics A-1, A-2, and RA-1 were all in Class 3 after the first laundering and after the second laundering. Fabrics A-1 and RA-1 changed to Class 2 after the fifth laundering, but A-2 retained a Class 3 evaluation. Fabric A-1 rose to Class 1 after the tenth and twentieth launderings. Fabric A-2 changed to Class 2 after the tenth laundering and to a Class 1 rating after the twentieth laundering, while fabric RA-1 returned to a Class 3 rating after the tenth laundering and changed to Class 1 after the twentieth.

Fabric A-3 remained in Class 1 throughout the twenty launderings. The printed design in this fabric helped to conceal surface wrinkles so that pressing was unnecessary for an acceptable appearance.

Fabric RA-2 held a Class 2 rating for the first two launderings. It changed to Class 1 after the fifth and retained this classification through the tenth and twentieth launderings. As the crispness of its finish lessened with launderings, its colored pattern helped to conceal surface wrinkles and made pressing unnecessary.

Fabric RA-2 was in Class 2 after the first laundering but changed to Class 1 after the second. It dropped after the fifth laundering to a Class 3 but rose again to Class 1 for the tenth and twentieth launderings.

Other observations were noted as the fabric appearance was evaluated.

Fabric A-3 discolored the wash and rinse waters up through the fifth launderings. This fabric was never washed in contact with the other samples. Black and orange specks - supposed to be dye particles not absorbed by the fibers - were also noted in the rinse water through the fifth laundering of fabric A-3.

Throughout the twenty launderings, fabric RA-2 remained reluctant to absorb water, and the fabric never seemed fully permeated - very much like a piece of wool might behave. This would be an excellent fabric for water repellant coats.

After the fifth laundering, steam no longer helped to restore body to the fabrics. The crepes, A-2, RA-1, and RA-3, became quite lifeless in hand.

It was found that when all fabrics were removed from the water before hanging, the last fabric to be hung developed and retained more wrinkles. It is advisable that the fabrics not be removed from the water until ready to be hung to drip dry.

On the basis of the laundering tests made, unless the garment is heavily soiled, normal hand laundering and careful drip drying and some pressing are sufficient to obtain acceptable appearance through at least twenty washings.

DIMENSIONAL CHANGES OCCURRING AFTER LAUNDERING

Dimensional stability in textile fabrics is as important to the manufacturer as it is to the consumer. John F. Skinkle, authority on textile testing, makes the following statement: "In general, we may say that, even without any label or claim, a shrinkage of more than 5% in either direction is excessive . . . "[1] Isabel Wingate, in her text, states that "The American Home Economics Association advises consumers to insist on cotton goods that are guaranteed not to shrink more than 2 per cent."[2] This amount of change is generally regarded as the maximum amount that would not be noticed in the fit of a garment. The textile manufacturer, however, is striving to meet one per cent residual shrinkage on gain tolerance set for sanforized products. "The word 'Sanforized" may be used at the licensee's option on fabrics of which 90 per cent of the yardage does not shrink more than three-fourths of 1 per cent and 10 per cent of the yardage does not shrink more than 1 per cent, both warp and filling."[3]

The percentage of dimensional change in the laundered fabrics is shown in Table III and graphically in Illustration III.

Fabric A-1, a knitted jersey, showed the greatest dimensional change. Shrinkage was 3.8 per cent in the warp after the first two

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[1]John F. Skinkle, Textile Testing (Brooklyn, New York: Chemical Publishing Company, Inc., 1949), p. 118.

[2]Isabel Wingate, Textile Fabrics (New York: Prentice-Hall, Inc., 1949), p. 317.

[3]Irving Teplitz, Principles of Textile Converting (New York: Textile Book Publishers, Inc., 1947), p. 92.

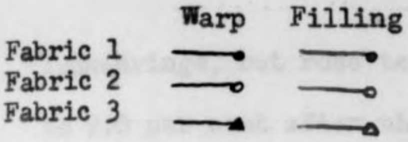
TABLE III

PERCENTAGE DIMENSIONAL CHANGE AFTER LAUNDERING

Fabric number	Number of Times Laundered									
	One		Two		Five		Ten		Twenty	
	warp	filling	warp	filling	warp	filling	warp	filling	warp	filling
GROUP A										
1	-3.8	-0.4	-3.8	-0.5	-7.5	-0.6	-9.0	-0.4	-9.0	-0.5
2	-1.2	-0.6	-2.1	-1.1	-2.8	-1.3	-3.1	-1.4	-3.5	-1.6
3	-1.4	+1.4	-1.7	+2.0	-2.0	+2.5	-2.2	+2.7	-2.5	+3.4
GROUP RA										
1	-1.8	-2.5	-2.0	-2.5	-2.4	-3.8	-3.4	-5.4	-2.9	-5.4
2	-2.9	-0.1	-0.6	-0.6	-2.6	-1.8	-2.5	-1.5	-2.7	-2.0
3	-1.6	-2.2	-2.6	-2.9	-2.8	-3.6	-3.2	-4.1	-2.2	-3.1

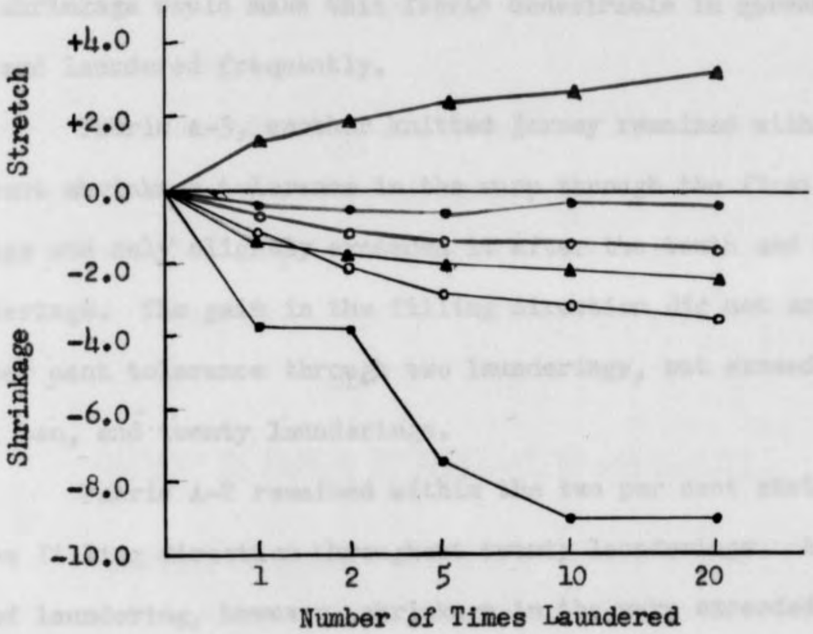
ILLUSTRATION III

PERCENTAGE DIMENSIONAL CHANGE AFTER LAUNDERING



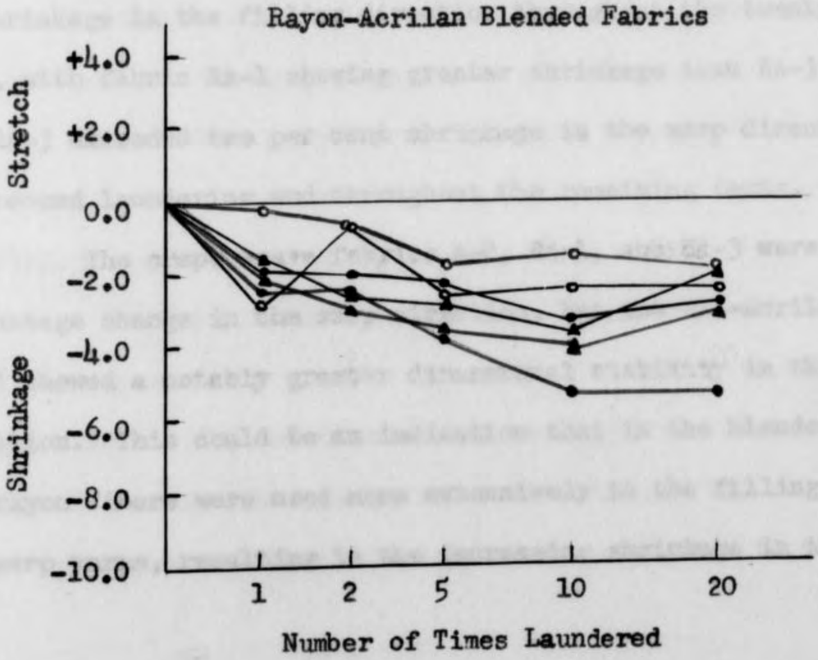
GROUP A

100% Acrilan Fabrics



GROUP RA

Rayon-Acrilan Blended Fabrics



launderings, but rose to 7.5 per cent after the fifth laundering and to 9.0 per cent after the tenth and twentieth. The filling shrinkage remained within the two per cent tolerance recommended. The great warp shrinkage would make this fabric undesirable in garments to be worn and laundered frequently.

Fabric A-3, another knitted jersey remained within the two per cent shrinkage tolerance in the warp through the first five launderings and only slightly exceeded it after the tenth and twentieth launderings. The gain in the filling direction did not exceed the two per cent tolerance through two launderings, but exceeded it after five, ten, and twenty launderings.

Fabric A-2 remained within the two per cent shrinkage tolerance in the filling direction throughout twenty launderings. After the second laundering, however, shrinkage in the warp exceeded two per cent.

Fabrics RA-1 and RA-3 exceeded the two per cent tolerance in shrinkage in the filling direction throughout the twenty launderings, with fabric RA-1 showing greater shrinkage than RA-3. Both RA-1 and RA-3 exceeded two per cent shrinkage in the warp direction after the second laundering and throughout the remaining tests.

The crepe weave fabrics A-2, RA-1, and RA-3 were similar in percentage change in the warp direction, but the all-Acrilan fabric (A-2) showed a notably greater dimensional stability in the filling direction. This could be an indication that in the blended crepes, the rayon fibers were used more extensively in the filling than in the warp yarns, resulting in the increasing shrinkage in this direction.

Fabric RA-2 remained within the two per cent tolerance in the filling direction through twenty launderings and exceeded two per cent in the warp direction through all testing periods except the second laundering. RA-2 showed less dimensional change than the other fabrics in Group RA.

The fabrics in Group A showed a slightly greater stability than those in Group RA. Both groups, however, showed enough gain on loss in dimensional stability that problems might be encountered by the consumer using these fabrics in garments to be washed frequently.

CHANGES IN FABRIC STRENGTH AFTER LAUNDERING

Breaking strength. The dry and wet strength of the fabrics after laundering are recorded in pounds on Table IV. The average strength of the fabrics are compared in Illustration IV. The percentage changes in strength after laundering are also recorded in Table IV and are shown graphically in Illustration V.

Breaking strength tests were not determined on fabrics A-1 and A-3 since the tests used were not satisfactory for knitted fabrics.

The all-Acrilan crepe compared favorably with the Rayon-Acrilan crepes in dry breaking strength. The dry warp breaking strength of the blended crepes, RA-1 and RA-3, was higher by approximately nine pounds through the first laundering. The all-Acrilan crepe A-2 showed a higher dry warp breaking strength throughout the remaining tests, averaging about $4\frac{1}{2}$ pounds greater strength than the RA group crepes in the testing periods. The dry filling strength of the Rayon-Acrilan crepes was also higher than that of the all-Acrilan crepe through two launderings by approximately eight pounds, and slightly exceeded the strength of the all-Acrilan crepe throughout the remaining test periods except number ten, when A-2 exceeded the RA-1 and RA-3 crepes by about five pounds.

The 100% Acrilan crepe, A-2, though it showed less dry strength than RA-1 and RA-3 in the original state and after the first laundering, gained enough in dry breaking strength throughout the remaining tests to compare quite favorably with the blended crepes. As seen in Illustration IV, all four fabrics tested show similar changes - a loss of dry strength through the first two launderings, a gain after the fifth, a loss after the tenth laundering approximately equal to the loss after the second laundering, and then a slight gain in strength after the twentieth laundering to approximately their original dry strength.

The all-Acrilan crepe, A-2, tested consistently higher than the blended crepes, RA-1 and RA-3, in wet warp and filling breaking strength. The wet warp strength averaged higher by approximately ten pounds and the wet filling strength by about four pounds. Fabric A-2 showed a loss in wet warp strength after the first laundering, and then a continuing rise in strength throughout the remaining tests almost reaching its original strength after the twentieth laundering. Fabric RA-1 showed a slight loss in wet warp strength

TABLE IV

CHANGES IN BREAKING STRENGTH AFTER LAUNDERING

(POUNDS)

Fabric Number	NUMBER OF TIMES LAUNDERED																							
	Original				One				Two				Five				Ten				Twenty			
	Dry		Wet		Dry		Wet		Dry		Wet		Dry		Wet		Dry		Wet		Dry		Wet	
	warp	filling	warp	filling	warp	filling	warp	filling	warp	filling	warp	filling	warp	filling	warp	filling	warp	filling	warp	filling	warp	filling	warp	filling
GROUP A																								
2	40.0	30.9	35.3	26.2	40.1	30.3	31.3	21.7	39.2	29.0	33.6	22.1	48.0	35.2	33.3	21.5	40.0	32.8	34.3	25.4	41.7	30.8	34.0	27.0
GROUP RA																								
1	49.1	37.8	25.8	21.5	46.1	36.4	24.1	21.8	35.6	33.2	22.3	19.7	49.6	41.7	24.2	21.0	40.0	32.3	22.5	19.9	43.1	35.5	23.1	20.8
2	53.8	50.0	38.0	33.1	46.2	41.9	37.4	34.2	42.8	38.9	39.8	33.5	57.5	53.4	38.9	36.0	42.5	43.5	36.0	34.8	48.0	49.1	38.7	35.2
3	40.7	34.1	22.7	28.0	41.0	32.7	23.0	18.5	29.4	24.9	21.8	18.8	45.2	36.7	24.1	16.4	32.2	25.9	23.1	14.3	38.6	29.4	22.5	15.2
PERCENTAGE CHANGE IN STRENGTH																								
GROUP A																								
2					+0.3	-1.7	-11.3	-17.2	-2.0	-6.1	-4.8	-15.6	-20.0	+13.7	-5.7	-17.9	0.0	+6.1	-2.8	-3.1	+4.3	-0.3	-3.7	+3.1
GROUP RA																								
1					-6.1	-3.7	-6.6	+1.4	-27.5	-12.2	-13.6	-8.4	+1.0	+10.3	-6.2	-2.3	-18.5	-14.6	-12.8	-7.4	-12.2	-6.1	-10.5	-3.3
2					-14.1	-16.2	-1.6	+3.3	-20.4	-22.2	-4.7	+1.2	+6.9	+6.8	+2.4	+8.8	-21.0	-13.0	-5.3	+5.1	-10.8	-18.0	+1.8	+6.3
3					+0.7	-4.1	+1.3	-33.9	-27.8	-27.0	-4.0	-32.9	+11.1	+7.6	+6.2	-41.4	-20.9	-24.0	+1.8	-48.9	-5.2	-13.8	-0.9	-45.7

Fabric Number	Original Dry warp	Original Dry filling	Original Wet warp	Original Wet fill…	…ling	Ten Wet warp	Ten Wet filling	Twenty Dry warp	Twenty Dry filling	Twenty Wet warp	Twenty Wet filling
GROUP A											
2	40.0	30.9	35.3	26.	2.8	34.3	25.4	41.7	30.8	34.0	27.0
GROUP RA											
1	49.1	37.8	25.8	21.	2.3	22.5	19.9	43.1	35.5	23.1	20.8
2	53.8	50.0	38.0	33.	3.5	36.0	34.8	48.0	49.1	38.7	35.2
3	40.7	34.1	22.7	28.	5.9	23.1	14.3	38.6	29.4	22.5	15.2
GROUP A											
2					6.1	-2.8	-3.1	+4.3	-0.3	-3.7	+3.1
GROUP RA											
1					4.6	-12.8	-7.4	-12.2	-6.1	-10.5	-3.3
2					3.0	-5.3	+5.1	-10.8	-18.0	+1.8	+6.3
3					4.0	+1.8	-48.9	-5.2	-13.8	-0.9	-45.7

CORRECTION

★ ★

PRECEDING IMAGE HAS BEEN REFILMED TO ASSURE LEGIBILITY OR TO CORRECT A POSSIBLE ERROR

TABLE IV

CHANGES IN BREAKING STRENGTH AFTER LAUNDERING

(POUNDS)

Fabric Number					NUMBER OF TIMES LAUNDERED																			
	Original				One				Two				Five				Ten				Twenty			
	Dry		Wet		Dry		Wet		Dry		Wet		Dry		Wet		Dry		Wet		Dry		Wet	
	warp	filling	warp	filling	warp	filling	warp	filling	warp	filling	warp	filling	warp	filling	warp	filling	warp	filling	warp	filling	warp	filling	warp	filling
GROUP A																								
2	40.0	30.9	35.3	26.2	40.1	30.3	31.3	21.7	39.2	29.0	33.6	22.1	48.0	35.2	33.3	21.5	40.0	32.8	34.3	25.4	41.7	30.8	34.0	27.0
GROUP RA																								
1	49.1	37.8	25.8	21.5	46.1	36.4	24.1	21.8	35.6	33.2	22.3	19.7	49.6	41.7	24.2	21.0	40.0	32.3	22.5	19.9	43.1	35.5	23.1	20.8
2	53.8	50.0	38.0	33.1	46.2	41.9	37.4	34.2	42.8	38.9	39.8	33.5	57.5	53.4	38.9	36.0	42.5	43.5	36.0	34.8	48.0	49.1	38.7	35.2
3	40.7	34.1	22.7	28.0	41.0	32.7	23.0	18.5	29.4	24.9	21.8	18.8	45.2	36.7	24.1	16.4	32.2	25.9	23.1	14.3	38.6	29.4	22.5	15.2
PERCENTAGE CHANGE IN STRENGTH																								
GROUP A																								
2					+0.3	-1.7	-11.3	-17.2	-2.0	-6.1	-4.8	-15.6	-20.0	+13.7	-5.7	-17.9	0.0	+6.1	-2.8	-3.1	+4.3	-0.3	-3.7	+3.1
GROUP RA																								
1					-6.1	-3.7	-6.6	+1.4	-27.5	-12.2	-13.6	-8.4	+1.0	+10.3	-6.2	-2.3	-18.5	-14.6	-12.8	-7.4	-12.2	-6.1	-10.5	-3.3
2					-14.1	-16.2	-1.6	+3.3	-20.4	-22.2	-4.7	+1.2	+6.9	+6.8	+2.4	+8.8	-21.0	-13.0	-5.3	+5.1	-10.8	-18.0	+1.8	+6.3
3					+0.7	-4.1	+1.3	-33.9	-27.8	-27.0	-4.0	-32.9	+11.1	+7.6	+6.2	-41.4	-20.9	-24.0	+1.8	-48.9	-5.2	-13.8	-0.9	-45.7

ILLUSTRATION IV

AVERAGE DRY BREAKING STRENGTH AFTER LAUNDERING

(Pounds)

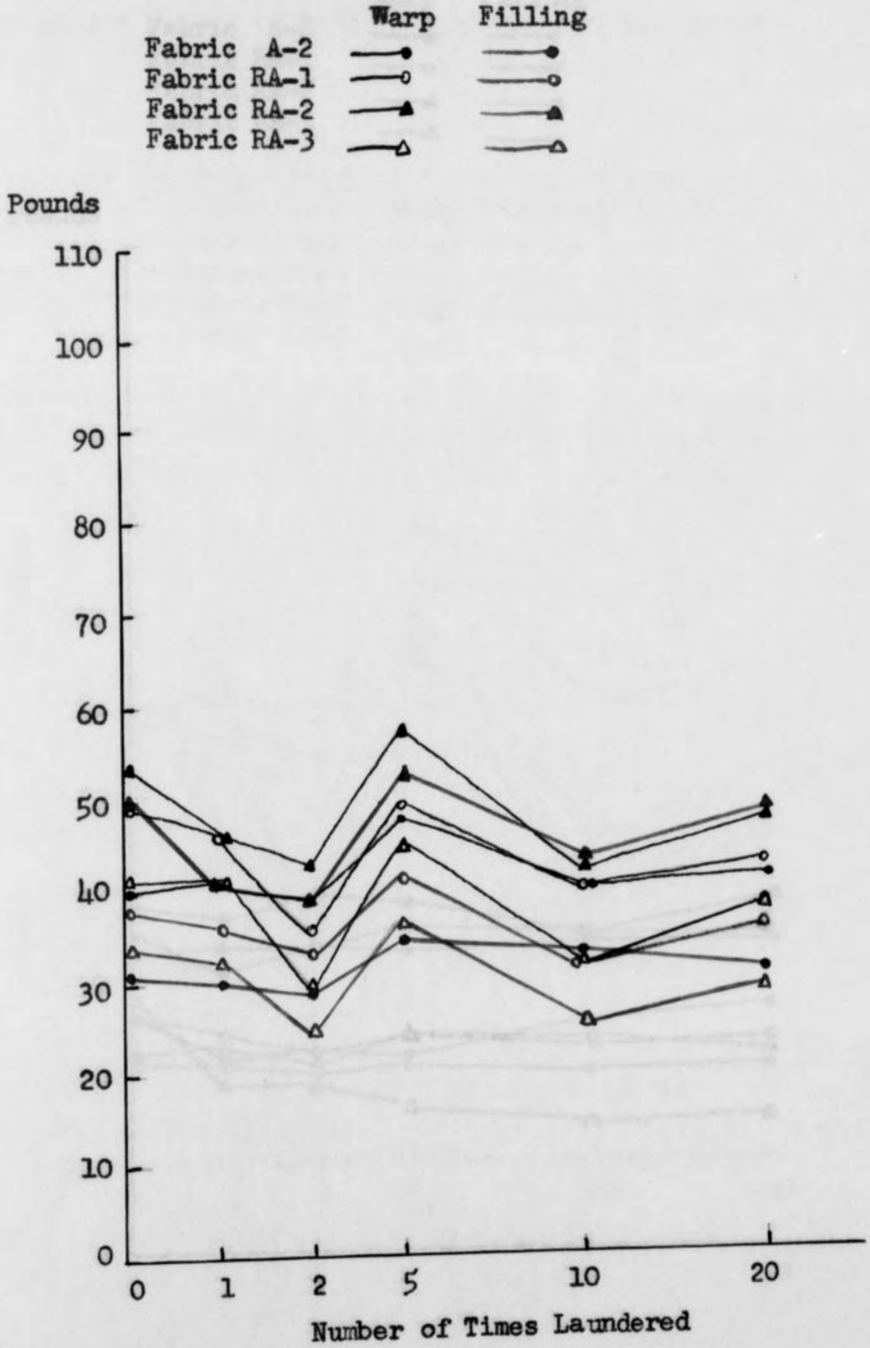


ILLUSTRATION IV (Continued)

AVERAGE WET BREAKING STRENGTH AFTER LAUNDERING

(Pounds)

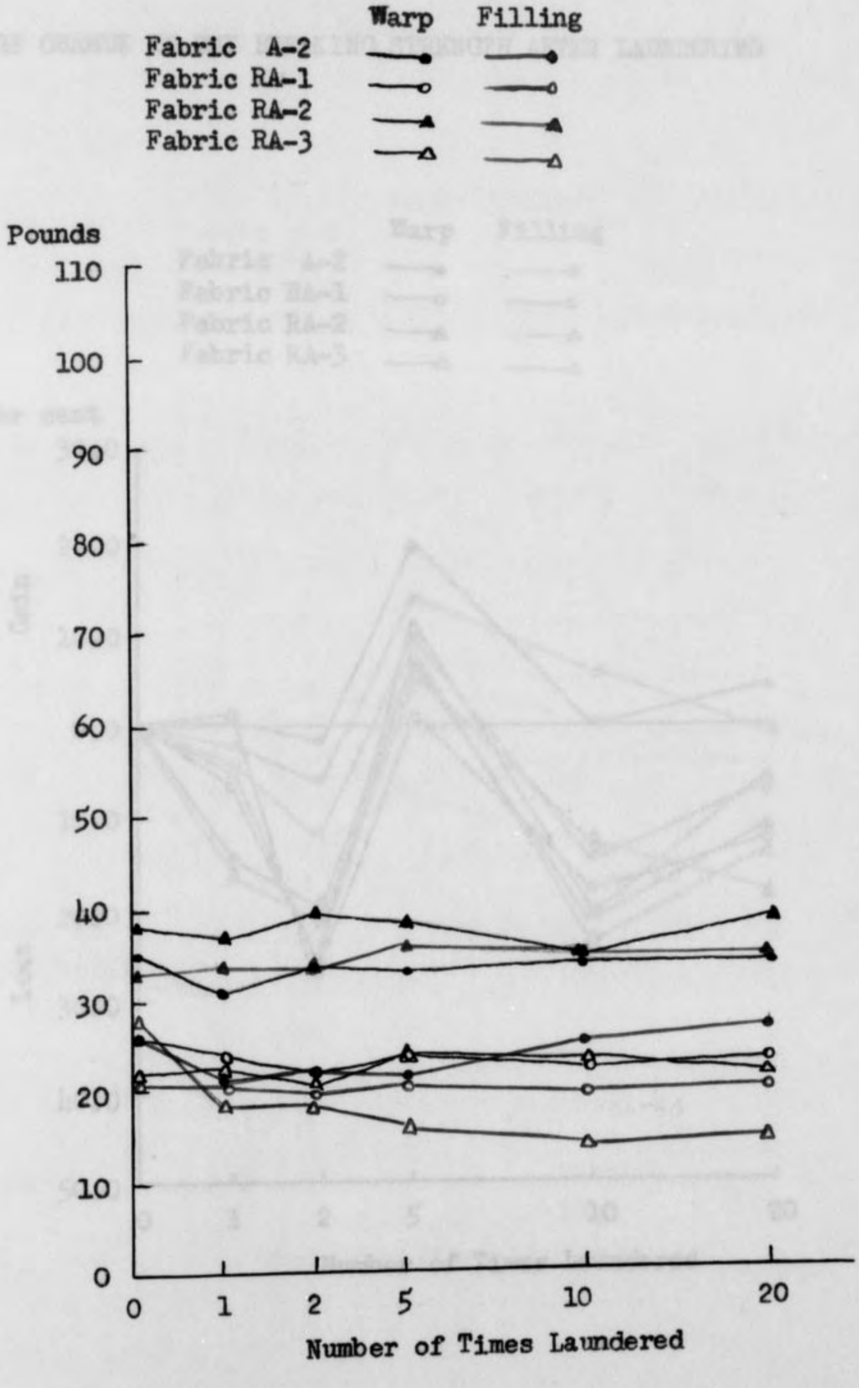


ILLUSTRATION V

PERCENTAGE CHANGE IN DRY BREAKING STRENGTH AFTER LAUNDERING

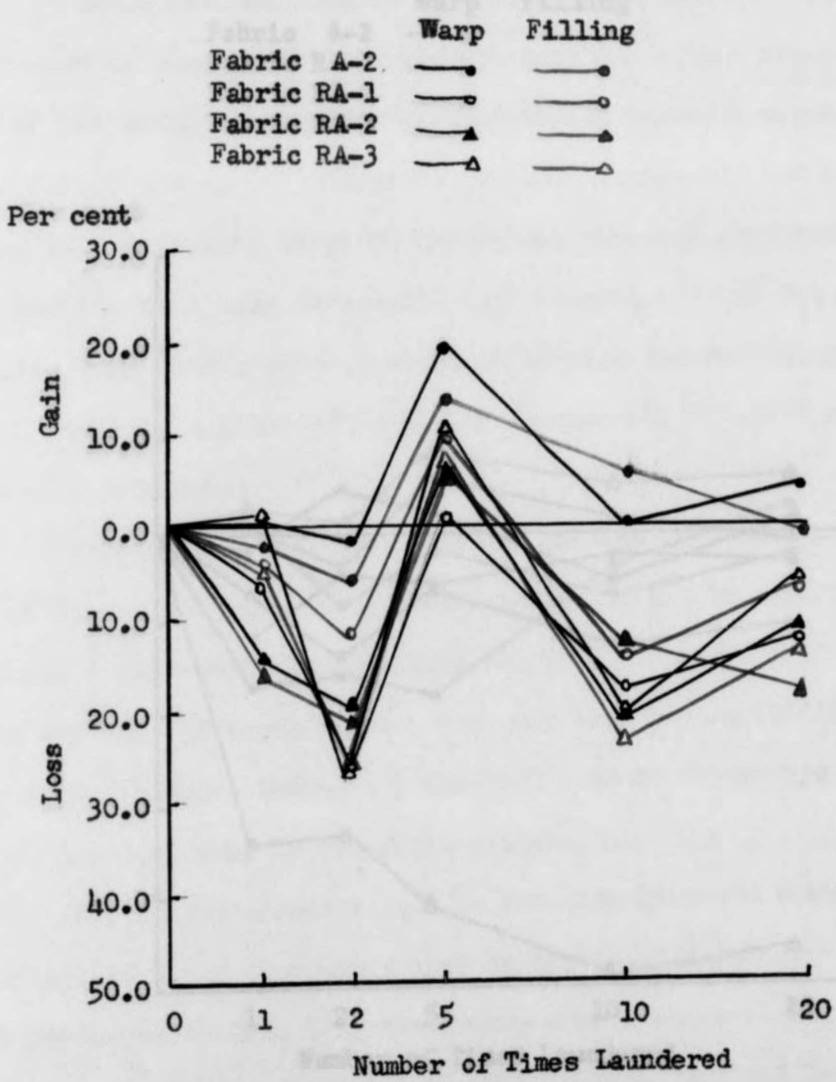
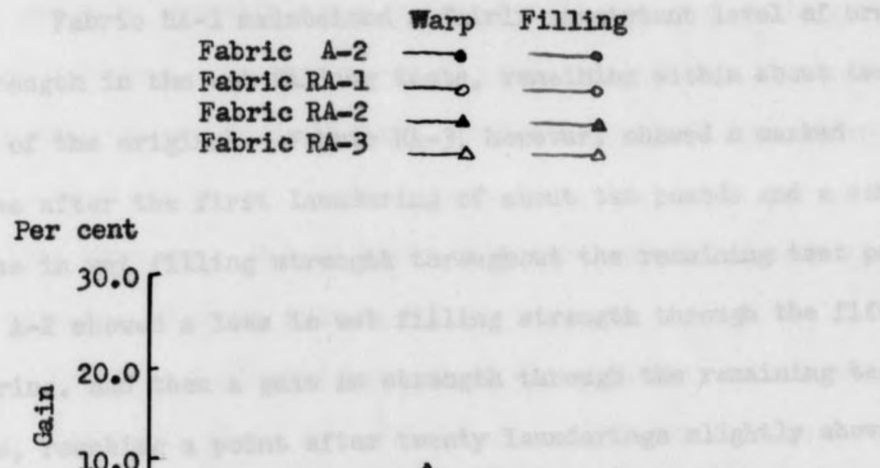


ILLUSTRATION V (Continued)

PERCENTAGE CHANGE IN WET BREAKING STRENGTH AFTER LAUNDERING



after the first laundering. Fabric RA-3 showed a slight gain which brought the two close together after the first laundering (as seen in Illustration IV). The two blended crepes showed similar trends throughout the remaining test periods, never moving outside the spread of pounds between their original states.

Fabric RA-1 maintained a fairly consistent level of breaking strength in the wet filling tests, remaining within about two pounds of the original. Fabric RA-3, however, showed a marked decrease after the first laundering of about ten pounds and a continuing decrease in wet filling strength throughout the remaining test periods. Fabric A-2 showed a loss in wet filling strength through the fifth laundering, and then a gain in strength through the remaining test periods, reaching a point after twenty launderings slightly above its original strength.

Fabrics RA-1 and RA-3 showed a greater range in percentage strength losses and gains in dry warp strength than in dry filling strength. After twenty launderings, fabric RA-1 showed a 12 per cent loss in dry warp strength and a 6 per cent loss in dry filling strength. Fabric RA-3, however, showed a 5 per cent loss in dry warp strength and a 14 per cent loss in dry filling strength.

Fabric A-2 showed a gain in dry warp strength after twenty launderings of 4 per cent and a loss in dry filling strength of less than 1 per cent. Fabric A-2, therefore, showed an over-all gain in dry breaking strength, while the blended crepes, RA-1 and RA-3, showed a definite loss of dry strength.

Fabrics RA-1 and RA-3, as seen in Illustration V, traced similar curves in percentage change in wet warp strength and opposing curves in wet filling strength. Fabric RA-1 showed a greater range in percentage loss and gain in wet warp strength than in wet filling strength. After twenty launderings, fabric RA-1 showed a 10 per cent loss in wet warp strength and a 3 per cent loss in wet filling strength. Fabric RA-3 showed a greater range in percentage change in wet filling strength than in wet warp strength, with a 1 per cent loss after twenty launderings in wet warp strength and a loss of 46 per cent in wet filling strength. Fabric RA-1, therefore, showed greater stability of wet breaking strength than RA-3.

Fabric A-2 plotted percentage change curves in wet breaking strength similar to those of fabric RA-1 - a greater loss in warp strength than in filling strength. After twenty launderings, A-2 showed a loss of about 4 per cent in wet warp strength and a gain of 3 per cent in filling strength. Fabric A-2, therefore, showed more general wet strength stability after twenty launderings than the blended crepes, RA-1 and RA-3.

Fabric RA-2 - the only non-crepe weave fabric used in the breaking strength tests-plotted similar curves in dry warp and filling strength, with greater warp strength through five launderings and slightly greater filling strength through the remaining test periods. After twenty launderings, RA-2 showed a loss in dry warp strength of about seven pounds, or about 11 per cent of its original dry warp strength, and a loss of approximately two pounds, or 18 per cent from

from the original. In wet breaking strength, fabric RA-2 showed reasonably good stability throughout the twenty test periods. There was a slight gain of about one pound or 2 per cent in wet warp strength after twenty launderings, and a gain of approximately two pounds or 6 per cent in wet filling strength.

Fabric RA-2 showed generally higher wet and dry breaking strength and greater stability throughout the twenty testing periods than the other fabrics tested. All the fabrics tested showed the most extreme changes after the second, fifth, and tenth testing periods, particularly the fifth. There was generally greater stability in wet strength tests than dry strength tests through all testing periods and for all the fabrics tested.

Bursting strength. This test was used as another method of indicating the relative strengths of the fabrics and any changes in strength that might be due to laundering.

There was considerable fluctuation in the strengths of the individual fabrics at each testing period. Group RA showed a greater fluctuation range in wet and dry strength than Group A. The strength in pounds and the percentage change in strength of the fabrics at each testing period is shown in Table V. The average wet and dry strengths of the fabrics are compared in Illustrations VI and VII.

There was a great difference between the wet and dry bursting strengths of Group A and Group RA. The dry strength of each group (and each individual fabric) was higher than the wet strength of the Rayon-Acrilan blends was higher than the all-Acrilan fabrics.

The changes after laundering when expressed according to percentage change from the original are shown in Table V and Illustration VII. The erratic fluctuations between increase and decrease in strength at the various laundering periods is more evident in this form than when stated in terms of actual strength.

There was more regularity in dry strength in the all-Acrilan fabrics. A strength loss was noted after the first laundering and a gain to a point above the original was noted after the second laundering. Strength losses were evident after the remaining test periods; however, fabric A-1 retained a gain of 1.2 per cent after twenty launderings, while A-2 and A-3 showed a loss. The RA fabrics were a little more erratic in dry strength and gain tendencies, and the direction of fluctuations was opposite to that of Group A through ten launderings. There was a tendency to gain in strength after the first laundering, to lose strength after the second, and to gain after the fifth. Fabrics RA-1 and RA-2 showed a loss after the tenth laundering, and fabric RA-3, a gain. Fabric RA-1 showed a gain after the twentieth laundering, fabric RA-2, a continuing loss, and fabric RA-3, a slight loss. Fabric RA-3 showed a gain in strength from the original at each test period as compared with the blended crepes which showed an over-all loss after twenty launderings.

In Group A, the crepe fabric A-2 showed greater stability in dry strength than the jerseys A-1 and A-3. However, fabric A-3

BURSTING STR

Fabric Number	Original Dry	Original Wet	One Dry	One Wet	Dr
GROUP A					
1	66.0	61.6	61.2	61.6	68
2	127.2	108.7	126.0	111.3	130
3	64.4	58.4	60.8	58.8	65
GROUP RA					
1	126.4	77.0	127.2	79.3	119
2	153.6	116.5	156.0	112.7	149
3	111.2	65.3	113.2	70.0	111

Perc

Fabric Number			One Dry	One Wet	
GROUP A					
1			-7.3	0.0	+:
2			-0.9	+2.4	+2
3			-5.6	+0.7	+1
GROUP RA					
1			+0.6	+3.0	-!
2			+1.5	-3.3	-:
3			+1.8	+7.2	-(

CORRECTION

PRECEDING IMAGE HAS BEEN REFILMED TO ASSURE LEGIBILITY OR TO CORRECT A POSSIBLE ERROR

TABLE V

BURSTING STRENGTH AFTER LAUNDERING
(Pounds)

Fabric Number	NUMBER OF TIMES LAUNDERED											
	Original		One		Two		Five		Ten		Twenty	
	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
GROUP A												
1	66.0	61.6	61.2	61.6	68.4	60.8	67.6	62.8	68.0	62.0	66.8	61.2
2	127.2	108.7	126.0	111.3	130.0	104.7	128.8	113.3	128.4	105.6	126.0	98.7
3	64.4	58.4	60.8	58.8	65.6	63.2	60.8	62.0	58.4	51.6	54.8	55.2
GROUP RA												
1	126.4	77.0	127.2	79.3	119.6	80.0	129.6	82.0	118.0	78.0	119.2	75.0
2	153.6	116.5	156.0	112.7	149.2	117.3	164.4	113.0	149.6	123.8	148.8	117.0
3	111.2	65.3	113.2	70.0	111.2	73.5	111.6	77.0	106.0	73.0	106.4	71.2
	Percentage Change in Strength											
GROUP A												
1			-7.3	0.0	+3.6	-1.3	+2.4	+1.9	+3.0	+0.6	+1.2	-0.6
2			-0.9	+2.4	+2.2	-3.7	+1.3	+4.2	+0.9	-2.9	-0.9	-9.2
3			-5.6	+0.7	+1.9	+7.9	-5.6	+6.2	-9.3	-11.6	-14.9	-5.5
GROUP RA												
1			+0.6	+3.0	-5.4	+3.9	+2.5	+6.5	-6.6	+1.3	-5.7	-2.6
2			+1.5	-3.3	-2.9	+0.7	+7.0	-3.0	-2.6	+6.3	-3.1	+0.4
3			+1.8	+7.2	-0.0	+12.6	+0.4	+17.9	-4.7	+11.8	-4.3	+9.0

ILLUSTRATION VI

AVERAGE BURSTING STRENGTH AFTER LAUNDERING

(Pounds)

GROUP A

100% Acrilan Fabrics

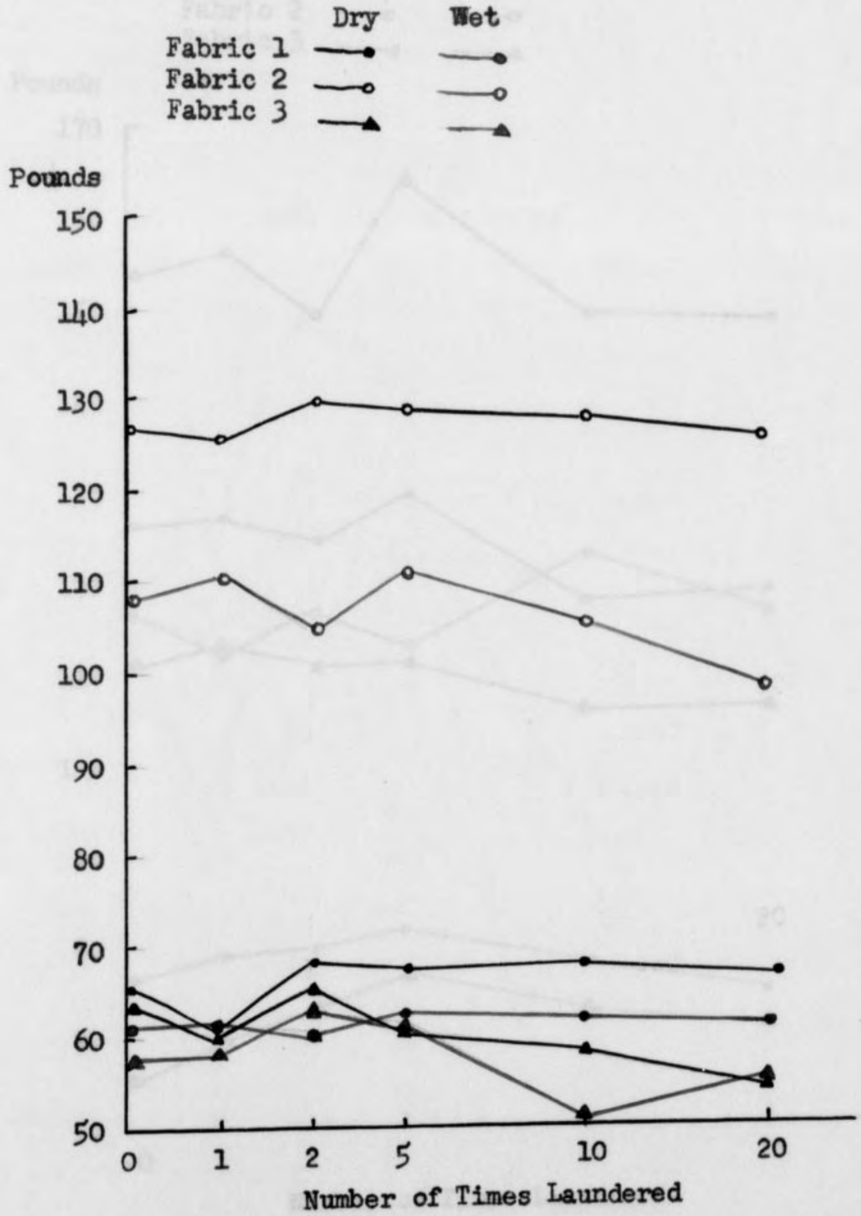


ILLUSTRATION VI (Continued)

AVERAGE BURSTING STRENGTH AFTER LAUNDERING
(Pounds)

GROUP RA
Rayon-Acrilan Blended Fabrics

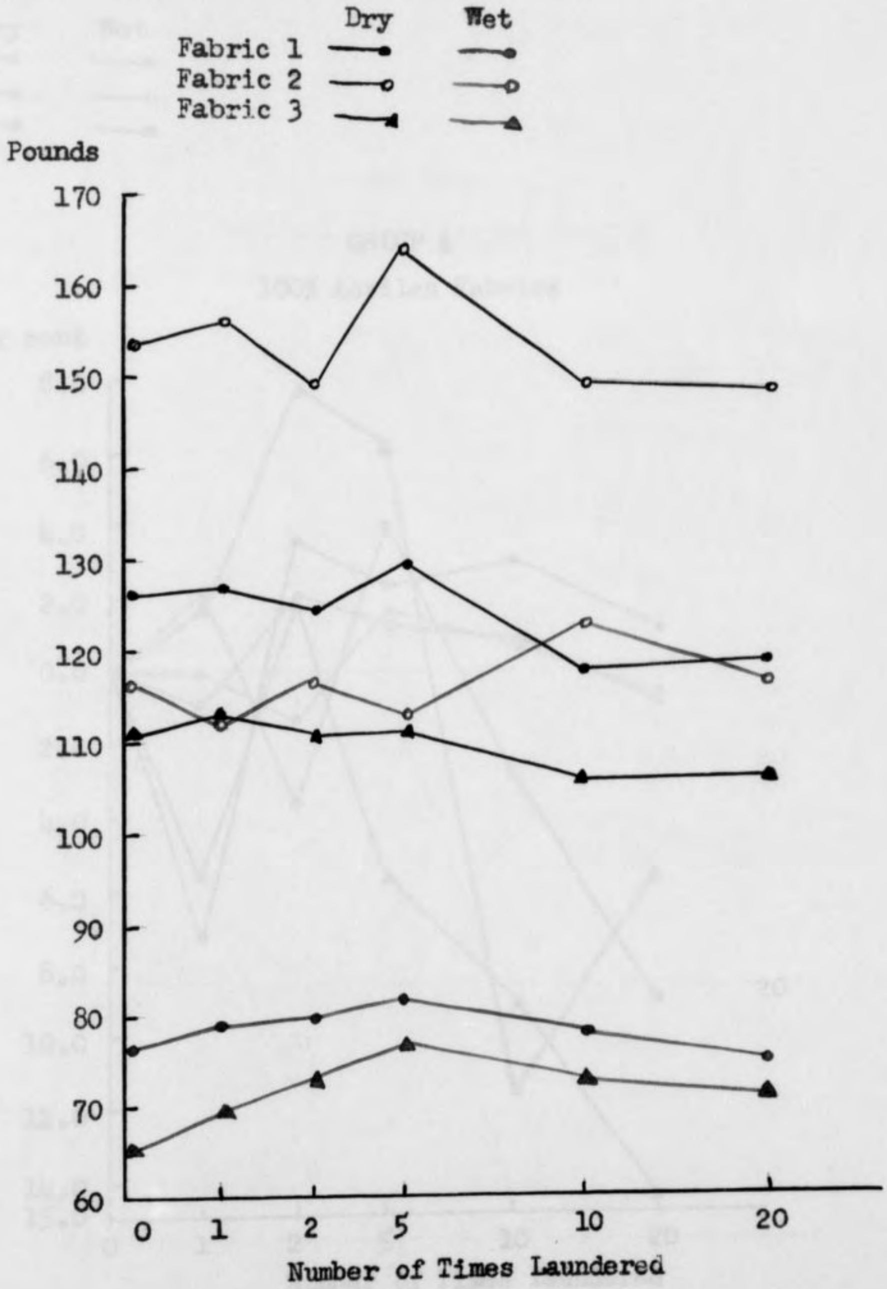


ILLUSTRATION VII

PERCENTAGE CHANGE IN BURSTING STRENGTH AFTER LAUNDERING

	Dry	Wet
Fabric 1	—•	—•
Fabric 2	—o	—o
Fabric 3	—▲	—▲

GROUP A

100% Acrilan Fabrics

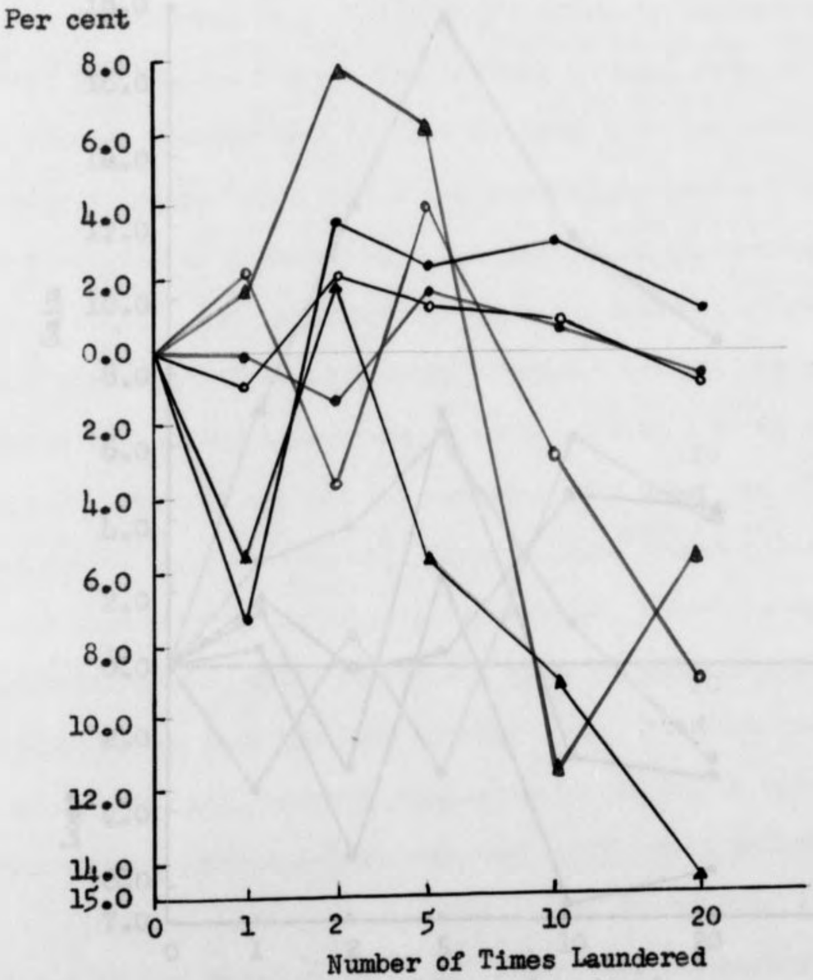


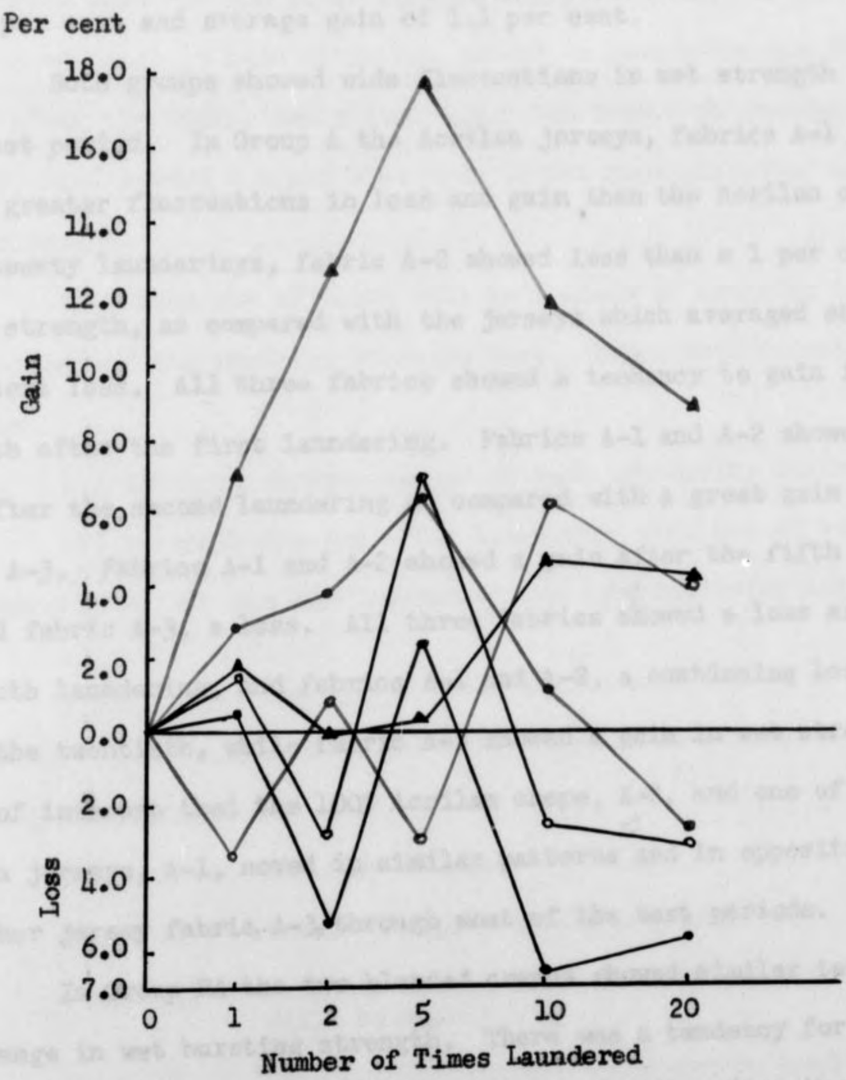
ILLUSTRATION VII (Continued)

PERCENTAGE CHANGE IN BURSTING STRENGTH AFTER LAUNDERING

	Dry	Wet
Fabric 1		
Fabric 2		
Fabric 3		

GROUP RA

Rayon-Acrilan Blended Fabrics



maintained a gain about its original strength after the second laundering and showed greater strength after twenty launderings than the crepe.

The all-Acrilan crepe, fabric A-2, showed a greater dry strength stability than the blended crepes RA-1 and RA-3. Fabric A-2 showed no loss greater than 1 per cent and no gain greater than 2.2 per cent, as compared with the blended crepes which showed an average loss of 5.3 per cent and average gain of 1.1 per cent.

Both groups showed wide fluctuations in wet strength after each test period. In Group A the Acrilan jerseys, fabrics A-1 and A-3, showed greater fluctuations in loss and gain than the Acrilan crepe. After twenty launderings, fabric A-2 showed less than a 1 per cent loss in wet strength, as compared with the jerseys which averaged about a 7 per cent loss. All three fabrics showed a tendency to gain in strength after the first laundering. Fabrics A-1 and A-2 showed a loss after the second laundering as compared with a great gain by fabric A-3. Fabrics A-1 and A-2 showed a gain after the fifth laundering and fabric A-3, a loss. All three fabrics showed a loss after the tenth laundering, and fabrics A-1 and A-2, a continuing loss after the twentieth, while fabric A-3 showed a gain in wet strength. It is of interest that the 100% Acrilan crepe, A-2, and one of the Acrilan jerseys, A-1, moved in similar patterns and in opposition to the other jersey fabric, A-3, through most of the test periods.

In Group RA the two blended crepes showed similar tendencies for change in wet bursting strength. There was a tendency for a gain in strength through five launderings, then a decline after the fifth and through the twentieth launderings. Fabric RA-3 showed a gain of 9 per cent after twenty launderings, however, while RA-1 showed a loss of 2.6 per cent. The all-Acrilan crepe, A-2, showed greater fluctuations of loss and gain at each test period than the blended crepes. After twenty launderings, however, it also showed a loss of about 9 per cent.

Fabric RA-2 showed greater fluctuations of change in each test period than did the other blended fabrics - a loss after the first laundering, a gain after the second, a loss after the fifth, a gain after the tenth, and a loss after the twentieth laundering. However, RA-2 showed a 4 per cent gain in wet strength after twenty launderings.

This test was of value only as a means of checking the observations of the breaking strength test. These conclusions may be drawn.

(1) Strength changes varied at each laundering period.

(2) Strength changes after laundering were not of sufficient importance to affect the performance of the fabrics during use.

<u>Colorfastness to light</u>. All fabrics were tested in the Fade-Ometer for 20 and 40 hour periods. Results were rated by the following classification:

Class I - No color change.

Class II - Little change from the original.

Class III - Definite change from the original but could still be worn.

Class IV - Very evident change; could not be used again.

Textiles which show no appreciable change in color after 20 hours of exposure to light are considered satisfactory for use where moderate fastness to light is desirable. Fabrics which show no appreciable change after 40 hours of exposure may be expected to give satisfactory performance where good fastness to light is essential.[4] The classifications of colorfastness to light are presented in Table VI.

TABLE VI

Classification of Colorfastness to Light

Fabric Number		Time Exposed to Light: 20 Hours (Class)	40 Hours (Class)
Group A	1	II	III
	2	II	II
	3	I	I
Group RA	1	I	I
	2	I	I
	3	II	III

After 20 hours of exposure, fabrics A-1 and A-2 were rated as Class II and fabric A-3 as Class I.

Fabrics RA-1 and RA-2 were rated as Class I after 20 hours of exposure. Fabric RA-3 was rated Class II.

After 40 hours of exposure, fabrics A-1 and RA-3 were rated as Class III, fabric A-2 as Class II, and fabrics A-3, RA-1, and RA-2 as Class I.

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[4] U. S. Department of Commerce, Textiles - Testing and Reporting, Commercial Standard C359-44 (U. S. Department of Commerce, Washington, D. C., 1944), pp. 22-23.

Fabrics A-3, RA-1, and RA-2 maintained a Class I rating throughout the testing periods. None of the fabrics showed changes great enough to make them unusable.

Colorfastness to laundering. Colorfastness to both fading and laundering are of importance to the consumer, particularly when she is handling a fabric advertised as fast and washable.

The fabrics tested were washed individually through the first five launderings. Only fabric A-3 showed any discoloration of the wash water. The discoloration was due primarily to the black dye used in the printed design of the fabric. After the fifth laundering, all fabrics except A-3 were washed together with no ill effects noted.

At the end of twenty launderings, all fabrics showed no appreciable color change. The dyeing processes used on these fabrics meet satisfactorily the requirements of colorfastness desirable in fabrics of these types.

The relative colorfastness of each fabric was measured by the use of a reflectometer, an instrument used to indicate even minute color changes with greater reliability than the eye. Table VII shows the comparable amounts of color difference of each fabric after each laundering period.

TABLE VII

Measurement of Amount of Color Difference After Laundering

Fabric Number		Number of Times Laundered 1	2	5	10	20
Group A	1	2.3	1.9	2.5	2.5	3.5
	2	2.0	1.1	5.2	2.8	1.2
	3*	---	---	---	---	---
Group RA	1	1.0	0.7	1.0	1.1	0.8
	2*	---	---	---	---	---
	3	3.0	3.2	1.9	2.2	2.8

*Color difference could not be measured satisfactorily on these printed fabrics.

According to these tests, fabric A-1 showed the greatest change after twenty launderings, and fabric RA-1, the least change. All fabrics showed irregular amounts of change at each testing period, so that there was no progressive change in color difference. Any change under 3.0 is considered undetectable to the naked eye. Although fabric A-1 showed a 3.5 rating after twenty launderings, the change was not enough to be visible.

Crease Resistance. In his book Textile Fibers, Yarns, and Fabrics, Ernest R. Kaswell has included considerable information on crease resistance. In his review of this subject, he cites the definition of crease resistance by Buck and McCord as follows:

"Crease resistance may be thought of as that property of a fabric which causes it to recover from folding deformations that normally occur during its use. The recovery may be almost instantaneous in which case there will be an apparent resistance to the formation of a crease. Recovery may be slower in other cases, with the crease mark disappearing gradually. The speed and completeness of a fabric's recovery from creases is the measure of its crease resistance."[5]

Evaluation of this crease recovery is described by Kaswell:

"There appears to be a general opinion that a crease recovery angle of at least 125° is necessary in order for a fabric to exhibit acceptable performance."[6] This degree angle interpreted in percentage crease recovery is equal to a 69.4 per cent standard.

The angle of recovery of each fabric before and after laundering is recorded in Table VIII. The percentage crease recovery of each fabric before and after laundering is also shown in Table VIII.

Both groups showed a rapid initial recovery and a slower recovery during the five-minute period.

In the fabrics in Group A, initial recovery was rapid with slow recovery during the remaining five-minute recovery period. Fabrics A-1 and A-3, the knitted jerseys, were below standard recovery in the filling direction throughout the twenty testing periods. Fabric A-1 showed an average filling recovery of 61.0 per cent and fabric A-3, a recovery of 55.1 per cent. This poor recovery in the filling of the jerseys is not surprising since there are no filling threads in a jersey fabric, and, strictly speaking, the fabric has only one woven direction - the warp. So that a crease made parallel to yarns is not

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[5] Ernest R. Kaswell, Textile Fibers, Yarns, and Fabrics (New York: Reinhold Publishing Corporation, 1953), p. 256 (Buck, G. S., Jr. and McCord, F. A., "Crease Resistance and Cotton," Textile Research Journal, 19:216 (1949).

[6] Ibid., p. 277.

TABLE VIII

ANGLE OF CREASE RECOVERY BEFORE AND AFTER LAUNDERING
(Degrees)

Fabric Number	NUMBER OF TIMES LAUNDERED											
	Original		One		Two		Five		Ten		Twenty	
	Warp	Filling	Warp	Filling	Warp	Filling	Warp	Filling	Warp	Filling	Warp	Filling
GROUP A												
1	163.8	115.6	164.2	103.8	171.2	106.4	149.5	109.8	153.2	110.2	172.6	113.2
2	133.0	148.6	141.0	142.2	147.4	155.8	141.2	142.0	141.8	141.6	143.6	143.6
3	169.6	105.0	170.2	98.4	180.0	101.6	155.6	93.0	171.4	104.0	157.2	92.8
GROUP RA												
1	139.0	135.2	140.6	142.4	139.8	127.8	135.2	137.4	141.8	141.0	148.2	142.2
2	151.8	143.4	135.0	135.6	135.8	147.0	117.4	128.8	132.2	133.6	145.2	123.4
3	146.0	135.2	114.0	114.8	139.2	139.4	146.8	140.2	127.0	129.0	142.2	140.0
	Percentage Change in Crease Recovery											
GROUP A												
1	91.0	64.2	91.2	57.7	95.1	59.1	83.1	61.0	85.1	61.2	95.9	62.9
2	73.9	82.6	78.3	79.0	81.9	86.6	78.4	78.9	78.8	78.7	79.8	79.8
3	94.2	58.3	94.6	54.7	100.0	56.4	86.4	51.7	95.2	57.8	87.3	51.6
GROUP RA												
1	77.2	75.1	78.1	79.1	77.7	71.0	75.1	76.3	78.8	78.3	82.3	79.0
2	84.3	79.7	75.0	75.3	75.4	81.7	65.2	71.6	73.4	74.2	80.7	68.6
3	81.1	75.1	63.3	63.8	77.3	77.4	81.6	77.9	70.6	71.7	79.0	77.8

likely to show as high recovery as a crease which cuts across naturally resilient yarns. Fabrics A-1 and A-3 were above the 69.4 per cent standard recovery in the warp after each test period. Fabric A-2 was consistently above standard recovery throughout the twenty launderings, and recovery in warp and filling were about equal at each test period. Fabrics A-1 and A-3 showed greater recovery in the warp direction than did fabric A-2.

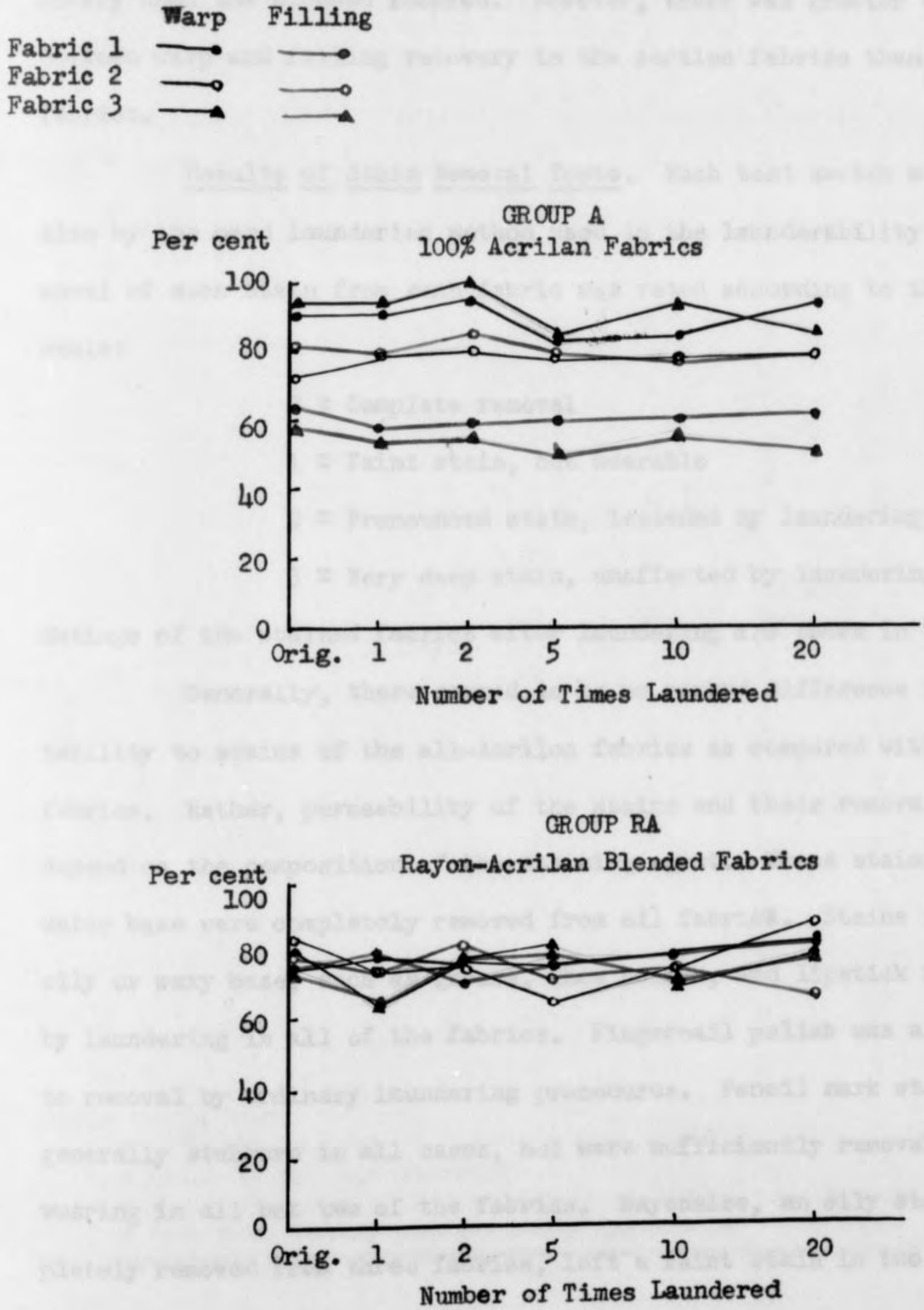
The fabrics in Group RA showed a rapid initial recovery and a slower recovery during the five-minute waiting period. All the RA fabrics generally showed greater resilience in the warp than in the filling throughout the twenty launderings. Only the warp of fabric RA-2 after the fifth laundering, the filling of fabric RA-2 after the twentieth laundering, and the warp and filling of fabric RA-3 after the first laundering were below the standard recovery of 69.4 per cent. There was little difference in the recovery of the crepe and woven fabrics. The all-Acrilan crepe showed a similar amount of resistance to creasing as did the blended crepes.

Illustration VIII compares the percentage crease recovery of the all-Acrilan fabrics and the blended fabrics.

Fluctuations noted at the various testing periods were slight for each fabric. With the exception of fabric RA-2, which showed a change from the original of 11 per cent in the filling after twenty launderings, there was no indication of a substantial increase or decrease in crease recovery following twenty launderings. There was less than 10 per cent variation in all other cases.

ILLUSTRATION VIII

PERCENTAGE CHANGE IN CREASE RECOVERY



Generally, there was a similarity in angles of recovery of the fabrics within each group, regardless of the difference in construction and weight.

The all-Acrilon fabrics showed a higher percentage of warp recovery than the blended fabrics. However, there was greater difference between warp and filling recovery in the Acrilon fabrics than in the blended fabrics.

Results of Stain Removal Tests. Each test swatch was washed one time by the hand laundering method used in the launderability tests. Removal of each stain from each fabric was rated according to the following scale:

0 = Complete removal

1 = Faint stain, but wearable

2 = Pronounced stain, lessened by laundering but unwearable

3 = Very deep stain, unaffected by laundering

Ratings of the stained fabrics after laundering are shown in Table IX.

Generally, there seemed to be no marked difference in the succeptability to stains of the all-Acrilon fabrics as compared with the blended fabrics. Rather, permeability of the stains and their removal seemed to depend on the composition of the staining agent. Those stains having a water base were completely removed from all fabrics. Stains having an oily or waxy base, such as grease, shoe polish, and lipstick were unaffected by laundering in all of the fabrics. Fingernail polish was also resistant to removal by ordinary laundering procedures. Pencil mark stains were generally stubborn in all cases, but were sufficiently removable to permit wearing in all but two of the fabrics. Mayonaise, an oily stain, was completely removed from three fabrics, left a faint stain in two others, and

TABLE IX

Rating of Stained Fabrics After Laundering

	A-1	A-2	A-3	RA-1	RA-2	RA-3
1	3	3	3	3	3	3
2	1	0	0	1	0	2
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0
12	0	0	0	0	0	0
13	0	0	0	0	0	0
14	0	0	0	0	0	1
15	1	1	1	1	2	2
16	3	2	2	2	3	3
17	3	3	3	3	3	3
18	3	3	3	3	3	3
19	0	1	0	0	1	0
20	0	0	0	0	0	0

Rating Scale Used:
- 0 = Complete Removal
- 1 = Faint Stain, but wearable
- 2 = Pronounced Stain, lessened by laundering, but unwearable
- 3 = Very Deep Stain, unaffected by laundering

showed a pronounced stain in the other fabric. Washable black ink left a faint stain in only one fabric, and mercurochrome a faint stain in two of the fabrics--one from each group. All other spots and stains were completely removed in one laundering.

Acrilon fabrics have been advertised as resistant to spots and stains. These tests were made to compare advertising claims with actual use. The jersey fabrics absorbed all the staining agents readily. The crepe weave fabrics were slightly more resistant, but accepted the stains. The plain weave, blended fabric showed more resistance, particularly to Cocoa Cola and other water-base staining agents. This water repellency characteristic was noted in this fabric during previous launderability tests.

Fabrics containing Acrilon which are of a construction that should be laundered by hand may present real cleaning problems when subjected to certain oily-base stains. It is believed, however, that the more common water-born stains can be successfully removed through ordinary laundering procedures as advertised.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS FOR FURTHER STUDY

I. Summary of Results

It was found that the amount of yardage and the variety of Acrilon and Acrilon blended fabrics available in retail stores in this area was not as great as promotional material would lead the consumer to expect. Therefore the fabrics for this study were limited to those which could be obtained from textile mills and wholesalers. Three 100% Acrilon and three Acrilon and Rayon blended fabrics were purchased.

According to laboratory analysis, the blended fabrics met the percentage composition of Acrilon and Rayon advertised.

There was a variety of construction in the fabrics used in the study. There were, however, similarities in staple length, and fabric thickness. The most prominent differencies were in the weave, yarn number, twist count, thread count, and weight per square yard.

Both the 100% Acrilon fabrics and the blended fabrics were pleasing in appearance and texture. Most of their attractive appearance was maintained through twenty launderings. Both groups showed good resistance to wrinkling. Less pressing was required as the number of washings increased. It was found that for maintaining the wrinkle free appearance of these fabrics, they should be hung to drip dry immediately following removal from the water

All of the fabrics exceeded the desirable two per cent maximum dimensional change either in the warp or in the filling or in both. The filling of the Acrilon fabrics came closest to meeting this tolerance. In laboratory tests, therefore, these fabrics showed dimensional changes great enough to make them unsatisfactory for use.

The strength tests indicated few differences between the blended fabrics and the 100% Acrilon fabrics.

The fabrics of both groups showed similar breaking strength measurements in both warp and filling. Only two fabrics showed a strength loss greater than 15% in the filling direction. Each fabric showed an original relatively low breaking strength, but strength changes after 20 launderings were not great enough to deter satisfaction in use.

There was less fluctuation in the bursting strength of the individual fabrics at the various testing periods than was noted in the breaking strength tests. Each fabric showed little change in strength after twenty launderings. No fabric exceeded a 15% change. The majority of the changes were 6% and less. The kwt fabrics showed less actual strength, but held their strength well through twenty launderings. There was generally greater stability in wet strength tests than dry strength tests through all testing periods and for all the fabrics tested.

All the fabrics showed good colorfastness to light through forty hours of exposure. Only two of the fabrics showed a definite color change, but this was not sufficient to make discarding of the fabric necessary.

All the fabrics showed good colorfastness to laundering. Colors were still bright after twenty launderings, indicating satisfactory performance in use.

There was some difference shown in the amount of crease recovery of both groups of fabrics. The all-Acrilon fabrics showed generally better recovery in the warp, and the blended fabrics in the filling throughout the testing periods. Only two of the fabrics dropped below the 69.4 per cent recovery in the filling. These two were knitted fabrics which showed excellent warp recovery. All the fabrics, therefore, met and generally exceeded the standard set for fabrics to exhibit acceptable performance.

All the fabrics showed the same general resistance to water-born stains and similar lack of resistance to those stains which had a greasy base.

II. Conclusions

From this study the following conclusions were drawn:

1. Fabrics containing Acrilon were not as available as promotional material implied.

2. It was apparent through twenty launderings that fabrics containing Acrilon were superior in their ability to maintain an unwrinkled appearance and almost no color change after laundering.

3. Regardless of claims for washability, the amounts of dimensional change indicated in end use testing make it important for the consumer to observe the directions given for each fabric. Garments made of Acrilon fabrics should be hung to drip dry immediately following removal from the water.

4. In a majority of the fabrics, though original strength was relatively low, the strength changes were not sufficient to affect the serviceability of the fabric.

5. Each fabric showed good colorfastness to light and to laundering.

6. All the fabrics met sufficiently the standard set for fabrics to exhibit acceptable performance.

7. Although advertised as highly resistant to spots and stains, oil-base stains were not removeable by washing, but water-born spots did wash out.

III. Recommendations for Further Study

1. To continue research in order to record the results of future improvements made in Acrilon fabrics and its use with fibers other than Rayon.

2. To compare the effects of dry cleaning and laundering of Acrilon fabrics.

3. To compare the results of machine laundering and hand laundering on Acrilon fabrics.

4. To determine the static qualities of Acrilon fabrics as compared with other synthetics.

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APPENDIX

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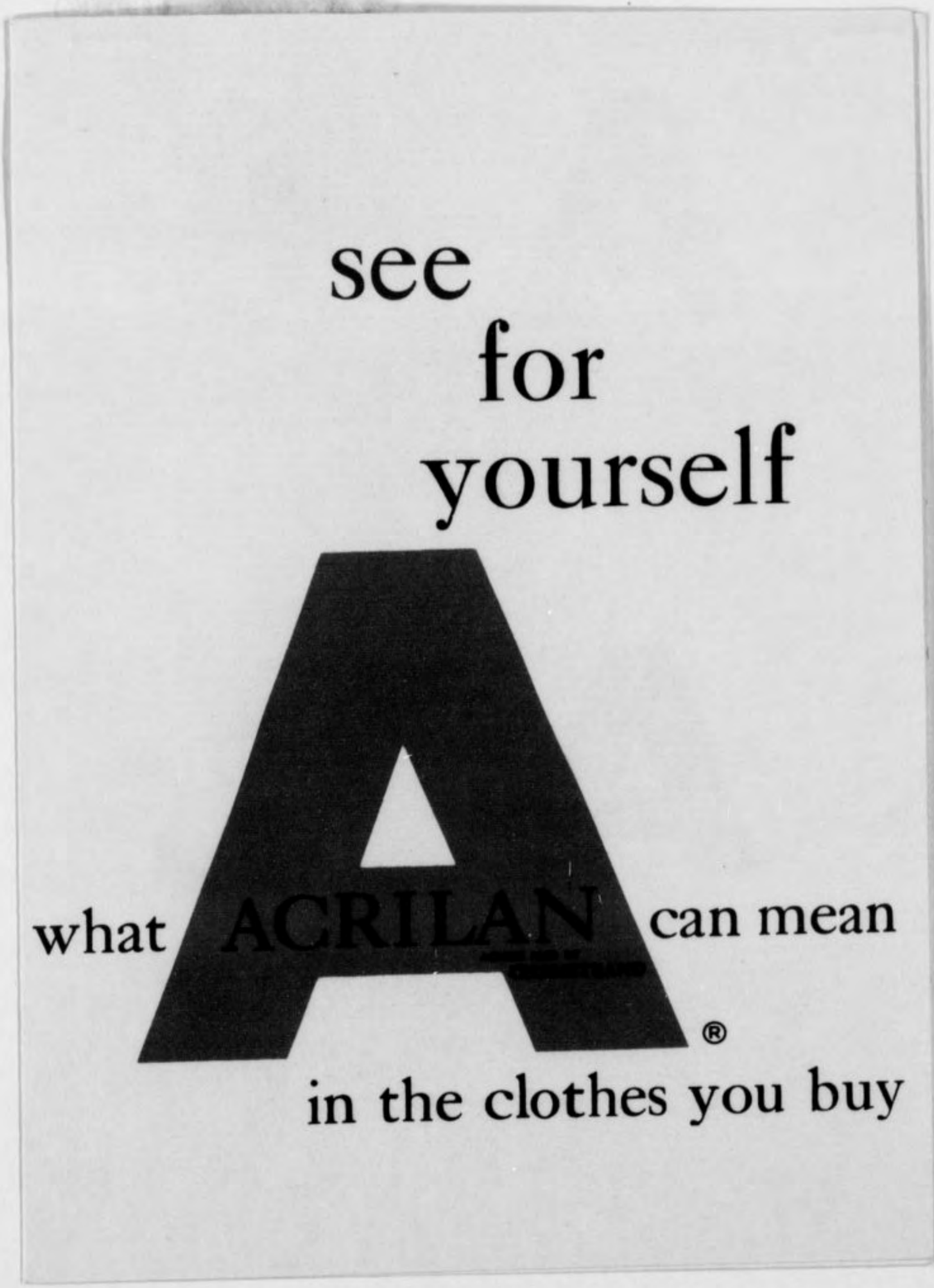


ADVERTISING COPY DISTRIBUTED BY

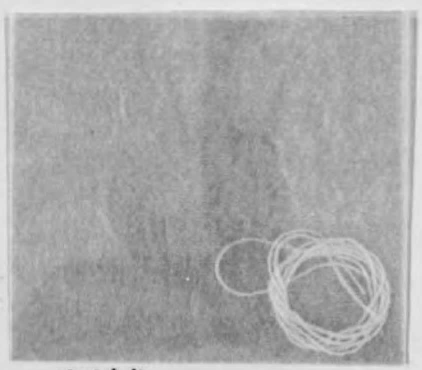
THE CHEMSTRAND CORPORATION

this is ACRILAN® fiber

pinch it
—note its lightness, its bulk, its resilience

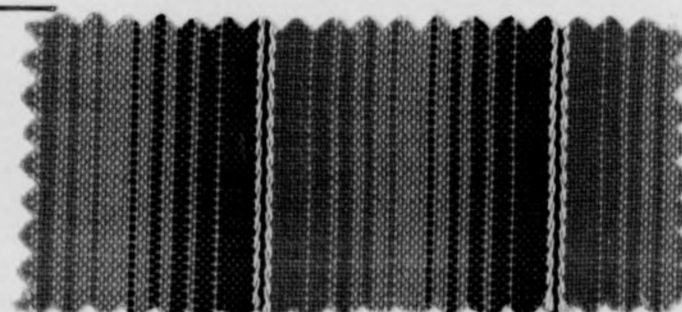
feel its rich, pleasant touch

this is ACRILAN® yarn



stretch it
—note its strength

feel how soft it is



this is one of the many interesting fabrics made with ACRILAN®

wet it
—note how it keeps its shape, doesn't shrink or stretch

wrinkle it
—watch it smooth right out

time it
—see how quickly it dries

feel how smooth it is, how luxurious, Acrilan never itches or scratches, feels wonderful always