DEPARTMENT OF COMMERCE
BUREAU OF STANDARDS
S. W. STRATTON, Director

MISCELLANEOUS PUBLICATIONS—No. 19

PROCEEDINGS OF THE SECOND ANNUAL TEXTILE CONFERENCE

HELD AT THE BUREAU OF STANDARDS, WASHINGTON
MAY 21-22, 1917

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ARUNDALE, H. B. United States Conditioning & Testing Co., East Orange, N. J.
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FINCKEL, C. B. Textile expert, New York, N. Y.
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HARRIS, G. S. West Point, Ga.
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HASSETT, P. J. Chemist, Remington Typewriter Co., Bridgeport, Conn.
HAVEN, G. B. Professor of machine design, Massachusetts Institute of Technology Cambridge, Mass.
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PROCEEDINGS OF THE SECOND ANNUAL TEXTILE CONFERENCE

Held at the Bureau of Standards, Washington, May 21–22, 1917

FIRST SESSION

OPENING ADDRESS

S. W. STRATTON [1]

We have invited you here for several purposes. Most important of all is the need of your assistance in the development of the scientific work of the textile section of the Bureau of Standards. The textile industry is one of the oldest and best established in the country, but it is not any further ahead in the applications of science than any of the other industries.

We in this country are coming to realize the great importance of the applications of science in all kinds of industry. The user of a material is interested in its adaptability and serviceability when applied to his special requirements. The manufacturer has, in addition, to concern himself with problems arising in producing his material. The laboratory determines what are the essential features of the material that make it good or bad. When these features become evident the manufacturer can be improved, and the product may be used more efficiently and more economically. The Bureau of Standards is an institution equipped for scientific work of this kind.

At the present time there is great need of developing textile materials for specific purposes. An example of this was called to our attention only a few days ago. As you know, this country has been using silk for powder bags. The sudden increase in the use of these containers threatens to cause a shortage, and it becomes necessary to find a substitute for the silk. The possibility of the use of ramie and other fibers to supersede linen in the construction of aeroplane fabrics and cords is also being given our consideration. There are many other problems of this kind coming up, and you can be of the greatest assistance in solving all of them. Many manufacturers have already offered their facilities to assist in the making of experiments to solve some of these problems. The Bureau is becoming more and more the court of arbitration in regard to the Government purchases. These purchases are made according to specifications which are often inadequate and antiquated. Through the Government organizations we hope to build up suitable and proper specifications and tests for materials. The Government must buy from competitive bids, and to make this fair and just it is absolutely necessary to have a standard of quality and method of measuring this standard and comparing it with the materials submitted. In this work we want you to feel that the Bureau represents you just as well as it does the Government and that we will do all that lies in our power to adjust disputes regarding questions of quality and measurement of quantity.

We have endeavored to so arrange the program of this conference that certain specific points may be brought out. There may be other things that you want to discuss, and we want your suggestions as to important things that should be considered. Most of all we want suggestions about permanent organization for carrying on technical work in textiles. This work should be laid out carefully and comprehensively, just as it is for many other branches of industry.

I thank you very much for your attention.

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[1] Director of the Bureau of Standards, Washington, D. C.

THE RESULTS OF A NEW METHOD OF COMBINING FIBERS

William D. Hartshorne [2]

A few nights ago I listened to a very interesting address by a young man, a Lehigh graduate, connected with a firm supplying different kinds of steel products for Government use. He told us what the Government experts had found out about the actual utility of phosphorus and sulphur in some classes of steel, facts which we did not know in our day as students of metallurgy. He emphasized also many other facts, among which the manner of the discovery of the so-called rustless steel particularly impressed me. He told us of certain bars of steel which had been waiting in a laboratory rather longer than usual for their turn to be tested. The expert found that all of them except one showed signs of rust. That one had not rusted at all, and the expert did not know why. He left it a while longer, and still it did not rust. He even applied weak acids with no material effect. In surprise and with much trepidation he went carefully through the analysis of it, noting that, physically, the bar was unusually compact and, chemically, that there was a large excess of chromium over the standard run. It was evidently a bar from an "off heat." I do not know all the details of his further experiments, but we were told that they are now producing, due to that man's observations on this "off heat" bar (which in the routine of business might have been thrown into the scrap heap), a rustless steel material of exceptional quality, which is proving extremely useful for making the finest cutlery for table wear and other purposes.

It was by a similar method that I discovered what I am about to tell you concerning a new way of spinning together almost any two classes of fibers regardless of their relative length. The two I was working with at the time were worsted and cotton. I had been making for special purposes some samples of what is called "core" yarn; that is, worsted spun around an already spun cotton thread, a class of yarn of which many thousands of pounds have been used in the past. I said to my spinner, "We have some rovings of cotton here. I want to try something." He said, "All right; we will try whatever you say," evidently doubting the success of the experiment. He put up a roving of cotton along with a roving of worsted and proceeded to try to spin them together. Of course it did not work at all at first; but we were persistent, and after a bit, owing to a curious combination of circumstances—remarkable because of the rarity of such an opportunity to permit what were afterwards proved to be the necessary adjustments—suddenly the right conditions were established for that particular combination, and the first yarn made by the new process was spinning. What had happened? The man at the switchboard had started up the frame before the spinner was ready. What was taking place? There was a marrying process going on. Those two roving ends were wrapping around each other in the ratch space. Why should they do it, and what was the benefit? These were the questions that had to be answered. A large variety of questions arose as to how the effect could be produced using different materials on different kinds of frames and what were the best conditions for satisfactory work. Many of these points have been worked out, particularly with reference to the specific question of spinning together worsted and cotton.

This is a practical process giving a novel product of special value, particularly useful at this time from a military point of view.

Here is the first bolt of a fabric for shirting flannel [indicating] just off the loom made on a service test order for the United States Marine Corps, and here are a few yards cut from it. The regular standard shade for the Marine Corps shirting flannel is a solid olive or yellow color like this sample [showing it]. At 50 feet away you can hardly tell these two shades apart, though the speckled white effect of the former makes the object it covers less conspicuous. The white is the cotton which has been

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[2] Consulting engineer and president of the Texet Corporation, Lawrence, Mass.

left undyed to produce this effect and also to help maintain the strength and wearing qualities of the material.

I was much pleased to find that the expert examiner at the Philadelphia depot fully appreciated the importance of leaving the cotton undyed, which not only gives more strength but also avoids the difficulty met in his experience, as well as my own, that in cotton and wool combinations, no matter how fast or well matched both materials are dyed, under any conditions of use or exposure they are unlikely to change color alike and soon a threadbare effect is evident.

It is, of course, well known that the ordinary standard Army or Marine Corps shirting flannels, whether all wool, all worsted, or one of the ordinary mixtures of cotton and wool, are liable to shrink greatly in washing, so that though a shirt may be several sizes too large when first put on, the chances are that before it has had time to be worn out it has become too short in the sleeves and too tight in the collar and around the body to permit continued use by the original wearer.

Now, a feature of great importance in this method of combining the wool and cotton is that the fabric made from it are not only soft and pliable, but also within reasonable limits, are practically unshrinkable beyond the usual results of sponging as applied by the tailor. Continuous or repeated washings do not cause the material to shrink and mat. The reason, I think, is evident in the manner in which the two kinds of fibers are put together.

This bobbin, a combination of black worsted and white cotton, I have had spun to show by its contrasting colors two facts—that it is "whole spun," not a twisted two-ply, and that there is no chance for a continuous contact of one set of wool fibers with another.

The intervening convolutions of cotton prevent continuous contact, no matter how the threads may be placed in the fabric. The first requisite for good felting is absent.

Some of these goods [indicating other samples] here shown have been fulled for hours. This particular one, a knitted fabric, has been fulled for four hours and shows no appreciable felting. It is to be used in fancy colors, piece-dyed, for sporting suits. You will note its elasticity—the fact that it recovers its form after much distortion.

Here are some stockings, made in different shapes, styles, and colors from this kind of yarn. In any of these fabrics the relative proportion of worsted and cotton fiber can, within reasonable limits, be varied to suit requirements, the percentages being determined by the relative sizes of the rovings used. Of course, yarn of this kind can be knitted or woven in conjunction with any others adapted to the fabric.

Here is a variety of yarns—silk and worsted, silk and cotton, silk and alpaca, mohair and alpaca, mohair and wool—made by this method. I have nothing woven from these as yet, but their beauty and adaptability to the designers' use is evident.

I have spoken of various combinations of different fibers. The method is also applicable to differing lengths of the same fiber—sea island and combed peeler cotton, for instance. Here is a sample of 1/23 tire-fabric yarn made from two rovings, one of sea island and the other of combed peeler spun on a worsted frame with about a 4½-inch ratch, just as a worsted and cotton combination would be spun. Here is another sample of a like combination spun on a regular cotton frame.

DISCUSSION

Mr. Bemis. Does the combination give as good a breaking strength as the long staple alone.

Mr. Hartshorne. You could hardly expect that. The strength of this sample appears to be about 90 per cent of its sea island component.

Mr. Bemis. Do you know whether for equivalent strength and efficiency you get any less cost in mixing two lengths of staple than in using just one staple of the length desired?

Mr. HARTSHORNE. I think some of the other gentlemen here can probably answer that question better than I can. I know that there is material difference in price between sea island or Egyptian and combed peeler at the present time.

Mr. NOLAN. What is the advantage of your system over the usual methods of mixing fibers?

Mr. HARTSHORNE. If you have anything over 50 per cent of the worsted material mixed according to ordinary methods it will shrink almost as much as if it were all worsted.

Mr. JELLEME. If you card wool and cotton together perfectly you get what the trade papers call Viyella flannels. That is a carded yarn, half cotton, guaranteed not to shrink.

Mr. NOLAN. What is the advantage of the cloth that you have over cloth like the Viyella flannel?

Mr. HARTSHORNE. It does not shrink unduly even with a large per cent of worsted and may be made into light or heavy-weight fabrics. It may be made in various weights and weaves, with either single, two-ply, or multiple-ply yarns. The yarns may be used in combination with any other kind. The Viyella flannels appear to be limited to about half worsted.

Mr. BEMIS. In the use of your process of spinning, do you change the distance between the rollers for different staples?

Mr. HARTSHORNE. The ratch, as it is called, is adjusted to take care of the longer staple.

Mr. BEMIS. If you adapt it to the longest staple that you are using in the mixture, will it work efficiently on the short-stapled fiber?

Mr. HARTSHORNE. Yes. In one case we had 4½ inches between the front and back rolls, while the cotton was only about 1¼ inches.

Mr. BEMIS. Have you tested for strength yarn made from two different grades, separately and combined?

Mr. HARTSHORNE. Here is a combination, half sea island and half peeler. The peeler alone I have not tried, but it was said to break at 105 to 110 pounds; the sea island broke at 135 to 140 pounds. The combination tested 123 pounds. The strength is roughly equivalent to the average strength of the two materials. The other properties I do not know.

Mr. FISH. In using inch and a half sea island with inch and a quarter peeler, the sea island, being the stronger and longer, would it not wrap spirally around the peeler at the spinning frame? If that is the case, would not the strain be taken off the sea island, thus weakening the peeler?

Mr. HARTSHORNE. Perhaps I have not made enough tests, but I expect you will get very nearly the average strength of the two materials using this method; and if carried far enough back in the drawing, both a greater strength and less cost than the average when spun separately.

Mr. STRATTON. We have got to get away from the old-fashioned practice of applying to special purposes whatever happens to be on the market. We have got to learn to specify the cloth wanted and then to produce it according to specifications. Mr. Hartshorne's work is a step in the right direction. The Navy Department is preparing to adopt a flannel-shirt standard and is not going to take what happens to be in the market for other purposes, but is going to specify what is wanted.

The question of production of long-stapled cotton is a vital one. The Bureau of Plant Industry is interested in the development of long-stapled cottons in the West, and there is quite a movement toward the rehabilitation of this industry in the sea islands.

A few days ago I saw the plan o fa machine, which seems to be very promising, for the preparation of some of the fibers that we have been overlooking. I have seen recently excellent fiber for cordage and for textiles prepared from the ordinary flax and hemp grown in this country, from cotton stalks, and from ramie. I was astonished at how well these fibers were prepared. It looks very much as if we are going to have available a larger number of fibers to experiment with, especially cordage fibers.

Mr. O. F. Cook. You spoke of the raising of the sea-island cotton in the West. A practical experiment was made on a lot of this fiber that has been in a mill. The principal objection found was that there was a tendency for it to be brittle. Possibly that might be caused by the dry climate. I think it might be well to state the general proposition that while a great deal of mechanical ingenuity is applied to the combining and substituting of cotton fibers, very much less interest and ingenuity is applied to securing the growth of fibers which are needed. It seems to me that if the proper interest were taken in the purchase of fibers much more satisfactory fiber would be available.

Sea-island cotton has been produced in California and Texas for 50 years at least, yet this fiber does not come to the manufacturer in a uniform condition. The general reason is that the conditions of production are too lacking in uniformity to allow a good fiber to be grown, except that Egyptian cotton is now being grown satisfactorily in a very dry climate. When the growth of the fiber is checked, the quality suffers, and fiber of a uniform character is not obtained. If the demand for various kinds of cotton can be projected back to the prdoucers, then suitable fiber will be grown. The cotton grown in the Carolinas is not well adapted to the southwest conditions. Good sea island can be grown there, but it requires unusual agricultural skill. The prices for long-stapled cotton have been extremely low. A profitable crop is not possible for much less than 30 cents a pound.

Mr. Stratton. I presume it is true that in cotton, as in many other things, the conditions must be adapted to the material. It is very seldom that you can substitute one material for another without adjusting the treatment to suit the material. Very frequently a substitute is better than the thing for which it is substituted, if properly treated. There may be some means of treating cotton to remove brittleness, even though it is grown brittle. This is a technical matter that will have to be investigated.

HUMIDITY IN COTTON MILLS

F. Gordon Cobb[3]

In an article prepared last year for a local mill paper I made the statement that it was cooler in the weave room than outside during extremely hot weather. Few people would believe this statement, and I had to produce the facts before they were convinced. In the spinning room all of the windows are generally kept open in hot weather, while in the weave room practically all of the windows are kept closed, but the thermometer is generally lower in the weave room than in the spinning room.

Very few people have ever tried to find out what the relation of temperature and humidity really is. Any boss spinner has trouble during hot damp spells, but few of them know how to improve conditions. Strangely enough, the best conditions for spinning are almost opposite to the best conditions for weaving.

The differences in production that weather conditions make are surprising. Automatic machinery has advanced so rapidly and the operation and setting of the machines has been brought to such a high state of efficiency that there is, very likely, no one thing which will improve the production of cotton-mill machinery in the next few years so much as the proper control of temperature and humidity.

The twist in yarn has to be greatly increased in summer, with consequent decrease in production.

[3] Superintendent of the F. W. Poe Manufacturing Co., Greenville, S. C.

Dry air, even when heated much above the average, still feels chilly, slight drafts are very noticeable, and colds are easily taken. For this reason a pan of water is sometimes placed on the heater in a room in winter. The evaporation will raise the humidity, making the air feel warmer, although the thermometer will show no increas in temperature. Excessive evaporation from the skin lowers the temperature of the body very rapidly, and more heat is required for comfort when the proper humidity is not present. A sudden increase in humidity without change in temperature often gives a feeling of oppressive heat.

A boss spinner came to me one day and said his work was running very badly. As it was on a rainy day in the winter, the first thought that came to me was that his room was too damp. He had closed up all of his windows in order to keep the dampness out and the thermometer in his room registered 85° F. while it was only 62° outside. I told him to open all of his windows and to start up the fans, and in about two hours his work was running nicely. The reason is obvious, for it takes temperature to retain humidity. Therefore when we opened the windows the temperature went down about 15 degrees and there was a smaller number of grains of vapor per cubic foot of air.

The fact that you must have high temperatures to retain humidity was demonstrated to me very clearly by noting the changes which take place in the storage room of an ice plant. This room was, of course, equipped with piping through which cold "brine" is passed to hold the temperature of the room low enough to keep the blocks of ice from melting. A few minutes after the brine was turned on the floor became wet, because the sudden lowering of temperature caused condensation.

In the early morning the outside air very often has a relative humidity of 80 to 90 per cent. This decreases as the day grows warmer, although there is just as much water vapor in the air, because the rise in temperature has increased the moisture-holding capacity.

It is a happy coincidence that the humidity condition which makes weaving machinery run well also makes working conditions more pleasant for the operatives. Dr. F. G. Haworth, health officer of Darwin, England, has said:

> It is my opinion that the introduction of moisture into the air of weaving sheds by artificial means is calculated to benefit the workers; that its action on suspended particles, whether dust or microbes, is beneficial; that the workers therein are not more susceptible to such diseases as pneumonia, bronchitis, consumption, and rheumatism than other people; and that the agitation against its use has its foundation in a misconception of the whole matter.

When mill engineers realize the enormous loss of production mills sustain by not being able to control temperature and humidity better they will give the matter more thought and find an economical method of regulation.

DISCUSSION

Mr. Stratton. The relation of humidity to temperature is very well known, being an elementary principle of physics, but physicists have paid little attention to the control of humidity. It would be a good thing to have a group of men looking into this problem. We have done some work along this line, because we needed in our own work a means of controlling the humidity of rooms. In making measurements of all kinds and in the testing of materials it is often very important to avoid errors or complications due to variation of moisture content in the material under observation. There is a very great need for systematic and scientific study of the application of control methods to factories, both those pertaining to textiles and to many other industries. It is a very important consideration in photographic and printing establishments. In such cases the ventilation and humidity control should be designed together so as to permit the windows to be kept closed. It is practically impossible to regulate humidity in any other way.

THE DIFFERENCE BETWEEN COMMERCIAL GRADING OF COTTON AND GRADING FOR SPINNING PURPOSES

F. Gordon Cobb

By way of explanation, let me say in the beginning that this paper is not intended as a technical paper at all, but rather as a practical paper, which I hope will give the technical expert food for thought.

I do not claim to be a cotton grader from a commercial standpoint, but the varied experience I have had for 18 years trying to produce yarn and cloth from the many grades of cotton has given me some idea as to what kinds of cotton will spin best. I believe that any man who is expecting to go into the business of buying cotton should endeavor to learn something about spinning it.

I am a firm believer in the axiom that "The final stage of improvement is never reached in any business, machine, or individual." However, we are so far from perfection in regard to buying cotton with reference to its spinning qualities that we need have no fear of having to go into minute details to find room for improvement.

I do not believe that men engaged in any other closely related businesses are working with so little regard for each other's interests as the buyer and the consumer of raw cotton. For example: The physician is very closely associated with the drug business, because he knows the composition of the drugs and therefore knows what the different grades of drugs will do. The shoe manufacturer is also very closely allied with the leather manufacturer. The shoe man knows precisely the grade of leather he must put into cheap shoes for the laborer or into ladies' expensive shoes.

Can anyone of you cotton men say that you know what grade or kind of cotton will produce a piece of print cloth with the greatest net return to the mill? You will probably reason that good middling cotton would certainly be better for any mill than middling. Then the first question I will ask you is, What kind of good middling cotton (which, no doubt, would sound like a foolish question to you)? However, the main point I am going to try to bring out is that there are several kinds of good middling cotton from a spinner's standpoint. If you should place before me 200 bales of cotton, 100 of them good middling and 100 middling, and ask me to select 100 bales to spin in the mill, I might pick out as many middling as good middling bales. I have tried this with boss carders so many times that I know that often a millman would rather have certain kinds of middling cotton than certain other kinds of good middling. Very often samples of middling cotton will have the very same character of staple, also that oily feeling which millmen so much desire, and most important of all, the same length and strength of staple as the good middling. Therefore there is no reason why it should not spin just as well as the good middling. This reasoning would not apply with the lower grades of cotton.

In making some classes of goods the cotton buyer is instructed as to the grades of cotton he must purchase on account of the appearance of the finished cloth; but then, too, he is buying entirely by commercial grade, having no thought whatever as to spinning qualities.

The vast majority of the spindles in cotton-growing localities are making yarns for plain woven cloths, such as prints, drills, sheetings, and percales. Therefore I will confine my discussion to grades of cotton best suited for this class of goods.

Many mills own large ginneries and spin practically all the cotton they gin. At the first of the season especially, when the top cotton or first opening is coming to the gin, they use hundreds of bales fully two grades above what the local millmen know is necessary for maximum production. This is very easy to demonstrate by going over the production records and noting if the production is materially greater while they are using good middlings and above than later in the season, when the grade is down to a middling average. This cotton all comes from one section and has the same length and strength of staple. These mills which have gins and are making prints, drills, sheetings, and percales are consuming thousands of bales of cotton every year that could be used for the finest lawns. Then why would it not pay them to employ expert cotton graders to assort their fancy grades? They could then sell them to mills which require high grades of cotton for making fine yarns, replace them by purchasing cotton of the proper grade to produce economically the plain fabrics they are making, and add the difference in price to the dividends of the mill.

Any boss carder knows that many bales of cotton which have enough fine leaf or stain to throw them off grade will spin practically as well in making medium-sized yarns as bales that would be rated a full grade higher, for the fine leaf or stain they carry does not affect the strength or length of the staple. Of course, there will be some difference in the amount of waste, but it is nothing compared with the difference in price. I have conducted tests that will confirm this statement. When you go below low middling and reach the grades which carry a very large amount of heavy foreign matter, immature fiber, and short staple, you seriously reduce production.

In North Carolina, South Carolina, Georgia, and Alabama there are practically 12 000 000 spindles, which produce an average of about 1¼ pounds of yarn per spindle per week. From information I have gathered I am confident that these 12 000 000 spindles are using enough cotton of grades higher than necessary for their maximum production, so that if it were sold at its market value and the proper grades purchased the difference in price would pay for building a good-sized cotton mill every year. In other words, American mills are using cotton fiber worth many thousands of dollars more than that which the European mills are using to produce the same goods.

I do not say that mills using good middling could just as well use middling. I am well aware of the fact that any mill should use a grade of cotton that will give the maximum production from its machinery with due regard for the class of goods being made. However, there are thousands of good middling bales being used as middling bales, especially when the mill owns the gin or is buying from gins located close by.

My prediction is that some cotton man is going to establish a system whereby his customers will profit by his knowledge of buying cotton in accordance with spinning qualities instead of by the commercial grade; and when he does he will have been the means of a long step forward on the part of the American cotton industry.

DISCUSSION

Mr. Bemis. Mr. Cobb has suggested a point to which I should like to refer. It is undoubtedly true that the mills in the South, located in the cotton-growing centers, do, for the reasons named, use a good deal of cotton of higher grade than is perhaps necessary for their particular requirements. This is because they buy their cotton locally and take the "gin run." It is not clear, however, that they could advantageously do otherwise.

Let us assume a mill, situated in the cotton-growing section, which is running on goods which could be satisfactorily made from middling cotton. The natural sources of supply for cotton are the local gins from which some of the gin cotton is bought. Early in the season as much as half of this "gin run" cotton may be good middling, which is better than the mill really requires. Suppose the mill were to sell such higher grade cotton as it had in stock. This would necessitate its being replaced with cotton of the desired grade, which would generally have to come from outside that section of the country. By the time the mill had exchanged this high-grade cotton for a lower grade it would have paid in commissions, freight charges, etc., at least the half a cent a pound which it might have gained by the exchange. The advantage derived from sorting out the good middling cotton would therefore be destroyed, and as much would have been paid for the even-running middling cotton as for the "gin run" in which there would have been a considerable quantity of good middling.

The cotton mill, which Mr. Cobb says could be built from the saving made by sorting out the high-grade cotton used by these mills in the South, would cost just about $3 000 000. Instead of having the money to build the mill with, however, it would have been paid out in additional cost of raw material. In other words, the saving that Mr. Cobb refers to would not exist.

A KEY TO THE NOMENCLATURE OF TEXTILES

LOUIS HARMUTH [4]

My appearing before this body has a two-fold purpose. One is to present to you a plan relative to the nomenclature of textiles. The other is to ask for your aid in carrying out the plan for every class of textiles, as I have found it almost more than a one-man job.

Anyone can find very easily in existing books the definition or description of a fabric if he knows beforehand its name; but if he happens to have a sample of some fabric, the name of which he does not know, there is no system in existence by which he could ascertain it without asking some one.

Since there are books which provide a key to the names of trees, insects, etc., it may be asked why a similar system could not be applied to textiles. The difficulty of applying the same principle through the whole range of textiles is, however, considerable. The system which will provide a key to textile nomenclature will have to be simple and must not take for granted more intelligence than that supplied by the average education, so that it will be of value to most of the retail store clerks.

Another difficulty is caused by the practice of various manufacturers of substituting materials and names, so that very often textiles sold under the same name have practically nothing in common with each other. For instance, when, a few years ago, the craze for matelasse swept through the country, some of the stores sold brocades, reversible fabrics, and other goods under that name. I found that many retail store clerks really did not know what the real matelasse looked like. A key to textiles, or a determinator of names backed by authority more than that possessed by a single individual would do a great deal of good in the trade. It would help to make the use of standard names more universal and would be of great assistance to the student and to the dry goods clerk. In my opinion such a key should be used in conjunction with some textbook or encyclopedia in which details of the composition and manufacture of the material can be found.

I take pleasure in submitting to you a system by which names of a large number of standard fabrics can be determined. One of the greatest difficulties found in developing this system was in describing the finishes of the various textiles in such a manner that they would visualize themselves, so that the person employing the system would recognize which of the descriptions of finishes applied to the sample in question. While in its main outlines this key or determinator has been worked out for all classes of textiles, there is still a great deal of detail work to be done, and in doing this I would appreciate the assistance of others.

I will attempt to give an outline of the system used in this key or determinator of textiles, although I am aware of the fact that in adequately describing a system by words, its working may appear considerably more intricate than is actually the case.

As an introduction mention is made of some of the elementary principles of the knowledge of textiles. In separate, consecutively numbered paragraphs are described methods of distinguishing cotton, linen, silk, wool, and artificial silk with the aid of a microscope and a few common chemicals. For instance, one paragraph states:

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[4] Fashion Editor of Women's Wear and author of Dictionary of Textiles.

Fiber shows scaly surface under microscope; when burnt will produce crisp ashes and gives forth an acrid pungent smell; when boiled in solution of alkalies will dissolve; nitric acid will dye yellow and dissolve slowly; cold sulphuric acid will not dissolve.—WOOL.

A few other introductory paragraphs describe how to distinguish such elements of construction as the warp, the filling, the selvage, the pile, the nap, the swivel, and lappet yarn. Another group of paragraphs describes the weaves. All of these descriptions begin with the enumeration of the characteristics and conclude with the name; thus, the name is always the result found. The paragraphs are numbered consecutively throughout the entire key.

In order to give an approximate idea of the actual application of this key or determinator, I will take up one example. Suppose we have a piece of Turkish toweling the name of which is to be found by this system. Upon dissecting the fabric we find, according to the introductory paragraphs, that it is pile fabric made of cotton. At the end of the paragraph by which it was found that the sample in question was a pile fabric, a number is given which refers to the chapter on pile fabrics. After turning to this chapter, the following course is taken:

The pile fabrics, in general, are first classified into warp-pile and weft-pile fabrics, the two large groups in this class. Upon further investigation we find that the sample in question is a warp-pile fabric, and we will consequently turn to the paragraph indicated by number as having to do with warp-pile fabrics.

This new paragraph on warp piles mentions two new subdivisions, one with cut pile and the other with loop or uncut pile, each of which is described and given a new index number. The sample in hand has uncut pile, we find, and so we look up the new number indicated.

In the paragraph for uncut pile we see that the material from which the fabric was made enters into consideration, and as we know already that our sample is of cotton, we find that it is terry or Turkish toweling.

DISCUSSION

Mr. Stratton. This last paper has brought out a very important point. We never consider questions relating to specifications or tests without finding that the first obstacle encountered is the nomenclature. This condition is not peculiar to textiles but exists in every branch of industry.

A year or so ago, when we began cooperative work with the nonferrous metal manufacturers, I was astonished to find how often terms were used with absolutely no understanding as to their meaning. It is impossible to proceed with the making of specifications or the developing of correct buying and selling without first understanding the methods of measurement that are going to be used and the terms that are going to be employed.

I think that almost the first permanent committee appointed should be one on nomenclature. The very first thing that the Advisory Committee for Aeronautics to which I happen to belong, did was to appoint a subcommittee on nomenclature. There is great difficulty in avoiding ambiguous terminology in new industries, but though the textile industry has been in existence for a long time it is still full of names ill-defined and based on tradition. It is time, I should think, that some of these were standardized in order that when you buy and sell you may know what the terms used mean.

Mr. Bivins. There is no dictionary or encyclopedia known to me in which the names of fibers are given systematically.

Mr. Harmuth. Dr. Matthews has written an excellent book. A late edition has been published and is one of the very best books on fibers and standard grades of materials.

Mr. Stratton. If that is true, how are we to know that this book is to be adopted as a standard authority? If it is not complete, let us fill up the gaps. One of the best branches of work this conference can initiate is the standardization of nomenclature.

Mr. Nolan. I come in contact with this subject in New York at the Appraiser's Stores. Part of my work there is to aid in classification of wool clothing. It happens that the word "flannels" is mentioned in Schedule K. A duty of 35 per cent is provided for wool cloths, with a special provision of 30 per cent for flannels. It is evidently very important to establish what is a flannel when there is a difference of 5 per cent duty involved, for 5 per cent of the valuation of importations of wool cloth will probably amount to millions of dollars during the time that this tariff will be in effect. Last spring I went to various manufacturers and dealers to find out from them what constituted flannels. It was surprising to me in my visits to find how much ignorance was displayed on the subject. I have looked up all the authorities on flannel for tariff purposes, and I find that dictionaries outgrow their usefulness on account of the fickleness of trade and fashion. Practical, theoretical, and technical men are all unable to give a precise definition. They have to take the commercial conception as a guide in giving decisions as to whether or not a given fabric is a flannel. It is surprising that the worsted and wool trade usually understands the word to describe a finish rather than a fabric. When asked for a flannel, the salesmen in some of the best clothing stores often show you a fabric of unfinished worsted. If you ask for an unfinished worsted, they will show you the same thing. The importing interests assume that any unfinished fabric with the handle or feel of a flannel may be entered under the flannel provision at 30 per cent. This is just an illustration of the value of proper nomenclature of fabrics.

Mr. Stratton. The point brought out in regard to the customs is very important and one with which we have frequently come in contact, but it is often even more important that there should be acceptable definitions for terms used in contracts. Every industry is full of terms that have been accepted by the trade without their having been defined with sufficient definiteness for use in contracts. The purchasing in the Government service is often done by persons who are quite familiar with the legal side of drawing up contracts, but who are not familiar with the technical details involved. An attempt is usually made to play safe by specifying a high-grade material; for example, specifying a pure material instead of a mixture. A remarkable instance of the results of a procedure of this kind occurred once when an official specified pure Pará rubber. In this particular case it would not have answered the purpose at all, although it would have cost several times as much. The official thought he was being safe in specifying pure Pará rubber. The standardization of nomenclature helps to guard against such reckless purchasing as that. I do not believe there is a business house in the country in which business is carried on with propotionately as little graft, as it is called, as in the Government service; but, on the other hand, the efficiency of the latter is often small, due to just such things as ignorance on the part of the buyer of the nature of the things he is intrusted to buy.

Mr. Bivins. I would like to ask whether the Bureau of Standards has all of the authority in the determination of standards and specifications for the purchasing of materials by the different departments of the Government? I ask this question because it seems to me there is great lack of uniformity among the departments in this. The different departments have different standards and different specifications for the same things, and the specifications of some of the departments are unscientific and impracticable.

Mr. Stratton. It is more a question of knowledge and cooperation than of authority. When such matters are called to our attention, we call together for discussion the Government representatives who are most interested. Discrepancies are largely the result of tradition, and when the facts are brought to light appropriate action will be taken. When the Government users have agreed in regard to specifications, the next step is always to consult with the outside users. Sometimes differences are reconciled by an agreement among various Secretaries, and in one or two instances by Executive order. In the case of cement, after the Government engineers had come to an agreement regarding specifications and tests, the President issued an Executive order requiring their use. That can always be done if necessary, but is seldom necessary.

We are intrusted with certain functions regarding Government buying, but the public always derives the greatest benefit, for what we work out for the Government is equally applicable in private transactions. It is our purpose that no specifications or terms should be adopted upon which all the parties interested have not had a chance to pass an opinion. That usually includes the manufacturer, the user, and the laboratory man.

COTTON WASTES

William N. Randle [5]

Cotton wastes are the result of inefficiency in growth and manufacture and have existed since primitive man (or more probably woman) first conceived the idea of imitating nature's wonderful tissue fabrics woven about tender tropical plants, the coarser canvas of the birch bark, and the rugged overcoating of the coconut. Spinning and weaving are much older arts than writing, hence we can only surmise when the prehistoric savage first noted the fibrous structure revealed by torn hides stripped from the bodies of animals killed for food or the coverings of broken limbs of trees, and set about devising ways and means of covering his own body and limbs with a similar covering. It is quite probable that temperature played a much more important rôle than modesty in this early invention. It is even more probable that the percentage of waste made in the construction of this first fabric far exceeded our grossest industrial sins of omission and commission in the modern factory system, but doubtless a greater degree of care toward waste prevention was practiced than by the operatives of this day and generation.

We have heard much about efficiency, and may we hear a great deal more, for true efficiency is based primarily on waste prevention and elimination and not merely on reduced movements of physical and mechanical manipulation, as some self-styled efficiency experts evidently believe. Let us remember that truthful old saying, "haste makes waste," and work toward the efficiency ideal having as its foundation the blending of rapidity with accuracy and resting firmly upon perfect coordination of hand and head. Nothing in human industry is more pitiful than waste of time, talents, opportunities, and materials. The waste of mere money is trifling by comparison, for money may be recovered; true waste can never be reclaimed at full value.

We of the textile profession must not confuse true wastes with by-products, for intelligent waste control comes from logical differentiation of these elements of manufacture under the factory system. For example, such items as card strippings, and comber noils are frequently considered as wastes, when as a matter of fact they are only wastes to the extent in which perfect long fibers have been eliminated in the processes for culling low stocks from higher grades, thereby preventing the longer fibers from passing to the succeeding process with the remaining longer fibers not so eliminated or intended to be culled out.

Let us remember that such so-called wastes as card strippings and comber noils are in truth products, by-products it is true, but nevertheless necessary in the manufacture of certain grades of yarns. Let us also make close study of these and other

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processes whereby stocks are divided mechanically, devising ways and means to prevent fibers of acceptable length and strength being thrown out with inferior stock to receive the classification and valuation of the lower grade. The waste in such processes is not the low stock properly removed from the longer fiber, but is the loss incident to the decreased valuation suffered when superior fibers are improperly transferred to any inferior by-product. Such wastes can only be eliminated by most careful study and further invention, but we can greatly reduce the amount of useless waste by impressing our overseers and operatives with the importance of stock-value conservation.

Cotton is susceptible to many wastes from seed selection to final use. The ease with which cotton may be grown and the low money value of the staple have been the chief factors contributing to these immense wastes, of which the most notable are the failure to take advantage of neglected opportunities to greatly increase the yield, the abuse of delicate fiber in ginning, extremely harsh treatment in manufacture, extensive damage in harvest, field, warehouse, compress, and transportation, and a lack of appreciation of the economical value of once-used cotton. Having been reared in the South and having had extensive experience in growing, handling, marketing, and manufacturing cotton and in doing research work with reference to the conservation of cotton and the utilization of its wastes, I feel that I speak with a fair measure of authority when I state that could wastes be eliminated we might do with half the acreage now devoted to cotton, which is only another manner of saying that we are less than 50 per cent efficient in the growth and utilization of cotton.

In striving to eliminate this useless waste, let us not overlook the possibility of further conserving our resources by investigation of the possibilities yet undeveloped in our by-products. Our by-products present wonderful opportunities for scientific research. It must be possible for fibers to be grouped, sorted, and utilized with the same degree of precision as Marconi has achieved in electrical wave-length selection and it may be that our by-products are to become more valuable than our principal products, as was the case when our industrial brothers, the chemists, developed our most valued dyestuffs from coal tar, theretofore a despised waste. Most of us would be eating unshortened bread in to-day's war time were it not for the oil crushed from cotton seeds, which our fathers of the last generation burned as useless rubbish; and we could eat little meat, except for the fact that an invaluable foodstuff for cattle was discovered in cottonseed hulls and meal, which meal is also our principal source of ammonia for fetilization, both being by-products of the new cottonseed-crushing industry.

I hope you have not expected a technical discussion of textile machine detail, care, setting, management, and operation, or a treatise on processes for waste manipulation, the system in use in the several countries, the commercial uses and values of wastes and products of cotton wastes, or statistics of the waste industry. These may be readily obtained from the admirable books, pamphlets, Government publications, and textile journals with which our industry is so bountifully supplied. My purpose has been to impress the necessity for a thorough understanding of the vast difference between cotton waste and cotton-waste products by those who would attain any degree of success in the theory and practice of waste control and limitation.

Our textile engineers are still laboring over many unsolved problems, and it may be that whole systems of processes may have to be revised before waste control can be mastered and perfect cleaning, attenuation, twisting, coloring, and weaving accomplished without the present near destruction of fibers in our factory systems. We need not be surprised if these inevitable improvements come from those not directly connected with the industry. We must remember that our greatest textile machine inventions have come from the outside, for was not the spinning frame invented by a barber, the fly shuttle by a watchmaker, and the power loom by a clergyman? Those engaged in highly specialized industries are liable to lose perspective in close application to detail. You visitors to the great city of Washington will note many beautiful things unseen by many born and reared here, as well as many opportunities for civic improvement unappreciated by those who are exerting their best efforts to make this, our Capital City, of which all of us are so proud, the city beautiful.

DISCUSSION

Mr. Stratton. Mr. Randle has again brought up a subject which is applicable to all industries—the saving of waste.

A few years ago certain questions relating to cotton bagging for cotton bales were taken up with us by the Treasury Department in connection with the collection of the import duties. I was surprised to find the character of stuff that had been used. Year after year the worst kind of rubbish from India and Scotland had been made into this bagging and sent over here for use. I suppose the waste that has resulted from using this kind of bagging would have more than paid the cost of a better quality. Yet they go on using it to this day.

A few days ago I saw a machine which produces from ordinary cotton stalks a very suitable fiber for making bagging. In this process the lint is cleaned from the stalks by an air blast, and I was astonished at the amount of lint that could be recovered.

Similar things are being done in all industries. There is a very large movement going on all over the country in the direction of the prevention of waste. We have been so prosperous and we have had so much to do in the past that we have not had time to look after these apparently little things, which in many cases prove to be large things.

Mr. Cook. The statement has been made that manufacturers do not choose their materials with consideration for the needs of the consumers. In the case pointed out, materials of better quality than needed were being used. As a matter of fact, in the production of cotton neither the needs of the manufacturers nor those of the consumers were considered. The system has grown without any intelligent direction, and consequently there is no connection between things. The confusion regarding nomenclature is just a typical illustration of the kind of confusion that exists throughout the whole system.

In regard to waste, we can reassure the speaker about prehistoric methods of textile manufacture. The savages did not bother with saving things of which they had a great deal to spare, but they did not waste any cotton. They beat it with a forked stick and spun all of the product. Waste is the result of our modern system of manufacturing. Furthermore, in discarding the primitive method of using cotton fiber all connection between the manufacturer and producer and between manufacturer and consumer has been lost. A large part of the cotton that is produced is of a character that is lacking in uniformity, and waste in manufacturing is often a direct result of inadequate attention to the production of the fiber. Sometimes farmers leave their cotton in the rain and let it be injured. They have not adopted the point of view of the manufacturer, and until they do, protests are without avail.

It seems to me that if the manufacturers, who occupy the middle ground, will take an interest both in the production and in the consumption of cotton—if they will direct their efforts back to the farmer—the kinds of cotton needed will be produced. There are hundreds and hundreds of different varieties of cotton, and manufacturers can be supplied with any of them if they will specify what they want and arrange their buying system rightly.

The possible uses of cotton and the different qualities that exist in cotton are subjects which have hardly been touched upon. We must recognize the general responsibility for stimulating investigational work which will tend to eliminate waste. If the cotton field contains fiber of various lengths, as is the case all through the South, a lot of complicated and expensive machinery would be required to separate the different kinds of fibers. The chances are that men who raise varieties of cotton that are uniform and are very much superior for textile purposes will not receive higher prices for it.

Mr. Bemis. While I agree with what has been stated as an ideal to which we should aim, I want to point out the difficulty of attaining it. Being impressed very much with the possibility of raising the kind of cotton that we would like to spin, I became interested in a plantation in Arkansas in a section where the general character of the cotton raised is what we would like to spin. The experiment has been going now four or five years. In spite of all our efforts we have not yet succeeded in getting just the kind of cotton that we want.

Mr. Marshall. Much is being done to call attention to wastes in cotton production and manufacture, but very little effort has been made to bring together the different people concerned. If anything is done here of a constructive nature, I would like to be sure that the conditions in the wool trade are not to be overlooked. I have had a considerable opportunity for observing the relation of the woolgrower to the manufacturer, and I have come to believe that the ignorance of the wool manufacturer about woolgrowing is only equaled by the ignorance of the woolgrower about what the manufacturer wants. The manufacturer should project his wants back into the fields to improve future production, and the woolgrower has been waiting for him to do so. Consequently the grower has always found it necessary to produce along lines of his own devising.

Mr. Fay. Lack of efficiency is well illustrated in the manufacture of sulphuric acid. The nitric acid fumes were allowed to escape until the people who breathed the air that came from the manufacturing plants had to compel them to save these wastes. Something more than the temptation of inviting prosperity by improving processes is sometimes necessary to overcome human inertia.

Mr. Randle. Before we can make much headway in reducing waste of cotton and wool, we must come to realization of the great difference between wastes and by-products. We are accustomed to think of anything except our major product as a waste. That is not true at all. After the acid fumes were confined and converted into a commercial product they were no longer a waste, but a by-product. The materials that have been considered as waste should be converted into by-products whenever possible.

Mr. Stratton. The last speaker brought out two or three important points. There are very few specific cases of waste that can not be handled if attention is called to them. Not long ago a paper manufacturer asked if we had done anything regarding the recovery of paraffin from waste paper. He told me of a large firm in New England which was destroying daily scrap paper containing about 1200 pounds of paraffin, worth several hundred dollars. When their attention was called to it, it was not difficult to find a remedy. Once a street car company in Washington had to be forced by law to adopt the use of electric motors instead of horses. I suppose they would still be using horses if they had not been compelled to use electricity. One of the most serious and often the controlling factor in all questions of saving is to make the people concerned realize that they are wasting something.

Mr. Veach. It seems to me that the great waste in the wool industry is the waste greases, potash salts, and possibly other valuable material, that result from the scouring of wool. If these materials were always recovered, probably two and a half million dollars yearly in valuable greases and potash salts would be added to our output, and, in addition, our streams would be freed from the most offensive kind of pollution. The fact that this is being done in some mills shows that the problem is not one that can not be solved.

Mr. Hartshorne. I have always been extremely interested in the problem just mentioned. The manufacturer has to be shown whether he is going to profit by recovering the wool grease. I was formerly connected with a mill which is at the present time profiting not less than 250 000 dollars a year by saving the grease. If they had not solved this problem 20 years ago they would probably have been forced to do so.

Mr. Pierce. There is another point regarding waste that has not been brought up. If the manufacturer is unable to get exactly the material he desires, he will suffer more or less waste. The trouble seems to be in present methods of grading or standardizing. We can standardize the sulphur put into iron because it is fairly homogeneous; but various parts of textile fibers are of different characters, and the only standard obtainable is the average. It may be that that minimum is sufficiently good for a certain purpose and so makes no difference, but for another purpose part of the material may appear as a waste. If the Bureau of Standards could show us some way in which we could express in figures, or by curves, or some other method, comprehensive standards for nonhomogeneous materials like wool, cotton, silk, leather, and paper, it would be doing a great favor to the various industries.

THE CONSERVATION OF GARMENTS IN LAUNDERING

H. G. Elledge [6]

I regard it as a distinct privilege to have the opportunity of presenting before this conference of textile experts a consideration of the conservation in laundering of all textile articles—garments as well as all household fabrics—that are commonly laundered.

Definite information regarding the length of time a textile in use should last is entirely lacking. One hotel which has been under the writer's observation for nearly two years has been in operation for two and one-half years. When this hotel opened it was sufficiently stocked with table linen so that when doing capacity business one-third of the entire stock would require laundering every day. There is, of course, no absolute record of the number of times each article of this lot of linen has been used and laundered, but it is a conservative estimate that each piece of table linen in the hotel has been subjected to laundering 228 times, assuming that for one-half of the time the hotel enjoyed capacity business and for the remainder one-half of that amount of business. Some of the napkins are beginning to show thin spots, but there are no holes or ragged edges. As a consequence, the management is entirely satisfied with his purchase of linen as well as with his launderer. The appearance of this linen is such as to please the most fastidious.

This stock of linen was of good quality when received from the manufacturer; but contributing quite as much toward the good showing has been the care in using and laundering. It has not been the practice of the hotel help to use the slightly soiled napkins as kitchen towels or dust cloths, as is actually the case in many hotels and restaurants. The laundry gave this linen just the treatment necessary for keeping it snowy white and no more.

In the above narrative the writer has indicated the three agents of responsibility that must function together if the useful life of any fabric is to be conserved. The cloth must be of good quality. The responsibility is directly that of the buyer, but ultimately that of the manufacturer. The cloth must be properly cared for—not soiled beyond the extent due to the ordinary conditions of usage. Towels to be kept white and of attractive appearance and yet have a proper life should not be used for shoe shining, etc. In this lies the responsibility of the user. The laundryman must judge, or have an organized group of workers to determine, the nature and extent of the treatment necessary to keep the fabric of attractive appearance and yield the longest life in service. This is the responsibility of the launderer.

The Laundryowners' National Association's Bureau of Textiles.—The association, which maintains the researches on the problems of laundry technology in the Mellon Institute of Industrial Research of the University of Pittsburgh, which

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have engaged the writer's entire attention for the past two years, also operates a Bureau of Textiles.[7] This bureau resulted from the work of a committee appointed to promote and support legislation for the correct labeling of fabrics. It has, however, grown to be a service feature to the members of the Laundryowners' National Association and has only recently been dignified by the name introduced above.

To cite one of the illustrative instances of the bureau's services, there was a tablecloth laundered for the first time with a lot of 60 tablecloths. This one cloth came from the ironer with one border shrunken. By common logic the laundryman knew that it was through no fault of the laundering process that this table spread was shrunken; but without some specific knowledge of what might cause the shrinking or where the responsibility might rest it was difficult for him to offer a satisfactory explanation to the irate owner of the tablecloth. The Bureau of Textiles is ready and willing to render assistance and advice to members in such a case and to assist in obtaining an equitable adjustment of the matter.

Likewise, another incident not entirely unlike the one just mentioned has come under the observation of the bureau. A new bedspread, upon its first trip to the laundry, came from the ironer with numerous strings of yarn, some 2 or 3 inches long, hanging from the surface. Other bedspreads of similar weave came through this same wheel at the same load without any such untoward results. The member having this experience obtained from the bureau expert advice which he employed in securing a satisfactory adjustment of the difficulty between the patron and the shopkeeper who sold the spread, thus absolving the laundry of any blame in the matter.

Through such means the laundry owners in every locality are exerting influence upon the distributors of these important household fabrics and are trying to teach their patrons that "seconds" are seldom real bargains.

Had the owner of the shrunken tablecloth or defective bedspread been an employer of a washerwoman instead of a patron of the power laundry, adjustment would probably have been made by the dry goods company with little questioning, the blame being placed on the manufacturer. Such a convenient scapegoat for the dry goods man is the laundry owner that in case of any defect being discovered by the first removal of the sizing, such as in the two instances mentioned above, it is more than likely that the laundry owner will have to pay unless his interests be conserved by his organization.

It is realized that there are many grades of raw materials that must be utilized in the total output of our textile mills; that automatic machinery and human hands are not infallible, and that economic necessity demands that all products of the mills at all suitable to human needs must be, somehow, marketed. Yet it is the feeling on the part of the laundry owners that the buyers, especially the housewives, should become more discriminating. In order to assist to this end, some means should be devised to curtail deception in the selling of fabrics, whether this deception be perpetrated by the owner or unscrupulous jobber into whose hands defective textiles might fall. In other words, goods classified as defective or seconds in the reputable mills should be so labeled or indelibly branded that they could less easily be represented as good cloth should they find their way into the hands of the unscrupulous dealer. Indeed, it would seem that such a measure would promote the welfare of the honest producer and consumer, as well as the laundry owner.

It is fully realized by the writer that the difficulties of the cotton manufacturer begin in the cotton fields and extend through every treatment the cotton fiber receives to the finished cloth. The wonder is not at the fact that evidence of the "scratch-up" needle is often found by the launderer on first washing a piece of goods, but rather it is surprising that it is not more often discovered. These considerations may casually appear to be somewhat beyond the scope of the writer's work. They are, however, vitally important in their relation to the problems under investigation.

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[7] J. Clair Stone, of Minneapolis, Minn., is the active director of this bureau.

Other factors relating to the responsibility of the manufacturer, of more purely a chemical nature and which offer a field for research, are the bleaching of gray cloth and the allowable weighting of silk. Better standards of control in the bleaching process, it seems to the writer, might be desirable. It is insufficient to state that a certain treatment does or does not tender a piece of cloth. Qualitatively any treatment that is given any fabric during the process of bleaching or washing has some tendering effect, but we are concerned about quantitative results. How much, for example, does this or that process or a certain bleaching agent tender a gray cloth of a certain weight and texture?

Responsibility of the Users.—The responsibility of the user in the life of a fabric seems so obvious that the writer felt inclined to refrain from discussing the factors thereof. It is, however, one of the most important considerations and, after all, is not quite so apparent to some users. A year or two ago any observing traveler might have frequently noted that the porter on a Pullman sleeper as a matter of practice dusted off the woodwork of the car with a pillowcase as he closed up the berths, and that frequently a pillowcase or face towel was employed by the porter to give the traveler's shoes the final touches. The Pullman Co. owns its own linen, and after this condition was explained by a progressive laundry owner such unnecessary abuse of the linen supply has been prohibited.

The fact that a garment or household fabric must suffer some wear in use is often lost sight of. Absurd styles and carelessness on the part of the user many times reduce the life of the textile article. For instance, a child's play garment should obviously be made of a weave that would endure more severe treatment than should be given to cotton underwear.

The Life of a Starched Collar.—Historically, the growth of the laundry industry is intimately related with that of the popularity of the detachable starched collar. While men's shirts and collars still constitute a large and important volume of the launderer's business, the progressive laundry owners have been bidding more and more strongly for the entire household laundry work. This policy alone induced the researches that have been undertaken in the Mellon Institute laboratories.

To illustrate how some laundry owners have established control indices on their washing process, affording thereby data regarding the respective proportions of the depreciation of a garment chargeable to wear in use and to wear in laundrying, the following example is cited: It is the practice in many laundries to place a date numeral, sometimes in code, on every new collar that is marked in. Others place a mark on each collar in such a way that the number of trips a certain collar has made through the laundry can easily be read. In addition to this, in one laundry that has come under the writer's notice a lot of new collars were marked and run through the usual process of laundering and finishing, i. e., starching and ironing. Then they were, without being worn, repeatedly put through the process until the collar showed signs of failure by cracking at the folds. These collars showed a life of from 35 to 40 trips through the laundry process, whereas a good showing for worn collars in the identical processes of washing is a life of about 20 trips through the laundry. This indicates that the actual wear in use is 43 to 50 per cent of the life of a collar. Much of the most severe damage that is done to a starched collar, it may be remarked in passing, is attributable to improper manipulating in putting it on and taking it off.

The Responsibility of the Laundry—Standards of Work Demanded by Patrons.—The average laundry has very definite standards with which the work must comply. The appearance must be that demanded by the patron or, in reality, that which the laundryman conceives to be required by the patron. The general experience of laundry owners in selling service seems to be that to the patron the appearance of the laundered work is held of more importance than any extra conservation of the life of the goods, the latter consideration constituting a point of secondary importance. With some, however, the order is reversed, so that neither factor can be lost sight of.

The restaurant owner who sends in severely soiled table linen usually wants his linen returned with the same snowy whiteness as is demanded by the manager of the first-class hotel mentioned in the introduction. Again, the housewife who thinks that because the power laundry does her work the housheold linen may just as well be badly soiled, requires the same standard of appearance in the laundered linen as is exacted by the housewife who cares for her linen as though she or her washerwoman expected to do the laundering in her home. Another requirement is that the laundering process shall be no more severe than is required to maintain the proper standard of appearance. Still another objective to be attained is that the linen be returned to the patron in a sanitary condition. As will be pointed out later, the power-laundry process automatically takes care of this feature.

Study of the Effectiveness of Washing Materials.—In the investigation presented below the mechanical equipment of laundries has been accepted as it exists in practice. While, as the investigation proceeded, the writer was observant for any possible improvement in wash-room equipment, he early became impressed with the fact that a remarkable approach to perfection has been attained in mechanism—truly a monument to American ingenuity. The detergent reagents were therefore studied, bearing in mind the wash-room equipment as it is.

Soft Water.—It is obvious that a good supply of soft water is the most important of the wash-room requirements. Where natural water containing less than 8 grains of calcium carbonate equivalent per United States gallon is not to be had, the advice of the writer to the laundry owner has been that the need of a water-softening plant is indicated. The various installations that are offered to the trade have been investigated, and consulting service has been rendered to a large number of the association members contemplating the purchase of water-softening plants.

Detergent Value of Soap.—The reagent next in importance is soap; and accordingly a study of the more recent theories concerning the detergent action of soap solutions has been made, not so much with the object of advancing any theory or modification of an existing theory, but more with the idea of finding a basis for measuring the value of the alkaline salts used in washing fabrics. By somewhat extending the work of Hillyer,[8] we feel that we have found a means of determining the relative values of these salts. These findings have been discussed in an earlier paper.[9] As far as the evaluation of laundry soap is concerned, investigations to date indicate that the most satisfactory method is on the basis of the fatty acids, alkali as soap, and alkali as filler determinations, taking into consideration objectionable impurities and the temperature at which a given concentration of the soap solution tends to "jell," this being indicative of what the laundryman terms the rinsing properties. In connection with and in addition to the usual analysis [10] the drop number or relative surface tension measurement, as described by Hillyer [11] and more recently by Shorter,[12] has been found useful by the writer in comparing the detergent values of two or more soaps. The drop number method can not be used as an absolute index for an unanalyzed soap, because a smaller percentage of real soap plus a larger percentage of carbonate alkali might indicate a higher value than a pure soap. For the present it is necessary and, indeed, desirable to recognize a difference between the commercial values and the detergent values of soaps.

Bleaching.—Before this conference it is not necessary to present the question as to whether or not bleaching is necessary for white cottons and linens in the launder-

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[8] J. Am. Chem. Soc., 25 (1903), pp. 511, 524, and 1256.

[9] Elledge and Isherwood, J. Ind. Eng. Chem., 8 (1916), p. 793.

[10] See Circular of Bureau of Standards, No. 62.

[11] Loc. cit.

[12] J. Soc. Dyers and Colorists, 32 (1916), pp. 99–108.

ing process. While bleaching and its attendant souring is likely to be the most harmful of the reactions employed, it is evident that to obtain the whiteness desired would be impossible in some cases without employing a bleaching bath. In many classes of white work the bleaching is, however, omitted.

So far as our investigations have progressed, sodium hypochlorite, prepared either electrolytically or from bleaching powder and soda or from chlorine gas and caustic soda, seems to be the best of the available materials for effecting laundry bleaching. Proprietary bleaching materials composed of soda ash and sodium perborate or soda ash and sodium peroxide have been offered to the laundry trade. An obvious objection to the ones containing sodium peroxide is the instability of that compound. Several samples claimed to be of such a nature have been found upon examination to contain no oxidizing power whatever.

Emulsified Solvents.—Many stains are encountered in laundering which do not readily yield to soap and alkali washing or to oxidizing bleaching. Kerosene or other solvents for greases and waxes, emulsified in water solutions of soap and alkali, have been offered to meet the needs presented by these conditions. Some of these have been found to be very good examples of stable emulsions but to possess a questionable value in washing clothes.

The writer can not quite agree with the conclusions of Pickering[13] that hydrocarbons are dissolved by soap solutions. The writer has found, however, that a hydrocarbon oil, such as kerosene, with about 1 per cent of oleic acid dissolved in it, is effective in removing oil and grease stains by the following procedure: Treat the dry soiled garment or cloth with the 1 per cent solution of oleic acid in kerosene; remove this solution as completely as possible by wringing (preferably in a centrifuge); then emulsify the residue by washing the garment or cloth in a warm alkaline bath. The oils left in the cloth are more readily emulsified by reason of the fatty acid already diffused throughout the mass. A similar application of this principle has been made for removing paint stains, using the vehicle of the paint with 1 per cent of oleic acid dissolved in it as the solvent and then operating as outlined above.

Fabrics are often more severely treated to remove a stain than would be necessary if the laundryman were advised by the patron as to the nature of the stain. In such instances the patron could often contribute to the conservation of the fabric by giving the laundryman the history of the stain. The use of the proper reagent, such as potassium permanganate and oxalic acid in the case of iron stains, is the practical procedure to restore the fabric to its former condition with the least loss of tensile strength. Other stains, such as "wagon stains" (wet street dirt), treated immediately following the soiling are easily removed, but after being allowed to dry are very obstinate.

Instruction as to the proper use and care of fabrics, such as is being disseminated through domestic science schools and magazines, will contribute in a large measure to the conservation of fabrics by promoting the cooperative assistance of the patron to the laundry.

Effect of Reagents and Mechanical Treatment.—The effect of all the washing materials on the tensile strength of fabrics has been studied by Faragher.[14] His tests were, of necessity, of the accelerated order and were conducted in the laboratory. It seemed desirable, therefore, to extend his work by securing further data concerning the effect of these reagents under conditions of rinsing and mechanical influences obtaining in usual practice.

In order to accomplish this, the following experiments were carried out in the laboratory "machine," a model of the usual type employed in power laundries.

To determine the effect of mechanical action in the water of the machine on cottons and linens, 8 pounds of miscellaneous cotton garments were placed in the machine with 10 gallons of cold water (room temperature). This load of 3 pounds of goods

[13] The Detergent Action of Soap, J. Chem. Soc.; February, 1917, pp. 86–101.

[14] Ind. Eng. Chem., 6 (1914), p. 640 et seq.

per cubic foot of capacity was chosen to make the test comparable to what had been found to be the most efficient loading of the machines in actual practice. In this load was placed a handkerchief (of the quality usually retailed at 25 cents), the breaking strength of which had been determined at four places along the warp and four places along the filling. The machine was then started and run continuously for 25 hours. At the end of this time the handkerchief was removed, dried in the centrifuge, ironed, and the breaking strength determined as before. The loss in strength was then calculated on the basis of the original strength. With cold water the loss amounted to 0.18 per cent per hour of treatment. The results of similarly conducted tests, but varying reagents, are as shown below:

	Loss per hour of treatment, per cent
Hot water, 10 gallons	0.277
Cold water, 10 gallons, 0.41 ounce soda ash, representing a concentration 6 times as great as recommended in wash-room formulas	.18
Hot water, 10 gallons, 0.8 pound soda ash	.48
Hot water, 10 gallons, 6 ounces soap	.5
Hot water, 10 gallons, 6 ounces soap, 0.8 pound soda	.22
(Copious suds throughout.)	

It will be seen from this statement that, as would be expected, hot water plus mechanical wear is greater than cold water plus mechanical wear; that, with cold water, sodium carbonate, in a concentration of three times the maximum concentration usually employed, had an effect entirely obscured by the mechanical effect, and that the combined effect of soap and soda in which a good suds persisted, even though the concentration of alkali was six times the maximum usually employed in the laundry, was less than that of a soap bath alone in which the suds did not persist, and even somewhat less than hot water alone.

These results are entirely in accord with those of Faragher, from which he concluded that soap and soda are the least harmful of all the washing reagents; and they even go further in that they indicate that, under conditions of practice necessary to cleanse fabrics, soap and soda, in addition to their detergent properties, actually have a conservative function in the washing process.

Twelve handkerchiefs similar to the ones used in the above tests were tested for strength and soiled with a uniform dirt mixture of 1½ grams of beef extract, 1 gram of dried egg albumen, and 2 grams of lampblack, all mixed into a good solution and suspension in 4 liters of water. Six of these handkerchiefs were sent to a power laundry and 6 were sent to a reliable washerwoman.

After each lot had been soiled and washed 10 times the breaking strength was again determined. The loss per trip to the laundry amounted to 2.6 per cent of the original strength, while the loss per trip to the washerwoman was 2.1 per cent of the original strength. The limit of error was estimated to be about 10 per cent; hence the results were considered to be of the same order of magnitude. The laundry was known to bleach in the last soap bath with 2 quarts of sodium hypochlorite of a strength of 1 per cent by weight of available chlorine, or a strength in the actual bath of 0.012 per cent of available chlorine, and to sour with 6 ounces of sodium bisulphite to a bath of 40 gallons of water. The washerwoman was known to use ordinary domestic bar soap and sal soda in undetermined quantities. The appearance of the laundered handkerchiefs was pronounced by impartial judges to be superior to that of the ones washed by the washerwoman.

Another test similar to the above in every way, except that only six washings were made, resulted in a loss of 3.6 per cent per trip to the laundry and 3.6 per cent per trip to the washerwoman. By comparing these results with the ones presented in the previous paragraph it will be noted that the effect of the washing process is greater per treatment for the first six treatments than for the last four. It would appear that as the cloth approached pure cellulose in composition the chemical effect of the washing process becomes less and less and all the loss becomes mostly attributable to mechanical effects. Since, however, this is more of academic than practical interest, the writer had to forego further experimentation along this line. The practical interest in the results of the tests is in the fact that a greater loss in strength is suffered in the first few washings than in subsequent ones and also because the effect of the power laundry process is no greater than the effect of the treatment given by the washerwoman.

Since the above experiments indicated that there was something in the ordinary washerwoman's process that compensated for the bleaching and souring in the power-laundry process, the following data were obtained to contribute to an explanation:

The Loss Due to Bleaching.—In order to eliminate mechanical influences as completely as possible, the effects of bleaching in a 0.012 per cent available chlorine bath were measured by the following procedure: Test strips of sheeting, about 18 inches square and weighing approximately 25 grams, were prepared and the tensile strength then measured in four places on the warp and four places on the filling. A piece so prepared was then immersed in a 300 cm^3 bath of sodium hypochlorite of the strength mentioned above and maintained at a temperature of 180° F for 15 minutes. The cloth was then removed from the bath, allowed to drain for two minutes, and immersed in a bath of fiftieth-normal acetic acid, in which it was thoroughly rinsed. The cloth was then rinsed thoroughly in tap water and dried in the centrifuge. This treatment was repeated 10 times, using freshly prepared baths each time. After the tenth treatment the cloth was ironed dry and the tensile strength again measured. The average loss per treatment was found to be 1.3 per cent of the original strength.

Effect of Washboard Rubbing and the Roller Wringer.—Since all reagents used by the washerwoman and the power laundry are practically identical, excepting the bleach and sour, and since the total effect on strength is approximately the same, this loss due to bleaching and souring in the power-laundry process must be represented by the effect of the washboard and roller wringer in the washerwoman's method. It is the opinion of the writer that the centrifugal extractor, as employed in laundries, is one of the pieces of equipment which contribute most to the conservation of fabrics in laundering.

Effect of Drying on Clothesline.—Exposure to the air when drying affects the strength of fabrics more than might be anticipated. A handkerchief was exposed on the roof of a city building for 23 days last July. In this period there were 184.8 hours of sunshine. After this exposure the handkerchief showed a loss of 60 per cent of its original strength. Of course the corrosive effect of substances carried in smoke exerted a decided influence on the results of this test. Undoubtedly under atmospheric conditions prevailing in the country, remote from industrial centers, the effect would be somewhat less. This test, however, furnishes an important object lesson to the city housewife and, moreover, affords an explanation of the definite way in which lace curtains often fail just at the line marked by the opened sash of the window. Certain hotel managers, appreciating that substances contained in smoke have a corrosive action on fabrics, have their lace curtains laundered more frequently than other considerations would indicate.

The mere effect of hanging clothes on the line, not considering the flapping effect, is indicated by the following test: The tensile strength of a handkerchief was measured as described before. It was then dipped in distilled water and hung up to dry. After the operation was repeated 18 times the handkerchief showed a loss of 4.35 per cent of its original strength, or a loss of 0.25 per cent for each drying.

Power-Laundry Treatment.—Correlating the data briefly presented above with the experience acquired in studying conditions in a large number of representative laundries throughout the country, the Mellon Institute Fellowship has recently prepared for the members of the Laundryowners' National Association a manual of standard wash-room formulas. It is expected that this work will contribute to the campaign, already well advanced, to bring the laundry work of the household from the home to the power laundry.

Selective Treatment.—When a washerwoman picks up an article to wash it, she will intuitively, if she is a good laundress, give the garment the treatment that is required by the nature of the dirtiness and texture of the article. If the article is a garment of thin lawn or nainsook, slightly soiled and perhaps somewhat tendered by age, the washerwoman will rub it less vigorously on the washboard than she would if the article being washed were a pair of white piqué trousers that had been worn by a boy of 5 years of age while at play. In view of the facts suggested in the above statement the laundrymen have been convinced that in this selective treatment lies the only point of advantage obtaining in favor of the washerwoman as to any superiority in the matter of cleansing or preservation of fabrics. To obtain a compensating advantage in the power laundry, the goods that come from the home are carefully classified, not only as to color but as to texture, kind of material, and degree of dirtiness as well. In the manual of standard formulas there is a detailed procedure for each classification.

In addition, there are provided in most plants special washing machines for the classes represented by the fine cotton and linen garments. Such a machine is termed a "pony washer." When washed in a machine, these goods of a more fragile nature are washed with a thick cushion of suds in order to minimize the mechanical wear.

Sanitary Considerations.—The sanitary features of power laundries have been thoroughly investigated by the Mellon Institute Fellowship as well as in other laboratories. There is absolutely no chance of disease being spread through the agency of the power laundry. The writer has demonstrated that even in warm water (40° C) soap, in concentration equal to that employed in washing woolens, has a bacteriocidal efficiency of 98 per cent for all the common pathogenes. That the high temperatures of the various baths, the ironers, dry houses, and hot-air tumblers, furnish sufficient sterilization, provided the goods are properly handled after ironing or drying, as they are in all good laundries, has been absolutely proved in the Mellon Institute laboratories. Proper handling after ironing and drying means that the goods are to be sorted in a room or place remote from the room in which the soiled goods are received.

The results mentioned above are amply confirmed by other investigators, as Dr. Wile[15] and Chapin.[16]

Summary.—An endeavor has been made to demonstrate that the responsibility of the conservation of fabrics in laundries is borne by three distinct agents—the manufacturer, the user, and the launderer. To last satisfactorily, the fabric must be of good material to begin with. To promote better care in the weaving of fabrics and to conserve the interests of the honest producers as well as those of the ultimate consumers and laundry owners, some effective legislation governing proper labeling of fabrics is desirable. Perhaps also a pure "ad" law would be for the general good.

The owners of the fabric must understand that the more severely a fabric is soiled the more drastic must be the treatment it receives to restore the original color, whether it be done by the laundress in the home or by the power laundry. We have also tried to show that a proper knowledge of the nature of stains, as imparted by domestic-science instruction, would in many ways serve to promote the conservation of the life of fabrics.

The laundry owner, in his effort to conserve the life of fabrics, is entirely at the mercy of both the maker and seller. It should be understood that every process of washing a fabric, wherever it is done, affects the life of the fabric to some extent. We have also shown that the process properly conducted in the power laundry conserves the life of the fabric equally as well as does the process employed by a good laundress.

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[15] Med. News; Dec. 3, 1904.

[16] Proc. Rhode Island Med. Soc.; 1908.

DISCUSSION

Mr. Lewis. There was a complaint that came to my notice a few days ago of a silk-ribbed soft collar that went to pieces in the first washing. Was not this due to improper sorting?

Mr. Elledge. There are good and bad laundries, but even a good laundry sometimes will make mistakes. If there should be a mistake in sorting out silks, the laundry should of course make good the resulting damage. My attention has been called to a number of instances in which the silk facings of soft collars failed the first time. Obviously, if they were washed with the white collars at 180° F. in a concentrated solution of alkali they would not last long.

Mr. Lewis. Were the tests made by the grab or the strip method?

Mr. Elledge. The tests were made in this way. I took a certain point on the corner of a rectangular handkerchief, measured the tensile strength on the warp at four different places, and the tensile strength of the filling at four different places in close proximity. Eight tests were made before and eight after exposure, the mean being taken for the calculation of the strength loss.

Mr. Lewis. The handkerchief was not cut but was put in the machine with the jaws extending in to the body of the fabric?

Mr. Elledge. Sufficiently far from the hem so that it could not affect the test.

PRESENT AND FUTURE TEXTILE LABORATORIES IN WESTERN LAND-GRANT COLLEGES

Ruth O'Brien [17]

For two years we have watched and marveled at the almost unbelievable strength and stability of the structure which the German Nation has reared in Europe, a structure which to a large extent owes its strength not only to the thorough technical and industrial training of her individuals but also to the ever-present and progressive research spirit with which she has surrounded them. She saw long ago what we have somehow failed to realize—that science and industry must work together if either is really to prosper—and the results of her wisdom and our folly are only too painfully contrasted in many of our present-day industries. The textile industry is no exception. In comparison with its wealth and extent perhaps there has been less interest in scientific improvements in the matter of textiles than in any other field.

This has been demonstrated most effectively during the last few months, and yet the tendency, even at this time, has been to lament and not to achieve. If ever we needed concerted action in developing and encouraging textile research in this country, we need it now—action which shall be as prompt and sane as possible, utilizing all of the laboratories, equipment, and workers which are available. With this idea in mind I present for your consideration the possibilities of the land-grant colleges of the Middle West.

In the past textile education and experimentation have been confined largely to our Eastern States, due, no doubt, to the fact that the textile industries are located chiefly in that part of the country. True we have the wool-producing States in the West, but the education and experimentation which have been needed and developed have been small and mostly in animal husbandry—just as in the South the work has been largely along agricultural lines. In the East have been the textile industries, and in the East are the textile schools. We are all proud of these schools and are watching their growth and development with the greatest interest. Yet some of us have come to believe not only that the advantages of many of their departments should be more accessible to the large body of college men and women through-

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out the Nation, but also that there are a multitude of unsolved textile problems which widely-distributed scientific laboratories of the country should be helping to solve. I say widely distributed because only in that way will the work attract a large number of our young and variously-trained scientists. It is true that many scientifically-trained persons have very definite ideas as to the line of work they wish to enter and will travel many miles to reach the most advantageous place to do that work; but, on the other hand, many merely seek the nearest school or laboratory for their training and in after life continue to work along the lines first presented to them. In this way a large number of our western students are never brought in touch with textile work and, not knowing its possibilities, do not even consider entering that field.

But the location is not the only factor to be taken into account. It is very imperative in this present crisis that these laboratories should be already built and already equipped and manned as far as possible. We do not have the time nor would it be sensible to attempt to build and equip new ones unless such a course is absolutely necessary, and it seems to me that the laboratories in our land-grant colleges make this very unnecessary.

It was as early as 1857 when Representative Morrill had a vision of a system of colleges throughout this country which, fostered by the Nation as a whole, should in time of peace so educate and strengthen the youth of the country that in time of war they could rally well prepared to protect that Nation. He introduced his bill for founding these colleges in that year, but it was five years later before it became a law. By its provision an amount of public land equal to 30 000 acres for each Senator and Representative to which each of the States was respectively entitled in 1860 was donated to that State. All money derived from the sale of such land was to be invested in safe stocks, the interest from which (in the words of the act) "shall be appropriated by each State which may take and claim the benefits of this Act, to the endowment, support, and maintenance of at least one college where the leading object shall be, without excluding other scientific and classical subjects and including military tactics, to teach such branches of learning as are related to agriculture and mechanic arts." Additional annual appropriations were provided by the second Morrill Act of 1890 and the Nelson amendment of 1908. As a result, we have to-day over 50 of these colleges, supported partly by Federal and partly by State funds, their size and scope depending largely on the wealth and generosity of the individual States. Some of these are departments of or are connected with State universities, others are parts of technical or industrial institutions, and many exist alone. In a number of cases the State experiment stations are directly or indirectly connected with them. Thus the Nation is trying to do her share, and living as I have in one of the largest of these colleges and seeing the response which they have given during the last two months, I have felt that in 1917, for the second time, they are paying their debt and Morrill's vision is coming true. They are furnishing us at this time not only men trained in military science, but also men trained in many other fundamental sciences. From their engineering departments of the past and present are rising the host of engineers upon whom our success abroad is to depend so largely, and from their agricultural departments are coming those whose efforts are to mean so much to the world. From them we should be also receiving some of our textile engineers and textile chemists. The laboratories are there, some of them, especially the chemistry and engineering laboratories, being (with the exception of very special apparatus) well equipped for our purpose. For example, the University of Illinois has a very fine engineering department and last year dedicated an exceedingly modern and extensive chemistry building which is large enough to take care of an enormous growth and expansion. This is also true of the University of Nebraska, whose engineering laboratories were completed a few years ago and which will enter new and very spacious botany and chemistry buildings next fall. The chemistry department of Iowa State College is just getting settled in its new and in many ways ultra modern building, and the engineering department and equipment is one of the best in the country. New Mexico, too, is just completing a chemistry building which will allow and encourage development along many new lines. These are only a few examples to give you some idea of the interest and support which the Western States are giving the scientific departments of their colleges and to point out to you that the time is exceedingly ripe for cooperation along any industrial line.

None of these colleges, as far as I have been able to inform myself, are giving work on the mechanical processes of textile manufacture, and very little work is being done on real textile design. A great many, however, are offering courses in textile chemistry and in general textiles. These are all undergraduate courses, but have done a great deal toward arousing an interest in the subject and can be used nicely as a foundation upon which to build worth-while graduate and research work. For example, the Utah Agricultural College is offering two courses and has carried on some textile research. The University of Wisconsin is offering one at the present time. The people at the University of Wyoming are at a particular advantage in having Prof. Hill, the wool specialist, with them and feel that they can offer laboratory facilities as well as equipment for an extensive research laboratory if the wool growers of the State could be induced to offer financial cooperation; and, by the way, such arrangements with local associations are becoming quite common in the West. For instance, the food laboratory at Iowa State College recently purchased an experimental milling machine in cooperation with the Iowa State Millers' Association and by its analytical work is returning its value to the association.

The Oregon Agricultural College has been giving elementary courses in textile chemistry for a number of years and is increasing its equipment at this time with the intention of making a specialty of this work. At Iowa State College we are offering three undergraduate courses at present and are increasing the equipment and scope of the work as fast as possible. A very spacious laboratory has been set aside for this work alone and will be completely fitted out next year. A large amount of money has already been spent on textile apparatus, and the amount and extent of the research which will be done in the future will depend largely on the encouragement which it receives from the State and the country. The Universities of Minnesota, Nebraska, and New Mexico, as well as the Oklahoma Agricultural College, have been considering the introduction of similar courses and are weighing the advantages of such action at the present time.

In other words, the start has been made, and the next few years will no doubt see many more of these undergraduate courses being given. It is only one step more to graduate work in such departments and the ultimate establishment of high-grade research laboratories in connection with the best of them; but this will never come unless the textile men of the country awake to the need of such a step. The colleges, depending as they do on State and Federal support, must have the strong backing of the people most concerned. We especially need this in States where the industries are few and the whole problem appeals to the taxpayer as being very remote and unimportant. I know this from personal experience and have a very warm feeling for a certain woolen mill in Des Moines which, while not nearly as large as many of your eastern plants, has come to our assistance many times. We need the little helps and the big helps. When you are sending out your representatives and motion-picture films, do not forget that there is a western half of this country; and when you come to realize the great need which the industry has for textile research and are ready to cooperate in the acquisition of equipment or the establishment of fellowships, do not forget that the western land-grant colleges have made a start and will do everything in their power to justify your faith in them.

FIG. 1.—*Apparatus used in first tests, partly erected*

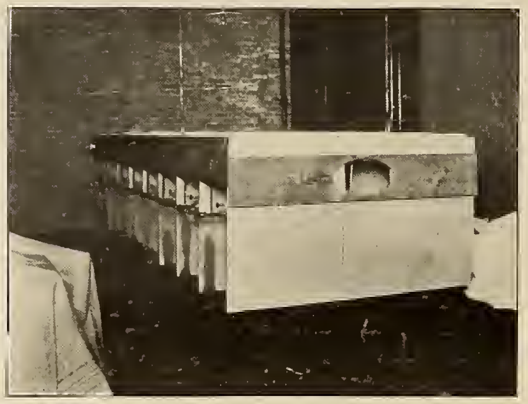

FIG. 2.—*Complete view of apparatus used in first tests, showing entrance side*

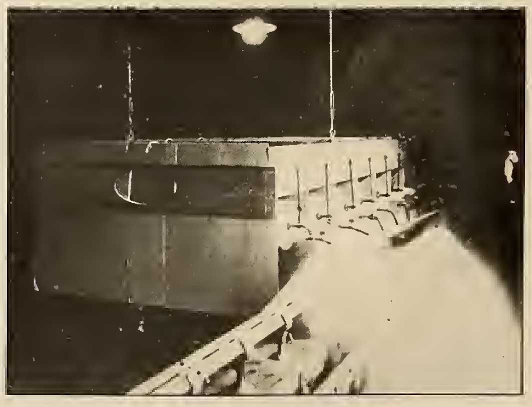

FIG. 3.—*Complete view of apparatus used in first tests, showing exit side*

MODERN METHODS OF TESTING BLANKETS FOR HEAT TRANSMISSION

George B. Haven [18]

In consequence of the marked growth in the excellence of cotton blankets during recent years and of the increasing price and scarcity of wool, the question has often arisen as to the value of the cotton fiber as a means of protection against cold. Without doubt well-woven and napped cotton blankets possess very high insulating value, much nearer to that of woolen blankets than is generally supposed. With a view of scientifically answering this question without the use of personal estimate or opinion, the author of this paper, in collaboration with Prof. George W. Swett, of the Institute of Technology, undertook some two years ago a series of tests for Messrs. Amory, Brown & Co., of Boston, selling agents for the Nashua Manufacturing Co., Nashua, N. H.

These first tests were, in a sense, primitive. The apparatus consisted merely of a series of 5-foot lengths of standard 4-inch iron steam pipe with the ends capped and heavily insulated. The exterior surfaces of the pipes were wrapped with the various blankets under consideration. The pipe units were all connected to a common source of hot-water supply, and after filling them and bringing them all to a temperature slightly below boiling, as indicated by an inserted thermometer, they were allowed to cool for about nine hours. The fall in temperature was noted every 15 minutes and of course was most rapid in the pipe unit which was left bare to afford a basis of comparison. The pipe wrapped with a heavy blanket retained its heat for the longest period, but after nine hours all the units were at approximately the same temperature. The fall in temperature was plotted against the time intervals, giving a series of descending curves, the most rapid for the bare pipe and the most gradual for the best blanket. Fig. 1 shows this apparatus partly erected and Figs. 2 and 3 the same when complete and ready for use.

These experiments, performed in May, 1915, were not deemed wholly satisfactory, since no heat was added to the pipe units during the test and the temperature was allowed to fall at will, conditions which do not approximate very closely those of the human body protected from cold by insulating fabrics. These rough tests gave, however, a remarkable illustration of the power of well-made cotton blankets to retain heat, and led to a subsequent series of experiments at the Institute of Technology in May and June, 1916.

At the suggestion of Robert Amory of the Nashua Manufacturing Co., the author of this paper undertook an entirely novel method of measuring the heat transmission through a series of blankets. A thin copper pipe was built containing an electric heater of sufficient capacity to raise the temperature of the pipe and the water with which it was filled to blood heat and to maintain that temperature while a large temperature gradient was maintained by performing the tests in a cold storage plant. The electrical energy necessary to keep the pipe and its contents at blood heat was accurately measured and the exact time recorded. The electrical energy was transformed into calories per minute, thus enabling the heat transmission through the various blanket wrappings to be compared.

A copper pipe 5 feet long and 4½ inches outside diameter was made for the purpose by the E. B. Badger Co., of Boston. The copper used was approximately one-sixteenth of an inch thick. The ends were closed with spun copper caps of the same thickness, soldered in place. The right-hand cap was made solid, while the left-hand one was reinforced and tapped at its upper edge for a one-half inch vent pipe. Near the lower edge of the left-hand cap a 1¼-inch hole was cut for the attachment of the electric heater. The electric heater was incased in a piece of three-eighths inch brass tubing 9 feet long, bent to the form of a U, with one wing attached to the electric

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wiring. The whole was inserted in the copper pipe and soldered in position. Inside the heater tube were placed two heating elements, and these were wired to a three-stage button so that the heating units could be used either singly or in combination. In the tests the high capacity unit was found very valuable in preparatory warming up, but the medium coil was used during the progress of all the tests. Fig. 4 shows the copper pipe and attachments.

In the top of the copper pipe were two outlets three-fourths inch in diameter and spaced 4 inches apart. By means of rubber corks an ordinary thermometer was introduced into the right-hand outlet. This was used simply to indicate the temperature of the water in the copper pipe when heating up the apparatus preparatory to a test. Through the left-hand outlet a thermostat was introduced and made tight by a rubber cork. Care was taken that the center of the mercury bulbs in both instances lay exactly upon the horizontal line at the center of the copper pipe.

In order to confine the radiation of heat to a definite area upon the barrel of the copper pipe, insulating cages 2 inches thick, made of pine, filled with plastic asbestos, and covered with a layer of canvas were placed at both ends of the copper pipe. The asbestos was thoroughly dried by admitting steam to the apparatus for several days prior to use. The outlets at the left-hand end for vent and wires were also covered with asbestos and taped tight. The length of copper pipe left bare between the insulating cages was 48 inches. In order to wind on the blankets under uniform tension, a groove was turned in each cage near its inner end. The copper pipe and its cages were suspended at each end from a wooden horse by wire loops which permitted the apparatus to be revolved. The horse was high enough to bring the center of the copper pipe 66 inches above the floor. Fig. 5 shows the bare copper pipe and cages with the thermometers inserted, the whole being suspended from the horse.

The samples of blankets were cut 48 inches in width by 66 inches in length, and along the narrow end a series of safety pins were inserted exactly 2 inches apart, each safety pin carrying four sheet-iron washers. Fig. 6 shows the apparatus at this juncture. This fringe of safety pins and washers provided just enough weight to keep the blankets suitably taut while winding them upon the copper pipe. The copper pipe was thoroughly washed before the tests began, as well as between tests, so that in no case did any accumulation upon the surface of the pipe interfere with the radiation. A few drops of glue were used along the top of the pipe to catch the end of the blanket, the pipe being kept meanwhile at blood heat. Fig. 7 shows the appearance of the blanket while being wound on the pipe. The method of emptying the pipe is shown by Fig. 8.

The winding on of the blankcts was easily accomplished by rotating the copper pipe and its cages while the wire loops in the grooves held it in position. Small slits were cut for the thermometer outlets as they came around, and the washers and safety pins were always allowed to hang free, thus maintaining a constant tension in the blankets, as shown in Fig. 9. As soon as three layers had been wound on, the fabric was securely pinned in position and the superfluity cut off. Pins were used to hold the tension so that it would not be diminished after cutting off the washers. The loose end was then carefully sewed down along the top of the pipe so as to give exactly three layers of blanket in every case. The blankets were rubbed horizontally a little to insure a good fit against the insulation cages, but no lengthwise tension was used except that due to the washers and pins.

To provide a method for controlling automatically the current admitted to the electric heater, J. B. Lewis of the Simplex Electric Heating Co., Cambridge, Mass., was consulted. Under his direction a relay switch was built and connected to the heating coils and thermostat. The thermostat consisted of an accurate mercurial thermometer having fine platium wires inserted in the path of the mercury opposite some low temperature and again opposite 100° F. The latter was assumed to be blood heat.

The principle upon which the relay switch worked was as follows: While the current was passing through the heating coils the temperature in the copper pipe would rise

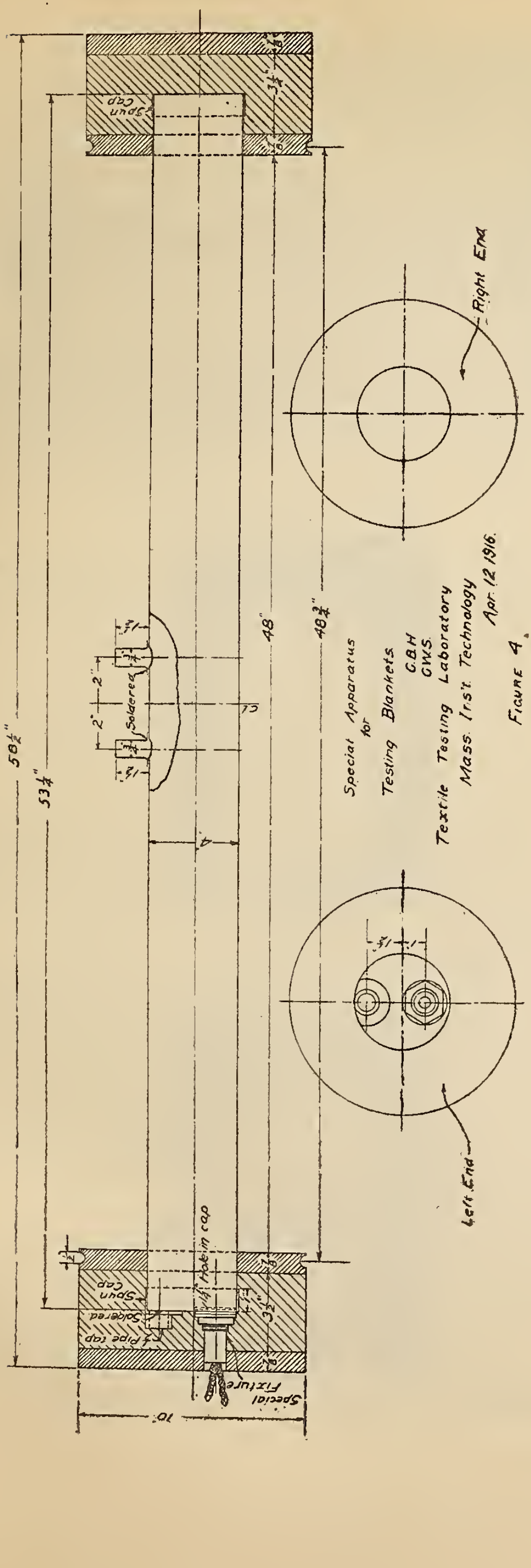
58½"
53¼"
48"
48¼"
Spun Cap
Soldered
Pipe cap
Special Fixture
10"
4"
CL
Right End
Left End
Special Apparatus for Testing Blankets
C.B.H.
G.W.S.
Textile Testing Laboratory
Mass. Inst. Technology
Apr. 12 1916.

FIGURE 4.

and the mercury in the thermostat would ascend. As soon as 100° F was reached the thread of mercury in the thermostat served to make connection between the platinum wires. The current passing through the circuit thus established was used to throw the switch and shut off the current from the heating coils. As soon as the temperature of the water fell a very slight amount the current in the thermostat was interrupted and the switch was automatically thrown on again, admitting the current through the heating coils. Thus the apparatus automatically shut off and shut on the electric current in the heating coils according to the changes in temperature of the water. This fluctuation could not be detected by the eye upon the thermometer and amounted therefore to not more than 0.1° or 0.2° F. The sensitivity of this apparatus was thus very good, permitting much less range of temperature than that occurring normally in the blood of a healthy person.

Of course the heavy electric currents running to the heating coils could not be directly utilized in the thermostat, since arcing would take place with consequent vaporization of the mercury. The current operating the thermostat was therefore shunted from the main circuit and passed through resistance sufficient to cut it down to a very small amount. This would not arc at the mercurial contact with the platinum wire and was just sufficient to throw a relay switch, which in turn threw the heavy magnetic switch upon the main current. The amperage and voltage were read every 30 seconds while the current was on.

A floor stand, Fig. 10, was built of pine and shellacked preparatory to receiving the wiring and instruments. The relay switch was built for 110 volts direct current. A plug screwed into an electric-light socket in the cold-storage warehouse chamber brought current to the floor stand. The wires were attached to a cut-out block carrying fusible plugs of 10 amperes capacity. One side of the wiring was interrupted for the insertion of an ammeter with the usual short-circuit block. The voltmeter was inserted across the wiring by means of soldered taps, and the circuit next went to the main switch. The thermostat circuit was connected to the relay, and the apparatus was ready for use. The copper pipe was filled with tepid water to save time in heating up, and as soon as the temperature reached 95° F, the heating coils were thrown over to medium and the thermostat connected. (See Figs. 11 and 12.)

In order to make certain that no air was pocketed in the copper pipe, thus changing the amount of heat necessary, the vent cock was left open during all the tests. The pipe was filled through the thermometer inlets to its full capacity. The end having the vent was then elevated so that all air bubbles would assemble and pass out. The pipe was then carefully leveled with a spirit level.

The procedure in the tests was as follows: After running the apparatus about one hour, all parts were assumed to be heated uniformly. The test was commenced at the instant the switch threw on by reference to the second hand of a watch. Voltage and amperage readings were taken every 30 seconds and the instant noted when the switch threw off. By multiplying together the average voltage, amperage, and the time the current was on in seconds, the watt seconds during the interval were found. Each test was run slightly over one hour and the total watt seconds added together. This quantity divided by the total length of the test in seconds gave the watts radiated per second, and this was transformed into calories and British thermal units.

A sample test is given in detail in Table 1.

In the left-hand column are shown the intervals expressed in seconds during which the current was on; the second column to the right the intervals in seconds during which the current was off. In the third, fourth, and fifth columns are expressed the hour, minute, and second of the day at which the test began or the readings were made. In the sixth and seventh columns are the voltage and amperage readings totaled and averaged. In the eighth column is the product of volts times amperes times seconds duration of the interval. In the last column at the right is given the temperature of the cold chamber in the warehouse simply to show its uniformity.

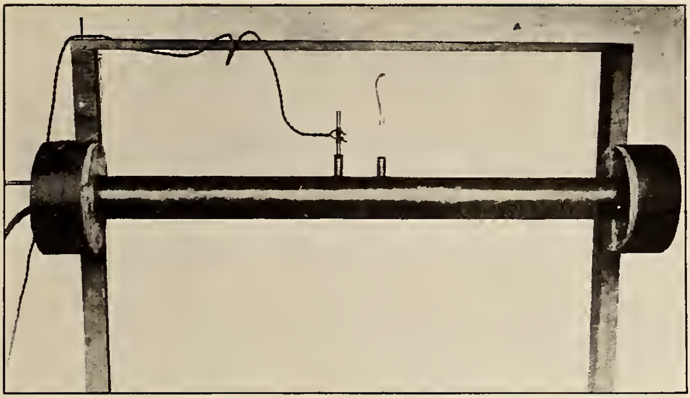

FIG. 5.—*Base pipe unit with thermometer and thermostat*

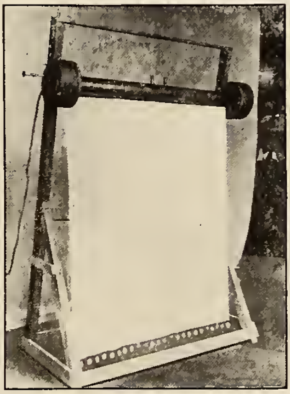

FIG. 6.—*Pipe unit with blanket ready for winding on*

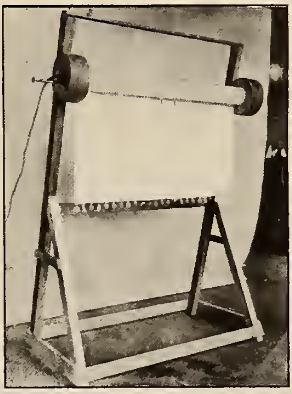

FIG. 7.—*Pipe unit with blanket partly wound on*

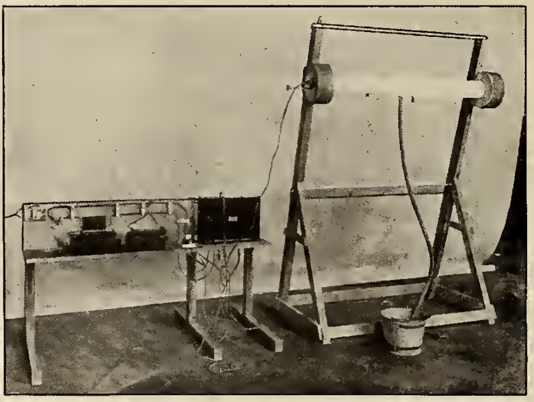

Fig. 8.—*Method of emptying pipe*

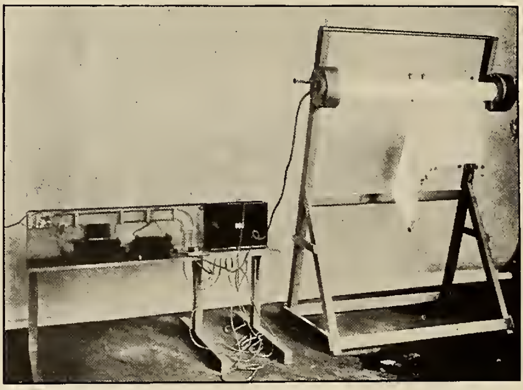

Fig. 9.—*Cutting off excess blanket after winding*

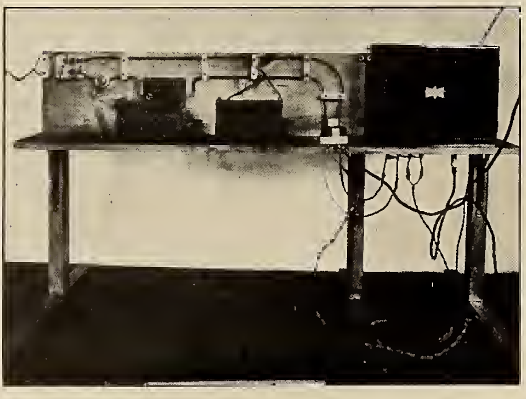

Fig. 10.—*Floor stand with instruments*

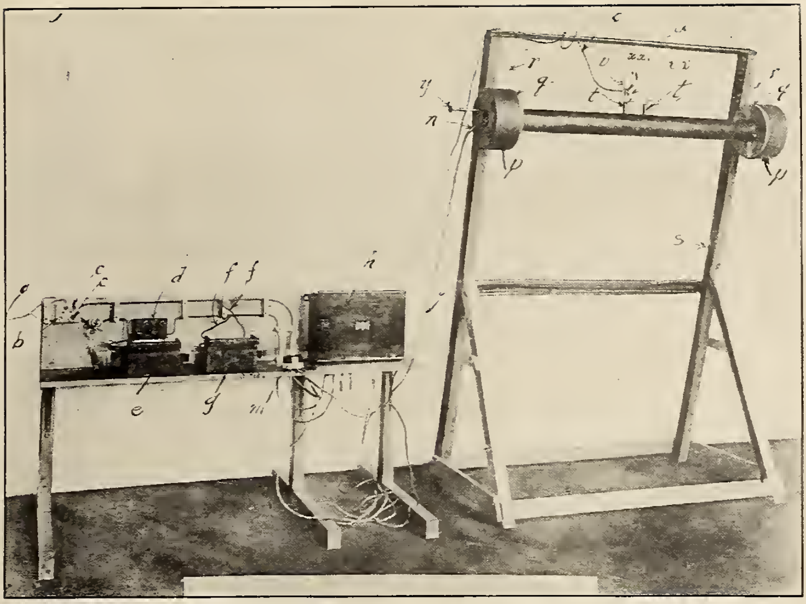

FIG. 11.—*General view of complete apparatus*

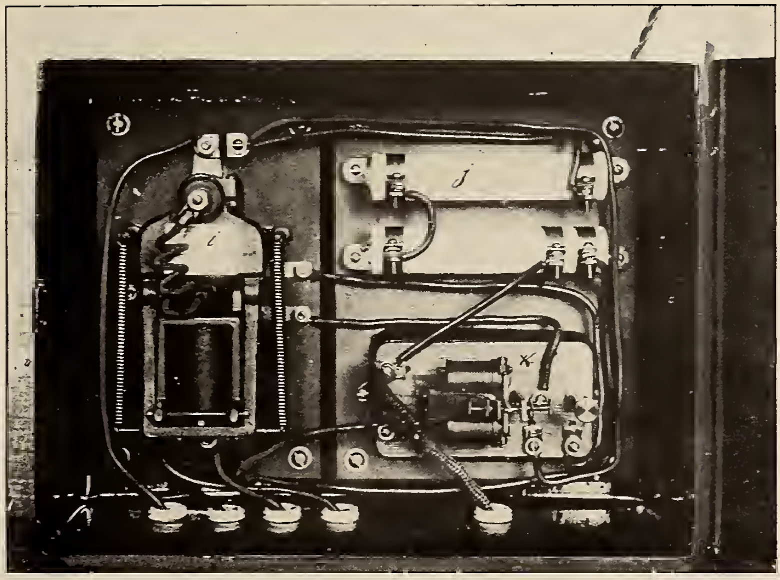

FIG. 12.—*Interior view of magnetic switch*

a, Wire from electric lamp socket; *b*, cut-out block; *cc*, 10 ampere plugs; *d*, short-circuit block for ammeter; *e*, ammeter; *ff*, taps for voltmeter; *g*, voltmeter; *h*, switch box; *i*, main switch; *j*, resistance; *k*, relay; *l*, wires to heater; *m*, three-stage button; *n*, attachment to heating coils; *o*, wires to thermostat; *pp*, asbestos-lined cages; *qq*, grooves in cages; *rr*, suspension wires; *s*, horse; *tt*, thermometer outlets; *u*, check thermometer; *v*, thermostat; *ww*, binding posts on thermostat; *xx*, rubber corks; *y*, vent cock to let out air

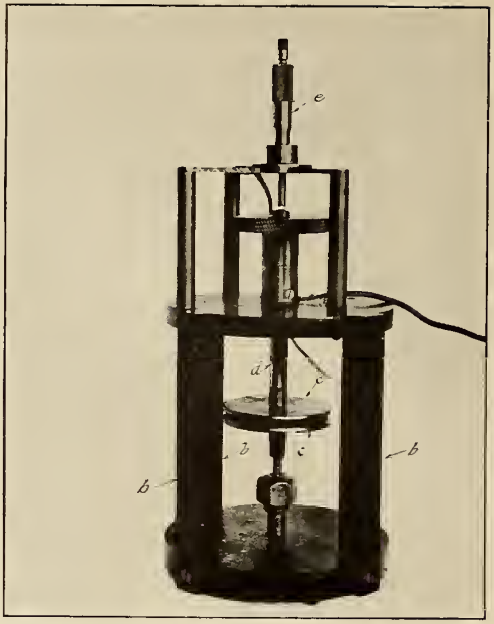

FIG. 13.—*Instrument for measuring thickness of blankets*

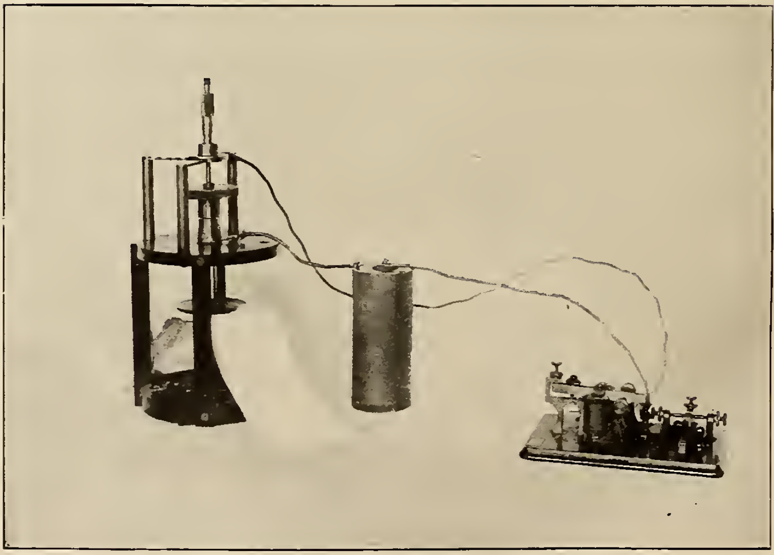

FIG. 14.—*Thickness measurer in operation*

TABLE 1.—Cotton Blanket

[Test No. 5, June 30, 1916. Throughout this table T.= "total" and A.= "average."]

Time current was—		Time of switch throw			Voltage	Amperage	Watt-seconds	Room temperature
On	Off	Hours	Minutes	Seconds				
Seconds	Seconds							°F
		1	4	45	104.3	2.40		
		1	5	15	104.1	2.38		
		1	5	45	105.0	2.38		
		1	5	59				
74					T. 313.4	7.16		
	186				A. 104.5	2.387	18 460	35.6
		1	9	5	104.0	2.40		
		1	9	35	104.4	2.38		
		1	10	5	104.0	2.36		
		1	10	10				
65					T. 312.4	7.14		
	176				A. 104.1	2.380	16 110	35.6
		1	13	6	104.3	2.39		
		1	13	36	104.6	2.38		
		1	14	6	104.2	2.36		
69					T. 313.1	7.13		
	185				A. 104.4	2.377	17 120	35.4
		1	17	20	103.9	2.39		
		1	17	50	104.2	2.38		
		1	18	20	103.8	2.37		
67					T. 311.9	7.14		
	170				A. 104.0	2.380	16 590	35.3
		1	21	17	104.5	2.39		
		1	21	47	104.3	2.38		
		1	22	17	104.0	2.37		
69					T. 312.8	7.14		
	179				A. 104.3	2.380	17 130	35.1
		1	25	25	104.0	2.36		
		1	25	55	103.8	2.37		
		1	26	25	103.4	2.34		
		1	26	32				
67					T. 311.2	7.07		
	170				A. 103.7	2.357	16 380	35.2
		1	29	22	102.5	2.35		
		1	29	52	101.6	2.30		
		1	30	22	101.1	2.28		
		1	30	30				
68					T. 305.2	6.93		
	178				A. 101.7	2.310	15 980	35.3
		1	33	28	99.8	2.29		
		1	33	58	100.0	2.28		
		1	34	28	102.3	2.40		
71		1	34	39				
					T. 302.1	6.97		
	179				A. 100.7	2.323	16 610	35.3
		1	37	38	100.0	2.28		
		1	38	8	98.7	2.25		
		1	38	38	99.2	2.24		
		1	38	52				
74					T. 297.9	6.77		
	169				A. 99.3	2.257	16 580	35.1
		1	41	41	98.6	2.25		
		1	52	11	99.7	2.25		
		1	42	41	99.0	2.24		
		1	42	52				
71					T. 297.3	6.74		
	160				A. 99.1	2.247	15 810	....
		1	45	32	100.2	2.28		
		1	46	2	99.8	2.26		
		1	46	32	102.0	2.29		
		1	46	43				
71					T. 302.0	6.83		
	173				A. 100.7	2.277	16 280	....

TABLE 1—Continued

Time current was—		Time of switch throw			Voltage	Amperage	Watt-seconds	Room temperature
On	Off	Hours	Minutes	Seconds				
Seconds	Seconds							°F
		1	49	36	103.1	2.37		
		1	50	6	104.3	2.36		
		1	50	36	103.0	2.35		
		1	50	42				
66					T. 310.4	7.08		
	174				A. 103.5	2.360	16 120	35.1
		1	53	36	103.5	2.38		
		1	54	6	105.4	2.39		
		1	54	36	103.9	2.37		
		1	54	43				
67					T. 312.8	7.14		
	177				A. 104.3	2.380	16 630	35.3
		1	57	40	102.5	2.33		
		1	58	20	103.1	2.34		
		1	58	40	102.5	2.33		
		1	58	48				
68					T. 308.1	7.00		
	173				A. 102.7	2.333	16 290	35.3
		2	1	41	102.0	2.33		
		2	2	11	102.9	2.35		
		2	2	41	103.5	2.34		
		2	2	49				
68		2	5	42	T. 308.4	T. 7.02		
	173				A. 102.8	A. 2.340	16 360	35.3
T.1035	T. 2622						T.248 450	T.458.9 A. 35.3

Two tests each were made upon seven different types of blankets ranging from the cheapest kind of camp blanket to a very expensive woolen blanket. The cost of the former was about $1.50 per pair and that of the latter about $12 per pair; thus, a wide range of quality was secured. In addition to the tests made with blankets upon the pipe, three tests were performed with the pipe left bare and the data secured from these tests were used as a basis in computing the efficiency of the various blankets as insulators.

Table 2 is a summary of the results of all the tests showing radiations in watts per second in the first column, equivalent British thermal units in the second column, equivalent calories in the third column, and the average temperature of the cold-storage compartment in the fourth column. These results are believed to be correct to four significant figures and show very conclusively that cotton blankets are nearly as effective as wool blankets as a means of protection against cold.

In the fifth column of Table 2 are recorded the average thicknesses of all the blanket samples. It will be noted that in general the heat transmission was least when the thickness of the blankets was greatest and that it was in large measure independent of the material from which the blanket was made. Thus tests Nos. 5 and 8 for a thick, pure cotton blanket gave fully as good results as the thinner commercially all-wool blanket of tests Nos. 3 and 6; also the blanket of tests Nos. 10 and 11, which showed the greatest thickness of any in the list, indicated practically the highest insulating power of any, although it was stated to be 50 per cent cotton and was retailed at a price to correspond. It has been conjectured that the amount of enmeshed air in a blanket has much to do with its efficiency as an insulator.

The measuring machine shown in Fig. 13 is one devised and built by Dr. Robert J. Wiseman, of the institute research staff, for measuring the thickness of a film of oil. While not designed for measing the thickness of textiles, it is the most accurate and logical instrument for this purpose which we have seen. Most thickness measurers exert upon the sample a degree of compression which varies with the thickness of the blanket. In Dr. Wiseman's machine the weight of the platform upon the fabric is always the same, no matter what the thickness. It consists, as shown by the photograph, of an ebonite base *a* with three vertical supports *bbb*. The measuring platforms *cc* are nicely made of brass and are flat surfaces, located in an accurate horizontal plane. The lower platform is fixed in the machine, being adjustable for height only. The upper platform ls attached to a hard steel shank *d* which reaches up through the center of the machine. The upper platform and shank are freely movable, and they rest upon the sample to be measured with their own weight. At the uppermost portion of the machine is fastened a rachet feed micrometer *e*, so arranged as to make contact with the steel shank.

TABLE 2.—Heat Transmission

Test number	Material	Watts per second	British thermal units	Calories per minute	Average room temperature	Average thickness
					° F.	Inches.
2	Bare pipe	114.7	391.4	98.64	34.8	....
7	Bare pipe	113.5	387.2	97.57	35.1	....
15	Bare pipe	109.8	374.7	94.43	34.9	....
1	Cotton blanket A	83.97	286.5	72.19	34.9	0.057
4	Cotton blanket A	81.70	278.7	70.25	35.3	.060
5	Cotton blanket B	67.95	231.8	58.42	35.3	.130
8	Cotton blanket B	67.16	229.2	57.75	35.8	.123
9	Cotton blanket C	66.44	226.7	57.12	36.2	.106
12	Cotton blanket C	69.60	237.4	59.84	35.2	.110
14	Half cotton blanket A	67.17	229.2	57.76	35.1	.112
16	Half cotton blanket A	70.35	240.1	60.49	35.2	.108
10	Half cotton blanket B	61.90	211.2	53.22	34.0	.139
11	Half cotton blanket B	62.87	214.5	54.05	34.3	.140
3	Wool blanket A	72.86	248.6	62.65	35.4	.099
6	Wool blanket A	69.68	237.8	59.91	35.0	.103
13	Wool blanket B	60.21	205.4	51.77	35.5	.121
17	Wool blanket B	62.76	214.1	53.96	34.7	.122

In taking a series of thickness measurements, the two platforms are placed in contact and the micrometer screwed down against the steel shank, thus giving a zero reading. In order to make the reading as definite as possible, the micrometer and steel shank were electrically insulated and a battery and telegraph sounder wired into the circuit to indicate when the micrometer contact took place. With a piece of the fabric inserted between the platforms, Fig. 14, a similar micrometer reading was taken and the difference between this and the zero reading gave the thickness of the fabric.

In measuring the thickness of the blankets, a strip was cut 4 inches wide and the full length of the sample which had previously been tested for heat transmission. A series of readings was taken at the beginning, middle, and end of this sample. These readings were all finally averaged to give the thickness of the blanket. It must be remembered that these thicknesses are purely relative, simply being the micrometer readings taken under similar conditions and with equal compression, using samples from the blankets tested. It is only when so considered that these measurements are of any value.

In order to bring together for final comparison the results of all the preceding tests, Table 3 has been compiled. In the first column at the left is given the name of the blanket, in the second column is stated the average electrical equivalent of the heat transmission in watts per second, in the third column the same expressed in calories per minute, in the fourth column the same in British thermal units per minute, and in the last column at the right the average thickness of the blanket as taken at three different places. This table expresses very clearly the efficiency of the various blankets as compared with that of bare pipe and also shows the effect of thickness.

TABLE 3.—Average Heat Transmission

Material	Watts per second	British thermal units per minute	Calories per minute	Average thickness
				Inches
Bare pipe	112.7	384.4	96.88	....
Cotton blanket A	82.84	282.6	71.22	0.0585
Cotton blanket B	67.56	230.5	58.09	.1265
Cotton blanket C	68.02	232.1	58.48	.1080
Half cotton blanket A	68.76	234.7	59.13	.1100
Half cotton blanket B	62.39	212.9	53.64	.1395
Wool blanket A	71.27	243.2	61.28	.1010
Wool blanket B	61.49	209.8	52.87	.1215

TABLE 4.—Comparative Heat Transmission

Material	Relative insulating value	Relative thickness
	Per cent	Per cent
Cotton blanket A	58.3	48.2
Cotton blanket B	88.1	104.1
Cotton blanket C	87.2	88.9
Half cotton blanket A	85.8	90.6
Half cotton blanket B	98.2	114.6
Wool blanket A	80.9	83.1
Wool blanket B	100	100

In order to compare the blankets one with another Table 4 has been compiled. Taking the average heat transmission of the best blanket as a basis of comparison, the percentages for the other blankets have been calculated. The same blanket is used as a basis in computing the relative thicknesses.

From these results it is believed that the relative efficiency of various blankets as heat conservers can readily and accurately be measured, and that cotton blankets when well woven and napped are very efficient as a means of protection from cold.

DISCUSSION

Mr. Lang. I would like to ask Mr. Haven what effect laundering has on the heat transmission of cotton blankets. Have you made any tests to determine that?

Mr. Haven. We have not yet been able to try the effect of laundering on heat transmission.

Mr. Elledge. I would like to ask the speaker if he means what effect the process of laundering will have on the insulating value of the material if it is merely washed and not carded after washing, or if he means washed and carded as it is usually done in first class laundries.

Mr. Lang. It seems to me the reason for cotton becoming a heat insulator is found in the air inclosed by the nap. Even if the blanket was properly laundered, its efficiency might be injured unless the nap were restored to its natural condition afterwards.

Mr. Elledge. It would be a part of the duty of a good laundry to restore that nap as nearly as possible to its previous condition.

Mr. Haven. Will you give us some idea as to how that is done?

Mr. Elledge. Some laundries—for instance, those handling a great many woolen blankets for the Pullman Co.—use stretchers and mechanical carders which go over the blanket and pick up the nap very lightly. Small quantities are handled by placing the blanket on a frame and carding it by hand.

COMPARATIVE SERVICE TESTS OF COTTON AND WOOL BUNTING

WALTER S. LEWIS [19] AND CHARLES J. CLEARY [19]

The recent substitution of cotton bunting for wool bunting in the manufacture of flags has given rise to considerable discussion as to the relative serviceability of the two materials. This paper sets forth the results of a series of tests designed to compare them with respect to durability and color fastness.

The test flags were made with red and white stripes only, no ensign being included, as shown in Fig. 1.

Four large flags and six small flags were exposed simultaneously, the dimensions, arrangement on the poles, and designation numbers being as shown in Fig. 2. Flags numbered 5 and 15, 6 and 16, 7 and 17, 8 and 18 were, respectively, made from the

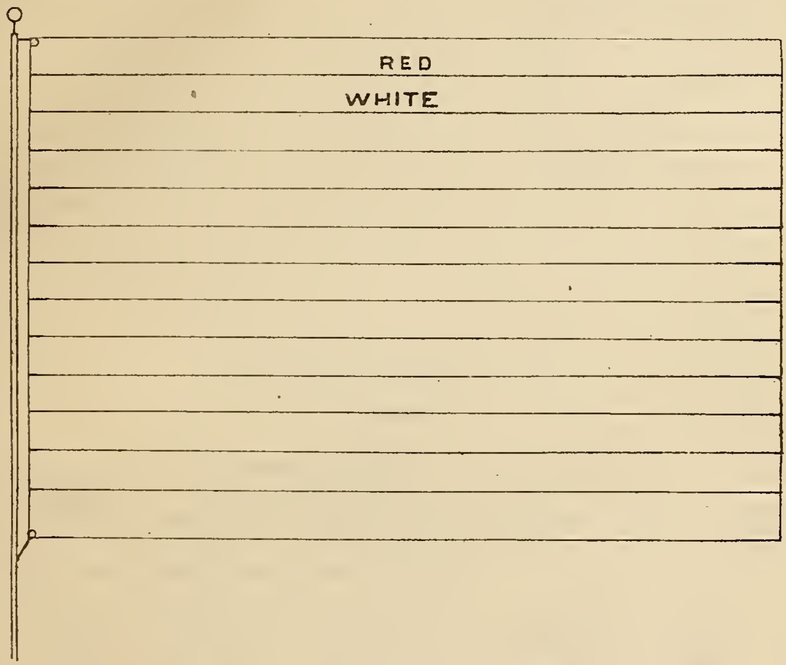

FIG. 1.—*Construction of test flags*

same material. Flags 19 and 20 were made from two other varieties of high-grade bunting. The exposure was continued for six months. At intervals of two weeks, samples for tensile-strength tests were taken, and the positions of the flags were changed in such a manner that each one was exposed in each position its proper proportion of the whole time.

The tensile-strength tests of the unexposed material were made upon 1-inch strips, the regular testing procedure of the Bureau of Standards being used throughout. The method of sampling is shown in Fig. 3.

The test specimens from the exposed bunting were prepared so as to contain the same number of threads as the corresponding unexposed specimens, irrespective of actual width. The average initial and final results obtained are given in Table 1. No filling direction tests were made upon the bunting in the small flags after exposure

[19] Bureau of Standards, Washington, D. C.

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because the narrowness of the stripes made it impossible to obtain specimens of sufficient length. The percentage gain or loss in strength during exposure, given in the last two columns, were computed on the basis of the original strength figures.

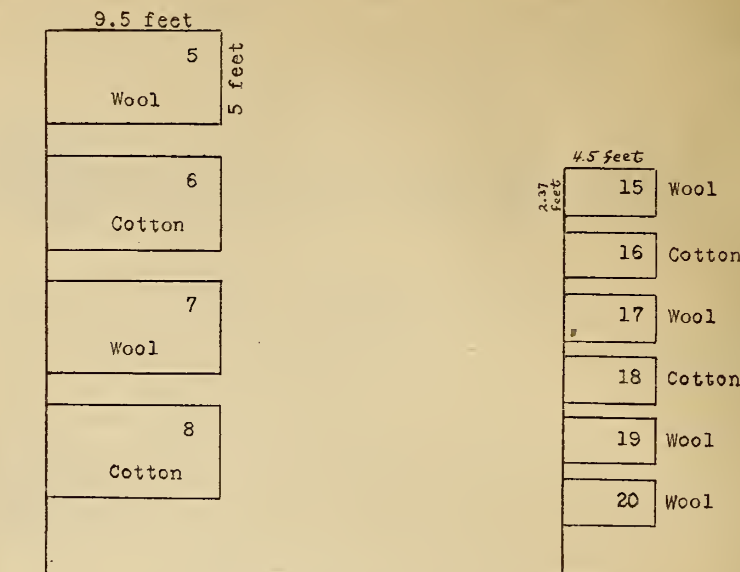

FIG. 2.—*Arrangement of flags on poles*

TABLE 1

Designation number	Material	Color of bunting	Tensile strength (pounds)				Per cent of loss (−) or gain (+) by exposure	
			Before exposure		After exposure			
			Warp	Filling	Warp	Filling	Warp	Filling
5	Wool	Red	29.5	25.1	28.9	25.5	− 2.0	+ 1.5
		White	28.4	23.5	24.9	20.9	−12.3	−11.0
15	Wool	Red	30.2	....	31.5	....	+ 4.1	....
		White	29.5	....	27.1	....	− 8.1	....
6	Cotton	Red	30.0	30.6	15.8	12.5	−47.3	−59.1
		White	37.0	41.6	24.6	24.2	−33.5	−41.8
16	Cotton	Red	31.9	....	13.9	....	−56.4	....
		White	40.3	....	24.4	....	−39.4	....
7	Wool	Red	28.8	25.8	31.7	22.8	+ 9.1	−11.6
		White	28.8	24.7	33.7	20.0	+14.5	−19.0
17	Wool	Red	32.6	....	33.2	....	+ 1.8	....
		White	32.5	....	35.0	....	+11.1	....
8	Cotton	Red	44.2	28.8	27.3	17.6	−38.2	−38.8
		White	44.2	40.5	33.5	30.6	−24.2	−24.4
18	Cotton	Red	46.0	....	24.6	....	−46.5	....
		White	45.0	....	29.5	....	−34.4	....
19	Wool	Red	31.3	....	29.7	....	− 5.1	....
		White	34.8	....	33.5	....	− 3.7	....
20	Wool	Red	32.2	....	33.5	....	+ 3.9	....
		White	33.7	....	34.1	....	+ 1.2	....

The results of tensile-strength tests before and after the six months exposure are plotted in Fig. 4. The best cotton bunting shows considerable loss in tensile strength, while the wool bunting was little affected. The very large proportionate decrease in strength of the red cotton bunting was evidently caused by the dye or the method of application.

FIG. 3.—*Flag from which test specimens have been taken*

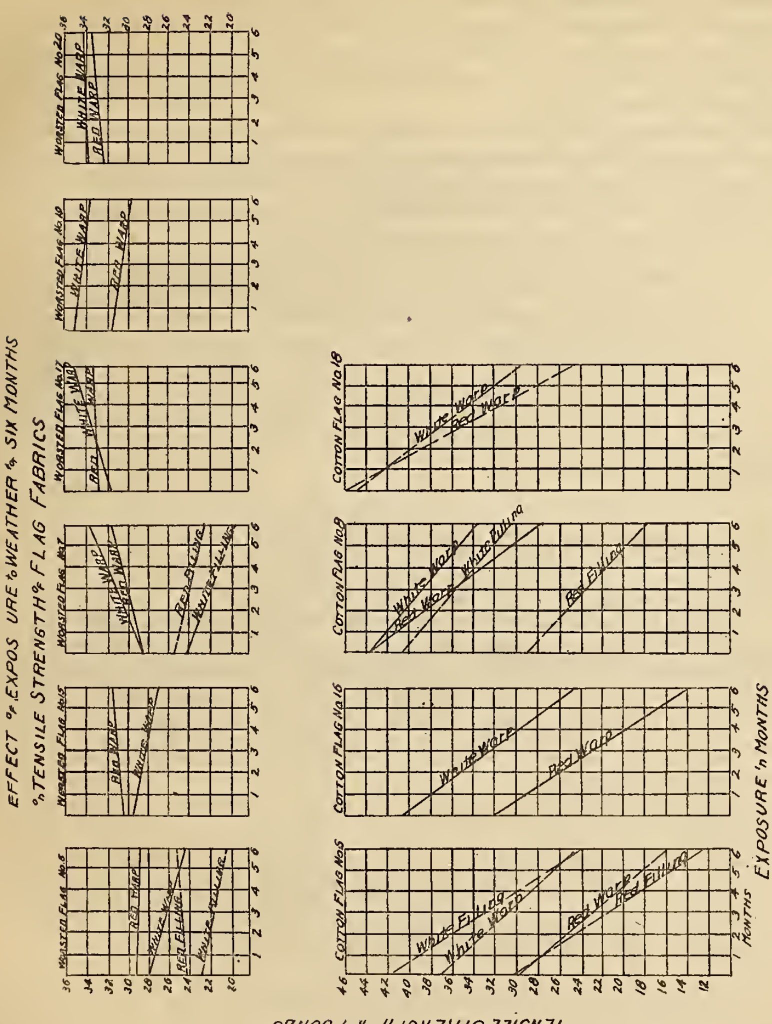
EFFECT of EXPOSURE to WEATHER for SIX MONTHS
on TENSILE STRENGTH of FLAG FABRICS
WORSTED FLAG No. 5
WORSTED FLAG No. 15
WORSTED FLAG No. 7
WORSTED FLAG No. 17
WORSTED FLAG No. 19
WORSTED FLAG No. 20
COTTON FLAG No. 5
COTTON FLAG No. 16
COTTON FLAG No. 9
COTTON FLAG No. 18
White Warp
Red Warp
White Filling
Red Filling
MONTHS
EXPOSURE in MONTHS
TENSILE STRENGTH in POUNDS

FIG. 4

The biweekly inspection showed that three of the large flags began to show signs of fraying after three months' exposure and the other after four months. The first fraying of the small flags was observed after four and one-half months, three being affected. Apparent fraying in the others commenced after about five months. In all instances the cotton bunting showed greater resistance to the action of wind and weather than the wool bunting. It was noted that the wool bunting became harsh in feeling during exposure, while no change was noted in the feeling of the cotton bunting.

As regards color changes it was found that the best red wool bunting faded less than the best red cotton bunting, and that the white cotton bunting remained white better than the white wool bunting. It was also observed that the red outside stripes faded more than the inner stripes.

Determination was made of the total change in dimensions due to the six months' exposure by computation from the number of yarns in 1 inch. The results obtained in the case of the large flags are given in Table 2, each figure being the average of results obtained on the red and white bunting. The small flags changed in relative dimensions about as much as the large flags.

TABLE 2.—Change in Size of Large Flags During Exposure

[Figures obtained by computation: (+) denotes increase, (−) denotes decrease.]

Flag	Width		Length	
	Inches	Per cent	Inches	Per cent
Wool No. 5	$+1\frac{3}{4}$	2.9	−8	7
Wool No. 7	$-\frac{3}{4}$	1.2	....	....
Cotton No. 6	$-3\frac{3}{4}$	6.2	−10	8.8
Cotton No. 8	−2	3.3	$-8\frac{1}{2}$	7.5

Summary of Results—1. The best red wool bunting faded only to a small extent, while the best red cotton bunting faded somewhat more; the white cotton bunting remained white much better than the white wool bunting.

2. The effect of the weather upon the tensile strength of the red and white wool bunting was practically the same; but the red cotton bunting was weakened to a much greater extent than the white cotton bunting. The fiber of the wool bunting was appreciably harsher and less lustrous after exposure than before. The cotton fiber seemed to have been unaffected by the exposure in this respect.

3. In regard to fraying or tearing the best cotton bunting gave much better results than the best wool bunting.

4. The cotton wrinkled, especially when beginning to dry after a thorough wetting, somewhat more than the wool.

5. The fraying or tearing of the stripes usually occurred in the filling yarns or the narrow dimension of the flag. The best cotton flags showed no signs of fraying up to about four months of exposure, while the best wool flags became frayed in about three months. Large flags were affected before the corresponding small flags in this respect.

6. The lightest bunting showed the greatest wearing qualities, this being a cotton bunting; but of the four kinds of wool bunting used the heaviest fabric showed the greatest resistance to the wind and weather. These results therefore do not enable a conclusion to be reached as to the best weight of a bunting in this respect.

7. The large and small flags showed about the same change in tensile strength and relative dimensions after the service tests.

8. The change in the size was greater in the lengthwise direction.

Manufacturing Suggestions.—1. The red cotton bunting should be dyed with colors that will remain practically the same shade after four months' weather exposure, and the dye or dyeing process used should not cause it to deteriorate faster than similar white bunting.

2. Cotton bunting could perhaps be shrunk to such an extent that little or no shrinking would occur later in the made-up flags.

3. It may be advisable to use better bunting for large flags than for small flags.

4. Stronger filling yarns or, perhaps, two-ply yarns would considerably improve the resistance of wool bunting to fraying and tearing.

5. Since the first indication of failure was observed in the corners of the flags, it is suggested that these be reinforced either by an extra piece of bunting or with several rows of stitching. Additional rows of stitching all along the free end of the flag might greatly improve the wearing quality.

6. It is further suggested that the shades of the red and blue colors be standardized to eliminate the present variation.

7. Effort should be made to make the red color of the wool bunting faster and so to prepare the white wool bunting that its whiteness will be retained better.

DISCUSSION

Mr. NOLAN. I would like to ask Mr. Hartshorne how he thinks his mixed cotton and worsted yarn would work for flags.

Mr. HARTSHORNE. I do not believe it would apply at all, because it would be difficult to dye.

Mr. NOLAN. I mean with respect to shrinkage.

Mr. HARTSHORNE. I do not think that it is an application that might be expected. If the cotton flag turns out well it will be unnecessary to use worsted at all.

Mr. LIND. A summary of the investigation shows that one is about as good as the other?

Mr. LEWIS. Yes.

Mr. LIND. Have you arrived at any conclusion?

Mr. LEWIS. The cotton bunting is apparently as serviceable as the wool bunting, and the Government is, consequently, now buying larger quantities of the cotton bunting.

Mr. NOLAN. Do they issue specifications as to the dye used? I think that is a very important consideration.

Mr. LEWIS. Yes, it is. We have planned an investigation for determining adequate color specifications.

Mr. NOLAN. I think you will find the dyestuff just as essential as the component material.

SECOND SESSION

OPENING ADDRESS

William C. Redfield[20]

I have no idea of making a speech to you, but I wish I could convey to you how it makes me feel to have you here.

I was thinking as I came along the hall how many groups we have seen in this room and how many more we hope to see; how much has come out of it for the good of our common country and for the people of our common industries.

I remember one day there were five groups of automobile engineers here. Every group was composed of technical men deep in the study of a particular phase of the sciences which underlie that great industry. At another time we had in this room men interested in the production of lime. The technical men of very many of the industrial groupings of the country have gotten more and more into the habit of gathering here for the purpose of utilizing our plant and for the purpose of advancing their own work.

This is one of the places in which I like to think there is no selfish interest. There is nobody in the force here gathered who is primarily interested in personal profit; there is nobody to whom it matters how long it takes to solve a problem; there is nobody to whom it matters, in a certain sense, how much the cost is. We can afford here to lay aside, through the wise provision of Congress, many of the elements with which you in your respective factories must certainly be concerned and to work for the truth without regard to whom that truth may affect; without regard to how long it takes to ascertain that truth within certain limits; without regard to whether a profit is to be made or loss incurred through that truth.

There is, to my mind, a very wonderful background of thought that lies behind the operation of the Bureau of Standards. We can be, must be, have no right to be anything else than wholly dispassionate. We can afford to be, must be, have been, intend to be infinitely patient. We do not have to debate whether work can be undertaken with a view to whether or not it is likely to be commercially successful. It is happily in our power to work from the standpoint of ascertaining the truth; and yet I should be glad to have you realize the immense economic and commercial gain which flows out of these activities.

Being a manufacturer myself, I think I never come here to talk with our scientific men without observing something which makes me want to drop everything else and follow that thing up, because my vision is opened on new fields untouched, new products unmade, new possibilities undeveloped.

The members of the staff here are reaching out into the darkness that surrounds the human mind and pushing back that veil of darkness little by little, day by day, a little here, a little there, reaching into that darkness to bring to light the knowledge that mankind needs. I would like to be far enough from it, and yet near enough to it, to see it with the eye of imagination and grasp the human side of it all. For after all, gentlemen, your work and mine and the work of a great institution is of no use in the world except in so far as it affects humanity. Unless men and women are to be bettered by what we do, I am wasting my time and you are engaged in a wholly futile endeavor. I was particularly proud one day to find a magazine speak-

[20] Secretary of Commerce, Washington, D. C.

ing of the Department of Commerce as the Department of Health. We do not exercise the police powers of the Government in the Department of Commerce; at least if we do in the Steamboat-Inspection Service, we hope to do so with the consent and the whole consent of the governed. Here no business man is in the presence of regulation. Here it is the whole purpose to help along and make business better and more equitable. Our difficulty is that the business world knows so little of this work. If we had the means and the men we could do here 10 times what we now have the means and the men to do. On the other hand we constantly find men enduring losses, inconveniences, and handicaps that we quite know how to remove in whole or in part if they knew we were here for that purpose.

It is a spirit of helpfulness that I would like you to get from this institution. I would like you to feel, after you go back to your own work, that this is the kind of a place to which you could send or come knowing that whatever we have in equipment or experience or organization is here for the purpose of helping you, and that it is freely, willingly, ungrudgingly placed at your disposal for that purpose; that you may send here the men who want to know and we will put them, in so far as we may, in the way of knowing. The man who wants to learn is the kind of man we are here to meet.

I doubt if there is any place in the world where the limits of knowledge are more clearly understood than in the Bureau. I do not think that you will find a spirit of false pride is to obtain here, but I do think that you will find that we feel a genuine satisfaction whenever we are able to help along. The idea is to take a great industry like this and by working together to put it on the sound business basis of scientific knowledge. That has been our great weakness in America, gentlemen; it is our great weakness. Germany's wonderful strength lies in the fact that her industries have been the outcome of ascertained science. As I have said more than once "Herr Doktor" has been welcome in every German factory. The scientist is at home in the industries of Germany and not at all in those of America. He has been cold-shouldered in too many of our industries. "What do I need of a chemist?" is the question asked by many of our American manufacturers. He needs that chemist far more than he has vision to understand. "What has science to say to me? What can technical men do for me?" has been too long and is yet too much the cry of the man who operates by rule of thumb. That rule of thumb is yet too prevalent; it is a part of the darkness, a part of the ignorance.

Out of that we are emerging, but we have a lot to learn. We could learn scientific application to industry from Germany. We could learn thrift from France. We have taught the world many things, but we ourselves must be learners still. I have not any fear for the industries of America in any contest of the future if we bring to the front, into commanding power, in those industries the men of science. When the mill superintendent and agent listen to the scientific man, and listen attentively, with a welcome and open mind, then American industry has nothing to fear. Our weakness has been that we have listened with closed ears to the voice of science and have not opened our minds to the men who have studied to know. I have been a manufacturing man all my life, and I know whereof I speak from practical experience. I think, however, that the day is dawning when the sun of light is going to shine more upon all our industries. Some of them are now almost wholly on a scientific basis.

I heard Dr. Steinmetz say not long ago that because his great industry was based upon scientific research and development he feared nothing from the competition of any nation on earth. I liked to hear him say this because the practical industrial success that has been achieved by the great industry of which he is the scientific brains demonstrated the profound truth that lay underneath his words.

When we know, and know that we know, and yet know how little we know, and are willing to know more, and learn from every fellow who is willing to search into the unknown, then, and not till then, will American industry have nothing to fear from any foreign competition.

CLASSIFICATION OF RAW SILKS AND STANDARDIZATION OF TESTS

J. A. Scheibli [21]

I will endeavor to explain the reasons why we do not have a "standard raw silk classification method" and will try to suggest one. Then I will endeavor to explain the reasons why we do not have a "standard raw silk testing method" and will also try to suggest one.

The Standardization of the Raw Silk Classifications.—Every country which produces raw silk in Europe and Asia classifies it by different grades and terms. For the purpose of comparing the quality of raw silks of different countries, inspectors are compelled to use a uniform grading for all silk. Some use the Japanese classification as their basis, others the Italian, others the French. In our laboratory we use a grading system of our own.

The best silk is graded 100, and in the range from this down to 50 are included all the grades of silk generally used by silk manufacturers. The lower range, from 50 to 1, is reserved for a separate class of cheap silks, used mostly for purposes other than the manufacturing of broad silks and ribbons.

Since this system of grading raw silks has been made public by the Silk Association of America it has been generally adopted by those interested in raw silk inspection. The classification committee of the Silk Association of America also indorsed and accepted it.

The Standardization of the Tests.—For finding the quality of a silk there is no standard testing method, but each one of the few American raw silk inspectors uses different tests, though almost all of them are graduates from the same textile school. Their difference in length of experience, in quickness of apprehension of good and faulty points, and in ability for devising new and improved testing methods are the causes of the variation. They are all experimenting and trying to invent tests which could be accepted as standards.

Lack of cooperation is, of course, also a cause of the nonexistence of a standard testing method. As is usually the case in such matters, those having little knowledge are particularly eager for cooperation in order to profit through learning from the experience of others, while the better informed, on the other hand, are naturally reluctant to impart their experiences without any return. The latter regard prize essays and convention addresses as being more just to them, because the knowledge disclosed by these methods is at least recorded under their own names, which, while in itself may not be much of a satisfaction, is regarded at least as preferable to having their experienc appropriated by others.

European raw silk testing methods are excluded from being accepted by us, not only because of the impracticability of their standardization, but also because they do not cover the requirements of our working conditions, which are much different from those of Europe.

The difficulty of constructing a standard testing method is realized when it is considered that yearly over a hundred and fifty million dollars' worth of raw silks are imported by us at prices from $5 to $6 per pound, simply on the classification estimate of foreign reelers and dealers, without our using any means, nor possessing any means, of checking or controlling this estimate until the silk is in operation, when it is too late to reject it.

What are the difficulties of finding standard testing methods? In the first place, chemical analysis fails to give any clues as regards the quality of silks, because it is not so much the chemical composition of the fiber that determines the value of the silk as the physical condition of the cocoon ends and particularly the degree of care taken in reeling these into thread. In the second place, to the manufacturer it is immaterial if one silk differs from another in the chemical composition so long as both run well in all operations and produce satisfactory goods. These are the only two points of interest

[21] Raw silk inspector for R. & H. Simon Co., Easton, Pa.

he has, and as he is the one who pays the price, his views and not those of the inspectors, salesmen, importers, or reelers are decisive.

In trying to develop a standard testing method with the manufacturer's point of view as a basis, a knowledge of the requisites of a standard testing method is required. These requisites are that the grade of a raw silk and the degree of perfection of the manufactured goods that can be made of it, may be, as quickly as possible, accurately ascertained by simple methods at any time and at any place of inspection. These requisites bar all tests, the results of which are obtained by judgment instead of by measurement, or which do not represent the true quality of the silk; they bar, also, the tests which require too much time or labor, or which are too complicated for general use; and last but not least, they bar those which can not be made in exactly the same manner at different inspection establishments.

A careful perusal of the tests known and generally applied reveals the fact that none of them can be used in a standard testing method, because they all lack one or more of the requisites. The shortcomings of each of these tests are explained in a paper I read at the First National Silk Convention in Paterson, October 13, 1915. It may suffice to say here that new testing methods which comply with all the requisites had to be devised, and I will now present, for the first time, the tests which are used in our laboratory for inspecting close to a million dollars' worth of silk yearly.

This simplified and practical method for ascertaining the grade of a silk, which I offer as a suggestion for a standard testing method, is composed of four tests. To obtain the classification of a silk, the first two tests only are used, as they alone represent the quality of the silk, while the second two represent values of the silk other than the quality. The principal or quality tests are (1) evenness and (2) cleanliness. The auxiliary or nature tests are (3) hardness of the thread and (4) winding.

The quality test results represent about 98 per cent of the price, and the nature test results represent only about 2 per cent; yet, since they are often the ultimate deciders of the last 5 to 15 cents of the price, which is usually all that is in question between sellers and buyers, the auxiliary tests seem to be of almost as much importance as the principal or quality tests.

The Two Quality Tests, Evenness and Cleanliness.—1. *Evenness, Its Test, Grading, and Value.*—Evenness is taken as the basis for the classification. It repre-ents two-thirds of the quality of the silk, and cleanliness one-third. Therefore, no efforts are spared to grade evenness accurately.

The principle of the evenness test is to separate a fixed finest-sized portion from the bulk of sizings and to measure the relation of its deniers to that of the whole. From the bulk 300 sizings are taken: a smaller number would give inaccurate results, and a larger number would be impracticable on account of the length of time required to take them.

For calculation of the evenness, the deviation of the 40 finest sizings from the 300 forms the basis. The coarse portion need not be computed, because its result in almost identical with that of the fine portion. The fine portion is the all-important one, because upon it depends the running quality of the silk in all operations, as well as the degree of perfection of the manufactured goods. The relation of the fine portion to the average shows the quality of the silk sufficiently well to make the computation of the less important coarse portion superfluous.

The finer in size the ends are found to be, the more they depreciate the quality of the silk, for which reason the 40 finest sizings are not taken as one quantity but are subdivided into five unequal sections, as follows: Section 1 is the 2 finest results; section 2 is the 3 next finest results; section 3 is the 5 next finest results; section 4 is the 10 next finest results; section 5 is the 20 next finest results; total, 40 finest results.

The deviation of each section from the average size is computed separately in percentage and with the help of tables is converted into grades from 100 to 50, the average of which is the grade of evenness of the silk. By this method of calculating the grade of evenness, the same value is given to the 2 extreme sizings of section 1, as to the 20 of section 5, and to the 10, 5, and 3 sizings of sections 4, 3, and 2, respectively.

The Test: This test is made in the following manner. For explanation a 10-bale lot of Japanese silk is used as a basis.

Ten skeins are taken out of each of the 10 bales, making a total of 100 skeins. (This number is also required of smaller lots than 10 bales and is sufficient for larger ones.)

The 100 skeins are wound 40 minutes, 25 skeins at a time, although only 6 minutes running is required for the evenness test. The other 34 minutes are required for the cleanliness test as will be explained later. Of the 100 bobbins wound from the 100 skeins, 3 sizings of half lengths of 225 meters, which is equal to about 246 yards, are made of each, or in all 300 sizings.

These small sizing skeins are weighed on specially constructed scales (so-called halfmoon scales), with divisions of fifth deniers from 2½ to 12½ deniers, but numbered for whole lengths (450 meters) or from 5 to 25 deniers. This scale is for regular sizes. For coarser sizes a second scale is required with the same subdivisions, but for 7½ to 17½ deniers and numbered for whole lengths, or from 15 to 35 deniers. The subdivisions into fifth deniers are required for greater exactness. The customary half denier divisions are not sufficiently accurate for this particular testing method. The divisions into fifths, with readings of tenths when the hand points between two divisions, are chosen in preference to fourths and eighths for convenience in adding.

The basis for the count or size of silk is a very odd one. The weight is expressed in 5 centigram units, called "deniers," but the length is peculiar, being 4 French ells of 112½ meters, or 450 meters, equal to about 492 yards. By increasing the length 11 per cent to 500 meters, it becomes a strictly decimal system which is called the "international denier" and which has already been adopted in many places abroad.

The 300 sizing skeins are weighed, one by one, on the halfmoon scale described, and the weight of each group of 10 is determined on the adding machine. From these 30 totals the average size is obtained. All the skeins are then weighed in bulk on a larger scoop-halfmoon denier scale for checking the total of the 300 single weights.

The 40 finest sizing results are selected and transferred on special forms on which the usual deniers and fifth deniers are printed in their order, one per line, in a vertical column. Each of the 40 fine sizing results is then indicated by a pencil mark opposite its deniers. These 40 results are next subdivided into the five sections explained before.

The total deniers of each section are then counted and their relation computed in percentage, preferably with the help of a calculation disk, to 2, 3, 5, 10, or 20 times, respectively, the average deniers.

The Grading: The five numbers thus obtained show accurately the deviation of the five sections from the average deniers. Each deviation is then converted into its grade from 100 to 50 with the help of a table, and the average of these five grades is the grade of evenness of the silk. This table, which is the result of thousands of tests, is the keystone of the standard classification which I am now suggesting.

The complete table, with 2000 numbers, can not be given here, but I will give as the basis from which the table can easily be made, the percentage of deviation of grades 100, 98, and 96, of each section.

Section	Grades		
	100	98	96
	Per cent	Per cent	Per cent
1	30.0	30.6	31.2
2	25.0	25.5	26.0
3	21.0	21.4	21.8
4	16.66	17.0	17.33
5	12.50	12.75	13.0

The continuation of the table upwards will end at grade 200. This is the starting grade for size 13/15 and would indicate an absolutely perfect silk with no variation whatever in size. Such an evenly spun silk, of course, exists only in theory. In practice the most perfect raw silk is midway between the absolutely perfect and the most uneven silk, or a half-perfect silk—grade 100.

The range of regular silk generally used by silk manufacturers comprises the silks from half to quarter perfection. Less than quarter-perfect silks are below the regular class and better than half-perfect silks are impossible to spin. For finer and coarser sizes than 13/15 either different tables are used, or what amounts to the same, additions or reductions are made from the average obtained from the table for size 13/15.

It occurs occasionally that some grades of sections are over 100 or below 50, but hardly ever the average grade. The grading from 100 to 50 allows such overlappings without interference with the calculation of the average grade, which is one of many reasons for its being a practical classification system.

The Value: The New York classification term is obtained from the average evenness grade with the help of a table which reads as follows, with the present prices included:

Table for the Classification of Japan Raw Silks

Grade	New York classification	Difference		Price per pound
		In grade	In cents	
				Dollars
100/95	Best double extra	5	10	6.00
95/85	Double extra	10	20	5.80
85/75	Best extra	10	20	5.60
75/70	Extra	5	10	5.40
70/65	Best No. 1 to extra	5	10	5.30
65/60	Best No. 1	5	10	5.20
60/55	No. 1	5	10	5.10
55/50	No. 1 to 1½	5	10	5.00

This table is adapted exactly to the prices; when the difference between two qualities is 10 cents per pound, the difference in the grades is 5; when it is 20 cents, the difference is 10 grades, making each grade difference equivalent to 2 cents per pound. Similar tables are used for all other classifications.

The prices of raw silks do, of course, change constantly but can be found in New York papers and trade journals at any time for each classification and grade. The New York classification of Japan silks is the Yokohama classification raised by one term. What Yokohama calls a best single extra, we call a standard double extra, and so on.

Taking as an example a 10-bale lot of Japan silk with the five evenness grades 92, 90, 88, 86, and 84, the classification basis reads "double extra grade 88 at $5.80 on May 21, 1917."

2. *The Cleanliness, Its Test, Grading, and Value.*—The next test is the measurement of the cleanliness and the spinning defects. Instead of trying to count the numerous small, medium, and large uncleanlinesses in the threads of silk from which to deduce its running in operation, as is usually done, a better way is directly to try the running of the silk.

The method of testing the cleanliness of the silk by passing the threads through metal cleaners, as is usually done when cleaning silk, can not be accepted as a standard test on account of the extreme unreliability of the results. To obtain reliable results, the opening of the metal cleaners would have to be adjusted to the size of the thread; but as the threads of all silks vary within comparatively short lengths, according to their quality, from one-third to one-half of their average size, the opening would have to be adjusted to the coarsest places in the threads to allow them to pass, and by doing so the smaller uncleanliness in fine ends would also pass through without breaking, which makes this operation inapplicable as a cleanliness test. Again, the average thickness of silks of various cocoon races varies from the thickness of a dime to that of a half-dollar coin, proportionately, although they are spun exactly the same size. This seems to be contradictory, but it is not, because the size of the silk in deniers is not a measure of diameter but of weight; and the difference in the specific gravity of cocoon ends of different races explains the difference in the thickness of their threads. Also, some raw silks contain up to 50 per cent more gum than others, which also influences the thickness of the thread and makes its diameter unlike those with less gum.

There are no practical means whereby the average thickness of a thread could be measured and the cleaner opening be adjusted to it. The metal cleaners have, therefore, to be thrown out of consideration as a standard test.

A perfect test of the cleanliness is applied in our laboratory where the cleaner opening is not stationary and, therefore, overcomes these difficulties. It shows the results accurately, whether the average diameter of the thread is fine or coarse, whether the thread runs evenly or unevenly, whether it has much gum or little, and its working is very simple.

The Test: In redrawing the silk from one bobbin to another on a winding frame, the thread is passed through a porcelain eye placed at the foot of the machine, between both spindles, the up-coming thread is twisted around the down-going thread by which live eyes are formed which, owing to the tension, adapt themselves to the average diameter of the thread and cause the ends to break at every uncleanliness, or at every spinning defect and fine end, which would cause the silk to break in manufacturing if run at a high speed.

The cleanliness test, like the one of evenness, is made in five sections in order to be thorough and to obtain most accurate results. The five sections of 20 bobbins each are tested successively with more tension and friction, the threads of the first section are twisted one time; of section 2, twice; of section 3, three times; of section 4, four times; and of section 5, five times. Each section is first run for 5 minutes without counting the breaks to get a fair start; then, during its next 25 minutes, the breaks are counted.

The Grading: Five tables, one for each kind of twist, show the grade from 100 to 50 of the number of breaks counted, and the average of these five grades is the cleanliness grade. For finer and coarser sizes than 13/15, allowances in form of either additions or reductions are made in proportion to their differences.

These tables differ from the evenness tables in so far as grade 120 is the starting grade with no breaks at all, instead of grade 200. The number of breaks of grade 100 for the sections 1 to 5, in size 13/15, are: 3, 6, 10, 15, and 22, respectively.

The Value: For each grade the cleanliness differs from the evennness, one-third of a grade is added or taken off, as the case may be, from the basis, the result of which then represents the actual quality of the silk. Taking as an example the cleanliness grade 76. It places the classification of the silk at 4 grades below the basis, because 4 is one-third of the difference between 88 and 76.

The complete classification of both quality tests reads, then, "best extra grade 84 at $5.40 on May 21, 1917."

The Two Auxiliary Tests, Nature and Winding.—*3. The Nature, Its Test, Grading, and Value.*—The prices just quoted with the classification tables are for hard-natured silks or Kansais. Soft-natured siks or Sinshius are quoted at 7½ to 15 cents less per pound. In our laboratory we distinguish a third kind of nature. These silks, which are semihard-natured, are called Bushius because they are generally raised in Bushiu, although many silks of Joshiu and of other Provinces are also semihard natured.

Soft-natured silks cost less because they fill less; in other words, more threads are used to produce the same quality of goods as regards to their touch or hand than are required of hard-natured silks. Another bad feature of soft-natured siks is that they usually run poorly in all operations. On the other hand, in regard to the beauty of luster, smoothness, and pliantness of the goods, as, for instance, in satins, messalines, and such weaves, Sinshius are far superior to Kansais.

Some believe the difference between hard and soft natured silks is not in the fiber but only in the gum; but the superiority of Sinshius over Kansais for dyeing bright colors when the gum is boiled out before the silk is dyed, seems to contradict this view.

No means are known for measuring the hardness of the silk. The problem is very simple and its solution may have been overlooked on account of its very simplicity. It is logical that the softer a thread is, the more it can be twisted before it breaks. For this reason, soft-natured silks are better suited than hard-natured silks for hard twists. Consequently, an accurate measure of hardness of a silk can be made by twisting the threads. The smaller the number of turns required to break them the harder is the silk and the higher in price.

The Test: The test is made as follows: The twist counter is set to 10 inches with the 2-inch extension rod unextended. The end is tied into this 10-inch space with such a tension that a staple placed over it touches the board. The extension rod, the heavy spring of which is replaced by a lighter one, is opened and the handle turned, which twists the silk.

In twisting the thread it naturally shrinks, and the sliding extension rod, extends out. The twisting is kept on with reduced speed until the thread breaks, and the number of turns are marked. This procedure is repeated till the 30 tests have been made, and the average breaking point indicates the hardness of the silk in the reverse order.

The thread is put in the twist tester as explained so that it may not break through tension caused by the shrinkage in twisting and become a tension and elasticity test. The breaks are caused by no influence except the inability to resist further twisting.

The threads to be tested are soaked and dried in advance on a lustering machine.

The Grading: With tables on hand the quality of hardness of the silk is obtained in grades; and here, the same as in previous cases, different tables are required for different sizes.

In size 13/15, grades 100 to 80, with breaking point at 125 to 145 turns per inch, are hard natured. Grades 80 to 65, with breaking point at 145 to 160 turns per inch, are semihard natured; and grades 65 to 50, with breaking point at 160 to 175 turns per inch, are soft natured.

The Value: The price reductions to be made for soft-natured silks are seen in the daily price quotations. In using 60 as example for the grade of hardness of the thread, our classification reads "soft-natured Japan best extra grade 84 at $5.45 on May 21, 1917." In using 90 as example for the grade of hardness of the thread, the classification reads "hard-nature Japan best extra grade 84 at $5.60 on May 21, 1917."

4. The Winding, Its Test, Grade, and Value.—The winding is figured as an extra auxiliary quality apart from both the quality and the nature, because other influences than the quality and the nature may cause silks to run poor in winding; as, for instance, poor crossing, poor lacing, hard gum places, and so on.

The Test: Of the 40 minutes during which the 100 skeins are wound on the winding machine, the first 15 minutes are allowed for a fair start and the breaks counted only from the sixteenth to the fortieth minute which, at the slow speed of 120 yards per minute, makes a total of about 300 000 yards, or 1 pound in a 14/16 deniers silk. The silk is wound unsoaked on pin swifts without weights with the gum rubbed out.

The Grading: The best winding silk is graded 100 and the poorest 50, and the starting grade is 120. The number of breaks of grade 100 is 15.

The Value: If the winding grade corresponds with the quality grade, its price remains unchanged. If it does not, 1 cent is deducted from the quality price for each five grades it is below, and 1 cent added for each five grades it is above it.

This, however, refers to hard and semihard-natured filatures only, because for soft-natured silks part of the higher winding cost is already allowed in their lower prices, and no dealer would consent to an extra compensation for the poor winding of Sinshius. The winding tests for these silks are, nevertheless, made with the same interest in its result for the manufacturer's own satisfaction.

In using winding grade 59, for example, our complete classification now reads "hard-natured best extra grade 84 at $5.60 on May 21, 1917, less 5 cents for low winding."

After the completion of the inspection, the silk from all the bobbins is reeled into skeins of 60 000-yard lengths on a small 10-end reel. This reeling of the silk into skeins is very practical because the silk is then in the most convenient form for storing until a certain quantity has accumulated, and it is always ready to be soaked, wound, and thrown into 6 to 12 end tram, or any other kind of thrown silk which balances the variety of sizes and natures of the silk for use in goods where such mixtures are of no influence on their quality. Thus, very little silk is lost as waste.

Concluding Remarks.—It seems to be appropriate to say a few words at this opportune time about our prospects of reeling the raw silks we consume and keeping the $150 000 000 a year at home, which we now send abroad in payment of our raw silk bills.

We can raise as good silks as any other silk-raising country, and the high price, which is our only barrier, can be lowered by the simple method of reeling directly on bobbins, instead of into skeins. This can be done in drying the wet silk thread by running it over a heated surface, which is a commonly known operation. Up to a few years ago it was thought necessary to have the silk reeled into skeins for soaking, but now a way has been found of soaking silk on bobbins. In reeling the silk from cocoons directly on bobbins and selling it in this way in the market, we eliminate enough labor and expense to offset our higher cost of labor.

When we reel and sell our raw silk on bobbins, foreign countries will hardly be able to compete with our own products because our prices will be as low as theirs; and they can not export their raw silk to us on bobbins, because it is appraised as manufactured silk and taxed as such.

A war situation forced us to free ourselves from foreign dyestuffs, but it is to be hoped that the same cause should not be needed to make our raw-silk industry independent, and the time for this preparedness is right now.

How simple our reeling and selling method would be in comparison to foreign ones is readily seen by citing an example, as follows:

A 10-bale lot of silk, reeled in the interior of Japan, for instance, is laced, taken from the reel, twisted into skeins, bundled and packed, then shipped to Yokohama, There it is labeled and packed once more, shipped to Vancouver, and by silk trains sent directly east, where it is sold and shipped to throwing mills. Here it is unpacked. the skeins opened, put in a soaking bath, soaked over night, put on winding frames, and wound on bobbins; and then it is in the shape in which we reel it directly.

In addition to the labor costs which we eliminate, we save steamship and railroad freight, also marine and fire insurance, bankers' commission, numerous middlemen's profits, the interest on the capital for one and a half to two months, etc. We can even go a step further and set, for instance, an organ spinning frame against the back of a reeling frame and throw the silk from cocoons directly into first time organ. For this operation the threads are to be soaked and dried while running, which can easily be done.

The Italian Government has advertised a competition with prizes up to 40,000 lires, among which the perfection of such combination frames takes the leading place, which proves that its construction is considered possible.

By the time we will have such time and labor saving combination reeling and throwing frames I hope to be in a position to suggest a standard testing method for thrown silk on the same basis as the one now suggested for raw silks.

DISCUSSION

Mr. Chittick. The cost of labor in Japan, in China, and in Italy in connection with raw-silk reeling is very small. In China the cost of this highly-skilled work is about 10 cents a pound and in Japan approximately 20 cents. I am certain that in this country we can not get highly skilled reeling operators for less than $2 or perhaps $3 a day. A highly-skilled reeler will reel from a first-class cocoon not more than 1 pound of silk a day. Supposing that 20 cents is paid and that a full pound of silk is reeled every day, and that labor can be obtained here for $2 a day, we would still have a difference of $1.80 a pound in cost of reeling. I think it is a very unpromising field for our domestic labor.

Mr. Stratton. Some time the supply might be cut off.

Mr. Chittick. If all the people in those districts of the United States where silk could be reeled were to do nothing else but reel silk, they would not produce as much as is required.

Mr. Scheibli. Some years ago a man brought up some skeins to New York to be inspected. These silk skeins were very well spun, comparing favorably with the best Italian silks. He told me that the first year he figured it had cost about $15 per pound. A year afterwards he came again with silk spun in Georgia, and he said that he had got the cost down to about $6. At that time Japanese silk was about $3.50. To-day Japanese silks cost $6, showing that if conditions would remain the same, American silk products could compete with Japanese.

Mr. Chittick. When you consider the significance of the fine variations in the silk, the generations of inherited talent that are back of the reeling, and the number of people required, it is evident that the difficulties are almost insuperable. Of all the industries in the world it is the one in which manual labor enters to its greatest extent.

Some time ago at the Bradford Technical Institute a story was told of a wool comber who invented the means of spinning silk. He said if he had been brought up in the silk trade he would have seen from the beginning that it was impossible.

Mr. Stratton. Very few cases have yet arisen where highly skilled labor can not be replaced by machinery. In consequence of the generations that are back of this silk industry I suppose that it is befogged by the law of tradition. It is probably imbued with the necessity of doing things a certain way because they have always been done that way before and is not susceptible to improved methods. This is not true of the silk industry alone. There is undoubtedly a great deal of truth in what you say. However, improvement is achieved by men who make an effort rather than by those who are impressed with the hopelessness of the problem.

CLASSIFICATION OF RAW SILKS AND STANDARDIZATION OF TESTS

Warren P. Seem [22]

I wish to acknowledge the courtesy of the Schwarzenbach Huber Co., at whose expense and direction these experiments were conducted for the benefit of the silk trade of the United States, and that of the Klots Throwing Co. for the preliminary researches and experiments.

It affords me pleasure, after 18 years of research work, to present to you what I believe to be a scientific method of classifying raw silk. My work was originally conducted for the purpose of standardizing raw silk thread. It has been very thorough, and every quality has been scientifically investigated with respect to its effect upon the quality of the cloth.

There are nine recognized qualities of raw silk—color, luster, hand, nature, cohesion, strength, cleanness, evenness, ductility. For reasons named in my article on "Silk throwing," now appearing in Silk, only four of these are essential qualities with

[22] General superintendent of throwing, the Schwarzenbach Huber Co., Altoona, Pa.

respect to which raw silk must be classified—strength, evenness, cleanness, and cohesion. These four qualities can now be measured by mechanical devices.

For strength determination I use the standard serimeter. This is known as the tenacity test. I make this test on 30 threads, selected from 20 skeins, discarding the 5 highest and the 5 lowest results and taking the average of the 20 intermediate tests.

Evenness and cleanness are determined on the gage reel shown in Fig. 1. A set of gages consists of 10 hardened steel gages accurately ground and adjusted with weighted feeler blades one-sixteenth inch wide, graduated in deniers to conform to the diameter of raw silk as determined by Rozenzweig by specific weight, given in Serivalor, and in Silk for December, 1916. The gages are adjusted to conform to the average diameter of the silk tested, and the thread run through is taken up on a reel to which a measuring device is attached. For details of test see Prize Essays, published by the Silk Association of America in 1915, and my paper on the "Value of standardizing raw silk," read before the First National Silk Convention at Paterson, N. J.

For cohesion I use the machine shown in Fig. 2, which was built upon the principles that govern the opening of the thread in weaving. The test is made on 200 threads in the following manner: Ten threads are wound side by side on a reel from each of 5 skeins, making 50 threads; a black card board 1¼ inches wide and 6 inches long is then fastened underneath these threads by means of gummed pasters on each end of the card; four cards with a total of 200 threads are used in making a test; each card is placed under the weighted lever of the cohesion machine, and the threads are stroked 1½ inches with a roller operated by a reciprocating rod until all of them are opened. The number of strokes required to open all of the threads is considered the cohesion, the final result being the average of those obtained from the four cards. The threads are examined with a flexible steel spatula after each 50 strokes.

Cohesion is the term applied by Rosenzweig in Serivalor to the quality of silk thread that causes the fibers to adhere together, forming one compact thread, and that prevents the thread from opening and splitting in weaving or in first-time spinning. It is dependent upon the adhesiveness of the sericin and the twist or croisure used in reeling the cocoons. It is one of the most essential qualities in weaving with grege. The spinning of the single raw silk thread obviates the necessity for a high cohesion in the case of organzine, but a cohesion high enough to overcome the opening up of the fiber during soaking and to prevent the thread from splitting in the process of spinning is necessary. For tram the cohesion must be high enough so that the fibers will lie parallel, thus preventing the extremely loopy or flossy condition which results when the cohesion is low.

A low cohesion indicates an open thread, a high cohesion a closed or compact thread, as shown in the microphotographs reproduced in Figs. 3, 4, 5, and 6. These were made for me by Messrs. Douty and Arundale, of the United States Conditioning & Testing Co. Fig. 3 shows the openness of a thread having a cohesion of 298 strokes; Fig. 4, 566 strokes; Fig. 5, 827 strokes; and Fig. 6, 1612 strokes.

This quality is generally judged by inspectors by scratching the thread with the nail of the thumb and noting the effort required to open the thread. On account of the roughness of some Chinas and hard nature Japans, caused partly by reeling in water containing lime and sandstone, the variations in sharpness and thickness of the nail and in the pressure exerted by different persons it is impossible to get an accurate cohesion test by that method. Generally too little silk is examined to give a representative value, even if the method were reliable. This quality can not be determined by friction, as the smoothness or roughness of various grades of silk seriously affect the results. The fact that the microphotographs do not show more openness for the thread having a cohesion of 827 than for that having a cohesion of 1612 (Figs. 5 and 6) does not prove that the machine is unreliable, but only that one or both of the following conditions exist: First, the depth of the thread may prevent a higher magnification being used to show whether a difference in the openness exists; second, it is possible that threads showing a cohesion of approximately 800 strokes

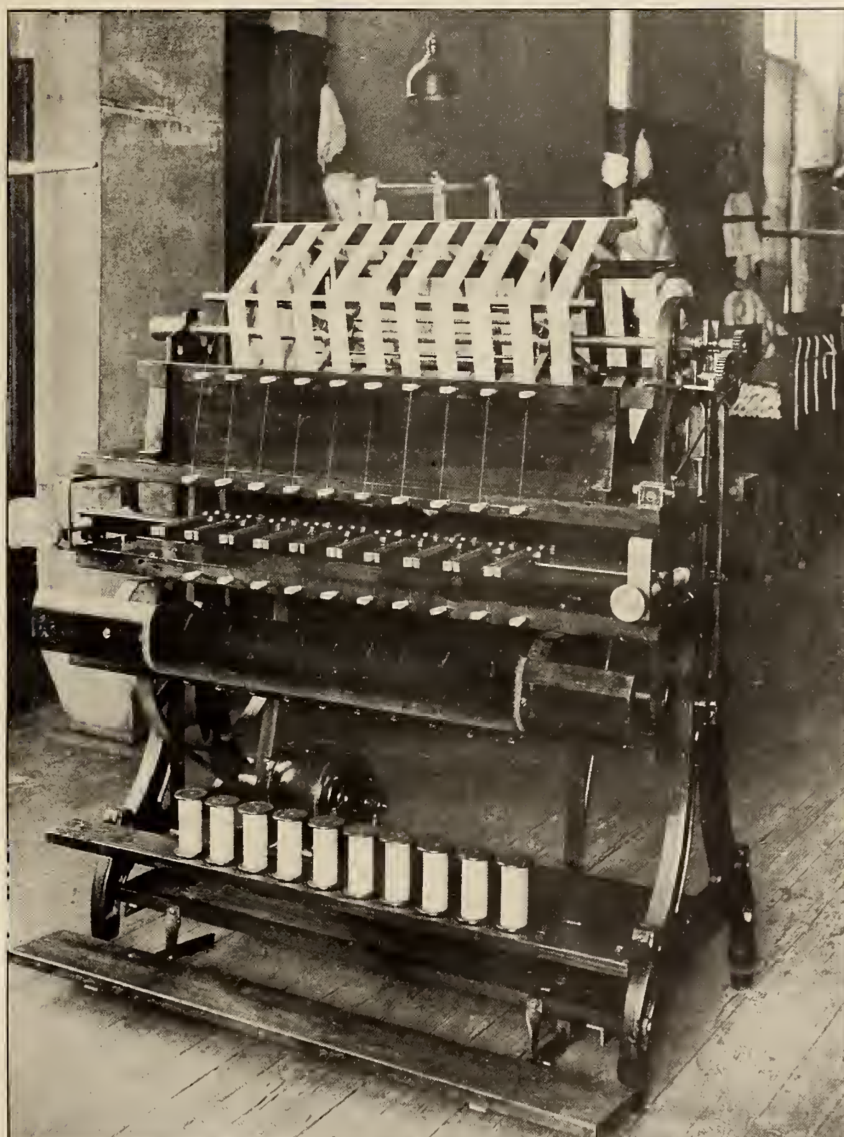

FIG. 1.—*Gage reel*

FIG. 2.—*Cohesion machine*

FIG. 3.—*Thread having cohesion of 298 strokes.* × 150

FIG. 4.—*Thread having cohesion of 566 strokes.* × 150

FIG. 5.—*Thread having cohesion of 827 strokes.* × 150

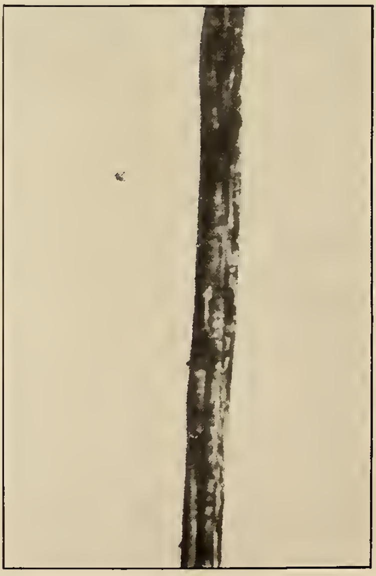

FIG. 6.—*Thread having cohesion of 1,612 strokes.* × 150

are of maximum compactness, a higher cohesion being entirely due to the adhesiveness of the sericin.

The classification used for cohesion is as follows: Very good, over 2001 strokes; good, 1501 to 2000 strokes; fair, 1001 to 1500 strokes; poor, 501 to 1000 strokes; very poor, 500 and under.

In general, Italian silks show the highest results. Chinas intermediate, and Japans lowest. There are, however, grades of Japans and Chinas that are as high in cohesion as the best Italians.

In determining the value of a sample of raw silk, four tests are made; winding, tenacity, gage, and cohesion.

After they are completed, the classification is made by the percentage method, which appears to be the only method by which all test results can be reduced to a common basis. The highest grade is rated as 100 per cent and the lowest as 60 per cent.

The winding test is made on 20 skeins, making a starting run of 15 minutes and then winding 300 000 yards, as described in Prize Essays, and in Silk for October, 1916. This test is made to assist in determining the value of the silk but does not enter into the clasification.

The strength, or tenacity, test is valued as follows: Four times average diameter, 100 per cent, very strong; three and one-half times average diameter, 87 per cent, strong; three times average diameter, 73 per cent, weak; two and one-half times average diameter, 60 per cent, very weak. Working results in throwing and weaving justify this classification. The tenacity test is an important one as it reveals the presence of weak threads which are frequently the cause of poor weaving qualities. Fine ends, loops, split ends, and corkscrews weaken the thread, and their relative number must be considered when rating the thread with respect to strength. The very fine threads average 50 per cent finer than the general average, and the fine threads 33 per cent finer with proportionately less strength. A loop or corkscrew diminishes the strength of the thread by that of one cocoon fiber or about 14 per cent. Split ends are only half as strong as those without defects. The relative value for strength is determined as shown in Table A. From the total number of defects appearing in the highest and lowest grades, as shown in August and September, 1916, Silk, we find that on XXX, 20 common defects equal 100 per cent; on No. 2, 210 common defects equal 60 per cent—from which interpolations are made for intermediate grades. The true strength equals the average of the tenacity test and relative value for strength due to defective threads, as shown on classification blanks.

TABLE A.—Relative Value for Strength

[Multiply the number of defects shown on gage test by the following amounts, sum up the results, and then apply table for relative value: Very fine, × 1/2; loops, × 1/6; corkscrew, × 1/6; fine, × 1/3; split, × 1/2.]

Class	Common defects	Per Cent	Class	Common defects	Per Cent
	20	100		120	79
	25	99		124	78
	30	98		129	77
Very good	34	97	Only fair	134	76
	39	96		139	75
	44	95		143	74
	49	94		148	73
	53	93		153	72
	58	92		158	71
	63	91		162	70
Good	68	90	Poor	167	69
	72	89		172	68
	77	88		177	67
	82	87		181	66
	87	86		186	65
	91	85		191	64
	96	84	Very poor	195	63
Fair	101	83		200	62
	105	82		205	61
	110	81		210	60
	115	80			

For evenness and cleanness determinations, 20 skeins drawn from different parts of the bale appear to be the usual number taken by testers, for which Rosenzweig in Serivalor gives good reasons. In considering the number of yards to be tested, we are confronted with the fact that defects come in very irregular order. They may be 1, 5, or 20 inches, or 5, 10, or 600, or more yards apart. If we examine a mirror having but 150 yards and slugs come only once in 600 yards, we must examine four mirrors to get one slug. While this may seem to indicate the presence of very few such defects, yet in 300 000 yards there would be 500 slugs which is very large number. In a yard of cloth with 20 000 ends, there would be 34 slugs, making a very unclean cloth. The point to determine is the amount of thread which should be taken in order to show the average condition of the bale. Several thousand tests made show that it is not governed by the yardage, but by the distance between defects, or in other words, the number found in 300 000 yards. The basis of 300 000 yards is taken because it represents a yardage upon which spinning results, waste, and cost calculations can be reliably based. On the lower grades of silk it is not necessary to test the same yardage of thread as on the higher grades. I have found that a determination involving 150 defects will give an average result; and when that many or more appear in 20 000 yards, the test can be completed with 20 000 yards; if the first 20 000 yards do not show 150 defects, then 40 000 yards must be tested; if 40 000 yards do not show 150 defects, then 60 000 yards must be tested; but it is never necessary to test more than 60 000 yards.

As shown by Rosenzweig in Serivalor, published by the Silk Association of America and by Silk in the July and August, 1916, numbers, evenness need only be considered with reference to extremely fine and coarse threads which appear with the following frequencies in the highest and lowest grades: Fine threads—XXX, 10 fine threads per 300 000 yards rated as 100 per cent; No. 2, 150 fine threads per 300 000 yards rated as 60 per cent; coarse threads—XXX. 0 coarse threads per 300 000 yards rated as 100 per cent; No. 2, 50 coarse threads per 300 000 yards rated as 60 per cent—from which interpolations are made for intermediate grades.

TABLE B.—Relative Value for Evenness

[The number of very fine threads is multiplied by 2 and the result is added to the number of fine threads. The corresponding percentage is then noted from the table. This percentge is averaged with the percentage similarly found for coarse threads.]

Class	Fine	Per cent	Coarse	Class	Fine	Per cent	Coarse
	10	100	0		84	79	26
	14	99	1		87	78	27
Very good	17	98	3		91	77	28
	21	97	4		94	76	30
	24	96	5		98	75	31
	28	95	7	Poor	101	74	32
	31	94	8		105	73	34
	35	93	9		108	72	35
Good	38	92	10		112	71	36
	42	91	12		115	70	37
	45	90	13		119	69	39
	49	89	14		122	68	40
	52	88	15		126	67	41
Fair	56	87	16		129	66	42
	59	86	17	Very poor	133	65	44
	63	85	19		136	64	45
	66	84	20		140	63	46
	70	83	22		143	62	47
Only fair	73	82	23		147	61	49
	77	81	24		150	60	50
	80	80	25				

The degree of cleanness is determined by the frequency of waste, very large knots, large knots, nibs, very large slugs, slugs, loops, bad throws, and corkscrews. These are classed as common defects and are reduced to a relative basis in proportion to their seriousness, and from this common basis we have XXX, 20 common defects

RAW SILK CLASSIFICATION

May 21st 1917

LOT NO 3 MARK Sample BALE NO. Sample

STOCK Japan CHOP Sample GRADE Sample SIZE 13/15

APPEARANCE

COLOR		LUSTRE	HAND OR TOUCH
WHITE	VERY EVEN	VERY GOOD	VERY SILKY
IVORY X	EVEN X	GOOD	SILKY X
CREAM	FAIRLY EVEN	FAIRLY GOOD X	NERVY
	UNEVEN	FAIR	FIRM
	VERY UNEVEN	POOR	STRAWY
		VERY POOR	SPONGY

HAIRYNESS— VERY BAD, PENALTY 5%
BAD, " 3%
GOOD " 0

SKEINS

STANDARD AMERICAN X NOT STANDARD
STRAIGHT CROSSING OTHERS
GUMS, SOFT X HARD NARROW BROAD

MEASURABLE QUALITIES
BASED ON 300 000 YARDS

Made on 20 000 yards

		RELATIVE VALUE AS PER TABLE				
		STRENGTH		EVENNESS PER CENT	CLEANNESS	
WINDING COUNT	40					
GAUGE TEST						
RAW KNOTS (240)						
VERY FINE; 50% UNDER AVG SIZE		x½				
FINE, 33%	120	x⅓	40			
COARSE, 33% OVER	45					
WASTE	120				x1	120
VERY LARGE KNOTS	210				x1	210
LARGE KNOTS	120			120 Fine 68	x½	60
NIBS	285			+	x⅕	57
VERY LARGE SLUGS	30			45 Coarse 64	x1	30
SLUGS	225			68 + 64	x½	112
VERY LARGE LOOPS	45				x1/10	5
LOOPS	810	x⅙	135	2	x1/10	81
SPLIT ENDS	15	x½	7			
BAD THROWS	150				x1	150
CORK SCREWS	240	x⅙	40		x1/10	24
TOTAL	2455	TOTAL	222		TOTAL	849
		PER CENT	60	PER CENT 66	PER CENT	60

TENACITY TEST GRAMS 47 TENACITY JUDGED GRAMS RELATIVE VALUE 84 %
COHESION TEST STROKES, UNSOAKED 349 SOAKED
COHESION JUDGED BY NAIL TEST, IN STROKES

STRENGTH— RELATIVE VALUE OF TENACITY IN % + RELATIVE VALUE OF DEFECTIVE THREADS IN % $\frac{60 + 84}{2}$ 72 %

EVENNESS— RELATIVE VALUE AS PER GAUGE TEST 66 %

CLEANNESS— RELATIVE VALUE AS PER GAUGE TEST 60 %

QUALITY— EQUALS AVERAGE OF STRENGTH, EVENNESS AND CLEANNESS 66 %
PENALTIES—LOW COHESION %
HAIRY CONDITION %

TRUE QUALITY 66 %

ENTER SPINNING REPORT HERE

QUALITY SCALE
BASED ON
COMPARATIVE VALUES

QUALITY %	QUALITY No.	GRADE	COHESION GRADE	COHESION STROKES	COHESION PENALTY
100			XXX	800	0%
99				700	3
98	50	XXX		600	5
97				500	7
96				400	9
95				300	11
94	100	XX		200	13
93				100	15
92					
91					
90			XX	500	0
89	200	X		400	4
88				300	6
87				200	8
85				100	10
85		Best No. 1			
84	300	to			
83		Extra	X	400	0
82				300	4
81				200	6
80		Best		100	8
79	400	No. 1			
78					
77			Best	300	0
76			1	200	3
75			to X	100	5
74	500	No 1			
73					
72			Best	200	0
71			No. 1	100	5%
70					
69	600	1 to			
68		1½			
67				Under Best	
66				No. 1 Not	
65				Penalized	
64					
63	700	No. 2			
62					
61					
60					

GENERAL REMARKS

SIGNATURE W. S.

FIG. 7

equal 100 per cent; No. 2, 700 common defects equal 60 per cent—from which interpolations are made for intermediate grades.

TABLE C.—Relative Value for Cleanness

Reduce each defect to relative size by multiplying as indicated in following: Waste, ×1; very large knots, ×1; large knots, ×½; nibs, × $\frac{1}{5}$; very large slugs, ×1; slugs, ×½; loops, ×$\frac{1}{10}$; bad throws, ×1; corkscrew, ×$\frac{1}{10}$. Add the results together, and determine the percentage from the following relative table:

Class	Total defects	Per cent	Class	Total defects	Per cent
	20	100		377	79
	37	99		394	78
Very good	54	98		411	77
	71	97		428	76
	88	96	Poor	445	75
	105	95		462	74
	122	94		479	73
Good	139	93		496	72
	156	92		513	71
	173	91		530	70
	190	90		547	69
	207	89		564	68
Fair	224	88		581	67
	241	87		598	66
	256	86	Very poor	615	65
	275	85		632	64
	292	84		649	63
	309	83		666	62
Only fair	326	82		683	61
	343	81		700	60
	360	80			

Let us now follow out a test and calculate the classification. The following are the results of actual test made:

Defects found by gage test made on 20 000 yards	Number	Multipled by—	Equivalent on 300 000 yard basis
Raw knots	8	15	(240)
Very fine			
Fine	8	15	120
Coarse	3	15	45
Waste	8	15	120
Very large knots	14	15	210
Large knots	8	15	120
Nibs	19	15	285
Very large slugs	2	15	30
Slugs	15	15	225
Very large loops	3	15	45
Loops	54	15	810
Split ends	1	15	15
Bad throws	10	15	150
Corkscrews	16	15	240
Total			2455

Number of winding breaks on 300 000 yards, 40; tenacity test, 47 grams; cohesion test, 349 strokes.

We will now proceed to fill out the classification blank and reduce the defects to a common basis by rules shown on classification blank, which gives us a true value on the test sample of 66 per cent or No. 1 to No. 1½ grade.

You will notice that on the classification blank (Fig. 7) I specify eight grades. We have found in thread making and weaving that five grades are sufficient to meet the needs of the American market. Mr. Jewett claims that five grades are also about the limit of the production of the filatures.

TABLE D.—Relative Value for Tenacity

[Test 30 samples. Drop the 5 highest and the 5 lowest results and average the 20 intermediate results. Apply the table to obtain the percentage. This result is averaged with the relative value for strength, obtained from Table A, on the classification blank, giving the final strength value.]

Class	Per cent	Deniers																	
		11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
	100	44	48	52	56	60	64	68	72	76	80	84	88	92	96	100	104	108	112
	99	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Very good	98	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
	97	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
	95	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
	93	41	45	49	53	57	61	65	67	71	75	79	82	86	90	94	98	101	105
	92	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Good	91	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
	89	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
	87	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
	86	39	42	45	49	53	57	61	63	67	70	74	77	81	84	88	91	94	98
	85	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Fair	84	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
	83	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
	81	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
	80	35	38	41	44	48	52	56	59	62	65	69	72	75	78	82	86	88	91
	78	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Only fair	77	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
	76	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
	74	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
	73	33	36	39	42	45	48	51	54	57	60	63	66	69	72	75	78	81	84
	71	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Poor	70	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
	69	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
	67	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
	66	29	32	34	37	40	43	46	49	52	55	58	60	63	67	69	71	74	77
	65	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Very poor	64	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
	63	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
	61	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
	60	27	30	32	35	37	40	42	45	47	50	53	55	58	60	62	65	67	70

In discussing the use of gages, the criticism is sometimes made that since the diameter of silk thread of the same denier may vary as much as 100 per cent according to the number of cocoons from which the thread is reeled and the sponginess of the fiber, no gage can be used.

There are, especially in the lower grades, a large number of threads that are from 40 per cent to 100 per cent larger in diameter than the average. I have never considered it necessary to weigh them, as evenness is a matter not of weight but of measurement. Since these coarse threads twist up tighter and show streaked in certain clothes, and since the best silks have very few of them, it is evident that silk can be reeled without them. To be complete the test must detect them. I find that the increase in diameter due to sponginess is about 8 per cent to 10 per cent, and when a spongy silk is tested, the gages used are coarser in that proportion.

These conditions invalidate the elaborate methods of determining evenness by weighing. I have repeatedly run through the gages 13/15-denier skeins which were very even by weight but which had four coarse parts, 5 to 50 yards long, over 24 deniers in diameter (according to Rosenzweig's measurements) and an equal number of fine parts of about the same length, 8 deniers in diameter. Consequently, the fine and coarse threads balanced each other giving an even weight. Mr. Rosenzweig says that to get the short fine and coarse threads 20 yards of thread must be weighed.

It is generally known that the best of silks have threads 20 per cent above and below the size limits and that such threads do not cause any serious consequences in manufacturing. The threads causing trouble are those that are 40 to 60 per cent above or below the limits. The gages are peculiarly suitable in view of this fact. As to the coarse threads this has already been explained. The fine threads are not themselves caught; but, as fine threads under 60 per cent of the average size are caused by carelessness in reeling, they are almost invariably accompanied at the beginning or end, by bad casts, bad throws, or other defects, which are larger in diameter than the average of the thread. These catch in the gages, break down, and the operator records both the defect and fine thread. The tension used also assists in breaking and thereby revealing fine threads.

It serves no useful purpose to know the minute defects in raw silk, but it is important to know the number that are larger than the average diameter of the thread, as it is these that show in the cloth. The defects plainly visible are generally twice as large as the average diameter of the thread. Assuming that a 13–15 denier silk is being tested and that the thread is running 10 deniers, the plainly visible defects are 20 deniers. If the thread is running through at 14-denier gage, they, of course, catch and break down. Now suppose that the thread has changed to 17 deniers and a defect one-fourth larger than the thread appears. This also catches and breaks down. On first thought this appears to show a fault of the gages but with due consideration you will find it a distinct advantage. A defect one-fourth greater than 17 deniers would be a 21¼ deniers, or quite a large defect. A defect proportionately twice as great on the 10-denier thread and not be as large. It will be observed, therefore, that the gages automatically give a practical result as to cleanness of the thread, which is exactly what is wanted.

The distinctive features of the gages are:

First. The size of the defects to be counted is not left to the judgment of the operator; the threads are broken down. This method, therefore, gives excellent uniformity with different operators.

Second. The cover a thread will give in the cloth has been estimated by the feeling; the gages provide a more accurate method.

Third. The evenness and cleanness are both determined by one test, which materially reduces the cost. The silk is run through the gages on a cross reel which makes the unwinding of the silk economical as to cost and waste. This also makes practicable the use of a greater amount of silk.

Fourth. As the sizing skeins have been proven unreliable for judging uniformity, a compound sizing test can be made.

Fifth. It is the extremes of evenness and cleanness that cause poor working qualities and defective cloth, and these the gages reveal. They also reveal other defects enabling a technical inspection of the silk to be made.

The results obtained with the use of mirrors are affected by the individual vision for which there is no standard. Often an average-size thread is compared with a coarse one and called "fine," whereas it should be called "even." There is also confusion in counting the various defects when they are numerous.

I solicit a thorough investigation of my methods, and will be pleased to assist in any way desired.

DISCUSSION

Mr. Chittick.—I fully approve of the viewpoint of Mr. Seem with regard to grading the quality of silks. We have been rather careless in our raw silk classification, and I think it would be highly desirable from a commercial as well as a scientific standpoint if a definite basis were reached for the proper grading of silk. I would suggest that for each lot there could be a paper setting forth the salient characteristics of that lot. Three lots, for example, considering all their attributes might be considered as of the same quality but one might be superior in strength, one might be superior in elasticity, and one might be superior in cleanliness. If such a paper were provided the purchaser would be able to select from them with reference to his needs. In this way a man who was going to make a strong woolen need pay but little attention to the regularity of the silk so long as it was strong; a man who was going to twist it into crepe would desire another quality; and another man would be primarily interested in the cleanliness of the silk.

A PLAN FOR THE VALUATION OF DYES

FREDERICK DANNERTH [23]

The scientists and industrials of our country are passing from a condition of selfishness to one of usefulness. We are in a transition period in which individualism is being displaced by rational communism—the greatest good for the greatest number.

Until recently it has been customary for each chemist or each laboratory, to devise methods of analysis without regard to the requirements of any other group of investigators; but fortunately for the industrial establishments of the United States, this condition is rapidly disappearing. The trend of the day is to compare notes, to coordinate ideas, and to reduce the experience of many chemists to standard methods of analysis. It is fitting, therefore, that a conference such as this should serve as a clearing house for data secured in any particular field of investigation, and with this in mind I present a plan for the valuation of dyes as developed in the Textile Trade Laboratory of Newark. This plan includes a determination of the following points: (1) The strength of the dye; (2) the money value of the dye; (3) the best method for applying the dye to fibers; (4) the fastness of a dye after it has been applied; and (5) proximate analysis of a dye.

In the case of silk we use a 1-gram sample of a light fabric weighing 2 ounces per square yard (boiled off), as this is easier to manipulate than skeins. In the case of wool we use a 10-gram sample of scoured worsted yarn or fabric. In the case of cotton we use a 10-gram skein 2/20's yarn which has been previously boiled off. If the dye is to be used in the factory for bleached yarn, the sample used for the test is bleached.

The standard solutions used for dyeing tests in this laboratory are:

Sulphuric acid: Dilute 10 g of 98 per cent concentrated acid (sp. gr. 1.84) with water to make 1000 cc. (One cubic centimeter of this solution is very nearly equivalent to 0.01 g sulphuric acid.)

Acetic acid: Dilute 10 g of 29 per cent commercial acetic acid (sp. gr. 1.040) with water to make 1000 cc.

Sodium sulphate or Glauber salt: Dissolve 100 g of the crystals in water to make 1000 cc.

Sodium chloride or table salt: Of the commercial salt take 100 g and dissolve in water to make 1000 cc.

Sodium carbonate or soda ash: Dissolve 100 g of commercial soda ash in water to make 1000 cc.

Soap solution: Dissolve 10 g of a certain oleate soap or a commercial olive oil soda soap, having approximately 30 per cent water content, in water to make 1000 cc.

Dye solution: Dissolve 1 g of the dye in the least necessary quantity of boiling water, and dilute with cold water to make 1000 cc. If the textile sample used for the test weighs 1 g as in the case of silk, and it is desired to use 1 per cent of the dye (based on the weight of the sample) it is necessary to use 10 cc of the standard dye solution; or, if the textile sample weighs 10 g, as in the case of wool, it is necessary to use 100 cc of the dye solution.

1. THE STRENGTH OF THE DYE.—To determine the strength of a dye we measure out a volume of the dye solution equal to 2 per cent of the weight of the textile sample. One gram of silk fabric would then require 0.02 g of dye (20 cc). The swatch is dyed according to the usual process for the particular dye, and the finished colored fabric is dried and examined with the unaided eye in a good north light. This test is sometimes of value for comparing black dyes to determine which is the fullest shade. In that case the dye should be applied in several strengths—1, 2, 10, 20 per cent.

2. THE MONEY VALUE OF THE DYE.—The method commonly used for control tests in European dye factories is the one used in our laboratory. It is based on a standard dye having an arbitrary value of $1 per pound. To examine a dye

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which has been offered at $1 per pound, we dissolve 1 g of the dye in 1000 cc of water. For the dyeing test we use a textile sample weighing 10 g and add to the dye bath 200 cc of the standard dye solution. This is equivalent to 0.2 g of dye or a 2 per cent shade. If another dye is offered to the purchasing agent in a textile mill, and the price charged is $0.75 per pound, we use $\frac{100 \times 200 \text{ cc}}{75} = 266$ cc of the solution. Or if a certain dye is offered at $1.25 per pound, we would use $\frac{100 \times 200 \text{ cc}}{125} = 160$ cc of the solution.

3. The Best Method for Applying the Dye to Fibers.—When the character of a dye is unknown, it is necessary to determine the method best adapted for applying the dye to vegetable or animal fibers. For this purpose at least eight different baths are prepared with 1000 cc of distilled water and the additions indicated. One series of tests is carried out with cotton yarn and another series with woolen yarn. In the preliminary tests, small 10 g skeins of scoured yarn are used, and 0.20 g of dye is added to each bath.

Bath No. 1. Contains no additions whatever other than the dye. The skein is boiled in the bath for one hour.

Bath No. 2. Add 10 g (that is, 100 per cent) sodium chloride. Note the absorption of the dye at various temperatures.

Bath No. 3.—Add 4 per cent potassium carbonate and 0.75 per cent olive oil soap. Note the absoption of dye at various temperatures.

Bath No. 4. Add 100 per cent sodium chloride and 5 per cent acetic acid. Note the absorption of dye at various temperatures.

Bath No. 5. Add 5 per cent acetic acid. Note the absorption of dye at various temperatures.

Bath No. 6. Mordant the skein in a bath containing 3 per cent potassium bichromate and 1 per cent sulphuric acid, at the boil for one hour. Then enter in a dye bath to which 5 per cent acetic acid has been added.

Bath No. 7. Mordant the skein in a bath containing 3 per cent potassium bichromate and 3 per cent cream of tartar, at the boil for one hour. Then enter in a dye bath to which 5 per cent acetic acid had been added.

Bath No. 8. Add 10 per cent sodium sulphate and 4 per cent sulphuric acid. Note the absorption of dye at various temperatures.

4. The Fastness of a Dye.—The fastness tests carried out at this laboratory are classed as follows:

1. Those encountered in the processes of textile manufacture. These include: (*a*) The alkaline influences met in the processes of scouring, fulling, boiling-off, and mercerizing; (*b*) the acid influences met in the processes of carbonizing, stoving, and cross dyeing; (*c*) the heat influences met in the processes of drying, singeing, ironing, calendering, and potting; and (*d*) the oxidizing influence of the chlorine bleach bath, and peroxides.

2. Those encountered when the yarn or fabric is in actual use: (*a*) Alkaline influences—street dust and laundering; (*b*) acid influences—perspiration, fuel gases, and fruit stains; (*c*) heat influences—the high temperatures experienced in household ironing, and in exposure to tropical sunshine; and (*d*) weather, which includes air, light, and rain.

Here are 24 influences which may affect the shade or the brilliancy of a colored fabric, but they are not of equal importance for all fabrics.

Some of the methods and solutions used by us are as follows:

1. Soap solution: Dissolve 10 g of sodium oleate soap in 1 liter of water. Agitate the sample in this solution for 30 minutes. Make separate tests at 60° C and at 100° C.

2. Alkaline solution (weak). Dissolve 2 g of dry sodium carbonate in 1 liter of water. Agitate the sample in this solution for 30 minutes at 100° C.

3. Alkaline solution (strong). Dissolve 20 g of dry sodium carbonate in 1 liter of water. Immerse the sample for 5 hours and hold at 60° C.

4. Acid solution (weak). Dilute 100 cc of hydrochloric acid (sp. gr. 1.18) with water to make 1 liter. Spot the sample with this dilute solution, and allow it to act for 10 minutes before noting the change in color.

5. Acid solution (strong). To 100 cc hydrochloric acid (sp. gr. 1.18) add 200 cc of water. Spot the sample with this solution and allow it to act for 2 hours before noting the change in color.

6. Chlorine solution. Immerse the sample in a solution of chloride of lime and leave at room temperature for 1 hour. Make one test with a solution having a strength of 1° Bé and a second test with a solution having a strength of 0.1° Bé.

7. Street-dust test. A paste is prepared by gradually rubbing down 20 g of ordinary lime with 150 cc of water. The sample is spotted with this mixture and allowed to dry. The powder is then brushed off and the change in color noted.

8. Light test. Whenever possible, a sample at least 2 inches square is used. One-half inch of the sample is exposed, the remainder being covered with black cardboard. The whole is placed under glass in a rain-tight frame and exposed on a roof for 50 hours of actual direct sunlight. The months usually best adapted for this test are July and August. A record should be kept of the approximate latitude at which the test was carried out. A daily record of the sunlight is kept in order to determine the number of hours of actual sunlight in a given period. We find this exposure test to give results similar to an actual open-air light test, even though the glass may act as a filter for certain light rays.

9. Perspiration test. We find that the character of perspiration varies with the race, condition of health, and age of the individual and with the season of the year. For general information we use a solution containing in 1 liter 50 g of 50 per cent acetic acid and 100 g of sodium chloride. The sample is alternately immersed and dried, and the change in color is noted after 10 immersions.

PROXIMATE ANALYSIS OF A DYE.—This examination includes a determination of foreign matter in commercial products. The substances most frequently encountered are (1) Glauber salt and table salt, usually added to a dye in order to standardize it, and (2) dextrine and glucose, usually added to dyes in order to assist their solubility.

"Standardization" as applied to dyes means thinning by the addition of some water soluble substance so that a pound of the dye purchased in one month will have the same coloring power as a dye purchased a year later. During periods when there is a dye scarcity an unscrupulous broker will naturally seek to sell as many pounds of dye as possible. He sincerely hopes that the purchaser—that is, the textile manufacturer—will not stop to discriminate between good and bad products. In this case the addition of salt or dextrine in quantity is an unqualified fraud, and this condition has been helped considerably by the apathetic attitude of dye consumers during the past three years.

"Homogeneity" refers to the chemical uniformity of a dye. If a commercial dyestuff consists of a mixture of two or more dyes this is ascertained by (1) blowing the powder onto a sheet of filter paper which has been previously moistened; (2) scattering the powder on sulphuric acid; (3) fractional dyeing; (4) capillary absorption; or (5) spectroscopic examination. All of these methods are too well known to require special description at this point.

Consumers are aware of the fact that most commercial products contain more or less "substances not dyes." In order therefore to obtain definite information on this point and to eliminate such dyes as are grossly adulterated, it is recommended that bidders on dyestuff deliveries be required to present a statement in connection with each bid on each dye, covering the following points (it will be noted that this is not a "specification" but merely a form of "request for information"):

1. Does the dyestuff contain more than one dye? If so, indicate the constituent dyes by their standard name (see Schultz Farbentabellen).

2. If any dyestuff offered consists of two or more dyes, quote separately on each constituent dye.

3. How much, if any, organic matter not dye is contained in the dyestuff offered under this bid?

4. How much, if any, inorganic matter not dye is contained in the dyestuff offered under this bid?

5. Quotations on dyes should be accompanied by dyed samples showing the application of the color on cotton, wool, or silk in definite percentages. (This will enable the purchaser to calculate the approximate cost for producing a shade of a given strength).

PLEA FOR A STANDARD NOMENCLATURE FOR ORGANIC DYES

Frederick Dannerth

In the fifth edition of Farbstoff Tabellen by Dr. Gustav Schultz, we find that 7300 distinct names or marks are used in commerce to designate approximately 1000 distinct organic dyes. Applying the rule of averages, one might say that each dye appears in commerce under seven different names.

The systems used by various manufacturers to distinguish their dyes from those of competitors have resulted in certain adjectives becoming characteristic for certain firms. As examples of this, we have the adjective pronouns diamine, oxamine, diphenyl, dianil, benzo, naphthamine, triazol, pheno, each of which is used almost exclusively by one firm.

What would an inorganic chemist say if I were to suggest that zinc oxide be sold under such names as "Barnegat white," "Euclid white," "Dearborn white," "Cheyenne white," "Absecon white," "Zinc white," and "Water white"? Most users of this important pigment would, I believe, object strongly to such a procedure. Then again, let us imagine zinc oxide being sold under the names of other well-known pigments, such as talcum, lithopone, barytes, whiting, gypsum, white lead, and so forth. Both of these conditions now exist in the organic dyes industry.

There are very few cases in which one dye of known chemical constitution is sold by all firms under one and the same name. Dye makers will claim that the chemical constitution of a large number of dyes is unknown or known to only one maker. In such cases a name might be adopted. When a manufacturer undertakes the production of a dye which is already on the market, he should, in my opinion, be obliged to adopt the existing designation for the dye. The fact is that competing dye manufacturers are so skilled in dye analysis that new dyes are examined and classified soon after they appear on the market. This part of analytical chemistry is most necessary to prevent infringements upon patents.

Dye manufacturers may claim that endless confusion would result if the names of their dyes were changed, and they may also claim that the present names are really "brand" designations. Such confusion would, at worst, be only temporary, and the name of the firm would be sufficient "branding" for all commercial purposes. In fact, the same name is now used in many cases by several firms.

It is one of the basic duties of technologists and scientists to secure for all materials a uniform nomenclature. We should apply this principle to our several industries. If you will stop to consider that some consumers are purchasing annually between $50 000 and $100 000 worth of dyes, you will realize the importance of standardization of nomenclature.

Dye makers may say that dyes are put out in various "strengths" in order to meet the demands of the consumers for low-priced dyes. This is well known by textile chemists. A cost comparison test carried out with a certain dye made by 10 different manufacturers will show that the price of the dye is very nearly proportional to its strength.

Dye makers may say that some commercial dyestuffs are mixtures of two or three dyes, adjusted to meet a special need. This condition is similar to the case of "blended whisky" in the food and drug act.

Textile chemists desire a uniform nomenclature for straight dyes of known composition. It likewise seems desirable to limit the adjectives "anthracinon," "alizarin," and "anthracene" to derivatives of anthracene. Another term used in the designation of dyes, and used very loosely, is the word "fast." In recent years this has been added to many dyes as a selling feature with the result that the word has almost lost its real significance. The words "acid," "direct," "diazo," "sulphur," "alizarin" are used as adjectives at the present time to designate certain dyes and at the same time indicate the manner in which they are applied to the fibers. This plan might be extended by the use of the terms "basic," and "vat," to designate dyes of the type of "methylene blue" and "indanthrene blue," respectively. In any case one term—for example, "acid red"—should be used to designate one and only one dye, because the brand of the dye can be adequately indicated by the firm name which accompanies it.

Proposals for standardizing nomenclature are, in most cases, effective only when they originate in technical societies under conditions which admit of an unbiased discussion of the subject by both producer and consumer. With this in view, I would move that the chairman appoint, within the next month, a committee of three or more textile chemists to consider the subject of this paper and make such recommendations to the next general meeting of this conference as it may consider fit.

To illustrate the confusion which now exists in the commercial nomenclature of organic dyes, I present herewith examples of the cases referred to.

Dyes which appear in commerce under the same name but which are quite different in chemical constitution are as follows (the numbers in parentheses refer to the dye numbers in "Schultz"):

Example 1.—Acid violet 4RS, Hoechst (526); Acid violet 4BN, Badische (527); Acid violet 6B, Bayer (529); Acid violet 6B, ter Meer (530); Acid violet 7BN, Hoechst (533); Acid violet 7B, Badische (534); Acid violet 6BN, Badische (548); Acid violet 6BNS, Sandoz (561).

Example 2.—Alizarin yellow 3G, Bayer (48); Alizarin yellow R, Hoechst (58); Alizarin yellow G, Sandoz (177); Alizarin yellow FS, Durand (482); Alizarin yellow A, Badische (770).

Example 3.—Crocein scarlet B, Bayer (249); Crocein scarlet 8B, Kalle (255); Crocein scarlet 3BX, Bayer (167); Crocein scarlet 4BX, Kalle (169); Crocein scarlet oext., Kalle (251).

Example 4.—Fast red D, Badische (168); Fast red S, Hoechst (166); Fast red VR, Bayer (164); Fast red O, Hoechst (161); Fast red B, Badische (112).

Dyes which appear in commerce under different names but which are identical or similar in chemical constitution are as follows:

Example 1.—The dye formed by the action of caustic soda on paranitrotolueneorthosulphonic acid. By varying the concentration of the solutions, the temperature, and the duration of the reaction, the exact composition of the product may be influenced. The essential and main product is in all cases, however, the sodium salt of azoxyazodistilbenetetra-sulphonic acid. The product of this reaction is a yellow, direct dye (consult Schultz, dye No. 9) which appears in commerce under the following names: Direct yellow R, Bayer; curcumin S, Berlin; naphthamine yellow G, Kalle; diamine fast yellow A, Cassella; sun yellow, Geigy; afghan yellow, Holliday; azidine fast yellow G, Jaeger; renol yellow R, ter Meer.

Example 2.—The dye formed by the action of paraphenylhydrazin-sulphonic acid on dioxytartaric acid. This is a yellow, acid dye (consult Schultz, dye No. 23) for wool and silk. It appears in commerce as tartrazin, Bayer; hydrazin yellow O, Greisheim; wool fast yellow, Basel; acid yellow AT, Casella; buffalo yellow, Schoellkopf; fast wool yellow G, Kalle; tartrabarin, ter Meer.

Example 3.—The dye formed by the action of concentrated nitric acid on the nitrosamine of the dye Orange IV. This is a yellow, acid dye (consult Schultz, dye No. 141) which appears in commerce as azo yellow 3G, Hoechst; azo acid yellow, Berlin; azoflavin S, new, Badische; Indian yellow G, Bayer.

Dyes having uniform names and chemical compositions as sold by different dye manufacturers are as follows:

Example 1.—The dye formed by the action of diazotized anilin on metaphenylene diamine. This is a yellow, basic dye (consult Schultz, dye No. 33), known in commerce as chrysoidin and sold as such by Badische, Holliday, Bayer, Berlin, Hoechst, Cassella, ter Meer, Griesheim, Basel, Geigy, and Kalle.

Example 2.—The dye formed by combining diazotized tolidin with 1:4 naphthylamine-sulphonic acid. This is one of the oldest of the direct red dyes, so important because they dye cotton without previous mordanting. This red direct dye (consult Schultz, dye No. 363) is known in commerce as benzopurpurin 4B, and sold as such by Bayer, Berlin, Levinstein, Griesheim, ter Meer, and Sandoz.

Example 3.—The dye formed by the oxidation of dimethylanilin with copper chloride. This is a violet, basic dye (consult Schultz, dye No. 515) known in commerce as methyl violet and sold as such by Berlin, Badische, Bayer, Cassella, Hoechst, Holliday, Griesheim, Kalle, and ter Meer.

This shows that it is perfectly possible to arrange for the coal-tar dyes a nomenclature which is at once rational and practical.

DISCUSSION

Mr. Stratton. Yesterday a standard nomenclature for fabrics was suggested, an exceedingly important thing. Here is another thing equally important. As has already been pointed out, reform can only be accomplished by bringing together all the parties interested. At the Bureau we are studying questions relating to colors. We have a special appropriation for an investigation of the methods of measuring color. There is no use specifying a color unless you can measure it. It is possible that dyes can be defined through specific chemical characteristics one of which may be color. It is important that some sort of permanent organization be perfected and small committees be appointed, consisting of five or six people, who are interested in nomenclature and who will study the problem and submit a report at the next meeting.

Mr. Pierce. I have had some close experience with this question, having been in the dyestuff business for over 18 years and connected with the people who successfully made aniline dyes in America in the face of the most severe German competition.

There was seldom any difficulty of the factory turning out a product equal in quality to that made in Germany, but it was never offered under the German name. The state of affairs is exactly the same as we now see in the drug market. We read "There is no aspirin except Bayer's aspirin," but they do not tell us that there are tons and tons of acetylsalicylic acid that can not be sold as "aspirin" on account of the name being copyrighted.

Occasionally a popular dye on which all patents and copyright have expired will become known by one of its original names—like tartrazin, for example. Formerly the standards for our own use were made in Germany, but now that there is a great American combination to make dyestuffs and intermediates, I think they would be glad to have American standards and would be pleased to have overtures from the textile industry looking toward the establishment of American standards.

Mr. CHITTICK. May not that be worked out along the lines of the color card of the French dyers? They send out cards to representatives of the different branches of the industry. The work was undertaken some time ago and resulted in a cooperative effort on the part of producers and distributors.

THE TESTING AND EXAMINATION OF ARMY CLOTH

K. B. LAMB [24]

When asked to present a paper at this conference, I had several subjects in mind, among them a description of the work we are doing at Wanamaker's in New York and Philadelphia to improve and test merchandise and to work out new problems. But I chose the subject you find on the program, as being of more timely interest.

Our Army must be built upon the most solid foundation. We must not do things in a slipshod or hurried way, and we must benefit by the initial mistakes of the allied Governments. One of their mistakes was the use of poor equipment. There is, and will be for some time, a shortage of supplies in this country and in remedying this shortage we must see that the best and most serviceable equipment possible is obtained. Of this equipment the most important factor, except food, is clothing. There is probably no service which is as hard upon a textile fabric as that of the soldier in the field. He lives, eats, and even sleeps in his uniform and unless it gives him proper service his efficiency becomes impaired.

During the first two years of the war I was the chemical engineer of the United States Conditioning & Testing Co. in New York. There we made the official tests for many of the foreign Army buying commissions who were then buying cloth in this country and, of course, for the American manufacturers submitting samples to these commissions.

In general, I believe in the honesty of the American manufacturer, but I will say that, to my mind, it was almost criminal to submit the type of cloth which in many cases passed through my hands for tests.

The allied Governments found it necessary thoroughly to test their samples and shipments, and we will also find it necessary. The object of testing is not only to detect dishonesty, but also to secure the right fabric for the purpose, and to indicate to manufacturers what they must work for. I believe that our mills can turn out as good, if not better, fabrics than those of any other country.

Before I describe the tests made, just a word in regard to the general requirements of Army cloth.

First, it must be strong to enable it to resist wear and tear and therefore must be made of good stock and have a large number of threads per inch.

Second, it must be warm and should therefore be partly felted.

Third, it should combine the above without being too heavy.

Fourth, it should be dyed with fast dyes.

I am not going to describe new, untried methods of testing nor to make this address very theoretical in nature, because I do not think this is a time for experimentation or theory. Now is the time, if ever, to apply what we already know in a practical and workable way. The tests which I am about to describe briefly have all been made and proved efficient. They are the official methods which we used for the foreign army commissions and upon which many of the large contracts were placed.

For convenience I have divided the tests under the heads (1) physical and (2) chemical.

1. PHYSICAL TESTS.—(*a*) *Strength*.—The first test of importance is the test for strength. This can be made by either of two methods: First, by the strip method; and second, by the American mill method (or as it is sometimes called, the "Navy test") of testing in the piece.

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[24] Textile expert with John Wanamaker, New York City.

The strip method, which is the one almost universally used by the European armies, is a tensile strength test performed upon a strip of cloth of given width and length.

The British standard strip is one 3 inches wide and 7 inches long (between the jaws of the machine). This is also usually used by the Russian Army when buying in England or the United States.

The French standard strip is one 5 centimeters wide and 15 centimeters long (between jaws). I believe they sometimes specify a strip 15 centimeters wide and 50 centimeters long. The Italian and Serbian Governments also use the 15-centimeter by 5-centimeter strip.

In preparing the test pieces, at least five samples each in the warp and filling directions of the goods are cut from different parts of the piece. Especially in the warp direction must the pieces be selected from several places distributed across the width of the goods. These samples are cut to within about three-eighths of an inch of the desired width and then raveled down on each side. This is done to insure continuous, unbroken threads throughout the length of the piece. If cut directly to size, some of the outside threads are bound to be severed, and in a cloth containing a low number of threads to the inch the strength will necessarily fall considerably below the true value. The strips are left about 1½ inches longer than the specified length, to provide clamping space in the jaws of the testing machine.

When prepared, the samples are placed in a conditioning room in an atmosphere of 65 per cent relative humidity and 70° F. In such an atmosphere the wool will theoretically contain its normal "regain," or moisture content.

The humidity of the air is a point too often overlooked by manufacturers in making tests and one which has a very great effect upon the strength of cloth. Tests which we made and which have been made by the Bureau of Standards all show that a variation of as much as 20 per cent in strength is sometimes found with a variation of about 50 per cent in the relative humidity of the atmosphere in which the tests are made. This extent of variation in humidity is a condition often met with in this climate. Thus we see how unfair a test may be if made under very damp conditions when the strength is lowest and then compared with another test which may have been made under very dry conditions when the strength was highest. By making all tests at a uniform humidity, they are all comparable.

There are various types of tensile strength testing machines now in use, and it will not be necessary to describe them in detail. However, they all work on one fundamental principle; they have two parallel jaws which are set at the required distance apart and which separate at a definite, uniform rate of speed until the sample, which has been clamped between them, breaks. The breaking point and elongation are both registered. The machines should be power driven, as this gives a uniform pull upon the sample. In our tests the jaws separated at the rate of 10 inches per minute.

Special care must be used in clamping the test strip. The jaws should hold it firmly without allowing it to slip, but without any danger of cutting it. The sample should be inserted so that the pull is directly perpendicular.

Good breaks, as a rule, run directly across the strip, although with loosely woven cloths this will not always occur. With very tight and firm cloths the break is often a sudden snap, showing that all the threads failed simultaneously. This shows that a uniform tension has been applied and that uniform threads make up the fabric. There is always a certain amount of variation found due to inequalities in the yarns or the number of threads per inch, twist, etc., but this variation should be low in a well-made cloth.

In the method of testing in the piece, jaws 1 inch wide are used. The jaws are clamped 1 inch apart in the goods. The machine used is similar to the strip-testing machine, being power driven by electric motor with the jaws separating at the rate of 10 inches per minute, and the test is carried out under similar conditions.

I do not consider this test fair or scientific. In the strip test the pull comes directly upon the warp threads—considering a test in the warp direction—without any filling threads on the side of the test piece affecting the result in any way. In the test in the piece, on the other hand, the filling threads at the side of the inch of cloth being tested have more or less effect upon the result on account of the more or less firmness given by them. This being a fact, it is evident that the kind of weave, texture, and finish of the cloth will introduce a variable factor in the test, so that results obtained will not show the strength of the 1 inch of warp or filling threads and are not even comparable unless cloths of identical weaves and finish are considered. The only advantage this test has over the strip test is that a test can be made directly without previous preparation of samples.

(*b*) *Stock.*—The next examination of importance is that of the stock used in the goods. The warp and filling threads should be examined separately, several threads being taken from different parts of the sample.

The approximate average length of fiber is found by untwisting parts of the different threads, measuring as many fibers as is practicable, and averaging the results.

Next, a microscopical examination is made which shows the appearance of the fibers and their diameters, thus helping to determine the grade of wool used. The microscope will also detect the presence of shoddy; at least, this is true in most cases, although occasionally a very high grade of shoddy, when intermixed with new wool, will escape notice. The ends of the wool fibers in the case of shoddy are torn and frayed out, and the scales are usually partly removed, these characteristics being due to the rough mechanical and chemical treatment necessary for reclamation.

(*c*) *Weight.*—Before determining the weight, the sample is placed in the conditioning room in an atmosphere of 65 per cent relative humidity and at 70° F. Under these conditions, as has been stated, wool theoretically contains its normal "regain" or average percentage of moisture.

The French unit of weight is the square meter. The British unit is the square yard, although many specifications are based upon a size of 52½ inches wide between selvages and 28 inches long. The Russian Government also used the latter size when buying in this country.

(*d*) *Threads per Inch.*—Another determination of importance is that of the number of threads per inch in warp and filling. This is accomplished by taking a length of at least 2 inches, pulling out several warp threads, and counting the ends of the filling threads. In a like manner the filling threads are pulled out and the warp threads counted. If 4 inches are taken as a basis, the result found is, of course, divided by 4 to give the threads per inch.

Samples should be selected from different parts of the piece and check counts made. When the sample has been felted, considerable care must be exercised in separating the threads not to injure or divide the thread ends to be counted.

(*e*) *Shrinkage.*—Another most important test is that of the amount of shrinkage. The following method is what we finally developed and used for the tests for the Russian purchasing commission: The sample is first placed in the conditioning room so that it will contain its proper amount of moisture. This is necessary, as the amount of moisture present affects the actual physical size of the sample. It is then cut to its proper size as specified and immersed in water of room temperature (70° F) for four hours. At the end of that time it is removed and dried in a drying oven. Then it is placed again in the conditioning room and brought up to the proper condition, for which an hour and a half is allowed, and finally, again measured.

It sometimes happens that the warp threads have a high twist in comparison with the filling threads. In such a case there will often be a slight elongation in the filling direction due to a squeezing up of the fabric by the warp threads, which, of course, shrink much more than the filling threads on account of their higher twist. Consequently, the fabric spreads in the filling direction with a large shrinkage in the warp direction.

Care must be taken to see that the sample is thoroughly wet through when first immersed in the water and that no air bubbles are held by it. The shrinkage is reported as percentage shrinkage in the warp direction, in the filling direction, and in area.

2. CHEMICAL TESTS.—(*A*) *For Fastness of Dyestuff.*—The principal tests of a chemical nature are those which are made to determine the fastness of the dyestuff used in dyeing the sample. Considerable emphasis should be placed upon this test, for uniforms are subjected to more rigorous conditions of wear than any other type of clothing.

The tests usually made are as follows:

(*a*) Fastness to Light: This test is made only when the necessary time is available. A strip of the fabric is put in a frame in which half of the strip is exposed to the light and half covered, the whole being under glass and in a window with southern exposure. At the end of one, two, three, and four weeks the samples are examined and the differences in color between the exposed and the covered portions noted. Those which show appreciable fading at the end of one week are rated as not fast and those which show no fading at the end of four weeks as very fast.

This test may also be made with mercury-vapor lamps. This, in a few hours, gives a result similar to that obtained by the regular sunlight test.

(*b*) Fastness to Washing: This is carried out by plaiting a strip of the sample with a white cotton and a white wool strip of like size. The three are then heated for 15 minutes at 40° C in a bath containing 1 per cent of pure neutral olive oil soap and 0.05 per cent of sodium carbonate. Another similar plait is heated in a bath of 1 per cent of the olive oil soap at 65° C for one hour.

After washing, the samples are thoroughly rinsed in warm water and dried. The fastness is then rated (*a*) according to the change in color in the sample, (*b*) according to the color of the soap solution used for the test, and (*c*) according to whether or not the color has bled into the white wool and cotton strips.

This test is also an important one for army cloths.

(*c*) Fastness to Acid: The fastness to acids is determined as follows:

First, the sample is spotted with concentrated hydrochloric acid and the change in color noted.

Then another sample is plaited with equal parts of white wool and cotton as before, and treated with a 0.25 per cent solution of bisulphate of soda for 1½ hours at 90° C. The sample is then washed and dried and the color compared with the original sample.

Finally, a third sample is heated in a 3 per cent solution of sulphuric acid at 80° C for one-half hour. The sample is then washed and dried and the color compared with the original color.

(*d*) Fastness to Alkali: The sample is plaited with equal parts of white wool and cotton as before and heated in a 1½ per cent solution of sodium carbonate at 40° C for one hour. It is then washed carefully, dried, and the color compared with the original color, and the white wool and cotton examined for stains. A second sample is heated at 90° C in a 0.05 per cent solution of sodium hydroxide for one-half hour and the change in color noted.

(*e*) Fastness to Perspiration: This is determined by spotting the sample with a 10 per cent solution of sodium chloride. It is then dried at ordinary temperature, well brushed, and the change in color noted.

(*f*) Fastness to Sea Water: This is an especially important test for all cloths to be used in the Navy. It is determined by plaiting a sample with equal quantities of white wool and cotton as before, and allowing it to stand for 24 hours in a cold solution of 30 g of sodium chloride (salt) and 6 g of calcium chloride per liter. It is then dried without washing and the color examined.

(*B*) *Finishing Materials.*—It is often advisable to determine the percentage of finishing materials in woolen goods, though as a rule this is not necessary. If the determination is desired, it is carried out as follows:

The sample is first dried thoroughly at 105° C and weighed. It is then treated by heating first in a 1 per cent solution of pure neutral olive oil soap at 80° C for one hour and then in a 1 per cent solution of hydrochloric acid for one-half hour, taking care to thoroughly wash all soap out of the sample before placing it in the acid bath. It is then washed, dried, and weighed and the percentage loss calculated.

In closing, I would like to say just a word about the subject of cooperation. We have had conferences of the raw-material people, of manufacturers, of jobbers, of retailers. I would like to have held a single conference involving raw-material people, manufacturers, jobbers, and retailers. Then we might accomplish something. It is only through the cooperation of every business concerned in the manufacture of our supplies that we are going to supply the great army we must raise in order to bring this war to an end.

DISCUSSION

Mr. Stratton. It is unfair to the contractor to introduce changes after a contract is let, but the Government often makes this mistake. Changes in the specifications or standards of test should be made by agreement between the purchaser, the manufacturer, and the tester. Too often the tester is one of the parties interested. That is one advantage of having the work done at the Bureau. It is probable that all inspection for war purposes will be done under the supervision of the Bureau. Frequently people are afraid to come in contact with modern methods and modern devices because they are afraid that the weakness of their methods will be exposed. After the establishment of a standard of quality has been agreed upon, the methods of maintaining this standard are the next consideration.

Mr. Shinn. The "regain" allowance for army cloth has been recently discussed at a conference held in New York and 11 per cent has been practically decided on as a suitable amount, There is no recognized standard in this country for regain for cloth. In making experimental tests I have not yet been able to make the moisture content of any form of textile material come up to the European standards. A standard condition of 65 per cent relative humidity and 70° F temperature would be all right if everybody would accept it. If the specifications are based on a percentage of regain, then I think there will be more trouble. The percentage of regain varies according to the way in which the cloth has been manufactured and handled.

Mr. Chittick. In connection with Mr. Lamb's remarks I want to call attention to the necessity of removing the oil before a test is made. For example, a lot of hosiery might be purchased which gave visible evidence of the presence of oil. In order to determine the amount of oil, it would be necessary to scour out the grease and then boil off the oil. There is a natural marrow inherent in the wool fiber, and if the scouring out of the oil was done with too great severity, the wool might be robbed of this natural marrow and its weight correspondingly reduced.

Another thing Mr. Lamb referred to was the grip of the jaws not being sufficiently tight to cut the fabric. I have made many tests, and I have found out that when the jaws of any thread-testing machine or cloth-testing machine are extremely tight, there is a tendency for the breakage to occur at the jaws on account of shearing action. Therefore, it is a question whether a test giving a break at the jaw can properly be thrown out and not included in the averages. It is also a question whether a slow breaking test should be regularly applied, since it does not correspond to the strain to which the cloth is often subjected. It seems that a quickly applied test should be added to the other. Further, I would like to ask Mr. Lamb if the British Government requires the test of a strip of cloth 3 inches wide or if the sample is raveled down so that there will not be any cut threads.

Mr. Lamb. A 3-inch width is actually broken. Usually they ravel down a quarter of an inch on each side. In regard to a jaw break we eliminate the test unless the piece is broken in the middle.

Mr. Bivins. The discussions we have had here have been largely about results of tests on textiles and raw materials, but I think if we were to analyze them, we would find that they can be grouped under three heads—classification, standardization, and uniformity of nomenclature. I am not a textile man, nor a chemist, nor a technical man, simply an ordinary business man, but all these subjects come up in our work. Dr. Dannerth spoke about the numerous scarlet dye varieties purchasable under the same name. We once lost thousands of dollars simply because the dyestuffs we had been accustomed to getting were not obtainable. Our customers lost confidence in us and we lost confidence in the dealers.

Dr. Stratton and others have mentioned the desirability of getting together to organize a permanent society through which all such matters would be considered. In speaking for the carpet-fabric industry, I want to say it would be welcome. If any effort is made this afternoon toward that organization, I would be glad to cooperate.

Mr. Chittick. I would like to ask Mr. Lamb if the dyes in foreign orders will give good results when tested according to the methods mentioned.

Mr. Lamb. At first they were strict in regard to dyes, but they soon found out that tests of the material submitted would not fulfill the requirements. They were especially careful about the washing test. Now they are much more lenient.

Miss O'Brien. I would like to ask if there is any machine for testing the wearing qualities of material.

Mr. Chittick. I saw one referred to in the Textile World Journal. I think it was not found possible to get satisfactory results. The tests were continued until the cloth was worn so that the light could be seen pretty clearly through it. It is possible there may be apparatus available which is not yet used in this country.

Mr. Pierce. After considering the various sources of ultra-violet rays, including flaming arcs, we finally installed the one which we are using at present for fading tests. The light is a mercury-vapor arc on the plan of the Cooper-Hewitt lamp familiar to all, but instead of a long glass tube, there is a fused quartz tube of 8 inches length. The tube is covered by a metal hood, and in working with this light the eyes must be carefully protected by amber glasses. The action seems to be approximately eight times that of direct sunlight. Often light tests outdoors are made by exposing samples under glass, but this should not be done, for ultraviolet rays are stopped by glass. Mr. Hartshorne once remarked to me that at the Arlington Mills they had noted that entirely different changes of color were observed when the fading of a weather test was compared with that of an artificial light. The explanation of this is evidently that under the ultra-violet light the heat is sufficient to dry out the sample, and the fading is due entirely to molecular disintegration.

In the presence of moisture there is formed both hydrogen peroxide and ozone. Consequently, a weathering test, being alternately dampened and dried, is subject to a bleaching effect in addition to the fading due to ultra-violet rays.

Moisture effects can be obtained under the ultra-violet lamp by occasionally wetting the sample, but as this is a purely arbitrary procedure, it is safer to make the tests always under dry conditions.

The value of the lamp is, at present, confined to the making of comparative tests. If the quartermaster's department wants olive-drab cloth as per a certain standard, the manufacturer naturally wants to know whether his goods are going to come up to specifications. Every test can be made quickly except the 30-day exposure test, but by putting the two samples under this light for, say, 30 hours, the desired information is obtained.

As soon as weather conditions are suitable, I intend to make an approximate standardization of the light as compared with sunlight. I have had made a quartz tube similar to a test tube. In this will be exposed such solutions as ammonium succinate with a quantity of uranium salts or a solution of ferrous oxalate.

These solutions yield gas on exposure to sunlight, and the measurement of the quantity liberated in a definite number of hours can be compared with the result obtained under the lamp.

Mr. Haven. I would like to ask whether Mr. Lamb noted a great many unbroken threads on the side of the sample.

Mr. Lamb. Yes, there are always some unbroken threads.

Mr. Haven. Were they counted?

Mr. Lamb. No, they were not. It does not make any difference how many threads are broken so long as the fabric breaks.

Mr. Haven. I would like to ask Mr. Lamb what means he employs to maintain a uniform condition of humidity and temperature. How long were the samples allowed to remain in the room before they were considered to be in moisture equilibrium with the atmosphere?

Mr. Lamb. The samples were exposed for two hours. To maintain a standard humidity we use fan which blows air into the room in dry weather. When the humidity is too high, the air is blown over ice.

Mr. Haven. Was it regulated by hand?

Mr. Lamb. It was motor driven, but regulated by hand. Any of the regular humidifying apparatus is adequate.

SEWING MACHINES AND MACHINE-MADE STITCHES

S. George Tate[25]

Evolution of trade during the last century has been synonymous with speed, for as commercialism increased by leaps and bounds, so did speed. The ever-increasing demand for greater production, but with less cost, was principally met through the agency of labor-saving devices and machines, and the sewing machine has certainly earned the right to be placed in this category.

In 1800 all sewing was accomplished by hand at the maximum rate of 30 stitches per minute, whereas to-day nearly all sewing is done on machines, the foot-operated and power-operated machines forming as many as 800 and 4000 stitches per minute, respectively.

For seaming fabrics by a straightaway line of through-and-through stitches, only three machine-made stitches have met with extensive practical application. These are known as (1) the single-chain stitch, (2) the shuttle stitch, and (3) the double-locked stitch.

The earliest attempt to produce stitches by a machine was apparently made by an Englishman, Thomas Saint, who in 1790 obtained a British patent which shows and describes a machine for making a line of chain stitches from a single thread. This machine, as far as is known, was never marketed and was evidently a commercial failure because it lacked two of the elements necessary to insure success, an eye-pointed needle and an automatic feed.

The first practical sewing machine was built by a Frenchman, Barthelemy Thimonnier, who, in 1830, obtained a French patent, No. 7434, thereon. This machine also made a line of chain stitches from a single thread. A firm was formed to exploit the invention, and in 1841, 80 wooden machines were actually in operation, each machine forming about 200 stitches per minute. A riot, caused by seamstresses and tailors who feared the machines would do away with hand sewing, put an end to these machines and also to the firm, and left Thimonnier a poor man. He later obtained a new partner and built machines of metal and increased the rate of speed. The Revolution of 1848, however, blighted his hopes and ruined both himself and his partner.

It was not until 1840 that Elias Howe, an American, conceived his idea of an automatic sewing machine. He built a machine and obtained a patent thereon in the United States, No. 4750, dated September 10, 1846. A company was formed and a machine known as the "Elias Howe, Jr." was placed on the market, the machine forming about 320 stitches per minute. This Howe machine embodied the main elements which are present in all machines of to-day. Specifically, it included a ver-

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25 Union Special Machine Co., Chicago, Ill.

tically reciprocatory eye-pointed needle, an automatic feed, and a shuttle which carried a second thread through the needle-thread loops to form a line of shuttle stitches.

The Howe machine remained on the market for many years, but was finally obliged to yield to the demand for higher speed, and this demand was filled by power-operated machines of other makes. Elias Howe's perseverance and success in placing the sewing machine on the market necessarily gives him the honor of being the originator of the sewing machine.

The double-locked stitch machine was originated by Grover and Baker, who obtained United States patent No. 7931, dated February 11, 1851, thereon. In this machine each needle-thread loop in the line was doubly locked by the second or looper thread which was carried by a lower needle or looper, the looper first entering the needle-thread loop and the needle then entering a loop in the looper thread. The commercial Grover and Baker machine was, however, apparently manufactured under their patent No. 9053, dated June 22, 1854.

The first commercial single-thread, chain-stitch machine was constructed by James E. A. Gibbs and was apparently manufactured under his three United States patents, 17427, dated June 2, 1857, 21129, dated August 10, 1858, and 28851, dated June 26, 1860.

Sewing-machine stitches are employed for joining fabrics in the process of manufacturing articles of almost every conceivable kind, and these articles may be grouped under three divisions—clothing, shoes, and miscellaneous. The clothing trade may very well include aprons, caps, cloaks, coats, collars, corsets, gloves, hats, jackets, leggings, mittens, overalls, pajamas, petticoats, shirts, skirts, stockings, sweaters, trousers, underwear, uniforms, vests, and waists.

In the shoe trade, sewing machines are employed in stitching together the various parts which enter into the formation of the shoe upper and also in applying the sole to the shoe upper.

Under the miscellaneous division may be listed automobile curtains, cushions, lamp covers, tires, and tops; awnings, bath robes, bathing suits, bed ticks, blankets, flags, mattresses, rugs, window shades, and tents, and also the manufacture of bags and the closing of filled bags.

A sewing machine usually comprises a support for the fabric, a reciprocatory needle which penetrates the fabric and carries a needle thread therewith, either a thread-carrying or nonthread-carrying implement movable under the support and cooperating with the needle thread to form the thread concatenations, and an automatic feeding mechanism for feeding the fabric in a positive, step-by-step manner, the distance the fabric is moved determining the length of the stitch being formed. In each cycle of operation, as the needle starts to rise the needle thread, which extends downwardly through the needle hole formed in the fabric to the needle eye, is caused to spread laterally to form the needle-thread loop. As this loop is being formed, the second implement enters the same and cooperates therewith to form a thread concatenation. The construction of these concatenations varies in accordance with the type of stitches being formed.

Machine-made stitches consist of a line of concatenations produced from one or more threads and spaced a predetermined distance apart, the distance between adjacent concatenations being considered as the length of a stitch and each concatenation constituting the end of one stitch and also the beginning of the next adjacent stitch. A seam formed from a line of machine-made stitches, in order to approach the perfection of the hand-made stitch, must have strength and elasticity, and the stitches must be incapable of raveling when placed under a strain.

The common chain stitch is formed by a single thread which is first looped downwardly through the fabric, and then at a point removed therefrom and at a stitch-length distance the thread is agaiu looped through the fabric and through the first-mentioned loop, and so on, thus producing a series of enchained loops on the under side of the fabric. A seam formed by this stitch embodies considerable elasticity and strength, but it lacks the vital nonraveling element. The last-formed loop is not locked, and a transverse strain imparted to the seam will cause the loops readily to unloop one from the other in progression along the entire line of stitches. Even if the ends of the seam are tacked, a broken or skipped stitch plus a transverse strain will readily cause the stitches to ravel from the point of breakage and thereby destroy the seam. This condition is somewhat relieved by waxing the thread with hot cobbler's wax, such as used in shoe and harness work.

The shuttle stitch is formed by two threads, one being supplied through the medium of a needle and the other being supplied from a bobbin carried by a shuttle, the shuttle passing through the needle-thread loop to place the shuttle thread over the needle thread, whereby when the threads are drawn taut they will directly concatenate or hinge one against the other. In practice, the concatenation is generally positioned in the middle of the needle hole in the fabric, so that a single line of thread on each surface of the fabric will be visible. Each needle-thread loop is not locked in position by the shuttle thread. This fact becomes readily apparent if the threads are severed between any pair of adjacent concatenations and a transverse strain applied to the seam at the point of breakage. The loose ends of the threads at the point of breakage will permit several concatenations on each side thereof to become loose and thereby open the seam and permit the seam to be readily ripped. Inasmuch as the threads are directly hinged and pull equally one on the other, the stitch is only as strong as the weaker thread employed, minus an indefinite amount caused by the fact that the other thread tends to chafe or cut it in two. It is advisable, therefore, to employ threads which, when in the material, will have substantially the same strength. The larger the bobbin the larger the shuttle, and consequently the size of the needle-thread loop through which the shuttle passes is dependent upon the traverse circumference of the shuttle. Each needle-thread loop has got to be pulled upwardly through the needle hole in the fabric in order to tighten each concatenation, and during each operation the thread is pulled through the material being sewed and through the eye of the needle. Thus a given point in the needle thread will pass through the needle eye from 30 to 60 times, the number varying in proportion to the size of the needle-thread loop formed by the shuttle plus the length of stitch being made. The seesawing action of the needle thread through the needle eye, as above described, necessarily reduces its strength when finally embodied in a seam. Also the tendency of one thread to chafe and cut the other at the point of joining when the stitch is being tightened, is considerable. To offset these weaknesses, an oversized needle thread should be employed. The tensile strength of a seam may be somewhat varied by increasing the size of the shuttle thread and by varying the tensions controlling both threads, so as to cause the shuttle thread to lie wholly on the under surface of the fabric instead of causing the concatenation to be pulled into the middle of the fabric. These stitches, in order to make a tight seam, must be set so that opposing strains are placed at each concatenation so as to cause one thread to pull directly against the other. The stitch is, therefore, practically devoid of any elasticity beyond that which is inherent in the threads. This may be readily tested by forming a bias seam and imparting an endwise strain thereto.

The double-locked stitch is formed by two threads, a needle thread and a looper thread, each concatenation being formed by a loop of looper thread being first passed through a loop of needle thread and then a loop of needle thread being passed through the loop of looper thread, and so on, thus producing a series of double loops in the looper thread on the under side of the material. These loops are concatenated with the needle-thread loops in a manner to doubly lock every one of said needle-thread loops. The bight of one looper-thread loop extends around both strands of the needle-thread loop and lies against the material, and both strands of the other looper-thread loop extend through said needle-thread loop below the first-mentioned looper-thread loop. The first looper-thread loop, when under strain, not only insures elasticity to each stitch but also acts on the needle-thread loop to bind the strands of the second looper-thread loop which pass therethrough. Furthermore, the second looper-thread loop not only acts as a staple to lock the needle-thread loop, but also locks the first looper-thread loop against slipping off the needle-thread loop. Thus each needle-thread loop is doubly locked, and consequently each end of every stitch is doubly locked, and should either or both threads be severed between any pair of adjacent thread concatenations the next adjacent stitches will not be affected when under strain and the line of stitching will remain intact. The double-locked stitch is, therefore, true to its name.

In the shuttle stitch the size and quality of the lower thread must at least equal that of the needle thread; and by increasing the size of the lower thread and laying the same in a straight line on the under surface of the fabric the amount of elasticity in the stitches will be equal to the elasticity of the straight thread, and the stitch obviously will not be any stronger than this thread. In the double-locked stitch an under thread much inferior both in quality and size can be employed, and this combination of threads in the double-locked stitch will give to a seam produced thereby a tensile strength approximately 50 per cent greater than the shuttle stitch employing the same size needle thread and an even-sized under thread. Therefore, an inferior and undersized lower thread gives to the double-locked stitch greater tensile strength than an even or oversized lower thread gives to the shuttle stitch.

Although the consumption of under thread in the double-locked stitch may be somewhat greater than in the shuttle stitch, the relative cost will be approximately the same on account of the different sizes and qualities of threads employed and because both threads are taken directly from spools, without any waste; whereas the lower thread of the shuttle stitch has to be wound on bobbins, which causes a considerable amount of thread to be wasted each time the shuttle is replenished and also causes thread to be wasted at the beginning of every line of stitching.

In conclusion, it will be noted: First, that the double-locked stitch can not unlock or come out itself under any condition of wear; second, that it will not ravel and the seam will not rip if the stitches are cut or broken, this being a point of more vital importance than all others where the strength and security of seam are the main factors; third, that the stitch can be raveled by one who knows the key, this method of raveling being an advantage rather than a disadvantage, and could only be a disadvantage if it affected the reliability of the seam, which is not the case; fourth, that it is necessary in order to ravel the stitch first to physically unlock the last-formed concatenation by withdrawing the looper thread which extends through and locks the needle thread loop; fifth, that frequently it is desired to remove the stitches in order to reserve an article for future use, or other use, and this feature makes the stitch of particular value in certain lines of manufacture; and, sixth, that the peculiar formation of the stitch, resulting in greater strength, elasticity, and security, with the added advantage that it can be unlocked and raveled out, if necessary, forms a combination of merits which is not possessed by any other stitch formation.

DISCUSSION

Mr. Honicker. I would like to ask the gentleman if he has worked out the relation that the upper and lower threads must bear to each other to get an equal strength of the two.

Mr. Tate. In the double-lock stitch the under thread is always inferior both as to size and quality.

Mr. Chittick. What is the reason that for machine work the threads generally have a reverse twist?

Mr. Tate. When the needle is down at the lower end of the stroke and starts to come up, the needle thread is caused to sway a little to form a loop into which the needle enters. If the twist is not proper or if it is in the wrong direction the needle will not enter the loop.

Mr. Shinn. I have had some experience with that in connection with sewing machines and also with the spinning. The twist in the sewing thread must be in the opposite direction to the regular twist in order to form the loop and to throw it in the right direction. If the thread has a regular twist, the loop will be thrown toward the needle.

A METHOD FOR TESTING FABRICS AT A STANDARD MOISTURE CONDITION

Chas. D. Honiker [26]

When the necessity for a definite knowledge of the strength of fabrics began to be felt, various means were adopted for making strength tests. For a long time proper allowances were not made for the effect of the moisture condition of the material being tested. Lately, however, owing to great discrepancies found in the results of tests made upon the same materials by different persons, it has come to be considered of the utmost importance that a standard condition be adopted. There is presented in this paper a method of regulating condition which is easy of application, costs little to install, can be operated at small expense, and gives entirely satisfactory results.

The method known as the "bone-dry" method has numerous disadvantages, the chief of which are: First, that the dry condition is not a usual working condition; second, that the essential oils of the fabric are dried out and the fabric structure changed; and, third, that the difficulties of maintaining a bone-dry condition increases in direct ratio to the number of samples to be tested.

A method of testing which yields satisfactory results and does not have these disadvantages consists in maintaining a moisture condition in the testing room which will give a standard amount of regain.

The following table gives the average results of several thousand breaking tests under varied hygrometrical conditions of outside air. It shows conclusively that the strength of the fabric remains practically constant while the same percentage of regain is maintained, irrespective of temperature between reasonable limits.

Average Strength at Regain of 8½ Per Cent

Material	Temperature			
	60–64° F	65–69° F	70–74° F	75–79° F
1 RX	81.58	82.00	80.96	79.60
2 DX	80.42	80.92	80.38	80.20
3 BRW	66.66	66.41	67.00	66.60
5 HSN	105.50	106.15	106.41	108.20
5 W	73.42	74.30	75.09	75.20
14 SW	112.25	116.55	116.81	114.00
17 NX	63.42	64.36	63.93	63.60
8 Y	177.83	172.33	177.68	185.60
Average	95.14	95.38	96.03	96.63
Average without 8 Y	83.32	84.38	84.37	83.91

The testing procedure is as follows:

The regain scale is constructed from a regular Brown & Sharpe yarn balance. In place of the pan for the samples there is substituted a wire rack on which samples

[26] Head of test and cost departments, Fulton Bag & Cotton Mills, Atlanta, Ga.

similar to those to be tested are exposed. This scale is inclosed in a case made of fine-woven brass wire cloth and can be set to indicate a regain of 8¼ per cent, or any other desired. Samples weighing exactly 200 gr in bone-dry condition are exposed on the rack. This bone-dry state is obtained by drying at a temperature of 105° C for a period of five hours. The scale beam is made to balance at zero with this bone-dry test sample in position on the rack.

The testing room is equipped with apparatus for supplying humidity and for circulating the air. The regain scale is exposed in the testing room at the same time as the samples to be tested, and readings are taken periodically. When a regain of 8¼ per cent is indicated, the testing is begun. The humidifying apparatus is stopped or started as may be necessary to maintain this amount of regain. The testing room is always in a livable condition, and the regulation can be done by a person without much technical knowledge.

Our investigations along this line have developed a number of applications which will be of interest to our cotton-manufacturing friends. The principal one enables the numbers of yarns to be kept regular irrespective of changes in hygrometrical conditions. A regain scale, similar to that described above, is installed in the opening and picking department. The amount of moisture in the cotton may be determined at any time. The weight of the picker laps may then be regulated according to the regain scale. If a large amount of moisture is indicated, the weight of the laps should be increased so that there will be the desired amount of cotton fiber, and vice versa.

Similarly a testing room may be used for regulating the size of roving and yarn. It will be found that fewer changes of gearing in carding and spinning departments are necessary when this system is employed.

I can give examples of surprising apparent changes in weight of yarns. For instance, a certain test showed a number of samples of yarn, rated as No. 20's, one day to size 19.72, and the next day 21.02, a change of nearly 7 per cent. This apparently large change in weight is of course entirely due to change in the amount of moisture contained in the yarn. Examples of this kind show conclusively that effective methods of making moisture allowances are necessary. Our method will give satisfactory results without the installation of an expensive equipment of humidity control for the entire mill.

DISCUSSION

Mr. Gassman. The Customs Service at the port of New York has an office called the analytical bureau which determines the component fiber of chief value in imported materials. In the course of this work they naturally come across many fibers. I have a few here which have been imported but are practically unknown on account of the war. One is a fiber grown in this country according to the authority I have here. I will read what the discoverer of that fiber says about it.

322 Russell Street, Saginaw, Mich.,
June 7, 1915.

Mr. H. A. Gassman,
New York City.

Dear Sir: I inclose a small sample of the new ozone silk fiber which I am obtaining from a wild plant found growing in American swamps, but I have not yet progressed far enough to have any cloth to dispose of. The manner of obtaining the fiber from the plant is a secret as yet and not patented.

The plant will grow in the New Jersey swamps and any one can grow them.

Very truly yours,

The Boyce Fiber Co.
By S. S. Boyce, *Pres't.*

I am sorry to state that I have not received the yarn or cloth from the man, so I am not able to give the results of the test. The fibers are here for inspection.

Mr. Chittick. I have had a great deal of correspondence with Mr. Boyce. I have quite a number of samples of fabrics made by the American Woolen Co. from fiber furnished by him. They contain about 80 per cent of ozone fiber from the swamp milkweed and about 20 per cent wool shoddy. This makes a very nice flannely looking cloth dress goods which seems to be a most acceptable and desirable kind of cloth. It is not by any means a freak and apparently it could be profitably raised in many localities. I have also received considerable correspondence regarding the samples Mr. Smith furnished me. I have many samples of this material both in the stalk and in the fiber. It has a very good tensile strength in proportion to the cross section of the fiber. Judging from the ease with which it can be produced and the amount of land suitable for its production, I imagine it will prove a very valuable addition to our textile fibers.

Mr. Gassman. I have three more fibers which have been imported from Germany. The following information has been furnished me regarding them:

Solidonia.—This is a vegetable fiber which is very similar to wool in structure and length, having a staple from 2½ inches to 12 inches. It has an even luster which improves greatly after dyeing. The raw material is white and can be bleached to an extreme white. The regular cotton dyestuffs and a certain number of wool and silk dyestuffs may be used in dyeing. Solidonia absorbs perspiration readily, affording to the skin a sensation of warmth, thereby differing favorably from cotton. This property makes it an ideal fiber for all knitting purposes, including stockings and underwear.

It may be spun on the worsted system to very fine numbers either by itself or mixed with shoddy, wool, cotton, or other fiber. It naps very easily, and has fulling capacity. For this reason it can be used in the design of new fabrics, having silky or velvety surfaces. One of the characteristics of the fiber is that mixed with wool, shoddy, or cotton and spun on the woolen system, it produces a cloth of worsted character.

There is a sample of lanella, about which I have the following information:

Lanella.—This can not be bleached. In appearance the fiber resembles jute, but is of an entirely different character. As a substitute it is similar to medium-grade wool and may be dyed with acid-wool dyestuffs. Cotton dyes can not be used. After dyeing the fiber develops a remarkable luster which brings out the colors very brightly. The handle is similar to that of a medium grade of wool. It has the ability of wool to resist the transmission of heat. It is recommended for use in men's wear and dress goods, for it gives a nice feeling fabric of woolly character. The unusual characteristics and the low price of the fiber offer unlimited opportunity for designing new fabrics.

Lanamar.—This fiber is somewhat coarser than lanella and can be substituted for it, giving a slightly coarser cloth. Owing to its low price it can be used as a substitute for jute in the manufacture of burlaps or any other material in which jute is required. The fiber will resist the influence of moisture, which makes it a desirable material for cloth used in mines in connection with the prevention of fire damp.

Mr. Chittick. What are the prices of those fibers?

Mr. Gassman. The prices are not given. Lanella and lanamar are prepared from seaweed which grows on the Chinese and East Indian coasts. All these fibers are prepared in Germany and are not now being imported into this country on account of the war.

Mr. Dewey. The difficulty consists in producing it in sufficient quantity. Swamp milkweed probably grows as well in the swamps of New Jersey as anywhere, but it is an exceedingly difficult problem to cultivate this plant in quantity. The growth of wild plants as perennials presents a great unsolved problem, and it has not been proven that they can be cultivated, although several of them grow where they are not wanted. If they did get the quantity they would have the same difficulty of separating the fiber from the stalk as with flax. Those of you who have tried it know how exceedingly difficult it is to get the flax fiber in quantity.

Now the second fiber mentioned, solidonia, was produced in Germany from the ramie plant. It was introduced in this country to a limited extent before the war.

Mr. Chittick. Regarding flax, the trouble is not so much getting flax as getting a flax that is suitable for spinning. It has been grown as close together as wheat, but we have not been able to get over the difficulty of weeding. As some of you know, when the flax plant is allowed to branch, the more it branches, the more flowers and seeds it will have, and the more oil will be produced. If it has been left in the ground until the seeds are full of oil and ripe, the stalks are too dry for the production of good fiber. When it is cut down and thrashed a broken mass of tow remains. It is a big economic question to find a use for such material. To grow that fiber, the seed is planted like wheat. When the plant is 4 inches high the weeds will grow faster than the flax and will kill it. It has to be weeded by hand. The pulling of the flax plant also has to be done by hand because the roots go down several inches into the ground.

Mr. Dewey. When I spoke of the milkweed, I did not intend to start a discussion on flax. There are two distinct kinds of flax grown. You can not get a long fiber from ordinary seed flax any more than you can get sweet corn from a yellow corn seed. The question of weeding is not serious if the land is well prepared. Our land for instance is not so weedy as the European land. As to pulling there were five flax pulling machines in the field last year. None of these machines proved satisfactory enough to be used commercially, however. Further experiments are being made.

Fiber flax is being grown in eastern Michigan on an area something like 15 times as great as last year. There are other large areas in Montana and Oregon where flax of as good quality as that grown in Belgium can be grown. We have not been able to produce the fiber, but we can produce the plant.

Mr. Lewis. I would like to ask Mr. Dewey if a good flax line or linen can be produced from cut flax straw.

Mr. Dewey. Certainly. The principal difference is not in the fiber flax root. Especially in the western regions the bundles are laid on the ground. The moisture from the ground extends up into the cut ends, discoloring and partly rotting the lower end of the stalk and weakening this portion of the fiber. If the plants are fixed so that they will stand on the roots, the whole stalk cards more uniformly, and the lower part is protected from injury. There is less danger of injury in Oregon because the time of harvest is very dry, while in Michigan, Wisconsin, and Minnesota they have wet weather.

Mr. Stratton. I would like to ask Mr. Dewey to what extent ramie is actually woven in this country.

Mr. Dewey. I do not know of any one who is weaving it. I saw a letter the other day in which a manufacturer of ramie threads stated that a test had been made with a certain fabric, but the fibers were not suitable for the fabric they had in mind.

Mr. Stratton. Is anyone engaged in preparing a fiber of this kind in this country. We are very anxious to secure some cloth from ramie. It is said by some that it makes a better cloth for airplanes than linen, that it is very free from shrinkage due to moisture, and that it keeps its shape very well.

Mr. Chittick. I do not know where you can get it. There has been a great deal of misunderstanding about the strength of ramie, but experience shows that it is not as strong as cotton.

Mr. Stratton. I would like to try it out.

Mr. Chittick. I can probably send you some British fabric containing certain percentages of ramie fiber, and I can also probably send you some that are ramie entirely.

Mr. Stratton. I want a cloth about the same weight as the finer linen.

Mr. Shinn. At the present time we have some ramie in our establishment. We are having difficulty in getting an even thread and especially a fine thread. The fiber is fairly strong but very irregular in strength, and consequently no standards for strength and fineness have been established. It is used considerably in making mantles for Welsbach lights, and it has been used to some extent for cloth, but I do not know of any cloth made solely of ramie. Ramie filling is sometimes used with a cotton warp but not in fine goods.

Mr. STRATTON. Are you familiar with the linen used on airplanes? We want a cloth made like that.

Mr. SHINN. Until a way is found of spinning ramie yarn to compete with linen, we will not be able to get a ramie cloth to take the place of linen.

Mr. STRATTON. I have been informed that the cloth was being made and used abroad and that it is as smooth as linen. I would like to get some of it for laboratory tests. We are making experiments to determine the comparative value of linen and cotton cloth for airplanes. If suitable cloth can be made from some other fiber, we will extend our work to include that fiber.

A SOCIETY FOR THE PROMOTION OF RESEARCH WORK IN TEXTILE TECHNOLOGY

S. W. STRATTON

I will say just a few words in regard to the meeting and to plans for continuing this work. It would be an excellent plan to institute a society which will, among other things, bring together at least once a year the men who are actually engaged in studying the physics and chemistry of textiles. There are a great many things that can come from such meetings, and they need not interfere with the work of any of the existing organizations. The various existing textile organizations very properly give their attention to economic considerations. We are principally concerned with the promotion of scientific work and the standardization of tests and nomenclature. It is quite as necessary to have standard terms and standard tests as it is to have standard pounds and standard yards. If we are to have proper contracts, especially in the Government service—if we are to buy according to the system laid down by law—it is exceedingly important that we have on hand proper specifications and proper tests.

Our attention has been called time after time to the practices of dishonest bidders. As a rule, the manufacturer intends to do the right thing, and we always proceed on the supposition that he is honest. Occasionally, due to the fact that competitive bids sometimes are considered without a rigid examination of the goods submitted, a dishonest manufacturer obtains a contract. An example of this occurred when a man combined all sorts of adulterated articles in making paints and oils, bid against the very people who had prepared them for him, and got the Government contract. Now, there are honest individuals in all the industries: in fact, it is the dishonest individual who is the exception. Nevertheless, if we are going to have competitive bidding as required by law, we must be exceedingly careful in establishing the standard beforehand. The manufacturer, the user, and the testing laboratory will then all understand that they have agreed to accept this standard.

This organization can be a splendid agent for bringing the Government purchasers face to face with the manufacturer. The man who understands the technical side of manufacturing does not often manufacture. If there is one thing more than any other to which the progress of American industries is due, it is to the organizations of technical men.

It is astonishing how the various groups of manufacturers will get together and compare notes with the utmost confidence. The days of business secrets have gone by. Sometimes an industrial chemist says he can not explain a certain thing because it is a secret. The chances are that he is either doing something that he ought not or else he is covering up his own ignorance. I have found out by attending conferences of this kind that you are all working toward the same end and in much the same way.

The method adopted by the automobile firms for utilizing their patents is of interest. They take out patents in the usual manner, but they have a cross-licensing system so that all of them may be universally used, thus doing away with all litigation.

We are primarily after the secrets of nature, which none of us know. The industries are beginning to look upon scientific work as most important. You would be surprised at the number of plants installing research laboratories. In some industries a large number of small producers prefer to unite for the purpose of working out their problems. In all these researches and in all the testing incidental to research this Bureau can be of great assistance.

In the first place, we are continually testing supplies purchased by the Government. We have taken up the various specifications for the testing of paper, rubber, textiles, and other things in order to put the Government purchasing on a sound basis.

It is not unusual for a large firm to send its buyer here to find out the method the Government uses to regulate its purchases. The work of the Bureau in connection with the Government departments is done in a spirit of helpfulness and cooperation because every department in the Government service is just as anxious to put buying on a good basis as we are. It is very important that we have correct standard methods of test. We have no business to make a specification for test unless we know on what the quality of the article depends. The usual procedure is to find an article which has proven good in use and a similar article that has proven bad in use and make a laboratory investigation to find out the physical and chemical properties that make one good and the other bad. The industries throughout the country are using imperfect specifications which must be corrected, and that can only be done by careful study of the uses of the materials and by associating the results obtained with suitable laboratory work. Now your organization will enable the Bureau to assist in this. I want to ask you to think of the Bureau's work not only with reference to your own industry, but also with reference to all the industries. There are very few aspects of the textile industry that you are not more familiar with than we are. On the other hand, there are many questions concerning the things that enter into your industry and the articles you use that we know more about than you do. For instance, we have in the Bureau a group of men who are measuring the standards of weight, volume, etc. Almost all measurements depend on the mass, length, capacity, and specific gravity, and these men can help you in questions involving these standards.

Another division of our work relates to electricity. One of the secrets of progress is to know the tools with which you can work. Electricity is one of the tools which you always apply. Here, there is a group of electrical experts to whom you can refer your electrical problems. They are studying the various problems arising in every industry with respect to applications of electricity.

In another division heat and thermometry are given consideration. If you want to know about the expansion of materials, melting points, boiling points, testing of thermometers, the measurement of temperature, or the conductivity of materials, you will find a group of experts working along the lines in which you are interested.

Then we have a division for optical work. If you want someone to suggest to you an optical arrangement, you will find assistance here. There is no industry into which optics does not enter to a far greater extent than would be supposed at first glance. For example, questions of color and the standardization of dyes are very important.

In the division of chemistry our specialists are well informed as to the fundamental facts of chemistry, and we may be able to solve chemical problems for you that have failed of solution previously.

Our engineering divisions give their attention to problems arising in the construction and use of steel, nonferrous alloys, brick, cement, stone, oil, and other building and engineering materials. Our men can often help you with work involving these things.

This brief outline shows the scope of the Bureau's work. All these questions are grouped about the fundamental facts of physics and chemistry. If you want to know these fundamental facts, you can get the information here, and maybe a knowledge of those facts will enable you to handle your particular work better than before.

I would not have you think that we are experts in textile manufacturing. We have, however, a section in which special attention is given to the determination and measurement of the physical properties which affect the quality of textiles. This, of course, involves consideration of manufacturing. The manufacturer is vitally interested in all aspects of the quality of his product, for a thorough knowledge of his raw and manufactured material enables him to produce an article which will suit the purpose for which it is to be used.

With this in view, I would suggest that you perfect an organization which will hold meetings here once a year to discuss these matters, to establish methods of purchasing and testing, and to promote scientific work which enters into the industries as a whole.

Some of the papers given here are of the greatest importance, and to those who are interested in scientific work, a regular organization of these bodies would prove a power in many ways. A large portion of the men making up the trade organizations are not scientific men, but they are intensely interested in results. They want to know the significance of technical work. Technical men want to know how results were obtained, and they want to discuss the details of procedure, the adaptability of nomenclature standards, and simil .r topics. To my mind an organization of the kind proposed will naturally give special attention to fundamental and vital facts and to applications of science to industry.

DISCUSSION.

Mr. HAVEN. I want to speak a word of personal appreciation of this meeting and also the one held last year. These conferences have very great value not only to the manufacturer but also to the men outside of manufacturing lines in the schoolroom or laboratory. I should like very much to have these meetings perpetuated, and just to bring it to a vote, I would like to make a motion that it is the consensus of this meeting that the Director of the Bureau of Standards be requested to call a conference similar to this in character approximately a year from now, and that he appoint a committee of five men as widely separated as possible in textile fields to assist in securing papers for presentation at that meeting.

Mr. NOLAN. I second that motion.

Mr. STRATTON. Motion seconded; are there any remarks? Would it not be well to appoint special committees to consider special questions such as the standardization of the nomenclature of dyes and fabrics? There have been several very important things that have been brought up at this meeting. Would it be well to let the committee spoken of handle those, or do you think we ought to have special committees appointed for that purpose?

Mr. CHITTICK. Would not that be a large undertaking for such a small committee? I want to suggest that it would be a wise course to send these problems to the secretaries of the various textile organizations. Many of their members have a decided interest in matters of standardization. Should you suggest to them the desirability of their forming a committee which might do some work along these lines, then one of the members of that committee might present the results of the work at the next conference. The representatives of these different organizations could possibly cooperate in this way to mutual advantage.

Mr. DANNERTH. There is a person here to-day who has given a good deal of thought to the promotion of textile and technical societies. I think we would appreciate it if Prof. Olney, of the Lowell Textile School, would tell us what his ideas are regarding the formation of a permanent society of the type suggested.

Mr. OLNEY. I will say that I think there is a grand opportunity for an official organization for establishing standards in textile work.

My principal interest is in regard to textile chemistry and dyestuffs, and I know that in that branch of the work there is a remarkable field, one which, up to the present time, has been almost absolutely void of any official or organized endeavor to put it upon a standard basis.

In regard to the various associations of textile manufacturers, I am interested in manufacturing myself, and I believe in some of those organizations, but the papers which are read at their meetings are written chiefly by nontechnical men. Many of the papers are purely of an advertising nature presented to bring before the society some particular apparatus, machine, or process. I think that, often, men go away from those meetings feeling that they have not received any technical or scientific information. I believe the manufacturers themselves appreciate this fact and would like to have some organization cause to be investigated systematically and scientifically matters of real concern to them. As yet they have not taken any move in that direction.

With regard to testing of dyestuffs, I will say that at the Lowell Textile School for 20 years we have been working on the testing of dyestuffs, and we are gradually building up a system of testing which is fairly complete from our point of view. We have changed it somewhat every year in order to improve it, but it is not official in any sense of the word. Of course, a great many of the students may go out and use some of the tests or perhaps the whole series, but it is not official.

Now I believe if men who have worked on this subject, like Dr. Dannerth and Dr. Matthews and perhaps a graduate of the chemistry course of the Lowell Textile School, were to bring the proposition definitely before the manufacturers, they would be more than pleased to cooperate even with financial assistance. As there has been no organization, they do nothing, and the whole situation remains simply as a future prospect.

The manufacturing establishments, perhaps because they are not scientific, usually do not feel that they can afford to hire a chemist, a physicist, and specialists in other branches of the sciences, so all of the scientific work devolves upon the chemist, and he may be called upon to perform investigations for which he is not trained.

The chemists at many large manufacturing plants will not come to a meeting of this kind because, as they say, they are too busy or are afraid their attendance would not meet with the approval of their superiors. When the agents and treasurers of these mills can be made to see the value of these meetings, they will tell their chemists that it is a part of their work to attend. A great many things can then be accomplished that are not accomplished to-day.

I think the agents and treasurers of mills will cooperate with the work of a technical organization if it is given some official status.

Mr. Stratton. You have brought out one very important point. In many industries, a great deal of attention is paid to the financial aspects, in accordance with the supposition that they were of fundamental importance. Some of them, having decided that they must have a chemist, hire one just as they hire a clerk, and the chemist is supposed to do everything. That is why so many of the industrial chemists are bluffs. They have to pose as knowing all these things and, therefore, are not personally to blame. If we organize, a great deal may be done toward teaching the capitalists the importance of having specialists to look after the various branches of their technical work.

I am sure you are just as much interested in the development of a technical society as we are, for the Government interests are much the same as those of the textile industry. You will be exceedingly fortunate in having a place at which you can meet the representatives of the various departments. If questions regarding contracts with the Government departments come up, all irregularities, crude specifications, and unjust inspection may be rectified. The Bureau is not a biased party at all. We are just as much concerned in seeing that justice is obtained for the manufacturer as for the Government.

Mr. Haven. In making my motion a few minutes ago I simply desired to bring before this gathering some means of perpetuating these pleasant and very profitable meetings. I would like to emphasize again my original motion.

The head of the Bureau of Standards shall select, if it be his will and discretion, a committee of five men representing respectively (1) cotton, (2) wool, (3) silk, (4) all other fibers, and (5) dyeing and chemistry; and these five men shall form, with him, a committee to conduct the next meeting, especially in regard to securing papers of value. The work of this committee need not be restricted to these five men. I think each of them would call upon others in his line of business for assistance. In that way the questions in which the manufacturers are most vitally interested can be brought up and discussed. These magnificent laboratories may find answers to many of these questions, and I think that bringing them to the attention of this Bureau is a great function. I wish to emphasize this point in connection with my original motion.

Mr. Stratton. Are you ready for the question? You have heard the motion. All those in favor of appointing this committee for the purpose of handling future meetings say "aye." Contrary, "no." The motion has passed.

I want to say in closing that we appreciate very much your coming here. The Bureau is striving to take up in its laboratories those problems which are most needed, and it is only through an intimate contact with the representatives of the industries that the Bureau can find out what the vital problems are. The effect of this meeting will be to make our work more efficient and to enable us to direct it along the lines of the most urgent needs. This will be of the greatest assistance to us, and we are very grateful to you. We know you are all busy at this time of the year, but we found out long ago that it is the busy man who does things.