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RAYON

by

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RAYON

I have prepared a brief summary dealing with the background and developments in rayon, which I will read, and then, as suggested, open the meeting for questions and discussion.

The earliest statement on record of the idea of "artificial silk" appears in 1664 by Robert Hooke, a well-known scientist:

> "I have often thought that probably there might be a way found out to make an artificial glutinous composition, much resembling, if not fully as good, nay better, than that excrement, or whatever other substance it be out of which the silkworm wiredraws his clew. If such a composition were found, it would certainly be an easie matter to find very quick ways of drawing it out into small wires for use. I need not mention the use of such an invention nor the benefit that is likely to accrue to the finder, they being sufficiently obvious. This hint, therefore, may, I hope, give some ingenious, inquisitive person an occasion of making some trials, which if successful I have my aim, and I suppose he will have no occasion to be displeased."

A century later, Rene de Reaumur, a French naturalist and scientist, said:

> "Silk is only a liquid gum which has been dried. Can we not make silk ourselves with gums and resin?"

Still another century passed before the first practical experiments to produce "artificial silk" were made by Count de Chardonnet, a pupil of Pasteur. He started work on the idea in 1878, knowing that the silkworm lived on mulberry leaves, - a principle constituent of which is cellulose. He successfully extracted the cellulose from mulberry leaves, and by pressing it through tiny apertures after chemical treatment, made his first synthetic fiber in 1886. For this discovery, he is called "The Father of

the Rayon Industry." He was granted a patent on his process in 1884, and at the Paris Exposition in 1889, fabrics made from his laboratory-produced threads, were presented as "artificial silk."

Since then four commercial processes have been developed.

The viscose process, which is the one that predominates, was developed by English chemists in 1892, and in 1911, introduced into the United States by the British firm of Courtauld's Ltd. Their offspring, the American Viscose Company, has for many years been the world's largest producer. The characteristics and method of manufacture are very simple and easy to visualize if you will just imagine taking the cellulose in the form of cotton pulp or wood pulp and dissolving it in certain acids and chemicals until it has the appearance, color and consistency of ordinary mucilage. That solution is forced through pipes and pumps to a cup known as a spinneret. There are many minute holes in the cup and the "mucilage" is forced through these holes into a chemical bath, which coagulates the substance. The process is more or less continuous. These coagulated filaments proceed from the bath to a revolving pot, and formed into a cake by centrifugal action. This cake forms the first yarn of commercial value. It is taken to the winding room, where the yarn is reeled into two or three ounce skeins. These skeins are then put through a neutralizing bath; are bleached, washed, dried, and sent to the inspection, sorting, and packing rooms, and thus, become the yarn of commerce.

The next important method is the acetate process. This was developed in 1869 and patented in 1894. The process of manufacture is very similar to that of viscose, except that purified cotton linters are used as the base instead of wood pulp. The cotton is dissolved in acids and chemicals and forms the same sort of "mucilage" as was the case in the viscose process. It is spun in the same way except instead of going into a coagulating bath, it is coagulated in a blast of hot air. That, by the way, is more similar to the spinning of real silk by the silkworm - real silk coagulates when it hits the air. The acetate process is unique in this respect: there is no waste problem. Any waste material that may result from the process of manufacture can be thrown back into the

pot and used again, which is not possible in the other three processes. Another difference between the acetate and the other three processes is that the acetate requires an entirely separate type of dyes which were developed especially for the acetate process. For that reason it is possible to use acetate in combination fabrics, that is, in combination with cotton, with other types of rayon, with silk, or with wool, as the case may be. By the use of combination dyes we get a cross dying feature. The acetate yarn will take the color intended and the other fiber will take another color. The dyes that are used on the other three types of rayon will not produce the same color on the acetate type. For instance, if it were a case of hosiery of mixed yarns to be dyed black, the acetate yarn in the hosiery would come out a gold color and the cotton yarn black if only one dye were used.

The third process is the cuprammonium process, patented in 1890. This process also uses purified cotton linters as a base and the manufacture is similar to that of the viscose process except that there are something over a hundred individual filaments in each ordinary commercial yarn, of the cuprammonium process, each filament as fine, if not finer, than some real silk filaments. The fineness of the cuprammonium filaments is produced by a stretch system in the spinning. The take-up is faster than the production at the spinneret so that the filaments are stretched before they are fully coagulated. Therefore, the cuprammonium process produced yarns with much finer filaments than any of the other processes. Within the past two years, however, the viscose process has been so improved as to produce filaments equally as fine as the cuprammonium. They differ in another respect, in that, the cuprammonium requires a stronger dye bath and is commonly termed "a glutton for dye stuffs."

The fourth process, nitrocellulose, was discovered in 1855, and was developed as a textile yarn by the English chemist, Sir Joseph Swan, before 1880 and later established as an industry by the aforementioned French chemist, Count de Chardonnet, in 1891. This process was used for a dozen years or more in this country by The Tubize Company in Hopewell, Virginia. Two or three years ago that plant was closed during a strike and it was never reopened. The entire machinery of the plant was transported to Brazil and set up for use. There are only

one or two other countries that I know of, Belgium and Hungary, where the nitrocellulose process is still used. The American Tubize Company has gone over to the manufacture of the viscose and acetate processes at Rome, Ga. We might consider the nitrocellulose process as now more or less obsolete. The characteristics and process of manufacture of the nitrocellulose was practically the same as that of viscose. (I recall that there was considerable difficulty with that process years ago when I was connected with a rayon dye plant in New York. The yarn was not evenly denitrated, which had a bad effect on the dyeing of the yarn commercially, in that, it came out very streaky, - darker shades in one part of a skein against lighter shades in another part.)

As to production of all rayon, only 30,000 pounds were produced in 1890. France was the first country to record commercial production, 80,000 pounds having been made in 1896. The United States did not start producing on a commercial scale until around 1911, when 365,000 pounds were produced. Japan did not enter the field commercially until around 1918, producing 100,000 pounds that year. Today Japan and the United States are the world's largest producers. Of the 1,004,300,000 pounds of rayon yarn produced throughout the world in 1936, 277,600,000 pounds were made in the United States and 275,000,000 pounds were made in Japan. Of the United States total about 23% was the acetate process; no acetate rayon was made at all in Japan. The world production averages around 85.7% viscose; 10.2% acetate; and 4.1% cuprammonium. No nitrocellulose was produced in 1936, at least very little if any. There may have been a few hundred thousand pounds produced in Europe, but I do not believe the Brazilian plant was in production in 1936.

All of the foregoing relates to what we call "filament" or "continuous filament" yarn. More recently a great change has come about in the rayon business by the more general use of staple fiber. Staple fiber is nothing more than the original rayon of continuous filament cut up into specified lengths ranging anywhere from an inch and one-half up to several inches, the shorter fibers being used in the cotton spinning system and the longer fibers being used in the worsted system of spinning. The world's production of staple fiber in 1934 was only 53,000,000 pounds; in 1935 it jumped to 140,000,000 pounds; in 1936 to 300,000,000 pounds; and the 1937 estimate is around 580,000,000 pounds. The

estimated consumption in the United States in 1935 was only 7,000,000 pounds; in 1936 it rose to 25,000,000 pounds; and for 1937 the estimate is 47,000,000 pounds. Approximately half of the United States consumption has been imported because our manufacturers have not been able to gear up their industry to the high rate of advance in the use of this staple fiber. It is produced in the same manner as commercial filament yarn except that the spinneret has, instead of 50 to 100 holes, let us say 2,000 holes, which of course would produce quite a sizeable "rope", somewhat thicker than the thumb. That "rope" is taken through a continuous process, (neutralizing the acids and what not) and is chopped into specified lengths depending on who is to buy it. A cotton spinner wants a staple length of about 1 9/16 inches. That is said to be the ideal length for fine cotton spinning. About 3-inch lengths are required for the spun silk system, spun silk being the system which spins combed waste silk - somewhat similar to the cotton method. That is an old industry in this country, and the spun silk manufacturers have taken on a certain amount of spun rayon business.

The longer lengths, from 4 inches to 9 inches, are used by the worsted manufacturers the same as fine wool is and spun on the worsted system. These rayon tops are usually blended with tops of wool. There is considerable worsted cloth business today consisting of 40% rayon and 60% wool. The use of rayon staple in the woolen and worsted industries has increased in leaps and bounds in the past five or six years. One estimate puts the use of rayon waste and cut staple in the woolen and worsted industries of the United States as upwards of 20% of the clean weight of fine raw wools. That is a very impressive development, especially in view of the general idea that rayon would possibly affect only the cotton and the silk businesses.

Incidentally and while on the subject of wool, the waste products of the rayon industry, not only the new waste but the reclaimed waste in the form of rags and used garments, are taken by the garnetters and shoddy manufacturers and reworked, producing suitable fibers for the manufacture of very cheap shoddy woolens such as cloths used for boys' suits and overcoats, a trade which formerly used large quantities of wool shoddy. The rayon recovered waste is now being substituted largely for the former low-grade wool shoddy. In my opinion, it is superior

because the waste rayon fibers are longer and in other respects more practical than the very low grades of wool shoddy previously used in the woolen trade.

Coming back to the production of rayon staple fiber, I have given you the world's production and the estimated consumption in the United States for the past few years. Italy is the largest producer, manufacturing 110,000,000 pounds in 1936; Germany is second with 90,000,000 pounds; Japan third with 45,000,000 pounds; Great Britain fourth with 26,250,000 pounds; and the United States fifth with 12,500,000 pounds. Incidentally, a large proportion of the imports that we have taken in the past few years has come from Japan. Our consumption of staple fibers has been substantially double our own production.

Taken together, the staple fiber and the commercial rayon yarns of continuous filament make Japan the world's largest rayon producer, surpassing the United States total in 1936 for the first time. The total rayon yarn and staple fiber production in Japan is 320,000,000 pounds, as compared with 290,000,000 pounds in the United States.

Italy, Germany, and Japan lead in the manufacture of staple fiber for economic reasons. These countries in particular want to free themselves as much as possible from the importation of foreign cotton. They have gone to extreme measures to bring this about, in Italy and Germany especially, requiring the cotton spinners to mix a certain percentage of their domestic-made rayon staple with the cotton. That means they buy less foreign cotton and use staple which is produced chemically in their own country by their own labor, and get a fabric which is substantially satisfactory. Japan has adopted a similar replacement in manufacture of woolens and worsteds which may mean Japanese imports of some 200,000 bales less of raw wool. The difficulty of financing imports into these three countries, plus labor conditions, has forced this economic measure upon them. Of course in all three countries: Italy, Germany, and Japan, they must of necessity, import the pulp from which they manufacture their rayon and rayon staple but they consider it much more economical to do that than to import raw cotton and wool and pay the cotton and wool price.

There is one other synthetic textile that I might mention in passing and that is the recent development of the casein fiber. It was patented in Italy about two years ago, and is produced from the casein, which as you know, is the by-product of the dairy industry - namely, skimmed milk. Casein has been utilized in most countries in the past for the manufacture of synthetic plastics such as buttons, imitation bone handles, and the like. It has somewhat the appearance and hardness of ivory or bone. One enterprising Italian said: "Well, if we can spin rayon, why not spin casein and produce another synthetic fiber?" And that is what he did. I brought along a sample of that fiber so you might see what this new development is. (Displayed sample.) This is known as "Lanital," and is the raw casein fiber. It seems to have more of the characteristics, feel, and appearance of wool that it does of silk, rayon, or cotton. I believe that it has great possibilities. It is a little brittle, however - that is about the only criticism I have heard about it so far. Our own United States Department of Agriculture has developed an improvement on the original product from Italy which, it is said, has done away with the brittleness. The Department of Agriculture has applied for an American patent on the improvement with the obvious purpose of keeping it a free public process.

There is one more incident I would like to mention: Several years ago a young man, connected with neither the rayon business nor the rubber business, but with considerable imagination said to himself - "If we can spin rayon, why cannot we spin rubber?" He developed his idea by taking the liquid latex (which is the raw milk of rubber that is imported in tanks by shiploads into this country by some of the rubber companies) and getting a pump from rayon machinery, put it through the same performance as rayon. He found that he could produce a rubber yarn which was superior to the elastic thread we had been using for many years, - superior in that it came out as a round thread instead of the old square-cut thread. The vulcanizing formed a protective coat over the entire surface of the thread, differing from the former square-cut elastic thread which always had two raw sides (the other two being the vulcanized top and bottom of the original sheet from which the threads were cut). Of course, it was just a bright idea but no one, either in the rubber business or the rayon business, had thought of

it. After getting a patent on it, the inventor turned it over to the United States Rubber Company for a substantial sum, and the use of that rubber yarn, called "Lastex", has almost completely revolutionized the elastic manufacturing business of the United States, and other countries, too, for that matter. The corset business was especially helped, because previous to this development the manufacture of elastic fabrics was limited to a stretch in one direction only. It was not mechanically practical to use the old type of cut rubber thread for weaving in both directions, that is, both warp and weft. It was not possible to knit it successfully so that the stretch could be had in all directions. The effect of the development of the "Latex" yarn is that it can be used for weaving or knitting fabrics with the rubber yarn in both directions. I mentioned this more or less as a side issue because it was prompted by the rayon process, just as the "Lanitol" was obviously prompted by the same trade.

During the past few months we have heard of still another development of producing a newer yarn from a dual solution of latex and viscose called "Viscolax" under British Patent 440,623 of 1937.

That concludes my notes prepared as a background. I will be pleased to answer any questions.

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Q. I would like to ask, sir, if anything has been done about the substitution of rayon for raw silk in the matter of powder bags?

A. I would say that if it were developed it would have to be a type which would not smolder and leave a spark thus creating a flareback. That would be more likely in the acetate type than in the other three types. The acetate yarn is similar to real silk yarn in this respect - when it burns it melts just as real silk does, leaving no soft ash, merely a hard, granular bubble. That is the characteristic of real silk and it is also the characteristic of acetate type of rayon. I do not know how far the experiments have gone in that direction but there may be some possibility of substitution.

Colonel Jordan: I might say that in 1905 they had some work done in the substitution of artificial silk for natural silk in powder bags at the Sandy Hook Proving Ground and I remember one incident very well in connection therewith. The sheen on this artificial silk was perfectly wonderful! I have never seen a more beautiful sheen on anything. A lady at the post decided she would like a dress made of that for an Ordnance party we were giving at the Brickhouse Mess. She had the dress made, but I will tell you the men who smoked that evening certainly were careful not to smoke near her.

Q. Is there any development in the glass industry which would indicate that we are going to get materials and fabrics out of glass?

A. Yes, glass also, similar to the rayon development, is now being produced in filaments. It is a special type of glass which is not too brittle. It will have rather limited uses though, I think, such as filter cloths for acids; curtains and other fabrics for theaters and airplanes, and for sea vessels where fire hazard is particularly undesirable.

Colonel Jordan: Will it be very brittle?

A. Well, it is brittle and it probably will remain brittle. It will be supple enough to get into a fabric and then if it is not subjected to too much stress or bending it will stand up all right, I think. (It did not occur to me or I might have brought over some samples that I have in the office.)

Colonel Jordan: How does the brittleness of regular silk compare with that of artificial silk, about the same?

A. No. The real silk is more elastic and superior in many ways to rayon. I think that the elasticity of silk is the predominant feature of silk as compared with rayon.

Q. Will rayon workers be subject to labor organizations different from those of the cotton and woolen workers?

A. No. I think the rayon workers will be subject to the same union organizations. The plant in Hopewell, Virginia, that I mentioned, which was eventually dismantled

in 1934 and shipped down to Brazil, was closed because of a local plant strike. Workers were not affiliated at that time with any recognized labor union that I know of, but in striking the workers struck themselves out of an industry, as well as a job.

Q. Will you give us some idea of the geographic distribution of the industry in the United States?

A. Yes. The majority of rayon is produced in the south, that is, below the Mason-Dixon line. The proportion as of 1935 was about 70% south and 30% north. It is produced in a dozen states, all the way from Massachusetts down to Georgia, with the western limits, Cleveland, Ohio, and Nashville, Tennessee.

Q. Can you tell us something about the extent to which the industry is integrated or is it integrated at all?

A. The production of rayon, you must understand from the start, is more a chemical industry than it is a textile industry. Generally speaking, the textile industry is not involved in the production of rayon yarn. The first interest that the textile industry takes is in the yarn itself. However, in recent years the rayon producing plants have gone further into the textile manipulation of their yarn than they did in the beginning. After some plants have produced rayon yarn, they now go a step further and convert it, that is, dye it and wind onto cones ready for the knitting machines, which is more or less an encroachment into the textile field. Some rayon companies have gone still further and have set up knitting mills in conjunction with their yarn producing plants. They knit tubular fabrics, particularly for the knit underwear trade, and sell that fabric by the pound to the cutters and manufacturers of knit underwear. In this case the rayon producers have encroached a little further on another section of the textile industry. So far as I know, none of the rayon producers have proceeded on and made finished garments.

Q. Why has the rayon industry gotten such a strong foothold in Japan, where silk has been a predominant business, rather than getting a strong foothold in other countries that are trying to secure a certain amount of economic independence from Japan's silk and textiles?

A. I am glad you asked that question. That does seem like a paradox, but still if you have studied Japanese psychology you will know that no one is going to keep the Jap "out on a limb." They saw, not only the value and possibilities of the rayon business, but the weakness of depending too largely on the threatened silk production which amounts to seven-eighths of the world's commercial silk. They went into rayon as they go into many other modern industries - utilizing that advantage which has already been worked up by the expenditure of huge sums of money by the western countries. The Japanese would consider it wasteful to spend time and money for creative experimentation, when they can blandly say: "We are quite satisfied with the American idea or the British idea or the German idea," and so start from there. They often make improvements and then apply Japanese cheap labor, ability, and adeptness to an industry and in very short order are well up or predominant. They did that in the manufacture of cottons and now have most of the other cotton weaving countries backed off the map. Do not forget that in one-half the time, let us say, that it took to develop our own rayon industry here in the United States, the Japanese have re-produced the same industry and surpassed us in quantity.

Q. I would like to know how the unit cost per pound of rayon compares with the unit cost of cotton and what effect the rayon industry is going to have on the domestic consumption of cotton fiber for textiles?

A. Generally speaking, since the advent of rayon we have consumed more cotton, more rayon, and more silk than ever before. Of course that is not a direct answer to your question but that fact stands out pretty well. As to unit cost (and competition which would naturally come through price) we have been rather surprised at the result for quite a number of years. You can find, let us say, rayon socks and cotton socks on the same counter in the five and ten cent stores at the same price, and they continue to sell side by side. Consumers' choice!

Q. What I would like to have is the cost of production per pound of rayon compared with the cost of production per pound (or the sales price controlled by the Administration as it is to a certain extent) of cotton as a raw material for the textile industry?

A. The difference in price is very slim indeed. A comparable yarn of cotton costs as much, if not slightly more, than a commercial rayon yarn of like weight and size. However, despite that, the consumption of cotton goes on for its recognized uses. Very often there is a mixture of the two fibers. A dozen years ago we could say, (and did say with a great degree of truth and experience) that rayon was selling more cotton than all the cottongoods salesmen in the business.

Q. How does the strength of the rayon cloth, wearing qualities and durability, compare with like material made from cotton?

A. Very favorably, especially in recent years. Of course rayon was not always what it is today. Even when the world's production was up in the hundreds of millions it was still pretty weak. Constant improvement in the manufacture has doubled the dry strength of rayon and the wet strength by about fifty percent, and that, I would say, was over the short period of fifteen years.

Q. You mentioned the use of wood pulp as a source of cellulose in the viscose process and in none of the others. Is wood used only in the viscose process and to what extent is it used?

A. The other three processes aside from viscose have always used one hundred percent purified cotton linters. Up to about three years ago the estimate (we had no definite figures on it) of the use of cotton linters in the viscose process was around 40% to 45%. That was the peak of cotton use in viscose. However, when cotton went up in the past two years (prior to the recent break in the cotton price) the use of cotton linters in viscose has receded considerably, so instead of 40-60 it went down to possibly 30-70, 30% cotton linters and 70% wood pulp. I would not be a bit surprised if today it were about 25% cotton linters and 75% wood pulp.

Colonel Jordan: Where is Japan getting its source of raw material for the artificial silk they are making? Are they using cotton or wood pulp?

A. They use wood pulp entirely and, strange as it may seem, they are getting about half of their wood pulp from the United States, principally Maine, Vermont and New Hampshire.

Q. Is there enough similarity in the manufacture of rayon to gunpowder to make the rayon industry a possible source of gunpowder in the next war, or with reasonable conversion?

A. Yes. (I might say that in "the good old days" when I was back in the New York trade we used to refer to the nitrocellulose yarn as "Gunpowder." That was our trade name for it.) The development of that plant in Hopewell, Virginia, was reversing the procedure. It was originally built during the war as a gunpowder plant and was turned into a rayon plant. Also the "Old Hickory" powder plant at Nashville, Tennessee, is now one of the units of the Dupont Rayon Company. The manufacture of guncotton is a rather simple process as compared with the manufacture of rayon.

Q. Can you give us some idea as to the types of equipment used by the industry and the sources of the machinery and plant equipment?

A. When the industry was first developed in this country it was fostered mainly by foreigners as branch factories of German, Italian, Belgian, French and British companies, they having made through cartels greatest development (see chart); so American companies starting up (including the du Pont Company) secured their original machinery, patents and scientific personnel, etc., from the European companies. There was considerable foreign financial interest involved in all the American plants in the beginning. The next development was that practically all replacements and new machinery were handmade here in this country, which made the introduction of additional rayon plants a rather expensive proposition. For these reasons the original prices of rayon were high as compared with present day prices, but the manufacturers here were pretty generally plowing back about one dollar a pound profit into the development and improvement of the plant machinery and the process. Does that answer your question fully?

Q. What I am interested in mostly is, who is actually producing those machines? Is the industry producing its own or importing them, or are machine tool industries here in this country making them?

A. Nowadays the machinery may be bought from United States machine companies that specialize in rayon machinery, but for a long time it was either imported from the parent company abroad or reproduced here by hand.

Q. I used some lacquer solvent once to take a spot out of a coat and it destroyed the lining of the coat. I wonder if the rayon made by all these different processes breaks down under acetone or similar solvents?

A. No. Only the acetate process is affected by acetone or ether, which will melt the acetate right up.

Q. The remainder of them are actually like cotton? They stand up?

A. Yes.

Q. Will you tell us something about your parachute cloth as to composition and comparison with Japanese silk?

A. There is now considerable experimentation going on in the Bureau of Standards and at Wright Field, Dayton, Ohio, on rayon parachute fabrics and other silk substitute equipment of the parachute such as the shroud lines and pilot chutes, etc. I do not know how far the testing has progressed. It is a pet of the Army, I believe, rather than of the Navy. The Navy is not so keen to develop a rayon cloth as a substitute for real silk cloth so long as it is woven on American looms. I imagine the Navy is more partial to cotton as a substitute. That has been my observation. (See Federal Standard Stock Catalog, Sec. III, Part 7, Group A, Div. 9, Class 49, Parachutes, etc. 1936, for details.)

Colonel Jordan: Is this Mock Leno you spoke of a method of weaving or is it a difference in the constituent?

A. It is a method of weaving. If, for instance, you are to use cotton and/or rayon it would be more practical to use the Mock Leno type of weave because the weave in itself is one of the characteristics which gives a higher strength factor to the fabric for resistance against ripping and tearing using exactly the same yarn. It also established the present standard of porosity test, as well as competitive bidding.

Colonel Jordan: That is no longer in use?

A. It was abandoned by the Navy (as I explained to you before the meeting) after several years of use because of the prejudice that was built up around it by way of propaganda from the Japanese cloth monopoly.

Q. I would like to ask particularly about the warmth qualities of rayon in the manufacture of blankets and overcoats. If you use 40% rayon would your coat or blankets still be as warm as the wool?

A. Warmth, in a garment or a blanket, is almost entirely due to the amount of air that you can "weave into the fabric." Blankets are napped to give them spongy, aerated qualities. Tests made some years ago by the Bureau of Standards on blankets made from cotton and from wool showed the same resistance to heat and cold, weight for weight. However, there is a different reaction to moisture and other weather conditions that would enter in there and change that effect. Wool has a natural moisture regain of 18%; cotton around 7½%; silk and ordinary rayon around 11%. Naturally a wool garment would be a lot more resistant to moisture than cotton because it can normally absorb more moisture before it becomes even damp.

Q. In locating a viscose plant, is there any particular water requirement in the locality that is served?

A. That brings to mind the visit of a delegation of about half a dozen engineers from Holland to pick out a suitable location in the United States for a rayon plant. They went first to their Wall Street bankers, who gave them a letter to the Department of Commerce. As I was handling the rayon at that time I was called in consultation. Well, they started right in insisting that they wanted a location that had the most abundant supply of soft water. They did not want to go to the expense of putting in a large, expensive softening plant, which most rayon companies have adjoining their plants. After inquiring at the Geodetic Survey and other places, I found that the most abundant supply of natural soft water was in the Ashville district of North Carolina, where the water

of the French Broad River has less than two degrees of hardness. So I advised the Enka officials, since they insisted on having a natural soft water supply, Ashville would be the ideal place for their plant. In addition, they would have a locality not already overdeveloped. They would have an abundance of help that was not being utilized. There were very few mills of any kind in Ashville at the time (one or two little cotton mills), and they could train their help right from the start. That is exactly what they did. They built a fine plant there and they have the most ideal natural water supply and labor conditions, I think, of any of the companies.

Q. What was the reason for this discussion of the Federal Trade Commission for forming trade practices for the rayon industry? Has the customer appeal or the merchandising chicanery forced the Federal Trade Commission into setting down rules for the industry which had not been previously existent?

A. Personally I think it is a mixture of both. There has always been the question of misbranding unfair trade and advertising practices in connection with rayon versus silk, and there has also been a determination on the part of the Celanese Company (which is the largest and the original producer of acetate yarn) to distinguish its product from the so-called rayon. They were successful to the extent of having Congress write into the Tariff Act of 1930 "rayon and other synthetic fibers," theirs being the other synthetic fiber. The Celanese Company was successful in maintaining that aloof position in the trade until quite recently. Business in general and the Federal Trade Commission have come to the conclusion that it is rayon and that it will be sold as rayon. The use of a brand will always be allowed, in conjunction with the term rayon.

Q. I would like to hear something about the merchandising end of it, what influence that has.

A. The merchandising is still somewhat of a problem. You must know if your fabric or dress is acetate or else (as with the gentleman's coat referred to in a previous question) there is apt to be a serious mistake made. Not only is there the danger of spilling acetone or ether on it but acetate must be ironed with a much cooler iron than

other types of rayon. If the iron is too hot acetate fabric will fuse; it will get just as stiff as a board and that, of course, is the finish. I might say, however, that the dry cleaners of America and Canada, who maintain an institute out here at Silver Spring, Maryland, have made exhaustive research into that subject and has instructed its members in the National Association of Dyers and Cleaners just what to do in the dry cleaning of various fabrics. Wherever there is the slightest doubt they take a small bit of the fabric and test it before attempting to dry clean it, dye it, or spot it.

Q. Can the rayon plant be used for the manufacture of artificial wool?

A. Strictly speaking, there is no such thing as artificial wool, unless you want to apply it to this "Lanitol." There is practically no difference in the procedure. They may have to have different types of machinery and different types of pumps. (By the way, each spinneret has its own individual pump which is synchronized with the flow of the solution and the take-up.) Another thing, the reason that rayon machinery is so expensive is that it has to be made of stainless steel or even glass lined pipes and all such things that make for big money in first costs.

Q. To what extent is the industry supported by foreign capital?

A. Not so much now as it was a dozen years ago. The American companies now have more or less jockeyed themselves out of the position of being under the financial domination of foreign companies. Although foreign directorships are prevalent, most companies' stocks and bonds are sold on the New York exchanges. One notable exception to American participation is that of the American Viscose Company, which is still the largest American producer but entirely British owned. There is not one share of stock in that company owned by an American. Of course they pay American wages and income taxes and all that, but the ownership is entirely in the hands of Courtauld's Ltd. of England. The chairman of the board, Mr. Salvage (a Britisher) in New York is the only other direct owner of any shares obtained by way of bonus.

Q. I want to come back again to the question of warmth and also the artificial wool that Commander Ney was talking about. I was talking to a German manufacturer this spring and the subject was the usual "Germany for everybody." He talked about artificial wool, said their artificial wool was much warmer than real wool because it had a hole in it. I just wondered what your reaction to a statement like that is?

A. There is one type of rayon known as "celta", which is spun more or less on the macaroni principle; it is hollow. That is not new; it has been on the foreign market for many years. If they cut "celta" up into a staple for utilization in the wool business it might conceivably have some additional insulating qualities for the reason that it is hollow.

Colonel Jordan: I have wanted to say one thing, and I have never had an opportunity until it came out so pat as it did this morning. I wanted to tell the Army members of the class that when I took the job of Director of The Army Industrial College a number of years ago I made up my mind, due to the fact that the Navy was in a minority here, that in any discussions that came up in the College I was on the Navy side whether I agreed with them or not, and I am, and any time I have a chance to brag about what the Navy has done I intend to do it so I do not propose that the Army members of the class shall laugh uproariously as they did here at the beginning of this lecture.

Mr. Nones: Colonel, I have some samples here which are of exceptional interest. Perhaps I should have mentioned them sooner - I do not know whether or not your time is limited. You may or may not have heard of the development of a rayon cord tire. This is the cord. (Displayed cord.)

Colonel Jordan: Is that impregnated with latex?

A. Not yet; it finally will be though. I have a brief paragraph or two here on this subject:

> "Cotton when subjected to a heat of 270 degrees Fahrenheit deteriorates in breaking strength 40%. Rayon when subjected to similar heat has a deterioration of only 5%. Naturally

when an automobile tire is in service and on the road it generates internal heat far in excess probably of 270 degrees--or at least somewhat in excess of 270 degrees. When the heat has generated up to the 270 degrees point it is due to speed, and of course at the high rate of speed that it requires to generate that heat you need more safety. As a matter of fact, with a cotton cord fabric you have 40% less safety at a time when you probably need 40% more safety.

"We understand that there was slightly more than 1,000,000 pounds of rayon cord fabric used last year in America. The principle volume of course was used by rubber concerns who own their own tire cord mills. There seems to be a gradual increase in the consumption of rayon cord fabric."

That is from "The American Wool and Cotton Reporter" of March 11, 1937, page 46.

Colonel Jordan: Will you show these samples to these gentlemen if they come up here after the lecture?

Mr. Nones: Yes, gladly. Here we have a sort of sideline in the rayon industry, artificial straw used for making straw braid for millinery purposes. The original skeins, of course, were continuous filament, - this has been cut. It can be spun in any desirable size. This is the very fine and this is the very coarse (displaying samples). Here we have a very nice horsehair, also used for making millinery braid. That is just one continuous filament. Instead of the one hundred, more or less, filaments to a spinneret, this spinneret has just one hole. In the case of straw (displaying artificial straw) the spinneret has one hole but it is a flat slit.

Colonel Jordan: There is a specimen of very fine rayon cord up here and I do not believe there is a man in the class who can break it. Some one might come up and try.

Mr. Nones, I want to tell you how much we enjoyed your talk, sir, and how much pleasure you have given us by coming down here. Thank you.