A Japanese Looks at the American Cotton Industry

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In the postwar years, the Japanese cotton industry has been host to quite a number of survey and study missions from abroad. Some of the most noteworthy on the technical side include the Leather Mission headed by Mr. E. C. Martin which was dispatched by the U.S. Government, and the more recent group organized by the N.C.C.A. and headed by Dean M. E. Campbell of North Carolina State College.

The Japanese cotton industry, in turn, has sent survey missions abroad, including the one dispatched to the American Textile Machinery Exhibition held in Atlantic City in April 1954, which I had the honour to head.

On this occasion, I had the opportunity of visiting more than twenty different laboratories, universities, institutions and other organizations — including the Department of Agriculture, the National Cotton Council in Memphis, and the S.R.R. Laboratories in New Orleans. I also paid official visits to nine spinning and finishing mills.

After our group broke up, I made personal visits to numerous other American mills. I later visited Canada and South America. It is gratifying indeed to realize that this two and a half months' tour of mine enabled me to acquaint myself with so many of the technical and operational features of mill management in the United States.

The spindleage in the mills I visited during my stay in the United States came to a total of 1,160,000. Since the total American spindleage is 22,600,000, this figure indicates that I barely covered 5% of the mills in actual operation. It would, consequently, be hasty to form any definite conclusions upon conditions in the American cotton industry on the basis of what I saw. I shall, therefore, confine myself simply to giving my impressions of the American cotton industry and of its technical features as compared with those in Japan.

At the Atlantic City exhibition I saw the best of the world’s spinning techniques on view, and was inspired by the tremendous engineering developments made in this field the world over.

The exceedingly high productivity shown by American mills both in the Northern and the Southern States were deeply impressive to me. The most noteworthy fact in this respect lay in the smallness of the labour force employed per unit of production. The figures for the mills I visited are indicated in Table 1, and these are substantially half the figure for Japan.

Table 1 Per Unit Number of Employees Used in the American Cotton Industry—including operatives, auxiliary and supervisory workers.

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<thead>
<tr>
<th></th>
<th>Number of workers</th>
<th>per 400 lbs. of yarn</th>
<th>3.0~4.0 average 3.5</th>
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<tr>
<td>Cotton Yarn</td>
<td>(basis 20's)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cotton Fabrics</td>
<td>per thousand square yard</td>
<td>1.5~2.5 average 2.0</td>
<td></td>
</tr>
<tr>
<td>(basis Sheeting 2A)</td>
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The basis for this high American productivity can probably best be explained by toaching and elucidating upon those features of the U.S. industry which struck me in the course of my travels.

The American cotton industry operates 22,600,000 spindles in spinning frames and 430,000 weaving looms. Its annual consumption of raw cotton amounts to 9,000,000 bales or close to four and a half times the amount allotted to Japan for the one year beginning April 1, 1955.

America has an exportable surplus in raw cotton amounting to 4,000,000 bales, after filling all her domestic requirements. Japan’s total spindleage is 8,019,000 (as of March 31, 1955) and the average count of Japanese yarns stands at 30.45's. On the assumption that the per spindle capacity of Japanese mills on a 16-hour day basis stands at 0.49 pounds for 30's, Japan would be able to consume the equivalent of 2,850,000 bales of American cotton annually. Actually however, she is able to import a measure 71% of this total capacity, which is the fundamental reason why in Japan such meticulous care and attention is called for in the selection and the use of raw cotton. A contrasting picture presents itself in United States.

Favored by an abundant supply of raw cotton, the American industry has ready access to the particular grade best suited for the type of finished product for which it is intended.
Uniformity is, therefore, maintained in the grade of cotton used for each specific type of finished product.

One evidence of the effect of the plentitude of raw cotton in the United States is the fact—to which I was an eyewitness—that, although American mills use roughly the same grade of raw cotton as we do, the staple length of a specific type of American yarn is actually 1/16" to 1/8" longer. This makes the American yarn about 10% stronger than comparable Japanese yarn, and reduces the breakage of the yarn during the spinning and weaving processes, which means that there is a resulting increase in productivity.

In the last few years, the Japanese cotton industry has come to apply the Micronaire in its work and is directing its attention to fiber fineness. In America, blends are made in fibers ranging in fineness from 3.5 to 5.5 in order to obtain finenesses of 4 to 5.

The American raw cotton used in Japan has a density running as high as 32 pounds per cubic foot. Most American mills use cotton of a density of 22~23 lbs/cu. ft., which makes for greater ease in picking and opening the bales. In my opinion, Japanese mills should make it a point to remove the iron hoops from cotton bales in the bale-opening room as soon as possible, in order to allow the cotton to return to an appropriate low density before being sent to the blending machine.

Simplification and Specialization in the Products

Another major factor contributing to high productivity in the American cotton industry lies in the simplicity of the producing processes. This means that the variety and number of both yarns and textiles are reduced and simplified, and that integrated processing is applied upon a wholesale scale. These are some of the predominant features of the cotton industry in America.

Another feature is that the products of each company have distinctive characteristics which are a result of high-degree specialization. As an illustration, a certain mill, with 100,000 and some spindles and 2,900 looms in operation, limits its raw material exclusively to high-grade Mississippi Delta cotton, of which it consumes 34,000 bales every year.

Another mill simplifies its processes to such an extent that it spins both warp and weft yarns from the same grade and type of cotton. By such simplification and specialization it is possible to avoid confusion in the processing methods by reducing the necessity for making unnecessary changes and, this brings about stability in operating methods and uniformity in quality.

With a teeming population of 87,000,000 crowding her tiny islands of an area of only 142,200 square miles and totally dependent upon imported supplies for her raw materials, the Japanese cotton industry can hardly aspire for such high-degree simplification and specialization. The alternative for her is to rely upon her industrious and willing labor force to try to turn out products which elsewhere would cost too much in labor to be produced profitably.

Rationalization Measures in Machinery and Equipment

The history of the American cotton industry goes back 315 years to 1640, when English settlers began spinning operations in New England, the first American cotton spinning mill being set up in Beverly, Massachusetts.

Despite its old history, equipment in American mills has been on the decrease in recent years, although the rate of decrease has not been excessive. For instance, in 1943 the spindleage totalled 24,070,000; in 1952 it declined by 6% to 22,600,000.

This means that most American mills are not necessarily modern or new. Conditions are rather that the old mills are making selective improvements and replacements of their equipment aimed at attaining the maximum mechanical and labor efficiency with the means at hand. This process of rationalization will be illustrated and detailed in the following.

(a) Simple and Continuous Processing

American mills carry out the opening and picking of cotton in one operation, and their layout plans for machines used in opening and picking are extremely simplified. This reduces the overworking of fibers and thus cuts down on the number of nep's appearing. Figure 1 shows some typical example of the layout of American opening and picking machines. Four to six bales are fed into one blending feeder, so that blendings can be carried out for a minimum of 12 bales up to a maximum of 60. In one mill, I saw counts ranging from 25's to 47's being spun from a single blending. This method of operation is not readily applicable in Japan, where raw cotton accounts for a major proportion of the price of yarn and we are unavoidably forced to select distinctive grades of raw cotton for each count in the narrow range of counts we produce. For example, we have to select one blend for 20's another for 30's and so forth. And because Japanese
mills produce yarns in a variety counts, they cannot apply the opening and picking machines now in operation in America.

Figure 2 shows the type of picker now in use in the most modern type of Japanese mill. In this single process picker, the cotton laid on both sides of the creeper lattice is spread by hand on the lattice in successive layers. This, I believe, is a distinctive feature of the Japanese cotton spinning methods today.

From the nature of the opening and picking machines now in use, three-passage drawing frames are common in Japan, although two-passage frames common in the United States are also coming into general use. It must be realized, of course, that these two-passage frames call for the application of the 5-roll system, the lap drawing system or the 3-over-4 system.

Roving in America is carried out by the one-process system for counts up to 40's and by the two-process system for finer counts. For counts above 30's, the spinning frame is fed by double-roving, which means that the draft in roving processes must be increased, and this is effected by using high-draft rovers. Fifty-two percent of the existing Japanese spindleage as of December 31,1955 was of the two-process roving and 46% of one-process roving. One-process roving is gradually showing an increase.

As of the same date, the number of Japanese spinning frames with drafts greater than 50 or what is known as Super High-Draft spinning frames increased to 900,000 in number. Super spindles and high draft spinning frames with 60 time draft. Since 1950, production in our firm has emphasized combed yarn, production in this line has proved highly successful, with the yarns being found exceedingly fine and smooth.

(b) The Application and Use of Automatic Machines and Automatic Controls

The high productivity of the American cotton mills and the uniform quality of their products are due, in a large measure, to the application of automatic operations and the use of automatic controls. Barber Colman's automatic spoolers and Terrell bobbin cleaners are already in common use in America. They have been coming into fairly extensive use in Japan also. Automatic quillers and drawing-in machines are also widely used in the United States. Among the new types of equipment coming into use in America are automatic lap deflectors and automatic can replacing equipment.

Another new innovation in the United States is the fiber meter. I saw one of these meters operating efficiently in a mill specializing in synthetic textiles. It was designed (as a type of blending feeder) to keep the blending ratio within the range of $\pm 1\%$.

Of the many automatic control devices em-
ployed in American mills, humidity control equipment is the most extensively used. The most popular humidity control equipment is a device which controls mist sprays by the use of animal membrane, which expands or contracts according to the relative humidity. In Japan, instead of animal membrane, hair is used with equally good results.

I found the relative humidity in American mills to be 50% for opening, picking, and carding, 60~65% for roving and spinning, 55~60% for spinning fine counts and 80~85% for the weaving room. Of especial note is the fact that humidity for the carding room stood at 50%.

Another popular automatic control device was the sizing machine. It automatically controls the temperature of the drying cylinder or the hot air, the level temperature and viscosity of the sizing in the sizing box, and the moisture content in, and the tension of the yarn. These control devices act to reduce variations in the pick-up or extent of sizing, and give excellent results, with, for example, a small sizing of only 8~10% on shirtings proving successful.

Automatic control devices have become an indispensable part of finishing machines, such as the J-Box and the Steamer.

c) High Speed

One of the latest efforts of the American cotton industry to attain higher speed has taken place in the replacement of old type combers with new high-efficiency combers. In the J-2 Combers of the Whitin Machine Works, the number of nips has increased from the normal 100 or so per minute to a minimum of 150, and this has increased production by from 2.5 to 3 times. Saco-Lowell's Model 54 Comber gives 106 nips per minute and a productivity amounting to three times (12 heads) the old-type combers. New combers like these are rapidly replacing the obsolete types.

In Japan, combers increased 35% in the single calendar year 1954. Serious efforts are being made to remodel existing combers with goals set at a production increase of 30~40%.

In America, the minimum speed of yarn on the winder has hitherto been 500 yards. Abbott's Automatic Travelling Spindle Winder has increased this to 600~650 yards and Barber-Coleman's spooler to 1,200.

Eighty-nine percent of the winder drums in Japan are quick traverse winders with an average minimum yarn speed of 153 yards per minute, according to a survey made in April 1954 by the Textile Machinery Society of Japan. Japan is, at present, importing Barber-Coleman's automatic spoolers and Abbott's winders to bring the most backward aspect of her cotton industry up to date.

Bobbin-changing type automatic looms from the shops of Draper's, Crompton and Knowles and Hunt are in wide use in America. They make 195 picks per minute for 44" and 185 for 50", which is at least 20% higher than the comparable Japanese looms, and their efficiency is as high as 93~96%.

d) Large Packaging

The large package system is an effective economizer of labor. It is being employed extensively and to an increasingly greater degree in Japan. The picker lap weight in U.S. mills is 50~60 pounds or 20~30 percent heavier than in Japan. As a result, the Americans are remodelling the fiddle backs of their picking machines and—as is being done by a segment of the Japanese cotton industry—replacing the brakes of their anti-friction racks with compressed air units.

American sliver cans of 12" diameter (minimum diameter) for cards and drawing frames are giving way to new, 14" cans. Cans of a 9~10" diameter have disappeared completely from the American scene. Ninety-two percent of the Japanese cans are still 9~10" in diameter, but they are rapidly being displaced by cans 12~14" in diameter.

I personally saw newly perfected American spinning frames capable of making packages as large as 3" in ring diameter and 11~12" in lift. But most American mills are remodelling their existing frames, instead of putting in new large-package frames. The sizes of packages I saw in the United States are given in Table 2.

<table>
<thead>
<tr>
<th>Count</th>
<th>Ring Diameter (inches)</th>
<th>Lift (inches)</th>
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<tbody>
<tr>
<td>16 ~ 20</td>
<td>2-1/2~2-1/4</td>
<td>9 ~ 8</td>
</tr>
<tr>
<td>30 ~ 40</td>
<td>2 ~1-3/4</td>
<td>8 ~ 7</td>
</tr>
<tr>
<td>50 ~ 60</td>
<td>1-3/4~1-5/8</td>
<td>7 ~ 6</td>
</tr>
<tr>
<td>80 ~100</td>
<td>1-5/8~1-1/2</td>
<td>7 ~ 6</td>
</tr>
</tbody>
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Of Japan's total spindleage in spinning frames, 54% are 6" lift and 30% are 7" lift, while 75% have rings ranging in diameter from 1-5/8" to 1-3/4". There is a tendency towards larger and larger packages, but limitations are imposed by such factors as the cost of labor and electric power and the overall production program.

In Japan, the weight of the cone or cheese runs from 1 to 15 pounds, while the weight of that on the automatic spooler is 2.5 pounds. On the Barber-Coleman's latest model spooler, it weighs as much as 6 pounds.

Japanese warpers' beams are 24~30" in diameter and American beams 38~40". Japanese weavers' beams are 18~20" in diameter, while American beams are 22~30". In Japan, cloth
on the loom is cut about 120 yards long along a marked cutting line (the maximum diameter of the cloth roller is 8 1/2”). In America, cutting is carried out when the cloth on the cloth-roller has reached 20” in diameter.

(e) Draft Rollers

Synthetic cots and aprons have been coming into increased use in Japan in recent years. In America, they are already in common use. American mills, furthermore, use ball or roller bearings for the loose boss rolls, which saves the worker the trouble of replacing the roll for varnishing and oiling. All he has to do is to clean the roller parts periodically with a roll picker.

(f) Mechanized Cleaning Equipment.

American mills have replaced their dust towers with air filters and return air condensers. When there is no need to expell the air, it is merely circulated to prevent the loss of heat or the variation of humidity. For spinning frames, American mills have a complete cleaning apparatus such as the Pneumafil or pneumatic cleaner. They also utilize travelling fans to prevent the accumulation of fly cotton in the spinning, roving, carding and finishing rooms, and a mono-cleaner to keep a fan in motion under the spinning frames.

Of the existing Japanese spinning frames as of December 31, 1954, 54% were equipped with pneumatic cleaners. Automatic card strippers developed by my firm and a few other Japanese companies are in use on about 8% of the 29,000 cards in use in our country.

Work analysis studies disclose that a Japanese mill worker in charge of a roving frame for 49’s spends 15–22% of her working time for cleaning. A worker in charge of a spinning frame who usually also handles the doffing, uses 30% of her time for cleaning. From these considerations, it is clear that mechanization of the cleaning operations is a task that should be given serious consideration.

The above are some of the most predominant features of the American cotton industry with respect to machinery and mechanical equipment. It must be noted that in remodelling and replacing the obsolete types of machinery, efforts are being expended to make the changes in the most speedily effective spheres or fields.

American Conception of Cleaning Periods, Frequency of Controls, etc.

Periodical cleaning, grinding of card clothing and quality controls in the U.S. cotton industry are carried out only to the minimum extent necessary, with no blind conformity to formality and consequently without the resulting waste of time and labour. Even quality controls are enforced only in consistence with economic considerations, subjecting the important stages of production such as the picking and opening processes to rigid controls, but limiting the control of less important stages such as the grain studies of the sliver and roving, to less frequent inspections and checks. The ultimate products, of course, are carefully checked for marketability.

Equitable and Just Distribution of Work and Fair, High-Rate Wage Level

America produced the famed F. W. Taylor, noted for his principles of factory management. His principles are observed throughout by the American cotton industry. Work is distributed fairly and accurately on the basis of time studies and other scientific job analysis studies. Wages are high and fair, and paid according to performance levels. The spirit underlying it all is that in America you are not paid unless you work.

The Zeal Displayed by Management and the Ready Cooperation of Labor

Visiting American mills, I sensed that in every firm, every worker from the president down, was fully aware that high productivity and low costs would increase the competitive power of their products in the markets, and would ultimately stabilize their own living and raise their standard of living. I was filled with a feeling of deep respect for the devotion to duty held by all workers from top to bottom.

The current minimum American cotton mill hourly wage is $1.10 and the average wage runs between $1.30 and $1.40. Considering that the average length of service is 14–15 years, it appears that the wage level is comparatively even.

Specialization and Non-Duplication in Research Studies

American manufacturers of textile machinery and accessories, of sizing materials, of dyestuffs and of textile chemicals all have highly equipped laboratories and research staffs composed of qualified technical experts. It is therefore inconceivable for any American mill to issue an order for a distinctive plan or exclusive blend of their own conception to the manufacturers, as Japanese manufacturers are forced to do. This is because they are able to use what the manufacturers offer them, with implicit faith.
The mills on their part devote their research facilities to their own fields exclusively. They exert themselves to seek means to increase production, to improve quality, to develop new lines and to open up new markets for their products.

Japanese textile equipment and supply manufacturers and mills are urged to take a leaf out of the book of their American confreres in this all-important aspect.

Conclusions

In my opinion, the American cotton textile industry has approached or almost reached the utmost in development, both materially and in mental approach. Under existing circumstances, further major improvements or progress can hardly be expected or hoped for without the appearance of a new invention that would prove entirely revolutionary in nature.

The Japanese cotton industry still lags considerably behind its American counterpart, however, and therefore further progress is possible if the proper efforts are brought to bear.

Here a brief reference to the Japan Cotton Industry Research Institute founded in 1952 will not be out of order. This institute has for its objectives the improvement and the emanation of technical developments in cotton spinning, weaving and finishing, and also of those in the mixed weaving of cotton with other fibers.

It has a 16-man board of officers, 15 of whom are presidents or vice-presidents of spinning companies, the remaining one being the executive director of the All Japan Cotton Spinners' Association. It has a board of councilors made up of 34 different spinning companies.

Acting independently and also working in cooperation with universities and various research organizations, the Institute has to date put into execution research studies upon 45 different projects. Besides the improvement of different processing methods, they include industrial hygiene practices, and the use of air filters in the mills as an aerodynamical consideration. Eleven detailed and comprehensive reports have developed from these research studies, and additional priceless information is being looked forward to.

My only regret is that this article must end in a depressing note. The fact is that the Japanese cotton industry is wholly over-equipped in relation to its existing markets and as a result has been forced to undergo a 12% curtailment in spinning and weaving operations since May 1st, following instructions issued by the Ministry of International Trade and Industry.

I live in hopes that with the proper efforts, we shall be able to bolster up the wobbly legs of the industry, and follow this up with plans to increase its depth and compass, that we shall be able to formulate a production schedule that will bring the best features of the Japanese people into full play and that these efforts of ours will prove to be the effective means to make a major contribution to the welfare of people in every corner of the globe.