UNITED NATIONS

ECONOMIC AND SOCIAL COUNCIL

E/CN.12/L.55
June 1971

FOR COMMENTS

ECONOMIC COMMISSION FOR LATIN AMERICA

THE TRANSFER OF TECHNICAL KNOW-HOW IN THE TEXTILE AND CLOTHING INDUSTRIES IN BRAZIL

prepared by

Luigi Spreafico, Consultant

Note: This report forms part of a study being undertaken by the Economic Commission for Latin America (ECLA), the Interamerican Development Bank (IDB) and the Division of Public Finance and Financial Institutions of the United Nations Department of Economic and Social Affairs on the problems of the transfer of industrial technology in Brazil.

TABLE OF CONTENTS

/1. Use of

/B. TECHNOLOGICAL

Page

/INDEX OF

INDEX OF TABLES

Chapter I

PRODUCTION IN THE TEXTILE INDUSTRY AND THE ACCUMULATION OF TECHNICAL KNOW-HOW OVER TIME

A. INTRODUCTION

Until recently, the textile industry was characteristically one of the branches of manufacturing that required relatively little technical know-how. And this was one of the reasons why in the early part of this century all the under-developed countries started off their industrialization process by manufacturing textiles.

At present, given all the progress achieved in the use of new synthetic fibres, new production techniques (especially for knitted goods and finishing processes), and automated spinning, the manufacture of textiles has become so complex that it is now possible to speak of a technical know-how specific to the industry.

Until relatively recently, the amount of technical know-how required for installing a textile plant consisted only in the identification of the product and the installation of the plant itself. The first of these was taken care of by the entrepreneur in rather arbitrary fashion, generally on the basis of data obtained from dealers. The second was taken care of by the manufacturers of equipment, without very much thought for local conditions and inevitably influenced by the economic interests at stake. Once the plant was installed and the preliminary tests had been run by the equipment suppliers, the entrepreneur then began to direct the plant, generally without much further technical support, in an improvised manner on the basis of trial and error. The largest plants usually brought in European technicians as managers, who often possessed a considerable stock of technical know-how, and these technicians were in complete control of the entire work programme, with the result that know-how was not transferred to the employees under them and no staff were trained to replace them. If the foreign technicians left, there was an administrative crisis in the plant until the enterprise found replacement for them.

/In the

In the textile industry today it is no longer possible to think in terms of technical know-how restricted to the installation, operation and maintenance of equipment. The appearance of new fibres, the interest of consumers in new products, the automation of machinery and other factors demand that the modern textile industry should possess technical know-how covering a vast range of specialized fields.

It can be said that the modern textile industry has points of contact with all the major categories of general technical know-how in the classification proposed by Mr. Nuno Fidelino de Figueiredo.1/

These categories, which are relevant to the textile industry, are as follows:

(a) Feasibility study and preinvestment analysis

(b) Selection of production process

(c) Identification (or design) of the product

(d) Plant design

(e) Plant construction

(f) Plant operation

(g) Staff training

For the textile industry the following have to be added:

(h) Quality control of raw materials, intermediate products and finished goods

(i) Preventive maintenance of machinery

(a) <u>Feasibility study and preinvestment analysis</u>

At present, no textile project of any size is initiated before a feasibility study has been made showing that the project is worthwhile, after determining such factors as the market, the supply of raw materials, the technical feasibility of the production process, the scale of production, etc.

(b) <u>Selection of production process</u>

There are many options open to the textile industry today as regards the choice of the production process to be included in the final project. Many new processes for combining synthetic and natural fibres have been

1/ Preliminary classification of technical know-how into major categories, in notes for internal discussion prepared by Mr. Nuno Fidelino de Figueire in May 1967, when he was Director of the ECLA Industrial Development Division.

patented. There are various new production techniques for producing similar articles or substitutes: woven or knitted fabrics, circular or longitudinal machines, non-woven fabrics, textured and non-textured yarns, etc.

(c) Identification (or design) of the product

Product design in the textile industry has become an increasingly important factor in recent years as a result of the boom in knitted fabrics and the appearance of synthetic fibres. Conventional specifications for knitted or woven fabrics used to be limited to the structure of the knit or weave and the type of finish. At present, however, as will be seen below in the section dealing with production, many other factors have to be taken into account before launching a new product on the market.

(d) Plant design

Plant design, which includes the architectural design, the lay-out of machinery, specifications for ancillary installations, etc., is still largely the responsibility of the suppliers of machinery, except for the architectural design. Even in the developing countries, however, with few exceptions, it is now being placed in the hands of specialised consultants who study various alternatives and discuss them with equipment suppliers and entrepreneurs until the optimum solution emerges.

(e) Plant construction

Formerly, plant construction comprised two stages. The first covered the building works, including ancillary installations, which the entrepreneur himself carried out either through a construction firm, or simply through a civil engineer and a builder. The ancillary installations (water, energy, steam, sanitation, humidification, security, etc.) were not always given enough attention or properly linked with the rest of the work.

The second stage was the installation of the equipment, which was the responsibility of the suppliers, as it is now. Frequently, however, the construction of the building and the installation of equipment were not properly co-ordinated, leading to losses of time on both counts. Moreover, because the ancillary installations were not the responsibility of the equipment suppliers, they did not always meet the necessary requirements, which led to problems that only came to light once the plant had started operations.

/(f) Plant operation

(f) Plant operation

When the equipment is purchased, the supplier normally makes a firm commitment to deliver the plant in perfect working order with a predetermined production rate for each machine, checked by means of tests.

The pre-work tests, therefore, are the responsibility of the equipment suppliers, and this is still considered even today to be the best way of doing things. But it is up to the entrepreneur to train the technical staff needed to run the plant after the official handover of the tested equipment.

(g) Staff training

The training of specialists in textile plants has never received sufficient attention. Only in recent years, as equipment has become more automated and maintenance needs have risen, have textile enterprises begun to turn their attention to training suitable staff to both operate and maintain equipment.

There are two other categories of technical know-how specific to the modern-day textile industry that are a consequence of technical advances in the manufacture of machinery producing more sophisticated articles, in which quality is of overwhelming importance. These are:

(h) Quality control of raw materials, intermediate products and finished goods, and

(i) Preventive maintenance of machinery

With respect to the first of these, the plant should have a well-equipped laboratory and test-shop, in addition to the necessary technical staff. With respect to the second, a section should be established within the plant administration to supervise specific maintenance operations.

These are the major categories in which technical know-how in the textile industry can be classified. Obviously, each category covers a wide range of specialized know-how, some of which will be considered in the present paper.

/B. THE ACCUMULATION

B. THE ACCUMULATION OF TECHNICAL KNOW-HOW IN THE TEXTILE INDUSTRY

For centuries weaving was the most important branch of artisan-type activity throughout the world, and it only lost its position as a consequence of the industrial revolution. Weaving and spinning first stopped being an artisan-type activity and became an industry around 1794 with the construction of the first cotton gins which were machines for separating the fibres from the seeds, a laborious operation which had previously been performed manually by agricultural workers.

Mechanizing this operation liberated a vast amount of labour and also substantially increased the supply of raw materials precisely at the moment when the output of the spinning mule, invented a few years earlier, was being increased.

By 1800 the mechanical loom was in widespread use, although its efficiency was affected by the low resistance to friction of the warp yarn. This problem was solved in 1803, when the first sizing machine was built which coated the yarn with starch to bind the loose fibres, thus increasing its resistance and elasticity. As a result, the mechanical loom began to be used extensively and began to compete very advantageously with the hand loom. Very soon the demand for yarn from the weaving mills had grown to such proportions that it began to exert pressure on the spinning mills to increase production. In other words, the difference in productivity in the two sectors forced the more backward of the two, in this case spinning, to make improvements to restore the balance.

These came in 1828 with the invention of continuous spinning with the ring spinner, which revolutionized the spinning techniques. Productivity rose so rapidly as a result that a new imbalance was created, with weaving now being at a disadvantage in terms of labour productivity. The main obstacle to the mechanization of looms was how to weave the weft into the material. Each time a shuttle ran out, the operation, which was mechanized, had to stop. The first attempts to replenish the shuttle automatically date from 1840, but it was only at the end of the 1800s that the problem was finally solved, and from 1900 onwards the automatic loom maintained its classic form until after the Second World War.

/During this

During this period, textile machinery was improved mechanically and made more efficient through small design changes, but the principles on which production was based remained unchanged.

In 1950, still without any alteration in the basic principles, the first automatic or semi-continuous spinning machines were constructed, but their over-all effect on production was negligible. Post-war research was mainly oriented towards automating conventional-type machines and reducing the share of labour in production, at the cost of an inevitable rise in capital intensity.

Nevertheless, the industry was slow to change and lagged behind in the technological advances that were then being spearheaded by the metal-transforming, electronics and chemical industries. It was the advent of synthetic fibres, at the end of the 1950s, and the great demand for them from the clothing industry, which finally spurred on the textile industry.

From that point on, spinning techniques were gradually simplified and weaving operations were automated. Controls were added to machines which raised the speed of operations and in some cases made it possible to triple or quadruple production. The Hanover Textile Fair at the end of 1963, marked the beginning of a new phase in the technological evolution of textile manufacture. The major new developments were the following:

(a) Consolidation of semi-continuous systems in cotton spinning mills;

(b) Introduction of the first open-end spinning machines;

(c) Confirmation of the economic viability of the shuttleless loom;

(d) Automation of continuous finishing processes;

(e) Appearance of new synthetic fibres, substantial reductions in their cost, and new techniques for mixing them with natural fibres;

(f) Mechanical improvement and automation of knitting machines to enable them to use synthetic yarns, giving an unexpected boost to this branch of the industry;

(g) Improvement of techniques for manufacturing non-woven fabrics;

(h) Automation of productivity controls of machines and computer programming of production;

(i) Appearance of new techniques for texturing synthetic yarns.

/Before considering

Before considering the significance of all this in the evolution of the textile industry, it is worthwhile illustrating the economic implications of technological progress over the past forty years. A good example to take is a cotton spinning mill designed to produce Ne 30 carded yarn, considered at moments that are representative of what may be termed the plateaux of technological progress, namely 1930, 1950, 1960, 1965 and 1970.

Table 1 illustrates the major coefficients relating to productivity and the level of investment required in each of these years. The data show a sharp reduction in the size of installations as regards both production units and area occupied. But what is most striking is the marked decrease in the size of the labour force, with a corresponding increase in capital intensity. Figures for particular plants will obviously vary within certain limits, since currently there are countless options available with respect to plant automation. In the example given here, the equipment considered most modern at the time and of proven efficiency was selected and equipment still at the experimental stage was disregarded. Even in 1970 the plant considered is still using the traditional ring-spinning system rather than the open-end system, despite the latter's bright prospects for the future.

But these are not the only changes that have affected the industry. The discovery by the chemical industry of man-made fibres with improved physical properties and lower prices brought a genuine revolution in clothing habits and stimulated the development of a branch of the industry that seemed doomed to stagnation, namely, the knitting industry.

Demand for knitted fabrics made of synthetic fibres stimulated improvements in both circular and longitudinal knitting machines, and this in turn led to more attractive products and a considerable reduction in manufacturing costs. Furthermore, the investment required per unit of product in the knitting industry currently runs at half or even a third of that required for woven fabrics, and there are virtually no economies of scale.

In addition, the needs of modern-day living, especially in the major industrial centres, have led the textile consumer to prefer ready-made clothing, which has developed another branch of the manufacturing industry that is increasingly becoming an inseparable part of the textile industry,

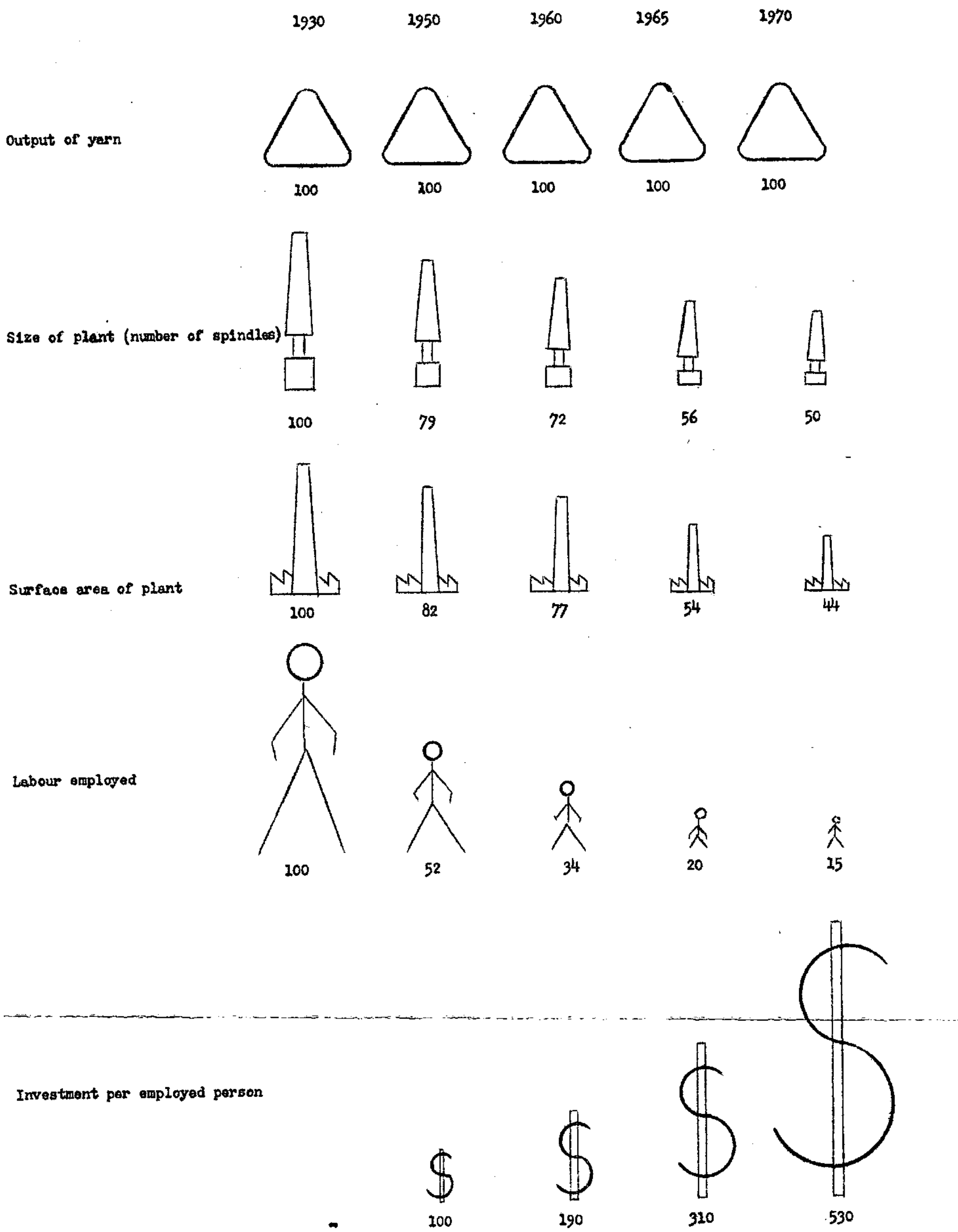
/Table 1

Table 1

PRODUCTIVITY AND INVESTMENT REQUIRED IN A PLANT PRODUCING NE 30

CARDED YARN IN SELECTED YEARS

(Index numbers)



/namely the

namely the clothing industry. At present, even in the developing countries where labour is cheap, consumption of fabric in lengths is on the decrease, and more and more confined to articles of clothing such as lady's wear (which is also being rapidly taken over by the knitting industry which produces a complete garment). It is somewhat curious to find that in the low-income countries the consumer of lengths of fabric is at the top and the bottom of the income scale: there is a small group at the top which can afford bespoke tailoring and a large group at the bottom which makes up the fabric at home. The vast mass of consumers are between these two extremes, with the result that the proportion of fabrics sold directly to the clothing industry stands at present at 90 per cent in the industrialized countries, and at close to 75 per cent in the more advanced Latin American countries.

The impact of the development of the clothing industry has been felt beyond the confines of the industry itself, since it has made it possible to use techniques in the manufacture of fabrics which had not so far been able to gain a footing. It must not be forgotten that the main obstacle encountered by the shuttle-less loom when it was first introduced was that it produced a fabric without a selvage, which was not easy for the consumer to accept. For the clothing manufacturer, however, the lack of selvage was no problem, and the shuttle-less loom is today considered a viable alternative in terms of economic advantage, and not an inferior competitor to the traditional loom as regards the quality of the finished product.

Another branch which today also constitutes a well-defined activity in terms of production techniques is the non-woven fabrics industry, especially fabrics for industrial uses or for clothing that is not worth washing and can be discarded after use, such as diapers, bed-linen for hospitals, towels for restaurants, etc. This branch of the textile industry, which can obviously only develop in a high-income market, has not yet been established in the developing countries, although in Brazil it is already being considered as an investment possibility. The most recent techniques for the production of non-woven fabric also yield mass consumption fabrics, that wear out quickly but are fairly cheap to produce.

/C. CHARACTERISTICS OF

C. CHARACTERISTICS OF THE PRODUCTION PROCESS IN THE TEXTILE INDUSTRY

1. Basic concepts

The manufacture of fabrics is a discontinuous process, in which the raw material goes through several stages of processing before it emerges as a finished product. Technological research in recent years has constantly been concerned with finding a continuous process for the industry.

In yarn production (which is only half the battle), the internal automation of machines processing cotton fibres has raised the possibility of a continuous process, but the final goal has not yet been achieved and does not seem likely to be for some time to come.

In the man-made fibres sector, which is really part of the chemical industry, the production of yarn (filaments) can be considered a continuous process. But this applies only to fibres used for a limited number of purposes. In many cases, filaments have to undergo further processing (dyeing, texturing, etc.) which breaks the continuity of the process. In others, the filament has to be cut and transformed into fibre, which involves spinning it just as if it were a natural fibre.

Another example of something like a continuous process is the manufacture of some types of non-woven fabrics, where the fibres are transformed directly into a flat resistant material with the properties of fabric; but this is only one example within a fairly large field.

The concept of the "process" in the textile industry does not appear to have received much attention in technical literature. This is understandable since the industry developed empirically and it has only been recently that researchers have begun to establish the physical and chemical laws governing processes, the behaviour of fibres in certain mechanical processes, and the way in which colouring pigments are fixed when dyeing fabrics, to mention but a few examples.

A clear conception of the "process", however, is fundamental for a consideration of many of the problems of the textile industry, and especially for a precise formulation of some questions relating to technology and the transfer of know-how.

/In a

In a document published by the Economic Commission for Latin America (ECLA),[2] the author developed an approach to this topic. The basic ideas put forward have been discussed and amplified at various levels and can be considered acceptable for a more comprehensive study of the topic.

The concept of the "production process" can be very broad, and various criteria can be used to classify the various phenomena within it into two basic approaches:

(a) The economic approach, by which the process is defined in terms of all the factors of production used as inputs to obtain the product. In other words, the process is identified by the volume of the factors of production required to obtain a unit of product, which means that any combination of factors that results in the same amount of product is presumed to represent the same process.

Hence, substituting labour for capital would not be modifying the process but simply changing its technological content. The process is only modified by changing the volume of the factors of production required to achieve a given amount of product.

This approach is certainly valid for many branches of industry, especially those using continuous processes; but in the textile industry, given all the possible combinations of factors in the different operations required to produce the final product, this approach would yield an infinite number of processes. In theory, since the combination of factors used in the manufacture of a particular textile varies depending on the degree of processing, any variation either in the raw material (the type of fibre, for example) or in the quality of the product (a thicker or thinner fabric, with or without a nap, etc.) would mean a different process. It therefore follows that, for practical purposes, this kind of classification will not do in the textile industry.

(b) The technological approach, based on the physical and chemical principles governing the operations of the process. As the physical (mechanical) and chemical principles involved in the various processing

---

2/ United Nations, La industria textil en América Latina, Vol. XII, Informe regional (United Nations publication, Sales No. : S.68.II.G/Mim.10).

/operations in

operations in the textile industry are perfectly identifiable, identifying the characteristics of the process is a feasible and practical task.

In traditional manufacture of textiles using natural fibres there are three clearly defined stages:

(i) The spinning stage, which consists in blending the fibres together into a continuous and even thread of predetermined diameter, the fibres being kept together by friction after being twisted. This blend of fibres constitutes the yarn. Natural silk spinning, however, is an exception, since it is based on a type of filament, and the process consists in twistint a number of the filaments together, which is also the process used in the production of man-made and synthetic yarns by the chemical industry. A distinction must be made with respect to spinning processes between carded yarn and combed yarn, as will be seen below when considering the mechanical principles applicable in each case. The spinning stage may also include a finishing process (gassing, mercerizing, bleaching or dyeing) which may completely or partially replace an equivalent process at the weaving stage.

(ii) The weaving stage, which consists in distributing and interlinking the yarn to obtain a flat, continuous and even fabric with predetermined characteristics as to weight, thickness, tensile strength, insulating properties, etc. The yarn produced in the spinning stage is used as raw material for traditional weaving; but in recent years weaving processes based on a layer of fibres have been discovered, which does away with the spinning stages. These are the processes for producing non-woven fabrics referred to earlier.

(iii) The final, or finishing stage, which consists in giving the fabric a number of properties to suit it to its final use: dimensional stability, appearance, softness (or roughness) to the touch, resistance to chemical agents or to the elements, etc. The processes used in the finishing stage are mainly chemical, although virtually always associated with a physical process.

Although a description of these processes falls within the scope of the present document, none will be given here since a fairly detailed exposition appears in the document referred to earlier.[3/] However, in order

3/ United Nations, La industria textil en América Latina, op. cit.

/to define

to define and illustrate the concept of the process, which is one of the aims of the present paper, it is essential to break down a textile process into its constituent basic operations. With this in mind, table 2 provides an over-all view of the three stages of production mentioned above.

In table 3, which also covers the three stages of production, the various processes are broken down into their different phases, taking the manufacture of cotton textiles as an example. The interrelationship of the various procedures and operations making up each process provides innumerable options that depend both on the raw material used and on the characteristics it is wished to give to the final product, depending on its final use. The example taken gives the largest possible number of combinations consistent with clarity of presentation, to make it as illustrative as possible.

Coming now to the main aim of the present examination of the concept of the process, table 4 breaks a process down into its various stages and identifies the operation (physical or chemical) characterizing each of them. Three examples are given, one for each stage of production, with chemical processes, as noted above, predominating.

2. Prospects of a radical change in the production processes of the textile industry

Research into textile technology has not always received a great deal of attention, even in the industrialized countries. The textile industry was for many years a traditional industry producing essential goods, and it always adjusted production to demand with a guaranteed profit margin, although not among the highest profit margins and despite the fact that it suffered cyclical and other forms of crisis. Crises in the textile industry became part of the economic history of some Latin American countries, but not only the developing countries. In 1952, when Europe was recovering after the war, the United Kingdom had to face problems in the industry and a large number of plants closed down in Italy.

It was the advent of synthetics, outside the textile industry, which stimulated interest in technological research in the textile industry itself. The chemical industry, with its vast fund of technological know-how accumulated as a result of research during the Second World War, soon developed products which, in the form of filaments, gradually replaced yarn

/Table 2

Table 2

THE THREE STAGES OF PRODUCTION IN THE TEXTILE INDUSTRY, BY MAJOR PROCESSES

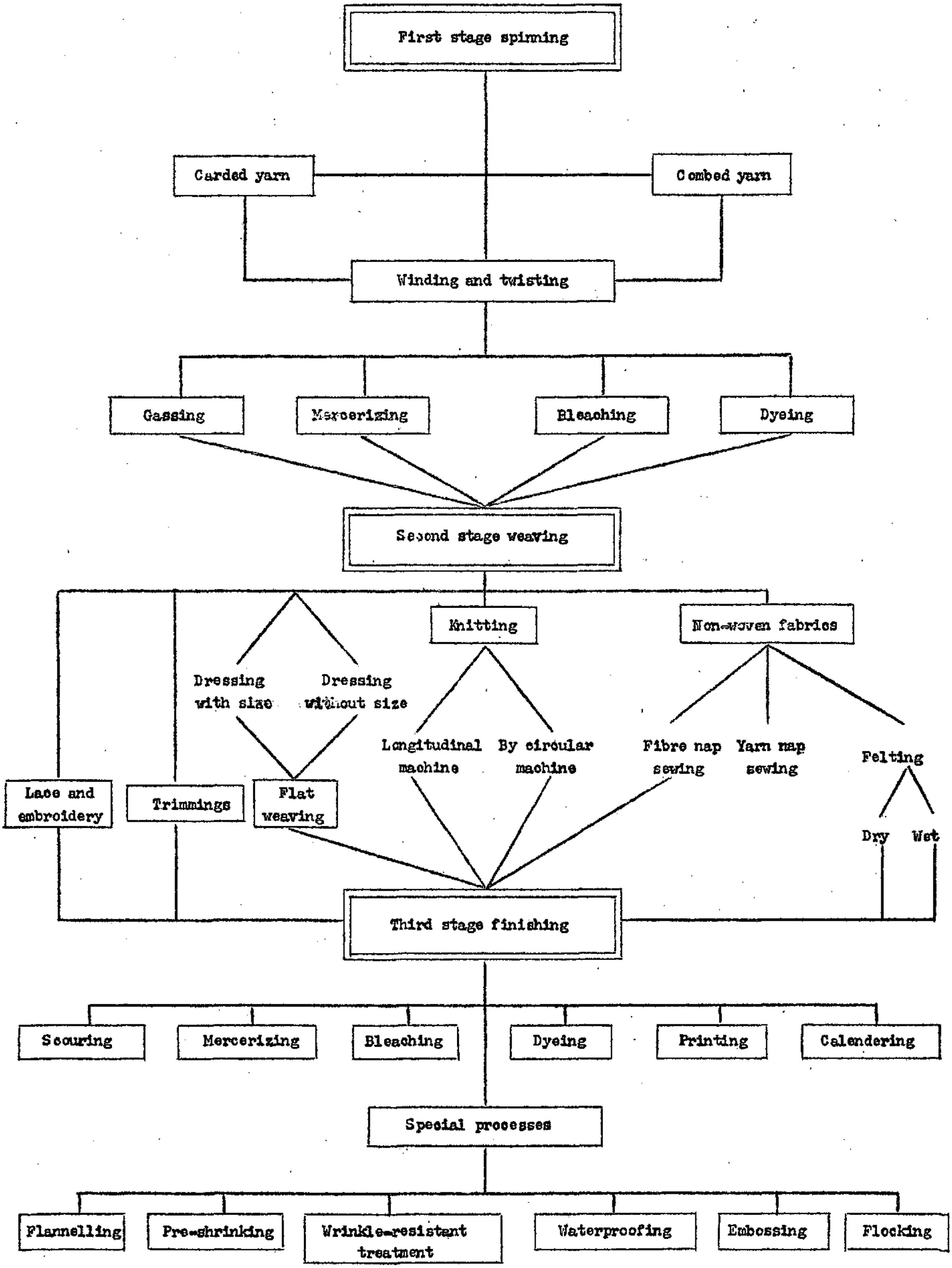
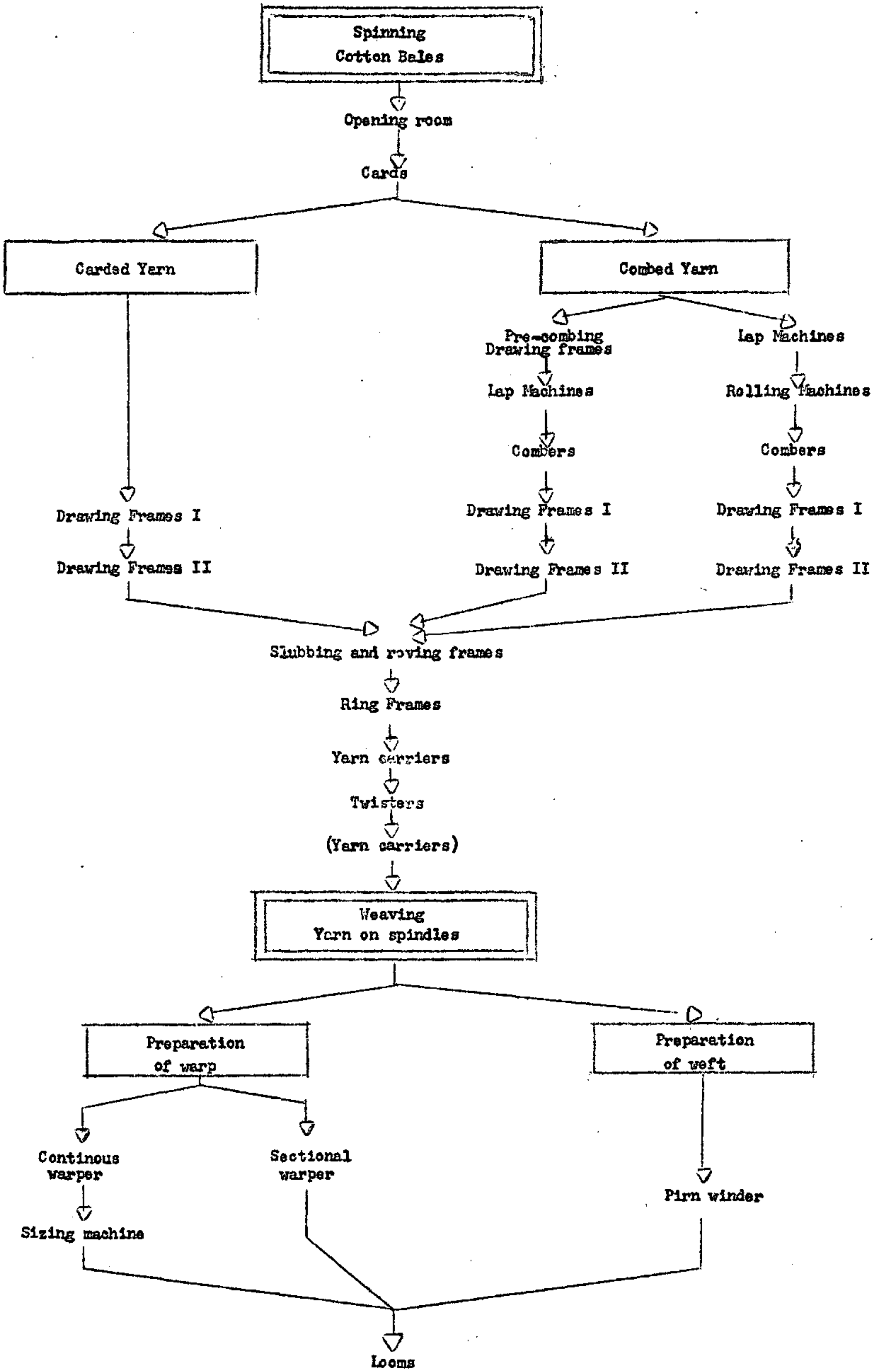
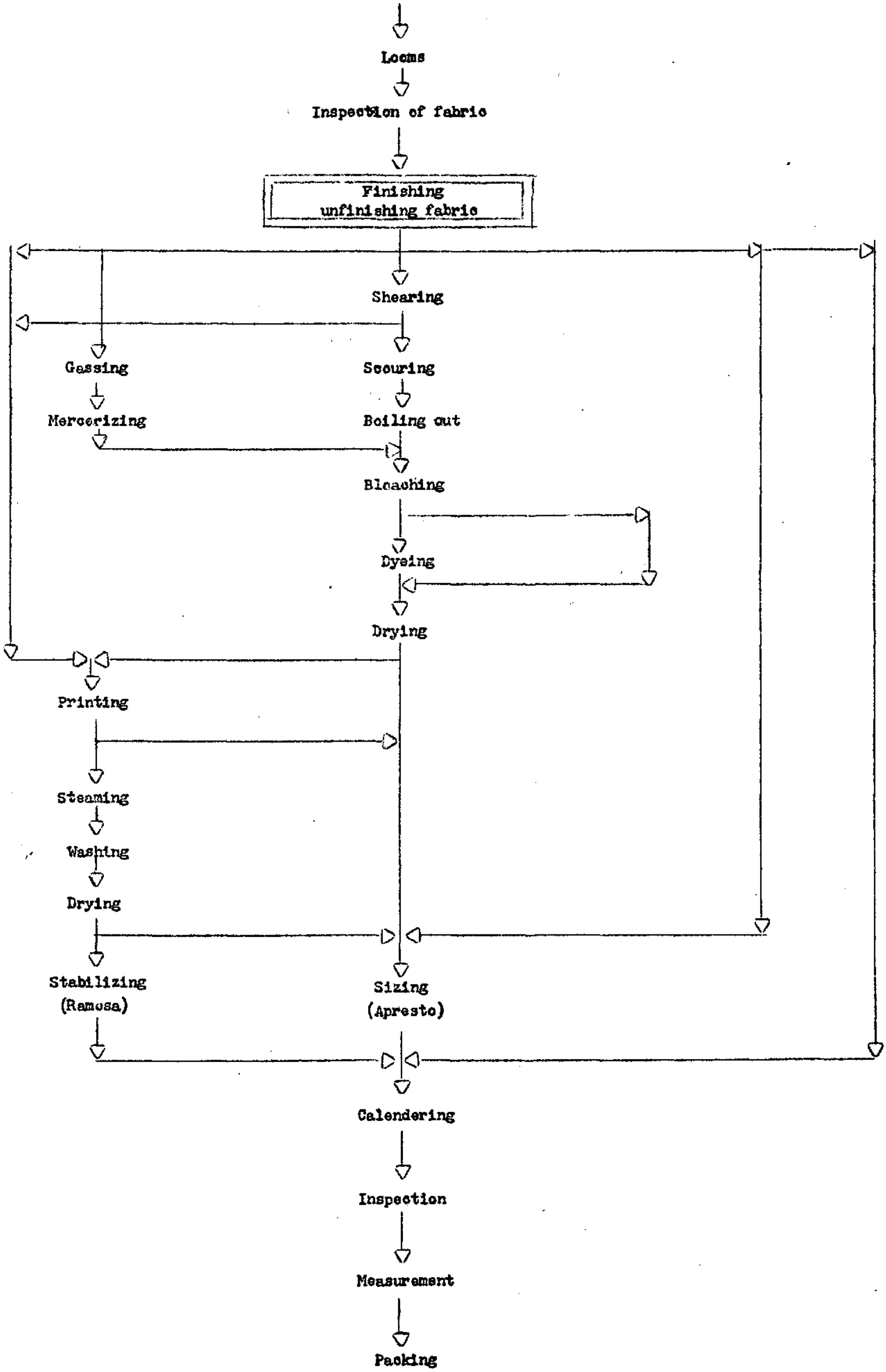


Table 3

PROCESSES USED IN PRODUCTION OF FLAT COTTON TEXTILES, BY OPERATIONS



/Table 3 (cont.)


Looms
Inspection of fabric
Finishing
unfinishing fabric
Shearing
Gassing
Scouring
Mercerizing
Boiling out
Bleaching
Dyeing
Drying
Printing
Steaming
Washing
Drying
Stabilizing
(Ramosa)
Sizing
(Apresto)
Calendering
Inspection
Measurement
Packing

/Table 4

Table 4

ILLUSTRATION OF THE BASIC OPERATIONS OF A TEXTILE PROCESS: FINISHING OF A FLAT MERCERIZED PRINTED COTTON TEXTILE a/

Stage	Basic physical operation	Basic chemical operation
1. Shearing	Removal of excess fibre and yarn by mechanical means (cutting)	
2. Gassing	Removal of floss by singeing (combustion)	
3. Scouring		Removal of coating of starch on yarn by means of a chemical reagent that makes it water soluble (enzyme treatment)
4. Boiling out	Treatment of fabric in rope form in weak alkaline solution at high temperature and under pressure (in an autoclave)	Removal of natural colouring matter in cotton and of other impurities susceptible to alkalis
5. Mercerizing	Treatment of stretched fabric in a concentrated alkaline solution at low temperature and under straight and cross tension	Modification of fibre structure, with the main component (cellulose) becoming oxy-cellulose, causing the fibre to "shrink" and change its shape from elliptical to circular.
6. Bleaching	Treatment of fabric in oxidizing solution, in rope form or stretched, at high temperature	Removal of natural colouring matter in cotton susceptible to oxidizers (sodium hypochlorite or hydrogen peroxide)
7. Printing	Application of colouring pigments by means of printing rollers to produce specific designs b/	
8. Final treatment	Washing and drying of fabric, with mechanical stretching to set its final dimensions	

a/ An earlier version of this illustration was given in ECLA, La industria textil en América Latina, op.cit.

b/ This is the most simple printing process. There are others using special aniline dyes requiring subsequent treatment to fix the dyes involving chemical reactions.

produced from natural fibre. It was only at this point that the textile industry began to realise the importance of research, partly to protect the economy of natural fibres and partly to find a satisfactory combination of natural and synthetic fibres or some way of improving upon the synthetic fibre.

The result was a restructuring of the textile industry, as mentioned earlier.

From the standpoint of the production process, which is the topic of specific interest here, the main objective of technological research in the textile industry, in which the developed countries have invested a great deal over the past decade, has been to develop a continuous process of production that eliminates the waste of effort involved in transporting the textile between one operation and the next and holding it between operations. This objective, however, still appears to be far from being achieved; there has been some success in eliminating certain operations, in simplifying others, and especially in increasing the level of automation of operations, but the continuous process has yet to be developed.

In several areas there has been relative success, but a process has not yet been found that fulfils all requirements as regards both final products and raw materials. The following examples illustrate the situation.

(a) The production of synthetic yarns by extrusion is basically a continuous process which does away with all the traditional spinning processes; but, since synthetic yarns in the form of filaments are not suitable for manufacturing certain fabrics, it is sometimes necessary to cut and spin the filaments by traditional methods. In any case, no bridge has been established between spinning and weaving.

Nevertheless, the advent of synthetic yarns, the polyamides and more recently the polyesters, has helped to simplify the production process by widening the range of knitting. Although this has brought no direct links between spinning and weaving, a substantial number of intermediate operations have been eliminated. Another contributory factor has been the appearance of texturing processes for synthetic filaments that have broadened their field of use (which, as noted earlier, was somewhat limited) especially in

/the clothing

the clothing industry. It should be noted, however, that the texturing techniques introduced in Europe in 1951 to produce stretch fabrics for sports clothing only reached a satisfactory level in the 1960s.

(b) For the reasons given above, the knitting industry, which has been neglected for so long, improved its equipment and took on renewed impetus. Knitting eliminates the preparatory work involved in weaving (warping, pirn winding, sizing) and brings a very large reduction in production costs and investment requirements.

In 1953, stretch fabrics had conquered the market and the first "one size fits all" stockings were released. In 1960, stabilized woven knits appeared on the United States market, produced in pieces from non-textured filaments which were perfect imitations of conventional flat fabrics and had the advantage of being more resistant and more pleasant to the touch. Only the fact that the price was high made them less competitive. Europe made a great stride forward in 1967 and 1968 with the production of smaller calibre machines which yielded extremely fine knitted fabrics from polyester filaments.4/ These fabrics, which have complete dimensional stability (something which was always a problem with knits), found a wide range of uses in the clothing industry, including the underwear industry, especially when they were produced from textured acetate filaments. As a result, knitted fabrics have been gradually increasing their share in total consumption. Estimates place their current share of clothing consumption in Europe at 35 per cent, and it is expected to rise to over 60 per cent by 1972. This may well happen if the relative price of synthetic fibres continues to fall and natural fibres continue to be unable to compete either in terms of price or by bringing out new and improved products. Latin America may follow this trend. In countries with a European-type climate, there is no doubt that it will; in tropical countries, knits are not equally desirable, but they may penetrate the market given the irrationality of the consumer of textiles, who is conditioned by a number of factors beyond his control. This point will be taken up at the end of the present document.

4/ It should be noted in passing that, as regards the development of new machines and processes, continental Europe has been taking over the position of leadership formerly held by the United States and England.

/(c) Non-woven

(c) Non-woven fabrics constitute the greatest area of effort to simplify the production process, for the fibre is transformed directly into fabric. This eliminates the entire spinning process and makes transformation of fibre into fabric a continuous process. Nevertheless, although this branch of the industry is clearly expanding, the uses for non-woven fabrics are as yet limited, and it is premature to speculate as to whether this process will be the final solution for the future.

Given this situation, research has been concentrated on two areas: first, stepping up the automation of machinery, with a reduction in the labour input; and secondly, making at least the spinning process continuous, once it became clear that it was impossible to combine spinning with weaving. As regards the first point, extraordinary results have been achieved. Investment per person employed in the cotton industry, on the basis of a three-shift working day, rose from 6,600 dollars in 1950 to 12,000 in 1960 and 20,600 in 1965.[5/] At present, a modern plant with a reasonable level of automation requires an investment of 35,000 dollars per person employed, and this figure can easily be as high as 40,000 dollars, depending on the degree of integration.

As regards the second point, actual progress has not gone further than linking the opening room with the cards. Attempts to link the opening room with the drawing frames (which in any case would not be a very decisive step) using the CAS system[6/] led to experimental projects but did not achieve any great results. In virtually all the countries that are traditional producers of textile equipment, manufacturers have developed their own systems of semi-continuous spinning. These efforts began to be abandoned around 1965, and research was switched to other areas.

5/ For more details on capital intensity and other coefficients of the cotton textile industry see ECLA "Choice of technologies in the Latin American textile industry" (E/CN.12/746).

6/ Continuous Automated Spinning, a system developed by the Toboyo-Howa Textile Engineering Co. Ltd., a Japanese company specially formed by the Toyo Spinning Co. and Howa Machinery Ltd.

/At present

At present, laboratories are endeavouring to achieve continuous spinning through electrostatic separation of the fibres, although the technical details of the process are still not well known. Another process which was tested and yielded practical results was the open-end spinning process. Although this is not a continuous process, it does simplify to some extent the production of cotton yarn (or cut man-made fibres) within certain limits of title, and raises the productivity of both machinery and labour. As far as is known, work on improving the open-end system is proceeding apace in some European countries, the United States and Japan. To date, however, the only open-end machine on the world market is produced in Czechoslovakia.

3. Classification of processes by type of fibre used

Textile fibre is the accepted term for any discontinuous material having the necessary properties for transformation into yarn. The term used to include natural silk, of animal origin, which in fact has the consistency of a continuous filament.

Subsequently, the first artificial fibres that appeared - viscose and acetate rayon produced from regenerated cellulose - also had the form of a continuous filament, although in many cases they were cut into lengths like natural fibres and then spun by conventional means in order to improve their properties.

A classification of textile fibres will be made in the present section - but without any intention of laying down the law - which differs from the traditional presentation of this topic. The objective is to provide the reader who is not too familiar with the textile industry with an outline of the textile materials being used today on an industrial scale, accompanied by brief comments on their relative importance.

Table 5 classifies fibres in major groups. Synthetic fibres, which are daily growing in economic importance, will be examined in detail at a later stage. As will be noted, the classification places synthetic fibres under the major division of man-made fibres, together with cellulose fibres. The term artificial fibres has not been used because it has caused a great deal of confusion, chiefly among the organizations responsible for compiling

/Table 5

Table 5

GENERAL CLASSIFICATION OF TEXTILE FIBRES a/

- Textile fibres
  - Natural
    - Vegetable
      - Seeds
        - Cotton
      - Stalks
        - Flax
        - Hemp
        - Jute
        - Ramie
        - Phormiun tenax
        - Kenaf
      - Leaves
        - Sisal
        - Henequen
        - Abaca
        - Caroa
        - Pita
        - Pineapple
      - Fruit
        - Coconut
    - Animal
      - Wool Silk
      - Fine hair
        - Mohair
        - Alpaca
        - Vicuña
    - Mineral
      - Asbestos
  - Man-made
    - Organic
      - Cellulose
        - Regenerated
          - Viscose rayon
          - Cuproammonium rayon
        - Cellulose esters
          - Acetate rayon
      - Protein (casein)
        - Lanital
        - Aralac
    - Inorganic
      - Minerales fibres
        - Glass
      - Metal fibres
    - Synthetic a/
      - Olefins
        - Polypropylene
      - Polyamides
        - Nylon 6
        - Nylon 66
        - Perlon
      - Polyesters
        - Dacron
        - Tergal
        - Trevira
      - Polyurethane
        - Glospan
        - Lycra
        - Numa
      - Acrilics
        - Orlon
        - Acrilom

a/ In order to identify the fibres more easily, some of the most well-known trade names are mentioned. A complete list of registered trade names is given in table 7.

/statistical data

statistical data.[7/]

Many of the natural fibres mentioned in the general classification are of economic importance in only a very limited area, for example metal fibres used on a very small scale in special fabrics for decoration or clothing, or glass fibre used in fabrics for curtains, for covering surfaces or even in the form of fleeces for use as thermal insulation. The same is true of asbestos, an extremely short mineral fibre that is difficult to spin, which has as yet not been replaced in the manufacture of cords and bands for packing and gaskets, or protective clothing for use at high temperatures.

The situation of some other fibres has changed over the years. Formerly, natural silk was of very great economic importance, but today its share in total fibre consumption does not even rate a mention in the statistics. Since the appearance of artificial silk (rayon) at an extremely low price, natural silk has never been able to recover its position. At present, in Brazil at least, it is relatively low in price, and in some cases cheaper than certain synthetic fabrics, despite its undoubtedly superior properties. It is used, however, by a small number of sophisticated consumers capable of distinguishing by sight and touch between natural and synthetic materials.

Despite their enormous variety, only two of the hard fibres, jute and sisal, are of economic importance. Both are used in the manufacture of sacking, cordage and, to a lesser extent, carpets. Of all the natural fibres they have been most affected by the advent of synthetic fibres; it would appear that, as the technical problems still existing as regards the packing of certain products in synthetic fibres are gradually solved, and the relative price of synthetic fibres goes down, natural hard fibres will be completely replaced.

7/ This new classification is designed to replace the terms "artificial fibres" and "synthetic fibres" used by ECLA hitherto. These terms have become unsuitable in the light of technical progress, and they also cause confusion, since both groups of fibres are produced by the chemical industry and are therefore produced artificially by man. The basic distinction was that artificial fibres were produced from natural raw materials (regenerated cellulose), while synthetic fibres were obtained by synthesis. However, for the layman these terms are interchangeable and this has been the reason for all the errors and divergencies of classification observable in statistics on production, consumption, foreign trade, customs tariffs, etc., to say nothing of all the normal problems of communication in the exchange of information.

/The two

The two natural fibres consumed on a large scale in the manufacture of fabric for clothing are wool, with 10 per cent of total world consumption, although it is tending to go the same way as natural silk and becoming a sophisticated low-demand product, and cotton, which accounted for 65 per cent of total world fibre consumption in 1962. Cotton clearly makes up the main bulk of textile consumption, but it should be noted that its share of consumption is also on the decrease, since in 1950 it accounted for 71 per cent of world consumption. The data are even more telling with respect to different regions. In western Europe, for example, cotton consumption accounts for only 50 per cent of fibre consumption.

Among man-made fibres, a distinction must be made, as in table 5, between cellulose fibres, which like natural fibres are losing ground, and synthetic fibres. There are now a vast range of synthetic fibres and their physical properties have been improved to such an extent that in many cases they are an advantageous substitute for natural fibres. However, the economic expediency of using them in developing countries is open to question.

It is useful to take account of the position of synthetic fibres in the world when looking at the transfer of technical know-how in the textile industry. The developing countries, whether they like it or not, are suffering the effects of synthetic fibres produced by a very dynamic sector of the petrochemical industry and protected by a small number of patents. This point will be dealt with at a later stage, from the standpoint of the transfer of technical know-how.

Man-made cellulose-based fibres, which at present are confined to viscose and acetate rayons, are produced from wood pulp. Until recently, cotton linter was also used as a raw material, but it was abandoned when it became too expensive. The production processes currently being used have not changed very much and, despite efforts to improve the quality of the fibre, for example the creation of polynosic fibres, consumption is stationary.

Man-made synthetic fibres are produced from petroleum or natural gas products and their production is a fairly complex process. The most important raw materials currently being used are given in table 6, which provides a brief outline of the flow of production with a list of the main groups of synthetic fibres now on the market.

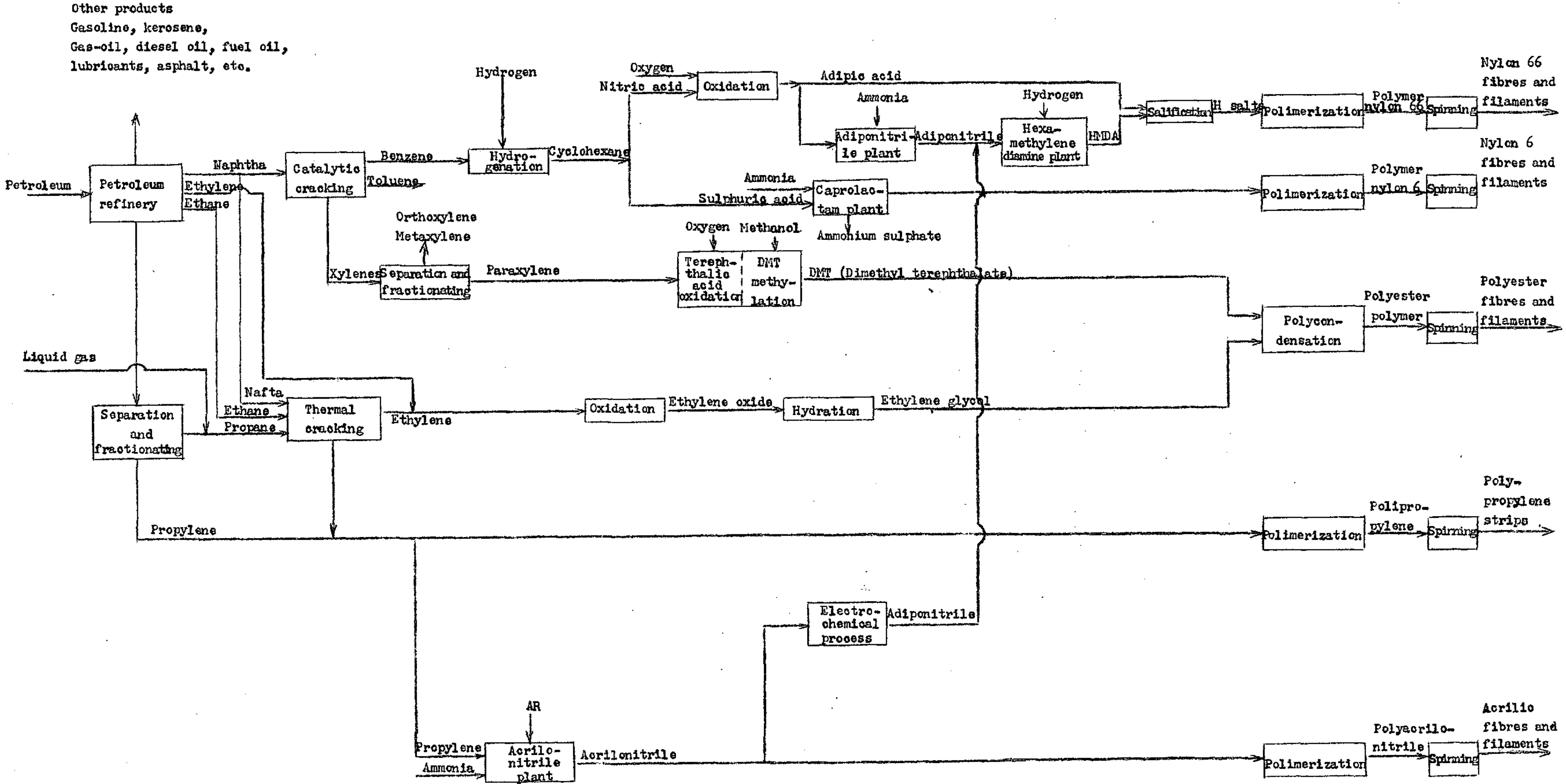
The number of plants producing man-made fibres in the western world totalled 445 in August 1969. Of these, 71 (16 per cent) were in Latin America. Brazil has only 14 plants producing man-made fibres.

The number of registered trade marks is high in relation to the number of plants in the western world. It is known, however, that the number of processes patented or which in some way constitute a production privilege is very small, probably less than twenty. All the other plants, therefore, are subsidiaries or produce under licence. Annex I lists the main trade marks currently in use by type of fibre manufactured and by manufacturer.

/Table 6

Table 6

RAW MATERIALS USED IN THE MANUFACTURE OF SYNTHETIC FIBRES AND A SIMPLIFIED OUTLINE OF THEIR PRODUCTION FROM BASIC HYDROCARBONS



Source: Marcelina Miranda and Enrique Bingeli, Simposio de las Fibras Manufacturadas (Buenos Aires, 1968).

Chapter II

DIFFERENT WAYS OF TRANSFERRING KNOW-HOW IN THE TEXTILE INDUSTRY

A. BACKGROUND

In the first part of this paper, reference was made to the main changes that have been brought about in the textile industry as a result of the technological development which has only begun to make itself really felt in the last two decades. This development, which was aimed at adapting the sector to new market demands, the availability of new raw materials, new cost ratios for the factors of production, etc., also produced a new attitude on the part of the textile manufacturer, which naturally led to a shaking up of the traditional structure of an industry where age-old production practices were the rule.

Thus, the way in which know-how has been transferred in the textile industry has also changed with time. It should be borne in mind that it was the very simplicity of the technology employed, compared with other sectors of industry, that was the distinguishing feature of the textile industry together with other factors, of course, right up to the early decades of this century. As a result, it was through the textile industry that the less developed countries started on the path of industrialization.

1. The establishment of the textile industry in Latin America

The first textile mills in Latin America began to make their appearance around 1800, but the golden age of the industry, when it really emerged as an industry, was from 1880 to 1905. During that period, the number of spindles and looms in Brazil, for instance, increased from 66,000 to 734,000 and from 2,000 to 26,000, respectively. [8/]

8/ United Nations, La industria textil en América Latina, op.cit.

/During that

During that period also, and for many years afterwards, the establishment of textile mills in Brazil took the simplest form imaginable: whole mills were transplanted from England, the only country that had equipment for export. These mills were installed complete with not only production equipment and auxiliary plant, but also structural supports for the buildings themselves, i.e., the metal columns 9/ and beams that supported the roof. This is the way it was done up to about 1920. It should be emphasized that new equipment was not bought for all the mills that were built in that period; as England began to modernize its textile industry, thanks to engineering advances achieved chiefly through the division of labour and mass production, there were many cases of the transfer of used plants to the Latin American countries. The technical staff needed to install the mill and keep it running were also English, with experience in the industry. The practice of importing English technicians to man textile mills in Brazil, and most probably in the other Latin American countries as well, continued up to the outbreak of the Second World War.

In the initial phase of the textile industry in Latin America, therefore, technical know-how and machinery came in a package deal. Even the buildings were designed in England, and the columns and roof beams mentioned above, came marked with letters and numbers to show where they should be put up.

It is difficult to know exactly how the entrepreneur made his decisions at that time. Everything points to the fact that, for a long time, textile manufacturers were sellers of textiles who, being familiar with market needs and demand patterns, and having accumulated profits in their commercial activities, decided to embark on an industrial venture.

The transfer of know-how as part and parcel of the sale of equipment continues to this very day; but in many cases the installation of a modern textile factory is such a complicated business that the entrepreneur is obliged to make decisions on his own account, or to seek the advice of specialists in addition to that of the machine manufacturer.

9/ These columns were made of cast iron tubing, and even to this day they can be found in mills in the north-east of Brazil.

/2. Current trends

2. Current trends

Nowadays, to set up any type of textile factory in all or nearly all the Latin American countries, decisions must be well considered and not the result of trial and error. On the other hand, with the technological development of recent years, the minimum economic size of the factories has increased considerably, necessitating a heavy capital investment, which means that the entrepreneur stands to lose much more if the factory has not been soundly planned. Thus, it is now possible to speak of technical know-how that is specific to the textile industry.

The know-how that is transferred in the textile and clothing industries will be divided into three different groups, to facilitate the study of the machinery through which such tranfers are made:

(a) Know-how needed to establish new factories;

(b) Know-how needed for re-structuring and modernizing out-of-date factories;

(c) Know-how needed to take advantage of special processes relating to one or more stages of the production process.

The first group will be studied in the light of the categories of know-how presented in the introduction to this paper. The second group is, in general terms, subject to the same categorization, but raises certain special problems that call for specialized knowledge of manufacturing techniques. It can thus be considered as a specific branch of know-how and will be studied accordingly. The last group relates to specific cases of the transfer of know-how in the textile industry and is divided into sub-groups, for each of which examples are given.

B. TRANSFER OF KNOW-HOW NEEDED TO ESTABLISH NEW MILLS

Taking as a basis the categories of know-how presented in the introduction, which are common to all industrial projects, the feature peculiar to the textile industry and the most common ways in which know-how is transferred in that sector will now be considered.

/First, however,

First, however, it should be made clear that even today the manufacturers of machinery are the major arbiters of the line to be followed in setting up new factories from the initial stage of decision-making, drawing up the production schedule, etc., up to the selection of equipment. Naturally, these guidelines are closely bound up with the manufacturer's interest in selling his machinery, so that the entrepreneur must try to exercise his own judgement by comparing information received from various manufacturers. However, textile manufacturers do not always adopt a rational approach when they are considering the alternatives that are open to them, and deciding upon one of them.

(a) Feasibility study and pre-investment analysis

Under this head are included the preliminary market survey, the definition of the line of products to be manufactured (production schedule), the dependability of the supply of raw materials and ancillary products, the availability of manpower and training opportunities, and any other data that may show whether it is advisable to continue with the project.

As a general rule, the study of the above data leads to the decision to draw up a project for the establishment of the factory that the entrepreneur has in mind. Nowadays, in Latin America, a textile mill is almost never installed without a plan being drawn up which can be used to direct the work or to obtain fiscal or financial support from the financing and development organizations. Nearly all the Latin American countries now have development organizations, banks or corporations which require a plan of the factory to be submitted to them before they will extend credit or grant fiscal incentives.

Since the entrepreneur himself is not qualified to draw up a plan, he has recourse to a firm or specialized consultant, though he generally already has a good idea of what he wants to do. The consultants carry out the feasibility study, using its conclusions to guide the entrepreneur and making any changes to the original idea that may be necessary.

/However, when

However, when an established industrial group wishes to build a new factory to diversify its production lines, it is the entrepreneurial group that carries out the necessary preliminary studies and makes all the decisions. Generally speaking, the groups that own several factories have a fairly wide range of professionals on their staff who are qualified to compile and interpret the data needed to make a decision. The entrepreneur aks a specialized firm to draw up the project only when it is necessary to obtain fiscal or financial help from government agencies.

This is what normally happens in Brazil, Argentina and Mexico, but it is impossible to generalize about the whole of Latin America with any certainty. However, it may be assumed that this is the case in the majority of the countries, including the small Central American countries, where the textile industry has already been the subject of analyses and expansion programmes carried out by both national and international organizations.

Obviously, this rule does not apply to small-scale enterprises, isolated spinning or weaving mills which manage to survive despite the difficulties they face. These are generally small weaving mills producing small amounts of special articles that it would be absurd to produce in large, well organized factories. There are also small spinning mills that produce thick yarn for the manufacture of rope and string. These small enterprises normally use old equipment and their success is usually due to the long experience the entrepreneur himself has acquired by working for other firms in the sector. This type of firm naturally uses somewhat out-of-date technology, and old and totally depreciated equipment; but this is quite in keeping with their aim, which is to exploit areas of the market that do not attract the large enterprises.

(b) Selection of the production process and equipment

Once the production scheme of the future factory has been determined, the entrepreneur, on his own initiative or through a consultant, requests several manufacturers to make bids for the supply of the equipment. The production process may be decided *ab initio* by the nature of the product chosen, and there may be no question of choice as regards equipment if the

/production process

production process is protected by a patent. [10/] In that case, the task of selection is simplified and the entrepreneur himself deals with the other stages of production.

Once the equipment is selected, the manufacturer plays an important part in the transfer of know-how, for to defend his machinery, he is obliged to enter into detailed explanations concerning the production process, to analyse its advantages and disadvantages and compare it with rival processes.

In fact, this is the only really effective manner of transferring know-how, since it enables the entrepreneur and his technical staff to keep their knowledge of production techniques up to date. Obviously, the transfer is to be made efficiently, the entrepreneur and his technical staff must have a basic minimum of knowledge which will enable them to discuss matters directly with the manufacturer, but this is not always the case.

(c) Definition (or design) of the product

The product has really been defined already in the feasibility study. What has to be done at this stage may more correctly be called the designing of the product, that is, establishing the final characteristics of the fabric with full technical details. Here, too, the transfer of know-how may take various forms, according to whether patented processes, special supplementary materials or registered trade marks are involved in the manufacture of the fabric. These special forms of transfer will be dealt with in more detail in the discussion of actual cases.

(d) Design of plant: construction of buildings and auxiliary installations and location of the equipment

A firm of architects specializing in industrial buildings is usually asked to make the plans for the plant, but in many cases the mistake is made of entrusting them to a civil engineer or directly to a firm of builders.

10/ This subject will be dealt with later in this report.

The latter work in close touch with the entrepreneur or with his consultant, so that building is planned to fit the needs of the textile industry. For this purpose, the consultant (or the entrepreneur himself) must supply the architect with complete data on staff movements, internal transport of materials, ventilation, temperature and humidity in the various departments, the amount of light, the minimum number of passage ways, the height of uprights and on many other things that are really the responsibility of specialists in textile factory design.

The auxiliary installations are entrusted to specialized firms: light and power systems, air conditioning, steam, humidification, fire prevention, etc. Only in rare cases, in very small factories, is work of this kind done by the entrepreneur's own technical staff.

A plan for the location of the machinery is always proposed by the machine manufacturers, who suggest it to the entrepreneur. The entrepreneur, in consultation with his technical staff, may make any changes he considers appropriate, but he will respect the rules laid down by the manufacturer for the amount of space to be left between machines.

(e) Construction of the factory: assembly and adjustment of equipment

The assembly and adjustment of equipment is always the responsibility of the specialized staff of the machine manufacturer, who charges separately for their services. Here there is a substantial transfer of know-how from those who are installing the plant to the local staff who help them to do it. If the local staff have been selected well, they will accumulate a detailed knowledge of the composition and operation of the machines during assembly which will be valuable for subsequent adjustment and maintenance. Neglect of this opportunity for training staff which does not involve any extra cost, has led to serious losses for many factories, whose machines often break down or lose their efficiency owing to faulty adjustments.

(f) Normal operation of plant and pre-testing

When they sell their equipment, the machine manufacturers accept responsibility for handing over the plant operating at a pre-established level of efficiency. After it is assembled, therefore, they carry out tests and make the adjustments required for it to meet production requirements. In addition, to the extent possible, they transmit specific know-how on the adjustment and maintenance of the machines to the local technical staff.

/It is

It is at this stage that the greatest amount of know-how on the performance, running, adjustment and maintenance of the equipment is transferred. In the last section, reference was made to knowledge acquired by local staff during assembly. In the testing phase prior to putting it into operation, such knowledge is given great breadth and depth, and the local staff learn how the raw material behaves as it is processed by the machinery. This is one of the most important phases in the transfer of know-how when new factories are being set up, and the alert machine manufacturer will devote sufficient time and effort to this task to be sure that his machines are left in the hands of competent staff; otherwise his reputation as a manufacturer would suffer. The cost of these services is included in the cost of assembly; this aspect will be dealt with in the appropriate section.

(g) Training of staff

In the previous sections several references were made to the training of staff that naturally takes place when the plant is being installed and in the period prior to its entry into operation. However, staff training cannot be limited to this transfer of know-how by the manufacturer; on the contrary, it must take the form of a regular programme of in-service training, both during the installation of the plant and during its normal operation.

This programme provides for on-the-job training during normal working hours, using instructors who have regular jobs in the enterprise and for sending staff from the factory to training centres or to the workshops of the machine manufacturers. In fairly large factories with an energetic administration, it is common for some high-level technicians to be sent to gain practical experience in factories abroad. The transfer of know-how thus obtained is remunerative and relatively cheap when the staff are selected properly. However, the staff to be sent abroad are not always rationally selected. In fact, it often happens in limited companies and family concerns that staff who do not have the necessary experience and technical background are selected and sent abroad supposedly for training, returning afterwards to become technical managers of the firm. In such cases, there is no transfer of know-how, since the staff chosen do not have the minimum qualifications to assimilate it. 11/

(h) Quality control of raw materials, intermediate and finished products

(i) Preventive maintenance of machines

Even in new plants, there are very few firms that pay much attention to these two items. In fact, only the large factories, which normally belong to groups already active in the sector, recognize the importance of preparing in advance a programme of quality control for raw materials and finished products and a programme of preventive maintenance.

Quality control in a textile factory calls for rather specialized know-how, both in the handling of laboratory equipment and in the interpretation of data. The manufacturer himself provides instruction in the use of equipment, the cost of which is normally included in the cost of the equipment. However, this is not enough to direct a laboratory in a textile factory, since it is essential to have a knowledge of production techniques and of the details of the composition of machinery in order to be able to analyze the results of tests properly and to make the necessary adjustments in each case.

11/ The research that the author carried out while drawing up the present work showed that this was common practice in the area covered by the Department for the Development of the Nordeste (Superintendencia do desenvolvimento econômico do Nordeste - SUDENE) in Brazil. There, thanks to government incentives, the amount of financing needed by the entrepreneur himself to install a plant is only 12.5 per cent of the total investment, so that the risk to him is negligible. Moreover, despite the facilities granted in respect of incentives, it was noted that the Government adopted a very tolerant approach to faulty projects and permitted the repeated reformulation of projects that contained technical errors. Obviously, this practice freed the entrepreneur of all responsibility for the technical (and hence economic) success of the enterprise.

/The maintenance

The maintenance schedule can be drawn up on the basis of the information supplied by the machine manufacturers themselves concerning the performance of the various parts and the minimum amount of cleaning, lubrication and adjustment required.

As was said above, only the large factories prepare a programme in advance to deal with these two items. The smaller enterprises work out some rule-of-thumb quality controls when these become essential. Some firms never reach the stage of maintenance, and do nothing more to preserve their machinery than repair defects or, at best, give a general overhaul when their efficiency begins to drop for no apparent reason.

C. TRANSFER OF KNOW-HOW NEEDED FOR RE-STRUCTURING AND MODERNIZING OUT-OF-DATE FACTORIES

It may seem strange to speak of know-how in connexion with the modernization of industries. However, because of the technological backwardness of the textile industry for so many years and the rapid development in the last two decades, there was a need for a general re-structuring of the industry. This process began in Europe, where the equipment installed after the Second World War was rapidly rendered obsolete by more modern machinery. In Latin America, the inefficiency of textile factories, owing partly to obsolete equipment and partly to defects in administration, was such a gigantic problem that several governments adopted measures of national scope to stimulate demand. ECLA was asked to collaborate in this work, and as from 1960, took over the responsibility for carrying out diagnostic studies of various Latin American countries.12/

These studies served as a basis for drawing up over-all programmes for re-structuring the industry in some countries, and for granting fiscal incentives (particularly exemptions from customs duties on imports of new equipment) in others.

12/ See United Nations, La industria textil en América Latina, op.cit., volumes I to XI, which deals with the textile industry in the following countries: Argentina, Bolivia, Chile, Colombia, Ecuador, Mexico, Paraguay, Peru, Uruguay and Venezuela. See also volume XII of the same series, entitled "Informe regional".

to decide on new lines of production, on the basis of personal observation and not always exact information supplied by wholesalers of textiles or dealers in secondary products and new raw materials. The knowledge of techniques for the utilization of new products and new raw materials is transferred to the consumer in the case of the textile industry by special means that will be examined later.

(b) Rationalization of the flow of production and simplification of intermediate operations

In many cases, an inadequate flow of production at the spinning or the finishing stage causes very high production costs. A review of this flow frequently leads to a simplification of the process, through the elimination of intermediate operations, to a reduction in the number of working hours in certain areas of production and even, indirectly, to an improvement in quality.

The source of know-how in such cases is generally outside the enterprise. It may be a specialized consultant recruited on a part-time basis or to carry out a specific task, or a technician from another factory with wide experience in the solution of similar problems.

(c) Modernization and replacement of obsolete machinery and relocation of machines

As was said earlier, the obsolescence of equipment is one of the chief causes of inefficiency in Latin American textile factories. In the programmes for the replacement of equipment that have been carried out in some countries, much emphasis was placed on the replacement of technically obsolete machinery, which implies a complete relocation of the machines. In many cases, production can be rationalized even without large-scale replacement of machinery, by relocating the machines so as to improve the transport of materials, provide space for the accumulation of stocks of intermediate goods, etc., thus achieving a considerable reduction in costs.

Two factors have influenced the textile manufacturers to replace equipment: the government incentives offered in countries with specific industrial development programmes, and the impossibility of competing on the market with antiquated machinery, which the entrepreneurs have found out for themselves.

The replacement of equipment does not always call for the introduction of a new technological process, though obviously a sound knowledge of what is offered on the market is required. The main responsibility for transferring know-how in such cases falls once again on the manufacturer of machinery. Generally speaking, the small-scale textile manufacturer is mostly unaware of the technological innovations being made in his sector. Publicity media, specialized magazines, technical bulletins, industrial fairs, etc., are not within his reach, since he moves in a very restricted circle, served at best by a trade journal, which usually appears rather irregularly.

In this case, the seller of machinery is also a medium for the transfer of know-how, which is obviously bound up with commercial interests, with the drawbacks already mentioned. The entrepreneur's decision is influenced to a greater or lesser extent by the skill of the salesman or by advantages that are quite unrelated to the needs of the project, so that the technical and economic considerations that should guide the choice of equipment are pushed into the background.

In the large textile factories which employ well trained technical staff on a permanent basis, the manufacturer of machinery still plays an important part in the transfer of know-how since he supplies information on technological innovations; however, it is for the entrepreneur to make a decision after a thorough study of the advantages of each alternative means of dealing with his particular problem.

(d) Establishment of systems for checking and reviewing administrative methods

The importance of administrative methods in relation to production costs has been understood in only a few textile factories in Latin America and the administrative shortcomings of the region's textile industry are

/well known.

well known. For instance, very few factories have suitable controls or even the most elementary quality controls for the final product and the raw materials purchased. The main controls needed for the proper running of a textile factory were mentioned in the section dealing with the establishment of new enterprises.

Obviously, no enterprise with administrative shortcomings can re-organize itself, and recourse must therefore be had to some source of specialized know-how. This type of re-organization requires a general knowledge of business administration and accounting procedures for the control of production costs, together with specialized knowledge of technical laboratory tests for applying quality control to raw materials, intermediate products in the course of manufacture and finished products. The firm must therefore call upon firms of consultants or recruit qualified staff on a permanent basis. Which approach is the most suitable will depend on a variety of factors, of which the most important is certainly the size of the enterprise. Only in a large-scale enterprise would there be any justification for recruiting, for its permanent staff, experts in various fields to establish systems that could be maintained with a smaller number of technical staff. Firms of consultants may supply a diversity of services at fairly low cost, and subsequently carry out complementary checks, at a minimum cost also.

The most important media for the transfer of this type of know-how are, in fact, the firms of consultants, since the first to be established in Latin America to advise the textile industry were all subsidiaries or branches of firms established in industrialized countries, with wide experience in all aspects of the textile industry. Even today, most of the advisory services available to the Latin American textile industry are offered by foreign firms. It is only recent years that have seen the appearance of the first local consultants and small firms employing staff with long years of practical experience.

/D. THE WAYS

D. THE WAYS OF TRANSFERRING KNOW-HOW ON THE USE OF SPECIAL PROCESSES AND SYNTHETIC RAW MATERIALS

The development of technology in the textile industry in recent years, which has frequently been mentioned in the course of this paper, has followed two lines that can be clearly distinguished:

(a) Perfecting production methods through the use of better equipment, simplification of the production process and automation of operations;

(b) Introduction of new products using new raw materials (synthetic or mixtures of synthetic and natural fibres) and better final processing of fabrics, thanks to new supplementary products or special equipment.

In the first case, know-how is transferred in the same way as when new factories are being built, through the sale of equipment, and the cost of the know-how is included in the cost of the equipment. In the second case, the methods or processes used in finishing the product or producing the raw material are heavily protected by world-wide patents, so that the know-how on those techniques or the mere right to use the trade mark can be transferred only through licensing agreements between the companies concerned.

The present section will be concerned with this way of transferring know-how, and it should be borne in mind that it is precisely this line of development that is increasing the technological dependence of the developing countries on the industrialized countries, a subject that will be dealt with at a later stage.

The main ways of transferring know-how on the use of special processes or new raw materials may be classified as follows:

1. Use of synthetic raw materials manufactured under well known registered trade marks, such utilization being subject to the use of the trade mark;
2. Use of patented equipment to obtain a product with special features, also subject to the use of the trade mark;

/3. Licensing agreements

3. Licensing agreements allowing the use of patented processes that improve the quality of the textile (pre-shrunk, non-crease, waterproof, self-adhesive, etc.);
4. Use of additional chemicals to improve the quality of the textiles or increase the efficiency of the processes;
5. Enterprise-to-enterprise agreements on the transfer or exchange of designs for the printing or embroidering of fabrics, and of patterns in the clothing industry.

This classification covers nearly all the forms of transfer of specific know-how that may be encountered in connexion with the use of special processes. Each of these groups will now be illustrated with a view to showing how the transfer machinery operates.

1. Use of synthetic raw materials

The appearance of synthetic fibres caused a real technological revolution in the textile industry. The current situation of the production of man-made fibres was described in chapter I of this paper. In addition, annex I gives a complete list of the most important man-made fibres produced in the western world, with the respective trade marks and the names of the manufacturers.

Man-made fibres in general, and synthetic fibres in particular, can be used to manufacture textiles either alone or mixed with natural fibres. Of the latter, the most common are cotton, wool and linen. The most widely used man-made fibres are synthetic, and of these, the use of polyester, both in its pure form and in mixtures, is growing most rapidly.

It is a well-known fact that the production of synthetic fibres throughout the world is the prerogative of a handful of manufacturers, owing to the enormous investment required and the vast sums that must be spent on research. Although the list of manufacturers in annex I, each with his own registered trade mark seems long, they all belong to a very few international holding companies.

For the use of synthetic fibres, the textile manufacturer pays only the price of the raw material (in which the cost of the know-how is obviously included) and receives permanent technical guidance in its processing.

/At the

At the same time, he undertakes to meet the technical standards specified for the product and agrees to permanent quality controls, which are applied by the manufacturer of the raw material, either in his own technical department or in some other with his concurrence. Once he has complied with these requirements, the textile manufacturer's product is certified under the trade mark.

This authorizes the textile manufacturer to print the registered trade mark of the synthetic fibre on the selvage of his fabric, and he must prove how many metres he has produced by submitting copies of the invoices or sales slips, and show that there is a balance between the amount produced and the quantity of raw material purchased.

The trade mark is protected by an intensive publicity campaign entirely at the expense of the manufacturer of the fibre.

Both the textile manufacturer and the clothing manufacturer are subject to control of the trade mark by the producer of the fibre. This means that, in order to be able to sell his garments with the fibre trade mark, the clothing manufacturer must not only manufacture the garments with a fibre that has a registered trade mark but also apply for them to be certified under the trade mark. For this to be granted, his goods must be made of fabrics approved by the manufacturer granting the licence, the design and measurements must meet certain specifications, and all accessories, linings, buttons, zip fasteners, packaging, etc., must also be certified by the holder of the trade mark. The clothing manufacturer does not pay anything to the licenser; all he must do is to adhere strictly to the conditions laid down in the contract and maintain the required standards of quality. The cost of these services is included in the cost of the raw material.

Once his products have been certified, the clothing manufacturer receives a certain quantity of numbered labels and tags made of cloth and cardboard; the cloth labels must be sewn into the garments and the tags attached in a very visible position. No garment may be sold or exhibited with only a label or only a tag.

The number of labels and tags used must correspond to the number of garments sold, which can be checked through the invoices and sales slips, copies of which must be sent to the licenser for control purposes. From time to time, the clothing manufacturer must also send the licenser a number

/of samples

of samples for quality control, without prejudice to the licenser's right to control samples collected by his inspectors from retailers. As can be seen, everything is controlled.

The fact that the clothing manufacturer has free use of an internationally - or at least nationally - known brand name is kept permanently in the public eye by extensive and judicious advertising, which guarantees sales, promotes the consumption of the certified textile and prompts further applications for the use of the trade mark. Increased demand for the textile leads the textile manufacturer to use more of the fibre for which he has the trade mark. In controlling the quality of the products of the textile and clothing manufacturers, the producer of the fibre preserves the reputation of his trade mark, since he ensures that the quality of the goods produced with his fibre comes up to the standard claimed in his advertising.

There are some manufacturers of textiles who use synthetic fibres that have unknown trade marks and are much cheaper. However, a survey carried out by the author in one area of Brazil showed that, in towns, the proportion of sales of goods with national trade marks compared to that of goods without or with little known trade marks was an incredible ratio of fifty to one.[13/]

The example mentioned above of the use of synthetic fibres with well known brand names is observable in all countries, including the under-developed, with slight variations according to local conditions.[14/]

The synthetic fibres most widely used in the manufacture of clothing (part of the example cited) are nylon, polyester and the acrylic fibres. Nylon is losing ground, and polyester has come to dominate the clothing market because of its superior qualities. In cold regions, it is the acrylic fibres that are gaining ground.

13/ The survey was carried out among twenty-two firms (seven manufacturers of men's clothing and fifteen retailers) in the towns of Recife, Natal, João Pessoa and Campina Grande, in the north-east of Brazil, an area where the annual per capita income is about 110 dollars.

14/ However, there is a vast difference between the price paid for the use of trade marks in the developed and in the developing countries. In the former, the price of synthetic textiles is levelling out at about two-thirds of the price of cotton fabrics, but in the latter, synthetic fibres are, on average, three times more expensive than natural fibres.

Another aspect of the use of know-how on synthetic fibres that should be mentioned (whether real know-how or only the use of trade marks) is the close relationship between the use of fibres and their manufacture. The manufacture of synthetic fibres, to which brief reference has already been made and which is really proper to the chemical industry, is a much more complex subject. For example, one of the newest synthetic fibres, polypropylene, is being used increasingly in the production of cordage and textiles for industrial and agricultural use.

The manufacture of polypropylene fibre (or, more precisely, filament or strip) is heavily protected by two patents and is therefore dependent on two licences.[15/] The first licence covers the right to produce the material called polypropylene; the second protects the right to use the manufacturing process itself. In most countries, the formula for producing polypropylene and the relevant patent belong to the Italian firm of Montecatini, with which Professor Natta, the inventor of the formula, is associated. Only Montecatini, therefore, can grant a licence for the production of the polymer of polypropylene. Some countries, however - Japan and Holland, for instance - do not grant patents covering formulas for the making of materials; and in the United States four companies are suing Montecatini for the patent, which they claim is theirs since they carried out the preparatory research for the production of polypropylene before it was discovered by Professor Natta.

The second licence that is required covers the right to use the process for the manufacture of polypropylene (and the transfer of the relevant know-how). Montecatini established a world pool of such licensees in collaboration with Professor Ziegler, the inventor of the process. The pool is managed by Montecatini in all the countries where the patent has been granted, except West Germany, where control is exercised by Professor Ziegler.

The situation is even more complex than it appears, however, since the control exercised by Montecatini and Ziegler is not limited to the manufacture of the raw material, but extends to its marketing and use. In some cases,

---

15/ The information given here on the production of polypropylene is based on the conclusions reached by the FAO Study Group on Hard Fibres at its third meeting, held in Rome in December 1968. The data used as a basis for the discussions of the group can be found in the FAO document Impact of Synthetics on Hard Fibres, which was presented at that meeting.

/the licensing

the licensing agreement prohibits exports of the material to countries where Montecatini can reserve for itself the right to use all the available raw material to produce the fibre, or where it may grant exclusive rights to use the patent to other firms.

2. Use of patented equipment to obtain a product with special features, also subject to the use of the trade mark

The type of know-how considered here includes the mode of operating machines and handling the raw material, the sale of patented equipment and the use of a well known trade mark, promoted by an intensive and permanent publicity campaign. Most of these procedures are adopted in the texturing of synthetic yarns.

When they were used directly in the form of filaments, the synthetic fibres, particularly nylon and polyester, lacked certain essential qualities that would have made them suitable for use in articles of clothing of which porosity or permeability to the air, hygroscopicity, elasticity and softness to the touch were the most important. This problem was solved by subjecting the yarn to a "texturing" process, which consists in so arranging the various filaments of the yarn that there is an extraordinary increase in bulk and it can be stretched up to four times its length.16/

There are various systems for texturing yarn currently in existence based on different principles, but all protected by patents. To obtain a licence to use the process, the manufacturer must purchase the equipment and establish in advance a level of remuneration for the provision of technical assistance periodically by the licensing firm. This includes quality control of the product since here too, the product must be certified before the trade mark can be used. The owner of the process - i.e., the firm that grants the license and holds the trade mark - is not always the manufacturer of the equipment. In some cases the equipment is produced by manufacturers of

---

16/ That is, a piece of texturized yarn can be stretched to four times its length and will return to its normal size when let go. With texturing, the so-called "covering power" of the textile is increased to an extraordinary extent, but without affecting its permeability, which is one of the main drawbacks of synthetic fibres. Thus, although there is no great difference of specific weight between the various synthetic and natural fibres, the weight per unit of area is always less in the case of synthetic fibres, other things being equal.

/traditional textile

traditional textile equipment under an agreement with the inventors of the process.

There are five basic processes for texturing yarn, the principles of which may be summarized as follows:

(a) Process of discontinuous twisting and untwisting; a strong twist is given to a continuous filament, the twist is fixed by heat treatment and subsequently relaxed. Thus, a very elastic, high-bulk yarn is obtained.

(b) "False twist" process: two filaments are separately given a powerful twist in opposite directions (that is, one is given an S and the other a Z twist and then immediately combined in a single yarn. They are fixed by heat treatment also. Very elastic high- or low-bulk yarns can be obtained by this process.

(c) Texturing with metal plates. Twisting is not used in this process, only heat treatment. The filaments are treated by being passed over hot metal plates. A high-bulk and fairly elastic yarn is obtained.

(d) Texturing in a compression chamber. The filaments are placed in a compression chamber to be given a crimp, which is fixed by heat treatment. High-bulk, non-stretch yarn is obtained.

(e) Air-jetting. This is a fairly simple process and has the advantage of making heat treatment unnecessary. The yarn is fed in by a pair of rollers, passed through an air jet and immediately wound on to another pair of rollers. As the yarn is wound off less rapidly than it is wound on from the rollers, the jet of air causes the filaments to form loops which become tangled and stabilized. As in the previous case, high-bulk, non-stretch yarn is obtained.

Whatever the principle, each process has its own individual characteristics, and is duly protected by patents, and those who obtain a licence are authorized to use the trade mark, subject to quality controls. The processes that are currently used to texture synthetic yarns and their respective registered trade marks are shown in table 7.

/Table 7

Table 7

PRINCIPAL PROCESSES FOR TEXTURING YARN AND THEIR REGISTERED TRADE MARKS

Registered trade mark	Licensing firm	Country of origin	Type of equipment and manufacturer
Helanca He; Nt; Sp; Soft	Heberlein and Co.	Switzerland	False twist machines, manufactured by Heberlein and Co.
Helanca Set; Boucle	Heberlein and Co.	Switzerland	False twist machines with special devices, manufactured by Heberlain and Co.
Ban-Lon Textralized	Joseph Bancroft and Sons	United States	Machines manufactured by Foster Machine Co.
Agilon	Deering Milliken Research Corp.	United States	Machines manufactured by Hoborn Aero Components Ltd. and Universal Winding Company
Saaba	Universal Winding Company	United States	False twist yarn passed through Universal device No. 511 made for application in the Leesona model 10 twister of Universal Winding Co.
Crimplene	Imperial Chemical Industries	United Kingdon	Machines manufactured by Scrag and Sons
Fluflon	Marionette Mills, Inc.	United States	Fluflon devices manufactured by Universal Winding
Taslan	Du Pont de Nemours and Co., Inc.	United States	Machines manufactured by U.S. Textile Machinery
Spunize	Spunize Company of America, Inc.	United States	Machines manufactured by Cocker Machine and Foundry Company
Superloft	Universal Winding Company	United States	False twits machines manufactured by Universal Winding Company
Tycora	Textured Yarn Company, Inc.	United States	-
Crinkle	-	United States	Machines manufactured by Scott and Williams and Textile Machine Works

/3. <u>Licensing agreements</u>

3. Licensing agreements allowing the use of patented processes that improve the quality of the textile

Enterprise-to-enterprise contracts lay down, among other things, the circumstances in which licenses may be granted for the use of special treatments to be applied in the final processing of the textiles, so as to change their characteristics, broaden the area of their use, increase their duality, and improve their appearance or softness to the touch. Agreements of this type usually provide for technical assistance to be supplied by the licenser on a permanent basis, the use of patented equipment, and the use of trade marks that have acquired an international reputation through extensive advertising.

The system is somewhat similar to that which obtains in the texturing of synthetic yarns described in the previous section, but there is a difference in the way remuneration is paid. Whereas in the previous case, the user buys equipment and pays for technical assistance only when he requires it, independently of his output, in the present case the machines may belong to the licenser or to a licensee, and the user pays a royalty based on the number of metres produced. Under the agreement, the user receives all the necessary instructions on the operation of the machines, is authorized to use the trade mark, and all his products are controlled from time to time by the licenser.

The processes applied under this heading relate to the finishing of the textiles and the most common of them are concerned with achieving stable (pre-shrunk) dimensions, water-proofing, increasing the durability of the fabrics or coating them with other materials (covering the textile with coats of resin, rubber, synthetic foam, rubber, etc.).

The transfer of know-how on these processes varies in complexity, since in some cases chemicals are employed in the process, in addition to equipment. Thus, the licenser may be, at one and the same time, the owner of the patent for the process, the manufacturer of the machinery and the supplier of the chemical product; or there may be a complex system of licenses whereby certain activities are delegated to sub-licensers.

/Of all

Of all the processes under this heading, the most important, in terms of the volume of material treated and the international reputation of the trade mark, is the pre-shrinking (or shrinking by compression) of cotton fabrics, patented by the United States firm of Cluet Peabody and Co., Inc., with the "Sanforized" trade mark. This process guarantees that the fabrics will not shrink more than 1 per cent in the direction of either the warp or the weft.

This is practically the only pre-shrinking process of universal application. The machines are not manufactured by the firm of Cluet but by other manufacturers, under license. The process could easily be copied, as is in fact done in some cases. However, the use of the registered trade mark is an important factor in the sale of pre-shrunk fabrics, because of its great publicity value; moreover, the licensing agreements contain fairly rigorous provisions in respect of quality control and the amount of material to be processed, prevention of copies or imitations of the process, control of the manufacture of machines and equipment by the licensing firm, the proper use of the trade mark or of anything approaching it.

As was stated above, the method of payment for the know-how on the processes dealt with here is different from that applying to the know-how of the previous section. The user purchases the equipment but has to pay a royalty on each metre of fabric produced and there is a minimum yearly payment when production does not reach a specified level. The user receives all the assistance he needs for the installation and operation of the machines, and guidance for testing the material. Moreover, his right to acquire any improvements to the process that the licensing company may subsequently introduce is guaranteed.

Another type of license that could be granted under this heading is for the use of a process for producing bonded and coated fabrics.[17/] Apart from the physical process in which patented equipment is employed, the license

---

17/ This process involves covering a fabric with a layer of some other material, generally plastic, or sticking two fabrics together to produce a third, or sticking a fabric on to a layer of fibres. There is an infinite number of possible combinations.

/covers the

covers the use of chemical products, in this case an adhesive resin. Under this type of license, the licensee does not buy the equipment but receives all the assistance he needs for its installation and operation, for which he pays a lump sum in advance. The licensee may use the process for as long as the contract remains in force and must afterwards return the equipment. He must also buy the adhesive product from the licenser, since it was created especially for this type of equipment, its formula is protected by patent, and the manner in which it is obtained is kept secret as far as possible. In this case also, the user pays royalties on the number of metres produced.

In Brazil, and in Latin America in general, the production of bonded and coated textiles has not grown so rapidly as in the industrialized countries, perhaps because these are sophisticated products, of fairly limited use. It is interesting to note that the few manufacturers of this type of material in Brazil have thought up their own rather crude and inefficient processes, or are branches of foreign firms. It is also possible that the complicated system of licensing, which calls for imports of auxiliary products (as in the majority of cases where adhesive resins are used), is an impediment to expansion in this branch of industry.

4. Use of additional chemicals to improve the quality of the textiles or increase the efficiency of the processes

The use of chemicals in the finishing of textiles is fairly widespread and is growing because of the efforts to reconquer the market being made by the manufacturers of fabrics from natural fibres which can only be modified by chemical processes.

The use of chemicals for finishing fabrics is not subject to licensing agreements, but it does require know-how which, although based on general rules that are normally known to the technical staff of the factory, is adapted to the particular features of each product. The know-how is transferred by the supplier of the chemical, without charge to the user since, for obvious reasons, it is in the supplier's interest for the know-how to be correctly applied.

/Among the

Among the chemical products employed in the textile industry, the most important groups is that of dyes for dyeing lengths of fabric or for printing, in addition to dyeing small quantities of yarn. Next in importance are the bleaches (hypochlorites and hydrogen peroxide) and auxiliary products such as alkalis, emollients, softeners, wetting-out agents, etc. Recently, as has been said, growing use has been made of resins to endow cotton with the characteristics of non-iron synthetic fibres.

Competition is stiff in the marketing of these products and the suppliers encourage regular visits by technical staff to the textile mills, to demonstrate their new products, make them known and discourage competition. The suppliers visit their regular customers from time to time in order to ensure that their products are being used correctly, to transfer the necessary know-how whenever there is a change in the technical staff of the enterprise, or to publicise innovations and improvements in the methods of application thought out by the producer.

The cost of these services is not very high, but it is obviously taken into account in fixing the price of the product. As competition is fierce and not all countries grant patents to protect the formulas of chemical products, the manufacturers frequently mix together several chemicals in a secret formula which is given a registered trade mark and promoted in the manner described above.

The more industrialized countries in Latin America, that is, Argentina, Brazil and Mexico, have now become virtually self-supplying as far as their needs for most of the chemicals used in their textile industries are concerned, though they still import a small percentage of special dyes and certain basic chemicals. The other countries still import nearly all the compounds they need.

5. Enterprise-to-enterprise agreements on the transfer or exchange of designs for the printing or embroidering of fabrics, and of patterns in the clothing industry

The transfer of know-how under this heading is also by licensing agreements signed by the enterprises concerned. The term "know-how" is not a good description of type of know-how, since it is not really the fruit of technological research, inventions or patents, and it does not necessarily

/involve any

involve any improvement of production processes or the use of special products. It more properly involves the transfer of the right to use an invention (a design, a model or any novelty introduced in respect of an article of clothing) which, by pleasing the consumer, can increase the volume of sales of the finished product, whether it be the fabric or the garment. As can be seen, this activity closely follows trends in fashion, and so changes in consumer tastes and how to create new tastes must be kept under constant study.

A classic example is the transfer of designs for textile printing by countries that are traditionally fashion leaders (e.g., France and Italy); these designs may be exploited at the same time as in the country of origin or, as happens more frequently, after the designs have been exploited on the markets of the industrialized countries (there is normally a gap of two years between the two stages).

In recent years, printing designs with tropical motifs and in bright, gay colours from Brazil and Mexico - to give two well known examples - have had a fair amount of success and have aroused interest in Europe. As a result, in many cases agreements have been made for the exchange rather than the unilateral transfer of designs.

In the case of embroidered fabrics, the way in which new designs are introduced may vary widely, according to the equipment adopted. Each manufacturer of equipment has his own system of creating designs, using different processes. Under the system where perforated cards are used to trace the design, the textile manufacturer may create his own designs and prepare the cards if the size of his enterprise so allows. Small enterprises can buy the designs (already in the form of perforated cards) from other enterprises of the same type or request them from the supplier of the equipment. As can be seen, this system allows the enterprise little freedom to introduce new designs.

Even in the field of embroidered fabrics there is a somewhat curious example of the transfer of know-how which is an interesting case of technological dependence. It concerns a European firm that produces machines for embroidering fabrics or ready-made clothes, with a wide range of designs. However, the user of the machine has no say in the making of the perforated

/cards that

cards that form the design. The manufacturer of the machine keeps a stock of designs in the form of perforated cards and these are sold separately from the machine at prices proportional to their size. If the user wishes to introduce his own exclusive design, he may have the necessary cards made by the machine manufacturer but the cost of the cards will be much higher in proportion to the number of stitches needed and will be worth while only if the sales volume is high. It is true that the machine manufacturer offers a wide variety of designs at a relatively low price; but it was observed that all his designs had highly conventional European motifs of little or no interest to other regions.

There is no doubt that such designs will sell the product in any event. Having a limited freedom of choice, the consumer will take the fabric that he finds most acceptable from among those offered. Moreover, if the textile manufacturer wishes to introduce his own design, the cost of the design of the motif and the manufacture of the perforated cards will be twice the cost in Europe.

In the clothing industry, the situation varies a great deal from one Latin American country to another: some still depend on foreign know-how while others are completely self-reliant. It should be made clear at the outset that in the clothing industry, know-how on the production process, that is, the cutting of the cloth, sewing, making buttonholes, putting on buttons, etc., is fairly unsophisticated and does not require much skilled labour. The problems that arise in a clothing factory are problems of work organization and rationalization, covering the location of machinery, the conveyance of material, control of stocks and of quality, etc.; such problems are common to any type of industry and the necessary know-how can be obtained from local consultants, even in countries that have recently started on the path of industrialization.

The only remaining specialized technique would be the styling of the clothes, which would require qualified staff not only to meet the fashion requirements of the consumer but also to ensure the economic viability of production on an industrial scale. For that reason this know-how was included under the present heading.

/However, clothing

However, clothing designs have become so uniform throughout the world that it is hard to imagine the possibility of new styles, even in the case of women's fashions.[18/] Moreover, no one would think of patenting the cut of a garment. Therefore, even the humblest cutter in any firm has access to any design. There remains the possibility of registering the trade mark (advertising an exclusive body styling, for instance) as a guarantee of a standard of quality.

Let us look at the situation in two Latin American countries, Brazil and Chile, which can be taken as examples of opposite extremes. In Brazil, the famous international brand names of ready-made clothing [19/] have either disappeared or compete on an equal footing with local brands. An inquiry was made among a number of large and small clothing factories in Brazil and all claimed to have their own models. When the models themselves were compared, they turned out to be identical. Only one of the firms consulted was using shirt designs under licence from a North American firm, though without using the trade mark. The firm did not intend to renew its contract when it expired, since it was not outselling its competitors by using a "better" design. A shirt made by this firm was compared with others on the market and was found to contain 30 per cent more fabric.

In Chile, all the big clothing factories work under licensing agreements and use famous trade marks. The fabrics are selected from among the best produced in the country. In one of the factories visited, which was licensed to use a famous trade mark, the system of transferring the design to the fabric which is currently employed universally, which consists in applying the pattern to the folded fabric, was not used. Designs were received from the United States in the form of paper stencils and in this form they were transferred to the fabric for cutting.

Obviously, the transfer of know-how in this way does nothing to raise the technical level of the developing countries. In some cases, such as that mentioned above, it would seem an easy task to throw off the technological

---

18/ Exception is obviously made of the "boutiques", which are already in the nature of an industry but which manufacture limited quantities of clothes for distribution to quality stores.

19/ By way of illustration, mention should be made of the most famous brand names in Latin America: McGregor, Arrow, Eagle Clothes, Manhattan Shirts.

/yoke that

yoke that surprisingly still exists; but there is no blinking the fact that the famous trade mark sells better because of its widespread promotion through advertising and because it guarantees uniform standards of quality.[20] Experience has shown that quality is one of the big problems facing countries with nascent industries, not only in the textile industry; but the problem is crucial in the textile industry, owing to the very nature of the production process, and has been the main factor in the small measure of success that has attended the attempts made by various Latin American countries to export their products to the developed countries.

As in the licensing agreements which provide for the use of the trade mark, quality control is insisted upon (organized and controlled) by the licenser, and its effectiveness is guaranteed. This obviously confirms a finding of previous studies: that lack of management capacity (defined in this paper as the ability to organize the technical and administrative sides of an enterprise) is still one of the most important causes of inefficiency in the textile industry in Latin America in general.[21]

E. THE USE OF FOREIGN CAPITAL AS A MEANS OF TRANSFERRING TECHNICAL KNOW-HOW IN THE TEXTILE INDUSTRY

Foreign investment, whether in the form of joint shareholding with national groups or through the establishment of subsidiary firms, is a fairly effective way of transferring know-how. In both cases, the parent company draws up the technical project, under which it even arranges the transfer of the necessary specialized personnel, and, for the duration of the firm's

20/ This does not necessarily mean that the quality is better, merely uniform.

21/ As an example of management capacity, great play has been made of the success of the textile industry in Colombia, where natural conditions were no more favourable than in other Latin American countries (see United Nations, La industria textil en América Latina, op. cit., vol. III, Colombia). Another example worthy of mention is the installation of a number of clothing factories in the state of Rio Grande do Norte, Brazil, a project initiated by an industrial group at a time when the minimum infrastructure for them did not exist. That state now has a number of clothing factories, all supplying the national market.

/existence, controls

existence, controls the production processes and, through them, the quality and quantity standards agreed upon (whether or not they are the same as those of the parent company).

This way of transferring know-how, however, does not necessarily mean that the manufacturing processes passed on from the industrialized to the developing countries are either the most up-to-date or the most suitable. On the contrary, there have been any number of cases where the techniques or equipment reaching developing countries in this way have merely been those that have become obsolete in their country of origin. However, this is merely by the way, as it does not come within the scope of this study to analyse whether or not the most advanced technology is the best suited to developing countries' needs - a matter that will be referred to again later on.

A typical example of the transfer of out-of-date know-how involves the manufacture of machinery for the textile industry. A world famous firm set up a subsidiary in Brazil for the production of spinning-machines which the parent company had ceased using. Although the imported articles - including those manufactured by the parent company itself - with which they had to compete were liable to customs duties, these machines were so unsuccessful on the local market that the plant eventually had to close down.

A third application of foreign capital entails the transfer of equipment as a minority share in the capital stock of a national company. Cases where this procedure has been adopted by machine manufacturers - mostly as a means of ensuring the sale of the equipment - are few and far between. Transfer of technical know-how does not play much of a role in this process, as it is restricted to technical assistance from the manufacturer during the installation of the machines and, for the rest, the same situation prevails as for direct sales of equipment.

Possibly because of its previously mentioned traditional character, which means that it can more easily attract small volumes of local capital in countries at the initial stage of industrialization, the textile industry has not in the past been especially popular with foreign investors.

In recent years, however, two factors have altered this situation: (a) the increasing consumption of synthetic fibres, whose production at the level of both the chemical industry and of the textile industry proper requires more complex technical know-how; and (b) the steady growth of the

Japanese textile industry, which, after saturating the external markets that were open to it with its products and finding its exports restricted, started investing abroad.

There have been several instances of Japanese capital investment in textiles in Brazil, though they are not so common in other Latin American countries. There have also been occasional cases of British capital investment in the Latin American textile industry, but on a much smaller scale than in the Far East. All in all, the United States is the only really large-scale foreign investor. The United States domestic market first began to suffer severely from the competition of imported textiles during the 1950s, and this encouraged its textile manufacturers to try to produce more cheaply in other countries. Between 1950 and 1960, United States investment in the textile and allied sectors jumped by 12,000 million dollars to 36,000 million;22/ it is worth noting, however, that its exports of textiles (including raw materials) during the same decade rose to nearly 40,000 million dollars, which more than covered its total investment abroad.

It should be pointed out that United States investment was not strictly limited to the textile industry but was spread over the production of synthetic fibres, which absorbed most of it and the production of equipment, which more properly belongs to the metal-transforming industry. Strangely enough, United States investment, at least up to 1965, was not concentrated in developing countries; more than 50 per cent of the total went to Europe, especially the countries of the European Common Market.

For all this, a large number of United States firms have invested in one way or another in the Latin American textile industry. Though no precise quantitative data are available on such investment, it is known that 20 per cent of United States textile factories operating outside the country in 1965 were located in Latin America. Table 8 gives a list of these factories and their distribution by country, together with the name of the firm, the kind of association involved and the product manufactured. It should be noted that the table cites a certain number of licensing agreements that presumably involve investment in machinery. Simple licensing agreements, which are also a means of transferring know-how, are not included here as they have been

---

22/ Textile Industries, September 1965.

/Table 8

Table 8

UNITED STATES FIRMS WITH INVESTMENTS IN LATIN AMERICAN TEXTILE AND ALLIED (MAN-MADE FIBRES AND TEXTILE MACHINERY) INDUSTRIES, 1965

Name of United States firm	Country in which capital is invested	Name of associate firm	Name of joint firm	Type of investment	Product manufactured
1. Albany Felt Co.	Mexico	Nordiska Maskingfilt Ab.	Albany Nordiska de México Cv.	Majority shareholder	Felts, fabrics for the pulp and paper industry
2. Ansonia Mills, Inc. (subsidiary of International Stretch Products Inc.)	Colombia	Sedas	-	Licensing agreement	Spandex fibre fabrics
3. Ansonia Mills, Inc. (subsidiary of International Stretch Products Inc.)	Mexico	La Hortensia	Ansonia Mills de México	50% shareholder	Spandex fibre fabrics
4. Bemis Brothers Bag Co.	Honduras	-	Compañía de Sacos Centro-americana	Subsidiary	Cotton bags
5. Bemis Brothers Bag Co.	Honduras	Fábrica Textil Bemis Handal	-	Associate	Cotton bags
6. Bemis Brothers Bag Co.	Mexico	Bemis Craftil S.A.	-	Associate	Cotton bags
7. Berkshire International Corp.	Argentina	Salzmann, Medias Paris, Sai y C.	-	Minority shareholder	Men's and women's hosiery
8. Berkshire International Corp.	Colombia	-	Berkshire de Colombia S.A.	Direct investment	Women's hosiery
9. Berkshire International Corp.	Peru	-	Berkshire Internacional de Perú S.A.	Direct investment	Men's and women's hosiery
10. Berkshire International Corp.	Costa Rica	Nylonera Nacional Ltda.	-	Licensing agreement	Men's and women's hosiery
11. Berkshire International Corp.	Mexico	Industrias Grunstein S.A.	-	Licensing agreement	Men's and women's hosiery
12. Bigelow-Sanford Inc.	Argentina	Alfombras Sparta Atlantida S.A.	-	Licensing agreement	Carpets
13. Burlington Industries Inc.	Colombia	-	-	Unknown	Synthetic fibre fabrics
14. Burlington Industries Inc.	Mexico	-	-	Unknown	Cotton and synthetic fibre fabrics, texturized yarn, and carpets
15. Celanese Corp. of America	Mexico	-	Celanese Mexicana S.A.	Direct investment (48% minority shareholder)	Nylon 6, polyester, rayon and acetate fibres
16. Celanese Corp. of America	Colombia	-	Celanese Colombiana S.A.	Direct investment (51% majority shareholder)	Polyester, rayon and acetate fibres
17. Celanese Corp. of America	Peru	Rayón Peruana S.A. y Filamentos sintéticos S.A.	Rayón y Celanese Peruana S.A.	50% shareholder	Polyester, rayon and acetate fibres
18. Celanese Corp. of America	Venezuela	-	Celanese Venezolana S.A.	Direct investment (70.8% majority shareholder)	Acetate fibres
19. Celanese Corp. of America a/	Venezuela	Creole Investment Corp.	C.A. Fibras químicas de Venezuela	56.7% majority shareholder	Nylon 6 and polyester fibres
20. Chemstrand Co. e/ou Monsanto Co.	Colombia	Bigio	Fábrica de Hilazas Vanylon	49% minority shareholder	Nylon 6 fibres
21. Chemstrand Co. e/ou Monsanto Co.	Uruguay	Slowak	Sintéticos Slowak	30% minority shareholder	Nylon 6 fibres

UNITED STATES FIRMS WITH... (continued)

Name of United States firm	Country in which capital is invested	Name of associate firm	Name of joint firm	Type of investment	Product manufactured
22. Coin International, Division of Coin sales Corp.	Brazil	Drastosa S.A.	-	Licensing agreement	Bonded and coated fabrics
23. Cone Mills Corp.	Argentina	Fábrica argentina de alpargatas SAIC.	-	Direct investment (minority shareholder)	Canvas, twine and rope
24. Draper Corp.	Colombia	Lanzaderas colombianas S.A.	-	Licensing agreement	Shuttles
25. Draper Corp.	Mexico	Lanzaderas Vidal S.A.	-	Licensing agreement	Shuttles
26. Draper Corp. b/	Mexico	Siderúrgica Nacional S.A.	-	Licensing agreement	Looms
27. E.I. du pont de Nemours & Co.	Argentina	-	Ducilo SAIC.	Direct investment (72% majority shareholder)	Rayon, nylon 6 and nylon 66 fibres
28. E.I. du pont de Nemours & Co.	Mexico	Nylon de México	Pclioréon de México S.A.	49% minority shareholder	Polyester fibres
29. W.R. Grace & Co.	Peru	-	Compañías Unidas Vitarte-Victoria Incas S.A.	Sole shareholder (100%)	Cotton yarn and fabrics
30. Jantzen Inc.	Brazil	Gilfort S.A. Comercio e Industria	-	Licensing agreement	Knitted fabrics
31. Jantzen Inc.	Chile	Industrias Textiles Subelman y Fliman S.A.	-	Licensing agreement	Knitted fabrics
32. Jantzen Inc.	Colombia	Colombiana de Textiles y Confecciones Ltda.	-	Licensing agreement	Knitted fabrics
33. Jantzen Inc.	Mexico	Caravel S.A.	-	Licensing agreement	Knitted fabrics
34. Jantzen Inc.	Peru	Scala S.A.	-	Licensing agreement	Knitted fabrics
35. Jantzen Inc.	Venezuela	Industrias Ha-ri S.A.	-	Licensing agreement	Knitted fabrics
36. Jonathan Logan	Venezuela	-	Texfin C.A.	Sole shareholder (100%)	Cotton and mixed fabrics
37. Jonathan Logan	Venezuela	Affil e Texfin C.A.	G.P. Kahan & Cia. C.A.	50% shareholder	Cotton fabrics
38. Jonathan Logan	Venezuela	-	Unknown	Sole shareholder (100%)	Polyester fibres
39. Kendall Co.	Brazil	-	Kendall do Brasil	Sole shareholder (100%)	Cotton and mixed fabrics
40. Kendall Co.	Colombia	-	Industrias Kendall de Colombia	Sole shareholder (100%)	Cotton and mixed fabrics
41. Kendall Co.	Mexico	-	Kendall de México S.A.	Sole shareholder (100%)	Cotton and mixed fabrics
42. Liberty Fabrics Inc.	Argentina	Unknown	-	Licensing agreement	Lace
43. Liberty Fabrics Inc.	Mexico	Unknown	-	Licensing agreement	Lace
44. Owens-Corning Fiberglass Corp.	Mexico	Fomento de Industria y Comercio	Vitro-Fibras S.A.	40% minority shareholder	Glass fibre
45. United Merchants and Manufacturers, Inc.	Argentina	-	Sudamtex S.A.	Sole shareholder (100%)	Mixed and synthetic yarn and fabrics
46. United Merchants and Manufacturers, Inc.	Brazil	-	Cotonificio da Gavea S.A.	Sole shareholder (100%)	Mixed and synthetic yarn and fabrics
47. United Merchants and Manufacturers, Inc.	Colombia	Compañía colombiana de Tejidos S.A.	Polimeros colombianos S.A.	50% shareholder	Polyester fabrics
48. United Merchants and Manufacturers, Inc.	Uruguay	-	Urace S.A.	Sole shareholder (100%)	Acetate fibres and yarn

UNITED STATES FIRMS WITH... (concluded)

Name of United States firm	Country in which capital is invested	Name of associate firm	Name of joint firm	Type of investment	Product manufactured
49. United Merchants and Manufacturers Inc.	Uruguay	-	Sudamtex de Uruguay S.A.	Sole shareholder (100%)	Mixed and synthetic fabrics
50. United Merchants and Manufacturers Inc.	Venezuela	-	Sudaceta C.A.	Sole shareholder (100%)	Acetate fibres and yarn
51. United Merchants and Manufacturers Inc.	Venezuela	-	Sudalon C.A.	Sole shareholder (100%)	Nylon and polyester fibres and yarn
52. United Merchants and Manufacturers Inc.	Venezuela	-	Sudamtex de Venezuela C.A.	Sole shareholder (100%)	Mixed and synthetic fabrics

Source: Werner Textile Consultants, Textile Industries, September 1965.

a/ After 1965, the Celanese Corp. of America set up a factory in Brazil in association with, and under the name of, Celfibras - Fibras Químicas do Brasil Ltda.
b/ In 1969, the Draper Corp. acquired 50 per cent of the shares of Howa do Brasil S.A.

/dealt with

dealt with elsewhere in this paper. The table does, on the other hand, cover certain industries connected with textiles that cannot be analysed separately, including factories producing synthetic fibres (which, though they really belong to the chemical sector, frequently turn out dyed and texturized yarn as a finished product) and textile machinery (of which there are only three).

The geographical distribution of these factories and the form the investment has taken, i.e., the kind of association with national groups adopted are very revealing. In the first place, Brazil, which is the largest market in Latin America besides being a producer of virtually every kind of textile fibre (including, in the medium term, synthetic fibres), attracted no more than four enterprises, while Uruguay attracted three and Peru four. This may, of course, be attributable to the fact that Brazil is industrially more advanced. It contrasts, however, with the case of Argentina, another industrially more advanced country from the point of view of the textile industry, which attracted the largest number of factories (six), a fact that is particularly notable since Argentina's textile market is much smaller than Brazil's.

Particularly striking is the way the United States investment has been concentrated in Mexico, where there are thirteen factories, Colombia, with nine, and Venezuela, also with nine: in other words, 60 per cent of factories operating partly or entirely with United States capital are to be found in these three countries. Although this concentration can be partly ascribed to various political and economic factors, such as political stability, absence of inflation, government incentives, size of market, etc., which were in any case not the same in each of the three countries mentioned, there is every reason to believe that their geographical location was the main reason for their selection by the parent companies.

By making for faster communications and cheaper transport costs, the relative proximity to the United States automatically set the enterprises off to a better start by simplifying administration, the transfer of technical staff and the training of local staff, and by offering better transport

/facilities for

facilities for possible exports. This makes the transfer of know-how both easier and cheaper.[23/]

The distribution of investment is also highly revealing as regards the type of product manufactured; it shows the predominance of synthetic over natural fibres. Of the 52 factories studied, 42 use pure or mixed synthetic fibres; of these, 15 produce fibres and yarn, 14 smooth fabrics of various kinds, and 13 knitted fabrics and lace. Only 7 manufacture cotton fabrics and 3 equipment or accessories. It should also be pointed out that most of the knitted fabrics in the list are manufactured under licensing agreements, and it is not known for sure whether the investment made by the parent company is substantial or merely symbolic, purely for the purpose of retaining a link with the company.

F. THE ROLE OF SPECIALIZED LITERATURE, TRIPS ABROAD BY TECHNICAL STAFF, AND THE TEXTILE CONSULTANT IN THE TRANSFER OF TECHNICAL KNOW-HOW

Strictly speaking, the transfer of technical know-how implies the transmission of practical, i.e., tried and tested, know-how. The theoretical background is of less interest since the main objective is to obtain results as quickly and as cheaply as possible. There are therefore two parties involved in the transfer process, who must be able to communicate in the most efficient ways possible.

23/ Though it refers here to a specific branch of the industrial sector, the importance of communications and transport between countries explains to some extent ALALC's difficulties in achieving its objectives. It is the author's opinion that transport problems were never accorded the attention they deserve in most of the studies that led to the setting up of ALALC but were always treated from a somewhat academic point of view. To mention only one example, a Chilean exporter wishing to send merchandise to Brazil, for instance, would in fact have to send them first to New York. So long as it involves successive delays in Valparaiso and New York, a wait for docking space in Santos, and trans-shipment at every port, there does not seem to be much hope of increased trade between these two countries except in goods that are worth sending by air freight. Though the example is very limited and perhaps extreme in so far as it only refers to two countries, there is no denying that this situation shows that priority should be given to the transport problem when Latin American economic integration is being considered.

In the wide sense adopted in this paper, the transfer may be made in various ways, even without any personal contact: whether or not the know-how is paid for, designs, plans, formulas, models and technical specifications, etc. can be transferred without there ever being any direct contact between sender and receiver.

Thus, the disclosure of technical data through the press is also considered a valid form of transfer.

1. Specialized literature

Though specialized literature has not been one of the most important means of transferring technical know-how, it cannot just be disregarded, especially now when technical knowledge is spreading so quickly. For all their limitations, technical books and journals are the only low-cost means of bringing know-how up to date. Though they are extremely useful as a source of technical data, books are not so helpful in providing specific or strictly practical information. Moreover, as a means of transferring know-how to developing countries, they have the following drawbacks - many of which could, and should, be corrected if given proper attention in the appropriate quarters:

(a) Being published in other languages, their distribution is limited, while, because of the high cost and the limited over-all market, translations are rarely a paying proposition. As there are now so many countries possessing advanced technical know-how, the seeker after knowledge has to know not only English (a reasonable enough requirement for a technical man) but German, French and Italian as well.

(b) They very quickly go out of date. A book takes so long to publish that, by the time it appears, much of what it contains is already obsolete.

(c) They are difficult to come by. Because they are relatively expensive in fairly short supply, the bookshops in under-developed countries cannot keep them in stock. Consequently, they have to be ordered from the country of origin, but since because of the exchange control regulations money cannot be sent abroad from developing countries except under regular, highly complex, import arrangements, there is no legitimate way of paying for imports on such a small scale.

/As a

As a means of transferring know-how, specialized journals are more effective, and, though this may not always be their express purpose, they do at least enable those interested to keep up with technological innovations and show them where to look for the know-how they need. Journals of this kind are published in the United States, the United Kingdom, Germany, France and Italy, and this of course again raises a language problem; nevertheless, the English-language publications on their own provide a fairly broad coverage of what is being published throughout the world. Some journals also have exchange agreements, which means that important technical articles appearing in Germany, for instance, are reproduced in United States and other periodical publications.

Here again, subscriptions cannot be paid because of exchange regulations.[24/]

2. Training abroad of technical personnel

Sending technical personnel to factories in the industrialized countries to specialize in specific production techniques has recently become a fairly common way of acquiring know-how. Obviously, this method cannot be applied to patented techniques, and even where factories do accept foreigners for training, they tend to guard their trade secrets very jealously. Training is therefore usually given by technical schools and institutes or in factories producing equipment.

Nearly all Latin American countries organize both intermediate-level and higher-level technical courses for the textile industry. Once technical staff have completed their basic training at the technical school, it is for the manufacturer, in his own interests, to give them further specialized training. Few entrepreneurs, however, really appreciate the fact that it pays to invest in specialized training even in the short term. It is therefore particularly interesting to note that the largest factories in

---

24/ Since the middle of 1969, Textile World, a United States journal published by McGraw Hill Publications, in an attempt to interest new subscribers in Latin America, has been accepting payment in local currency at the local branches of a United States bank.

/Colombia, which

Colombia, which has the most efficient textile industry in the region, always have some of their technical staff in training in the United States.

3. Role of the technical consultant

The technical consultant is relatively new in industrial relations. In Latin American entrepreneurial circles, consultants are beginning to make an appearance in specialized branches of administrative management (especially paper-work) and in auditing and accounting. They are still almost unknown in the textile industry, however, where some entrepreneurs have never even heard of them.

Though it is not the specific function of technical consultants to disseminate technical knowledge, they are included in this paper because they are a means of transferring know-how. Their basic role is to solve problems which the enterprise does not have the technical staff to cope with and for which it would otherwise have to recruit permanent staff, a solution that would obviously be too expensive. The consultant therefore assists in the transfer of know-how in two ways:

(a) He introduces the most efficient techniques; solving any factory problem entails his explaining to the local technicians and auxiliary staff the most efficient way of doing their work in future;

(b) He acts as an intermediary in the transfer of knowledge on new production techniques and processes from the source to the user. Equipped with an extensive experience which he keeps up to date with respect to the latest trends in the sector, the consultant is in a position to indicate without loss of time from what sources the most suitable know-how may be drawn in each case. He may make the necessary contacts, and he may or may not act as an intermediary in any negotiations that take place, or as a technical director for the execution of the work, or give technical guidance in applying licensing agreements, etc. His role will vary from case to case, and will sometimes consist only in establishing contacts.

The use of the big firms of consultants for turn-key jobs adds a further dimension to their role in the transfer of know-how, since in this case the consultants take full responsibility for the project, and not only act as intermediaries but may introduce new working methods and techniques as well. However, only a handful of factories have been installed by firms of consultants under turn-key arrangements in Latin America.

/Chapter III

Chapter III

COST OF TRANSFERRING TECHNICAL KNOW-HOW IN THE TEXTILE INDUSTRY, TECHNOLOGICAL DEPENDENCE AND FORMULATION OF A POLICY FOR OBTAINING FOREIGN KNOW-HOW

A. COST OF TRANSFERRING TECHNICAL KNOW-HOW IN THE TEXTILE INDUSTRY

In reviewing specific cases in previous sections, the cost of transferring technical know-how was repeatedly stressed. In this part of the study an attempt will be made to quantify the cost of this transfer in so far as the available information permits, on the basis of specific cases. It is difficult to know how far the data given in this section are generally applicable. It is considered, however, that although the information presented here is by no means exhaustive, it does provide a reasonable basis for estimating the average price paid for foreign know-how by the Latin American textile industry.

It is not easy to estimate the cost of the transfer of know-how in any branch of industry. In some cases it can be determined because it is laid down in a specific contract covering the provision of such know-how. In other cases, as already shown in this study, the price paid for technical know-how forms part of an over-all operation which includes the sale of equipment, the provision of instructions and permission to use the trade mark concerned, and it is impossible to know what proportion of the total cost is accounted for by each of these items, or even what their total cost is. The approximate cost of certain fabric improvement processes is known to the textile industry, and the cost of training staff to operate a machine or a set of machines can be estimated; but it is not possible to estimate the cost of using a trade name, which is bound up with the use of a particular raw material or secondary material.

On the basis of actual prices the costs involved in three systems for the transfer of know-how in the textile industry which are described in this study are examined below.

1. Cost of the transfer of know-how through contracts granting licenses

It is probably only in the case of enterprise to enterprise contracts granting licenses that the cost of transferring technical know-how can be fairly accurately determined in the textile industry. As noted above, these contracts generally cover the right to apply special treatments to fabrics, and sometimes the sale of equipment and the use of trade marks.

In such instances, payment for technical know-how takes the form of a royalty or a rate charged per metre of fabric produced by the firm which has been granted the license for the process concerned, with an annual minimum to be paid if a specified production level is not reached. The rate per metre does not usually have anything to do with the cost of the final product, i.e., the more expensive the product, the lower the cost of the process to the manufacturer of the fabric.

Some idea of the cost of these services may be gained from the two following examples, which may be considered representative of this category. Since it is not easy to obtain these data from either the licensing or the licensee firms, the figures may vary from one case to another.

The first example relates to treatment for stabilizing the dimensions of a pre-shrunk fabric, and the second to the treatment of bonded or coated fabrics, that is, coating it with a layer of some other material, which is generally synthetic.

The firm granting the right to use the pre-shrunk treatment receives a royalty of 25 dollar cents per metre for fabrics up to 100 centimetres wide, with a surcharge of 10 per cent for wider fabrics. The minimum fee to be paid each calendar year by the firm holding the license if it fails to attain the requisite level of production is from 2,600 to 3,000 dollars for each machine installed.

In addition to defraying these costs, under the terms of the agreements signed with the licensing firm itself, the licensee must purchase whatever machinery is required from third parties. In Latin America a machine costs about 90,000 dollars and can produce about 15 million metres annually on a two-shift basis. If the machine is assigned a maintenance

/cost of

cost of 10 per cent and a useful life of ten years, the depreciation will be around 0.067 cents per metre. Therefore, the cost of the treatment under the head of royalties and other license costs will be 0.317 dollar cents per metre of fabric produced (for fabrics up to 1 metre wide). These payments should be exempt from any tax or charge payable on the product in the country concerned, and should be duly compensated for in the event of any tax being levied after the contract has entered into force.

The second example is that of a bounding or coating process invented by a firm which designed its own equipment and invented the formula for the adhesive used. In this case, instead of being sold, the equipment is rented to the licensee for the period covered by the contract, on the basis of a lump-sum payment. The royalty is 0.5 dollar cents per metre of material manufactured, plus the initial lump sum for the use of the machine over a period of three years for the production of a two-layer fabric. For a three-layer fabric, the royalty is 1 dollar cent plus the lump sum. Unfortunately, it was not possible to determine the lump sum charged for the hire of the machine.

2. Cost of transferring know-how in the form of complete plants or groups of machines

In theory, machine manufacturers provide free technical assistance; in other words, the price paid for such assistance is only what the manufacturer would have to spend on subsistence for the skilled personnel he has sent to assist the customer. This is the method always used, and it could not be otherwise because of the keen competition in the sale of textile equipment today. It is greatly to the interest of the manufacturer to provide as much technical assistance as possible so as to obtain optimum performance from his machines and boost his reputation. He therefore tries to charge his customers as little as possible for this assistance.

The assistance provided by the manufacturer falls into two categories:

(a) Assembly and adjustment of the machines and preliminary testing before they are put into operation;

/(b) Periodical

(b) Periodical overhauls to see that the machinery is properly adjusted, according to a timetable laid down by the manufacturer, or at the customer's request.

In neither case does payment for such assistance include royalties; it is limited to the technical expert's travel and accommodation expenses and subsistence in the currency of his country of origin. The subsistence allowances are usually high by salary standards in Latin American countries. The customer is also responsible for the payment of compensation for work-incurred accidents and for taking out life insurance policies and arranging for medical and dental care. If the work takes longer than a year, he must also defray the cost of the expert's vacations, including the round-trip fare to their own countries.

That is how it is usually done. The cost of technical assistance for the installation of a new plant may be estimated at about 4 to 6 per cent of the cost of the equipment. After the equipment has been installed, experts remain at the plant a longer or a shorter time, until the local staff has learnt how to handle and adjust the machinery.

The cost of periodic overhauls depends on the state of the equipment, since this determines how long the expert has to spend in the plant. In the case of overhauls, the manufacturer pays the expert's travel expenses, since he will visit several plants in the same country.

3. Cost of transferring the know-how of salesmanship

As shown above, the use of certain raw materials or secondary materials, particularly in the area of synthetic fibres, is indicated by the actual supplier, who permits the use of his registered trade mark backed by a strong publicity campaign.

In this case no royalties or other fees are paid for the supplier's services, although their cost is included in the price of the raw material or secondary product bought by the consumer. It is hard to say what proportion of the total cost of the product these services represent. It should be borne in mind that such services, which include the standardization of the product under a trade mark, are rather complex since they begin with technical guidance in the processing of the raw material (in the case of synthetic fibres) and continue throughout the production cycle up to the making of clothing. In addition, there is all the parallel work of quality (and quantity) control and large-scale publicity campaigns through practically all the information media.

To some extent, the fact that the production of synthetic fibres is something of an oligopoly, a point which has already been discussed elsewhere in this study, explains the operation of this system. Although it is impossible to know how much the final consumer pays for these services, the profit/price ratio for these products in the Latin American countries is very unfavourable compared with that obtained in the industrialized countries. Other aspects of this question are discussed later in this paper from other points of view.

It is impossible to determine the cost of the know-how incorporated in secondary materials, i.e., chemicals, bleaching agents, dyes, etc., but there is no point in speculating too much about it as, owing to the keen competition in this sector, prices are kept as low as possible. No doubt this cost covers services that are actually provided, that is, technical guidance in the use of the product, distribution costs, etc., since the trade mark is not important here and does not appear in the final product.

B. TECHNOLOGICAL DEPENDENCE IN THE TRANSFER OF KNOW-HOW FROM THE DEVELOPED TO THE UNDER-DEVELOPED COUNTRIES

At the beginning of the last decade, the developed countries faced a serious crisis in their textile industries. Despite the great strides made in technological development, which accounted for the increase in capital intensity from less than 13,000 dollars per person employed in 1960 to more than 40,000 dollars in 1968, textile production began to become uneconomic in some of those countries to the point where they could no longer compete with less developed countries, in spite of the tariff barriers. The countries most affected by competition from imported textiles, the United States, the United Kingdom, the Federal Republic of Germany, Belgium, Italy and other European countries, tried to place quantitative restrictions on the entry of textiles produced in countries employing cheap labour in order to avoid market disruptions.

/These restrictions

These restrictions, which applied mainly to cotton textiles, were given official force in the GATT Long-Term Arrangement Regarding International Trade in Cotton Textiles, which fixed the maximum quotas for each country.[25]

The textile manufacturers in those countries began to put pressure on the manufacturers of equipment to supply them with more efficient and automated machines. The feverishness of the activity in this branch of industry can be gauged by the number of highly automated machines and devices that are currently in the experimental stage, the number of enterprise to enterprise agreements of different kinds and the creation of consortia to develop joint programmes and for the use of designs under license.

These activities produced some results and led to a considerable reduction in the number of persons employed in the production process, as the figures given above show. But the complexity of textile manufacturing, by its very nature a discontinuous process, led to the invention of mechanically sophisticated machines and devices, the economic advantages of which are still a controversial question. One example of the automatic doffing device invented to replace two operators in an operation that a machine takes four minutes to accomplish. Six devices of this kind were invented in different countries, and they are now manufactured under eighteen different trade marks. The list of manufacturers and their respective licences given in table 9 is worth noting for it gives an idea of the efforts being made to achieve completely automated yarn production.

From the large number of trade marks and the great variety of types of such machines on the market it might be concluded that such equipment offers great advantages to a textile mill, and that the decision to install depends on the relative cost of the factors of production. Few enterprises have installed such machines, however, even in the United States and Europe, and so far nothing has been heard of any Latin American firm doing so. The above example does not give a full picture of the technological progress made in the textile industry, but it is not an isolated case.

25/ Brazil did not adhere to the Long-Term Arrangement on Cotton Textiles.

/Table 9.

Table 9

WORLD: MANUFACTURERS OF AUTOMATIC DOFFING DEVICES AND THEIR RESPECTIVE TRADE MARKS, UP TO JULY 1969

Trade mark	Type	Name of manufacturer and/or licenser	Country	Firms that manufacture under license
Mobile doffers				
1. Autodoffer	Doffing of single spindles	Kanegafuchi Mfg. Co, Ltd.	Japan	-
2. Diamond D	Idem	Willcox and Gibbs Inc. (licenser)	United States	Draper Corporation, United States
3. Doffmat	Idem	Ingolstadt	Germany	-
4. Maier Doffer	Idem	C. Eugene Maier Gmb H.	Germany	Whitin Machine Works, United States
5. Mark IV - A	Idem	Willcox and Gibbs Inc. (licenser)	United States	Platt Brothers, England
6. A.D.H.	Idem	Fugi Spinning Co. Ltd.	Japan	-
7. Pony-Doffer	Idem	Nihon Spindle Co. Ltd.	Japan	-
8. Continuous Autodoffer	Idem	Toyoda Automatic Loom Works Ltd.	Japan	-
9. Automatic Doffer	Doffing of groups of 6 to 10 spindles	Diawa Spinning Co.	Japan	-
10. Marzoli Doffer	Idem	Fratelli Marzoli	Italy	-
11. Roberts Autodoffer	Idem	Shirley Institute (licenser)	United States	Roberts Co.
12. Twin Automatic Doffer	Idem	Toyobo-Howa Ltd.	Japan	Saco-Lowell Shops, United States
13. Deering Milliken	Idem	Deering Milliken (licenser)	United States	Whitin Machine Works, United States O.M. Ltd., Japan
Fixed doffers				
14. Augsburg Doffer	Simultaneous doffing of all spindles on one side of machine	Mech-Baumwollspinnerei, Augsburg	Germany	Ernst Jacobi, Germany
15. Co-We-Mat	Simultaneous doffing, both sides of machine	Zinser Textilmaschinen	Germany	Saco-Lowell Shops, United States Ishikawa Seisakusho, Japan
16. Hispadoffer	Idem	Hispano Suiza	Switzerland	-
17. Pneumadoffer	Idem	Nueva San Giorgio	Italy	-
18. Do-Co-Mat	Idem, combined with automatic winding	Industrial Research N.V. (licenser)	Netherlands	Zinser Textilmaschinen, Germany Metter

This small /

This small digression was intended to show that achievements have not always been commensurate with efforts to automate production in the textile industry. The main target, the creation of a continuous process, continues to present a challenge to textile engineers, and everything points to the fact that there will be no change in this situation as long as textiles are made of interwoven yarn.

More progress has been made in some processes than in others: an attempt has been made to get round the old system of weaving the weft into the fabric by improving knitting machines, which have a higher output, and also to replace yarn with non-woven fabrics, but the conventional methods still prevail, and, what is more remarkable, there are still factories in Latin America that have an economically viable output using machines that are sixty years old.

The socialist countries have also entered the fray with non-woven fabrics of the "Arachne" and "Mali" brands from Czechoslovakia and East Germany, respectively, but they made no great impact to start with. Recently, however, the open-end system of spinning cotton and man-made fibres, started in Czechoslovakia, has begun to worry western manufacturers, where this process is still in an experimental stage. Several Brazilian factories are trying out the Czechoslovak system, apparently with successful results. However, it has not been proved that the production of yarn by the new process is more economical than by the conventional methods.

There are some corollaries to the observations already made which will be defined with a view to finding answers for some of the questions about prospects of the textile industry in the under-developed countries.

(a) In the industrialized countries efforts are being made to devise a technique that is suited to the costs of their factors of production, so that they can:

(i) Continue producing textiles economically from imported raw materials;

(ii) Substitute synthetic products for natural fibres, as appropriate and to the extent deemed desirable (price control, checks on raw materials, dumping, etc.).

/(b) The

(b) The industrialized countries are trying to force the under-developed countries to consume synthetic textiles at a price that is higher than their real price;[26/] this is because their output is dependent on imported inputs whose prices are controlled in the countries of origin, with the drawback that consumption of such inputs is prejudicial to the industry based on natural fibres.

(c) Although there have been some spectacular improvements in production processes, they have not jeopardized the advantageous position of certain under-developed countries which produce natural fibres and have cheap manpower available. This is proved by the fact that, despite the restriction of imports from countries with cheap manpower, North America and Europe are still importing more and more textiles. Although the position of the above-mentioned under-developed countries is tending to become less advantageous as far as the textile industry itself is concerned, it will become more so in the clothing industry (which is an extension of the first), which is still quite labour-intensive and where the possibilities of automation still appear to be more remote.

(d) The developed countries will transfer new technologies to the textile industry of developing countries only under one or more of the following conditions:

(i) When the technique is already technically or economically obsolete in the country of origin;

(ii) Through licensing agreements, when the processes are heavily protected by patents and through the payment of royalties based on the volume of output;

(iii) Through direct investment;

(iv) When the country exporting the know-how has already chosen to import textiles, because it considers local production uneconomic.

26/ It has already been said that, given equal conditions of quality, the price of polyester fabric in the United States and Europe is practically the same as that of cotton fabric, whereas in nearly all the Latin American countries, including Brazil, the price of the former is nearly three times that of the latter.

The situation in the developed countries is different, for although licensing is the rule, there is an exchange of know-how between the countries, as can be seen, for example, from the manufacturing and research agreements that have been signed in recent years. There is therefore a sum total of efforts by which all the countries benefit. As the under-developed countries have nothing to offer in the way of technology, they have to pay a high price for any type of know-how, including know-how of doubtful utility..

From the above it may be inferred that, although the developing countries are especially well equipped to develop an efficient textile industry and to supply the developed countries with textile goods, they are to some extent technologically dependent. This dependence does not stem from the complexity of the technical processes employed, for the cost of the know-how is justified in this case, but from the control exercised by the more industrialized countries over the use of trade marks and patents for dubious processes and to impose the use of raw materials that are unsuitable for local consumption but which the consumer has been conditioned to demand, etc.

Regarding the problem of technological dependence, it may not be out of place at this point to give one of the most striking examples of how the consumer of textile products can be conditioned or induced to use a specific article instead of another, without considering the merits or advantages of either. It is the campaign organized by the marketing department of a North American firm to launch a new synthetic product.27/

The problem consisted in putting on the market a new synthetic fibre fabric with the appearance of natural silk. After the new fibre had been tested at every stage of manufacture up to its transformation into fabric, and once an evaluation had been made by experts on natural silk, among others, and the direct approval of the enterprise had been obtained, a certain amount of fibre was taken to the home of silk fabric art, the town of Lyon, in France. There, using the new fibre, a group

---

27/ This case was taken from Textile Industries, September 1969, p. 77, and is reproduced here as an example of an efficient marketing system, without involving the author's opinion of the product concerned. The transcription is almost literal, a mere summary having been made of the original text.

/of commercial

of commercial fibres were produced. From there on, the fibre was introduced to newspapers and magazines, radio, television and wire service people in eight cities in the world in five languages at the same instant. This means that, at 7 a.m. in Los Angeles, at 10 a.m. in Buenos Aires, New York and Montreal and at 3 p.m. in London, Paris, Düsseldorf and Milan, over 1,000 cities saw the experimental fabrics which had been woven and finished in the laboratories of the United States firm and heard the trade-mark name. The publicity from this effort generated nearly 15,000 enquiries, from different elements of the industry and from a number of colleges and universities, all curious about the properties and potentials of the new product.

There then arose the problem of presenting the fabric [28/] to the French couturiers, without disclosing what it was, though of course the manufacturer wanted to be honest with them. The system used was for the fabric houses of Lyon to show fabrics for initial placement identified only by number. Later, when the first sample cuts had to be delivered, the couturiers were advised that if they ordered fabric numbers so and so, on the premise that it was silk, they could withdraw the order because it was not silk but a new synthetic fibre.

More than 116 garments made of the new fabric were shown by the top Paris couture, and the response by retailers was excellent. Following this success, the fabric was promoted in the United States in the conventional manner.

The above example shows how an efficient distribution network can induce the textile consumer to buy a specific product without knowing exactly what it is, given the impossibility of evaluating the product at the moment of purchase.

Obviously, this does not mean that the new product is considered to be better or worse than its nearest competitor, which is of little

---

28/ The fabric promoted in France had been produced in Lyon, the greatest European centre for natural silk. This being so, it would never have occurred to a Frenchman that it could be based on a synthetic fibre. (Author's note).

/relevance to

relevance to the particular aspect being dealt with here. The point is that the distribution network, the trade mark, publicity and other devices employed in modern marketing greatly influence the consumption of textiles, and that the consumer has little choice given the nature of the information that he receives on the product.

Bearing these facts in mind and considering the economic interests of the Latin American countries at their present stage of development, the following conclusions may be drawn in respect of the transfer of know-how in the textile industry:

(a) The technology that is imported must first have been screened. Apart from the degree of automation and the level of capital intensity that is considered appropiate, which may vary from one country to another, some types of know-how are unsuitable because:

(i) They lead to a consumption which is irrational in the light of the availability of local factors of production;

(ii) They are not know-how in the real sense of the term, but rather known processes protected by patents that have already been used and in many cases are already out of date in the country of origin;

(iii) They consist in nothing more than the granting of authority to use the trade mark promoted by permanent publicity campaigns, and although they may guarantee a specific standard of quality to the consumer, they do not bring with them any new manufacturing techniques.

Examples of the transfer of know-how of the latter type can be found in this paper. Each case should, of course, be judged against rational technical and economic criteria, and the cases that have been mentioned in connexion with methods of transferring know-how should be taken merely as examples.

(b) The price paid for the transfer of know-how is worth while when there is a real transfer of a technology that is suitable for the receiving countries. The cases mentioned above should, therefore, be disregarded, for there are cases where not only is the price of the transfer unjustified, but the transfer itself would be harmful, even if it were cost-free.

(c) The ways of transferring know-how are not completely satisfactory. In some cases they should be made more flexible to obviate institutional obstacles. Often, there are deficiencies in the technical information media themselves. Moreover, the area from which the know-how is taken should be broadened. Some Eastern European countries have made important advances in the textile industry, but the difficulties in the way of trade relations with those countries have prevented better advantage being taken of manufacturing processes that might be suited to the developing countries.

(d) It is not only advisable but feasible for the Latin American countries to develop their own technology or to adapt imported technologies. The high cost of applied research has discouraged governments from carrying out programmes of that kind. However, the prospects for expanding the regional domestic market and the natural conditions in the Latin American countries (comparative advantages, etc.) for the production of textiles, which place them in the forefront as producers and possible exporters of those products, fully justify a study of the feasibility of technological research programmes for the textile industry. It may even be possible to obtain results in the medium term.

C. SUBSIDIZING THE FORMULATION OF A POLICY FOR IMPORTING KNOW-HOW THAT WILL PROMOTE THE DEVELOPMENT OF LOCAL TECHNOLOGY IN THE TEXTILE INDUSTRY OF THE UNDER-DEVELOPED COUNTRIES

When the under-developed countries are mentioned in the present paper, what is meant is the Latin American countries and, in particular, the three countries mentioned above - Brazil, Argentina and Mexico - which have reached a more advanced stage of industrialization than the others. To these countries should be added Colombia, which has the most efficient textile industry in the region and whose exports have already found a market in the industrialized countries.

On the basis of the analysis made in the previous pages, some suggestions will be put forward that may be useful in the formulation

/of a

of a policy to regulate imports of know-how and in the implementation of research programmes to enable the region to evolve its own technology. The governments of some of the countries have been thinking about this, and at least one - Brazil - has initiated a programme of studies for the formulation of a general scientific and technological policy for the country.

1. Policy for importing know-how

At the current stage of industrialization in the countries under consideration, there can be no doubt that there is an urgent need to regulate the importation of what it has been agreed to call know-how. In the textile industry, the possibilities of import substitution were exhausted a long time ago, and the current target is to promote exports. A distinction should therefore be drawn between what is a real contribution of know-how that will help to raise the standards of efficiency in the industry or to introduce new production processes, and what is no more than the collection of royalties on the use of a trade mark or a production process that is already obsolete but protected by patents.

The developed countries have a natural protection against this type of agreement, in their own level of technology and their own marketing techniques, since they compete on the same market. The developing countries, on the other hand, can only protect themselves with special regulations.

Very little information is available on the technological options in the textile industry,[29/] but it is generally agreed that the most advanced technology available should be adopted, from which it may be concluded that imported know-how will continue to play an important part for some time to come. Moreover, this approach simplifies the choice between real know-how and know-how that makes no positive contribution to existing technology, since the distinction between the two becomes clear.

29/ On the cotton textile industry, see ECLA, Choice of technologies in the Latin American textile industry (E/CN.12/746), 1966.

/When new

When new manufacturing processes that combine know-how with equipment have to be imported, the price that is paid for the know-how is not only fully justified but is reasonable. That is, the direct cost of the know-how, which includes assembly, instructions, training of technical personnel, etc., seems to be a reasonable proportion of the total cost of the equipment. The indirect cost, which is included in the price of the equipment, cannot be evaluated, but given the fierce competition between manufacturers of machinery and the large number of countries competing on the market, it may be assumed that the cost has been kept down as much as possible.

The entry of patented processes relating to the finishing of the textiles should be discouraged or restricted when their only merit is the reputation of the trade mark, and also the use of processes that encourage the consumption of imported raw or ancillary materials, licensing agreements for the use of designs which boil down to the use of a trade mark, and other agreements of the same kind.

Lastly, as regards the much discussed question of the replacement of natural fibres by synthetics, special guidelines must be laid down for each sector.

As a general rule, within the over-all framework of the economy, the consumption of synthetic fibres in the under-developed countries is uneconomic since it is detrimental to the whole traditional agricultural sector, which, in some regions or states like Brazil, Argentina and Mexico, may contribute up to 50 per cent of the gross product. Moreover, synthetic fibres cost more to the consumer than natural fibres, while in the developed countries exactly the opposite is true.

The consumption of synthetic fibres should, therefore, be restrained, either through a tax on the product or through special incentives for consumption of natural fibres or restrictions on production of other kinds.

However, it should be borne in mind that, in the long run, synthetics will dominate the textile market, since their relative prices are going down. Thus, even if urgent measures are adopted to restrict production and so protect natural fibres in the short germ, the countries where it is feasible to establish a petrochemical industry will eventually be able to produce synthetic fibres at competitive prices and should consider installing plants of that kind. At the same time, the branch of agriculture concerned with the production of textiles should gradually be prepared for crop substitution.[30/] As can be seen, any measure aimed at restricting or promoting the consumption of a textile product should be an integral part of a broad programme covering both industry and agriculture.

2. Development of local technology in the textile industry of the under-developed countries

In present circumstances, it does not seem feasible for the under-developed countries to develop their own technology in the broadest sense of the term, that is, a technology that uses resources to the full, bearing in mind the relative cost of the factors of production. Even assuming that enough information can be obtained, which can be done fairly rapidly in the textile industry, there are many problems, such as the redistribution of the value added, the possibility of re-investing the economic surplus in the free-enterprise system, etc., which have not yet been cleared up sufficiently for radical political decisions to be taken. In other words, the old controversial problem persists in the following terms:

Labour-intensive technology (abundant factor)	More employment ..	More consumption
	= slow growth	
	VERSUS	
Capital-intensive technology (scarce factor)	Less employment	Less consumption
	= rapid growth	

30/ There is a serious problem in some areas (for instance, areas where hard fibres are produced in Mexico, cotton and agave in the north-east of Brazil and wool in the extreme south of Argentina where the cultivation of other crops is said to be impossible. Such cases require special research programmes.

/Even if

Even if it were possible to solve the problem at the technical level, it would continue to give rise to difficulties at the political level, in view of the paucity of the instruments for action in the planning organs of government.

Therefore, to be realistic about the question of local technology, the role of the under-developed countries must be to choose the most appropiate technology from among those developed in the more advanced countries, paying for know-how when it makes a really positive contribution to the know-how they already possess, as was said before. In other words, it is not advisable to try to develop new production processes for the textile industry or to design original machines within specific programmes, given the amount of resources that would have to be devoted to research in order finally to arrive at results that are already known. Obviously, this does not mean to say that this type of activity should be discouraged or that certain isolated cases of improvements to processes or machine designs do not deserve government support.

Although it is not worth while to carry out research in that sector of technological development, there are some technological problems that the under-developed countries ought to study. They are problems that are peculiar to these countries, relating to the use of natural fibres and their slow but inexorable replacement by synthetic fibres. The latin American countries (particularly those mentioned above) should pay attention to these two fields and should devise a plan for technological research that would include specific programmes aimed at developing local know-how. As regards raw materials, studies should be carried out with a view to:

(a) Making better use of raw materials, especially cotton and wool, by producing a better class of products;

(b) Finding ways of improving the finished products, so that they may continue to compete with synthetic fibres;

(c) Finding alternative uses for certain types of fibre, such as hard fibres, which are inevitably doomed to disappear from the textile industry and the production of which is still an important activity in some areas;

/(d) Studying

(d) Studying new ways of combining natural fibres with synthetic fibres, with a preponderance of the former, contrary to current trends. As everyone knows, the combinations currently in use are dictated by the manufacturers of synthetic fibres as a condition of the use of the trade mark.

In conjunction with these measures, which are aimed at protecting and enhancing the value of natural fibres, it would be advisable to initiate a research programme within the petrochemical industry with a view to developing local manufacturing processes, since world production of synthetic fibres is now a monopoly. This proposal would appear to conflict with the measures suggested for the protection of natural fibres. However, it should be borne in mind that, in the long run, synthetic fibres will eventually absorb a very large share of the market for textile products and their consumption cannot be prevented. When that time comes, therefore, the Latin American countries will be well advised not to depend on imported know-how for their production, because of the inflexibility of the system of patents in the international sphere, discussed above.

It is difficult to know how much will have to be spent to achieve results in programmes of this kind, and the proposed goal may appear to be rather ambitious. Since the petrochemical industry in the Latin American countries is in its infancy, it is possible to implement parallel programmes of technological research. These programmes, which must be budgeted for on a properly planned basis so as to avoid waste, always produce good results, for although they may not lead to revolutionary discoveries, they are an excellent means of training personnel.

It would not be out of place to recall that the technological institutes in the newer countries could play an important part in the proposed programme. Some of these institutes have first-class equipment and facilities, which are often not used to full capacity. The mere fact of breathing new life into these institutions, for which international technical assistance could be obtained, would make it possible to carry out research work with a considerable saving in fixed investment.

Annex 1

WESTERN WORLD: PRINCIPAL REGISTERED TRADE MARKS AND MANUFACTURERS OF MAN-MADE FIBRES

1. Acrylic

Acribel	: Fabelta
Acrilan	: Monsanto
Acrilia	: Fibras Acrílicas
Beslon	: Toho Beslon
Cashmilon	: Asahi Chemical
Courtelle	: Courtaulds
Creslan	: American Cyanamid
Crilenka	: Cyanenka
Crylor	: Soc. Crylor
Crysel	: Celulosa
Dolan	: Süd. Chemiefaser
Dralon	: Farb. Bayer
Euroacril	: ANIC
Exlan	: Japan Exlan
Leacril	: Chatillon SpA
Nymcrylon	: Kunst. Nyma
Nymkron	: Kunst. Nyma
Orlon	: Du Pont
Redon	: Phrix; FEFASA
Toraylon	: Toyo Rayon
Velicren	: Snia Viscosa
Vonnel	: Mitsubishi
Zefkrome	: Dow Badische
Zefran II	: Dow Badische

/2. Modacrylic

2. Modacrylic

Dynel	: Union Carbide
Kanekalon	: Kanegafuchi
Teklan	: Courtaulds
Verel	: Eastman

3. Polyester

Acrocel	: Sudamtex (Arg.)
Avlin	: FMC
Blue C	: Monsanto
Dacron	: Du Pont
Dicrolene	: Petro. Sudam
Diolen	: Glanzstoff
Encron	: American Enka
Fortrel	: Fiber Industries
Kalimer	: Co. Gen. Resine
Kodel	: Eastman
Kuraray	: Kurashiki
Luxel	: Copet
Nitiray	: Nippon Ester
Nycron	: Cotonificio Gav.
Polycron	: Quimica Ind.
Quintess	: Phillips
Terene	: Chem. Fib. India
Tergal	: Soc. Rhodiaceta
Terital	: Soc. Rhodiatoce
Terlenka	: AKU
Tersuisse	: Soc. Visc. Suisse
Terylene	: ICI
Tetoron	: Teijin; Toyo
Toyobo	: Toyobo
Trevira	: Hoechst; Hystron

Venecron	: Fib. Sin. Venez.
Vestan	: Faserwerke Hüls
Vycron	: Beaunit
Wellen	: Wellman
Wistel	: Snia Viscosa

4. Rayon

Avril	: FMC
Bemberg	: Bemberg
Cidena	: CTA
Coloray	: Courtaulds NA
Colvera	: Spinnfaser
Cordron	: Courtaulds Aust.
Cuprama	: Farb. Bayer
Cupresa	: Farb. Bayer
Danufil	: Süd. Chemiefaser
Danulon	: Süd. Chemiefaser
Evlan	: Courtaulds
Fiber HM	: American Enka
Fiber 700	: American Enka
Fibro	: Courtaulds
Hochmodul	: Chem. Lenzing
Loplon	: Snia Viscosa
Lirelle	: Courtaulds NA
Meryl	: CTA
Nupron	: IRC
Phrix	: Phrix Werke
Polycot	: Teijin
Rayflex	: FMC
Supralan	: Borregaard
Tenasco	: Courtaulds
Tufcel	: Toyobo
Vincel	: Courtaulds
Xena	: Beaunit
Zantrel	: Am. Enka; CTA
Zaryl	: Fabelta

/5. Acetate

5. Acetate

Acele	: Du Pont
Carolan	: Mitsubishi
Celacrimp	: Celanese
Celafibre	: Courtaulds
Celaperm	: Celanese
Celatow	: Celanese
Celltoron	: Daicel
Chromspun	: Eastman
Cycloset	: Du Pont
Dicel	: Courtaulds
Estacel	: Courtaulds Aust.
Estrella	: Novaceta
Estron	: Eastman
Krasil	: Kohinoor
Lansil	: Lansil
Rhodalba	: Rhod. Ind. Quim.
Rhodia	: Rhodiaceta
Setilteint	: Fabelta
Silene	: Novaceta
Velion	: INACSA

6. Triacetate

Arnel	: Celanese
Rhonel	: Rhodiaceta
Soalon	: Mitsubishi Acetate
Starnel	: Amcel
Tri-a-faser	: Deutsche Rhod.
Triafil	: Can. Celanese
Tricel	: Brit. Celanese
Trilan	: Can. Celanese
Trinese	: Celanese Mex.

/7. Nylon 66

7. Nylon 66

Antron	: Du Pont
Blue C	: Monsanto
Bri-nylon	: ICI; Fibremarkers
Cadon	: Monsanto
Cantrece	: Du Pont
Carana	: Cel-Cil
Cumuloft	: Monsanto
Dorosuisse	: Soc. Visc. Suisse
Fabelnyl	: Fabelta
Hisilon	: Hisisa
Nailon	: Soc. Rhodiatoce
Nevanylon	: Glanzstoff
Nylfrance	: Rhodiaceta
Nylsuisse	: Soc. Visc. Suisse
Phillips 66	: Phillips
Qulon	: Beaunit
Rhodianyl	: Rhod. Ind. Quim.
Wellon	: Wellman

8. Nylon 6

Allyn	: Allied Chemical
Amilan	: Toyo Rayon
Ayrlyn	: Rohm and Haas
Bodanyl	: Feldmühle
Borgolon	: Torc. Borgomanero
Caprolan	: Allied Chemical
Carbyl	: Inquitex
Celon	: Courtaulds
Crofyl	: Sin. Slowak
Delfion	: Bombrini
Dorix	: NV Bayer
Enkaloft	: American Enka

/Forlion : Soc.

Forlion	: Soc. Az. Orsi
Helion	: Chatilon
Hilon	: Hanil Nylon
H-Nylon	: Holeproof
Jayanka	: J.K.Synthetics
Jaykaylon	: J.K.Synthetics
Kanebo	: Kanegafuchi
Lilion	: Snia Viscosa
Misrnylon	: Soc. Misr.
Nichiray	: Nippon Rayon
Nilom	: Fazal
Nivion	: ANIC
Nytelle	: Firestone
Ortalion	: Bemberg SpA
Perlon	: (Six Licensees)
Türlon	: SIFAS
Ulon	: United Nylon
Unel	: Union Carbide Can.
Vivana	: Dow Badische

9. Spandex

Dorlastan	: Farb. Bayer
Enkaswing	: AKU
Espa	: Toyobo
Fujibo	: Fuji
Fulflex	: Carr-Fulflex
Glospan	: Globe
I-Faden	: Kölnische
Lastralene	: Kölnische
Lycra	: Du Pont
Mobilon	: Nisshin
Neoron	: Teijin Houdry
Numa	: Am. Cyanamid
Opelon	: Toyo Products

/Sarlane : Fabelta

Sarlane	: Fabelta
Spanzelle	: Elastomeric
Unel	: Union Carbide
Vairin	: Pirelli Lastex
Vyrene	: Uniroyal
Vyrene	: Uniroyal

10. Olefines (Polypropylene)

Amco	: American Mfg.
Celaspun	: Cel-Cil
Chevron	: Chevron
Cournava	: Brit. Celanese
DLP	: Dawbarn
Durel	: Celanese
Filmtex	: Platon
Herculon	: Hercules
Marvess	: Phillips
Meraklon	: Polymer Ind. Chim.
Multiflex:	Roblon
Patlon	: Patchogue
Polycrest	: Uniroyal
Polyloom	: Chevron
Polysplit	: Wahlbecks
Prolene	: Copet
Pylen	: Mitsubishi Rayon
Tiptolene	: Lankhorst
Tritor	: Plasticisers
Trofil	: Dynamit
Tufton	: Thiokol
Vectra	: Enjay
Vestolan	: Chem. Werke Hüls
Ulstron	: ICI

/11. Fibre glass

11. Fibre glass

Beta	: Owens-Corning
Deeglas	: Deeglas Fibres
Duraglas	: Turner
Enkafort	: Silenka
Fiberglas	: Owens-Corning
Garan	: Johns-Manville
Gevetex	: Gevetex
Glasron	: Asahi Fiber Glass
Iceberg	: Nitto
Marglass	: Marglass
Microglass	: Nippon Glass
PPG	: PPG Industries
PRG	: Peace River
Silenka	: Silenka
Silionne	: Soc. Verre
SIV	: Soc. Ital. Vetro
TBtex	: Vetreria Ital.
Texover	: VASA
Ultrastrand	: Gustin-Bacon
Unistrand	: Ferro
Vetroflex	: Fibres
Vetrolon	: Gevetex
Vetrotex	: Vetreria Ital.
Vitron	: Johns-Manville