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WOOL TEXTILE INDUSTRY SURVEY FOR WEST TEXAS

TEXAS TECHNOLOGICAL COLLEGE
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Foreword

The purpose of this report is to set forth the advantages of West Texas for wool textile manufacturing, and to compare these with advantages of the present location of the industry. The report is intended to serve as a comprehensive guide for acquiring a segment of the wool textile industry. It is not intended as a definite instruction for locating a specific mill in a given locality. Individual products will require detailed market surveys, and individual towns will require local area surveys.

Texas Technological College
Research Committee

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Summary

West Texas, this bulletin will show, has many reasons for desiring expansion of activities in turning wool into cloth.

The economy of a region is supported by livestock raising and agriculture in the early stages of development. In the beginning these usually will more than support the population. However, after the population has increased beyond a certain figure, a purely agricultural economy will not support it to the best advantage.

Wool is an important resource to any section where it is produced. This is especially true in West Texas. In 1947, Texas produced approximately 62,000 pounds of wool, 25 percent of the total clip of the United States, and 95 percent of this was of the highest quality combing wool. Also, Texas produces more than 90 percent of the United States production of mohair, a total of 18,000,000 to 19,000,000 pounds annually. Most of the State's yield of these fibers comes from the Edwards Plateau in West Texas.

Wool Manufacturing in West Texas and in Other Sections

The first processing of wool in the United States began in 1643. Several families of wool combers and carders, from Yorkshire, England, settled in Rowley, Mass., where fulling mills were established to prepare coarse homespun cloth by special processing. The early wool mills were the outgrowth of these fulling mills. The first plant in which wool was spun by power machinery was established in Connecticut in 1788.

Development of wool manufacturing consisted mainly of making woolen piece goods, and the weaving of woolen cloth was a household industry until the beginning of the 19th Century. Worsteds did not attain commercial importance until the invention of power machinery for combing wool, about 1860. The rise of the worsted industry, from 1870 to 1900, was brought about chiefly by the development of improved machinery for cleaning wool, as well as the perfecting of combing machinery. Almost all types of wool could be combed by 1900, and consequently could be used in the manufacture of worsteds, which rapidly were gaining consumer preference. Also, the rise of the industry was aided by upbreeding of sheep, passage of favorable tariff legislation, and the establishment of large mills with foreign capital. At the same time, hundreds of small woolen mills were closed down.

Demands for worsteds, and more especially woolens, was stimulated by the effect of World War I. Consumption of both types of fabrics increased until 1920, when wool goods began to lose their popularity. After the middle 1920's, there was a steady decline in wool production machinery and a trend toward multiple shift operations, as the industry attempted to adjust its productive capacity to the declining market. The industry generally was in bad circumstances, from which it made little recovery until about 1938.

As a result of World War II, the wool textile industry enjoyed a period of unusual prosperity. But, many of its plants still are equipped with old machinery. During the last several months there has been a lull in activity in the industry. However, this can be considered temporary, and modernization can be expected to continue at a brisk pace, in keeping with new developments in machinery and equipment.

Along with equipping the woolen and worsted textile industry with newer and more modern machinery, it is probable that many mill owners will move their plants to new geographic locations. Conditions in the present location, the Northeastern States, are in some instances not the best for economical manufacturing, and some manufacturers are considering other areas for relocation. Texas is one of the areas receiving serious consideration.

Texas acquired its first wool processing plant less than a dozen years ago. This seems to have been little more than a promotional scheme and continually operated at a loss, so that it changed hands about a half-dozen times. However, within the last year this plant has been purchased by a Northeastern manufacturer with many years of successful operation, and is being operated on a sound basis. A worsted yarn plant and a woolen blanket mill have been established here within the last ten years and both have made satisfactory progress. Two woolen mills have been moved to Texas within recent months and have not yet been completely re-erected. This seems but the beginning of a movement of the industry to this area.

Expanding Western Markets

West Texas is strategically located in that it is not far South of the center of the United States. It is nearer to the Farm West, Southwest and Far West markets than is the Northeastern section. Also, its location should enable it to take advantage of the South American markets.

The estimated population of the United States is between 10 and 15 percent higher than the census of 1940. It has been estimated that the increase over 1940 will be more than 15 percent by 1950. The population gain for some of the Far Western states is as much as approximately 40 percent. The more densely populated industrial East did not grow at anything like the same rate. With this great trend of population westward, there also has been a steady movement from the farm to the factory so that this country, once predominately agricultural, now is predominately industrial.

This "Go West" pattern of the Nation's population is pictured graphically by the map, **Figure 1.** This shows a population trend for each state between the last census, 1940, and the Census Bureau's estimates as of July 1, 1947.

The Farm West, Southwest, and Far West have a much expanded and much larger over-all market in terms of population and income, 32 percent and 31 percent respectively. Though they

MAP OF POPULATION TRENDS IN THE UNITED STATES
1940 - 1948

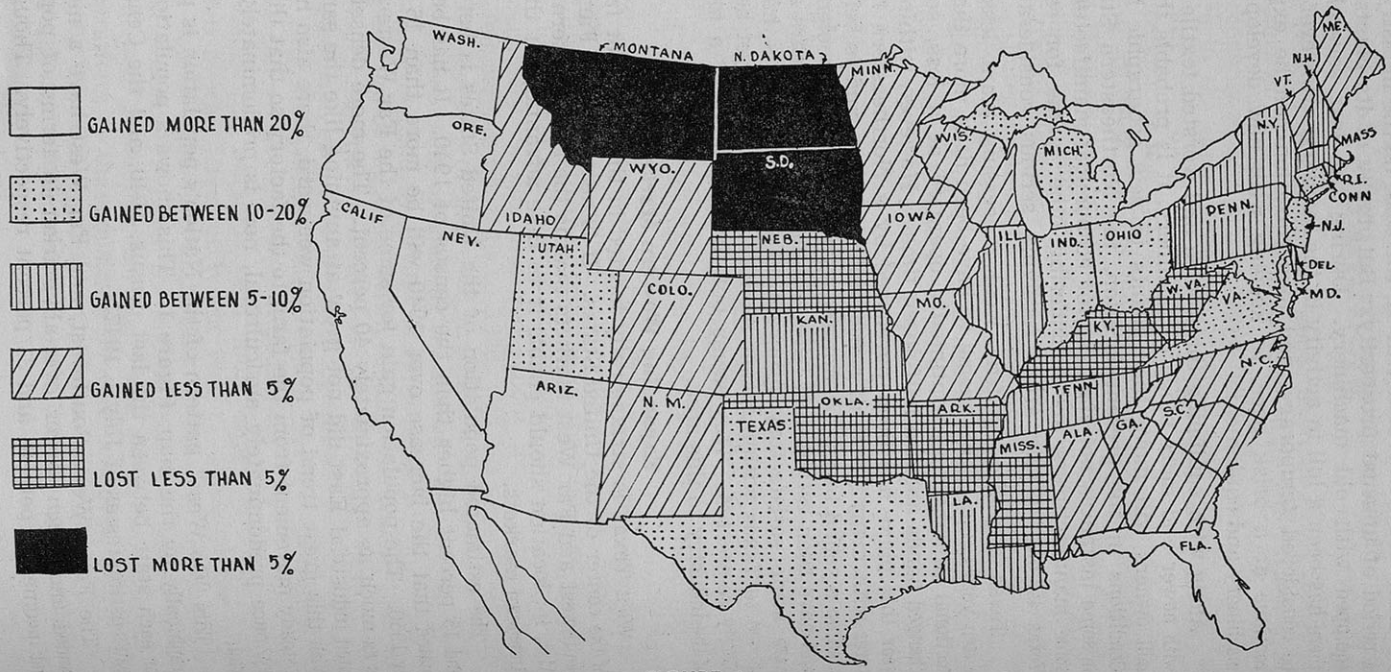


FIGURE 1

still have less than 3 percent of textile employment, after a wartime gain of 0.5 percent, the trends here are for accelerated textile growth.

West Texas is in an especially favorable spot to acquire a large part of this textile growth. Many women who worked during the war would prefer to continue working if suitable employment could be found. And there are many others who did not do war work, but who no doubt have the same desire.

West Texas is a Good Location

This region is one of the greatest wool and mohair producing areas in the world. The annual production of mohair is about 90 percent of the United States clip; that of wool, about 25 percent. Of the wool clip, 90 percent or more is 64s or finer. This section is unique in the uniformity of its production—a production of the highest quality. Also, Texas probably is the only state where 80s wools are produced in large amounts. These wools are suited to the best quality wearing apparel for men, women, and children.

West Texas has a distinct advantage over most sections west of the Mississippi River. It has several cotton mills, in addition to its newly acquired wool mills, which will furnish a nucleus of skilled help, one of the first requirements for establishing an industry. During recent years it has obtained facilities for training wool graders and sorters. Trainees are working under the supervision of experienced graders and sorters from New England.

FIGURE 1

The only textile engineering school West of the Mississippi River is at Texas Technological College in Lubbock. Training is offered in textile engineering, chemistry and dyeing, and weaving and design; and degrees are granted. This is a continuous source of trained "know-how"—essential to the existence of a textile industry. Key managerial and technical personnel could be imported to make the beginnings of an industry, and a reservoir of skilled labor could be built up with the aid of the textile school.

Trend Toward Decentralization

Although decentralization in wool manufacturing has been slow, mill owners have become nervous, and it appears that the industry will move from the Northeastern States. The foremost reason for the resistance to decentralization has been the dominance of Boston as the wool marketing center for the entire United States clip. This dominance has been maintained by expensive facilities for receiving, storing, preparing and grading wool, both foreign and domestic; and has been supported by the buying habits of the garment industry, the major customer of the woolen and worsted mills.

However, with the inevitable change in times, manufacturing costs in the Northeast have climbed sharply. Mill management in that section is unable to make as large machine assignments as those in other areas. Also, taxes are comparatively higher in that sector, as well as other operating costs and living costs.

At the present time machinery costs are still rather high, so that it is cheaper to operate older mills which are carried on the books at a nominal value, than it would be to build and operate new mills. Increase in availability of machinery in quantities and a definite trend toward a more normal pricing system should lend momentum to the building of new mills and to the movement of the industry to new locations. During the periods of prosperity and business expansion the trend in the textile industry is toward integration. Vertical integration permits flexibility of production, thereby widely increasing net profits. In times of depression and declining markets, the trend is away from integration. But, over the long term the trend is always toward integration, so it appears that at some time in the future virtually all textile manufacturing will be within integrated companies.

Integration inherently results in certain influences which tend toward dispersion of industry. The management of large companies logically would be disposed, to a certain extent, to scatter their holdings over as broad an area as practicable, to gain a favorable attitude from a greater number of representatives in the Government. Since the prospect is that with the passing of time, the textile industry is bound to become more highly integrated, it seems that decentralization must follow.

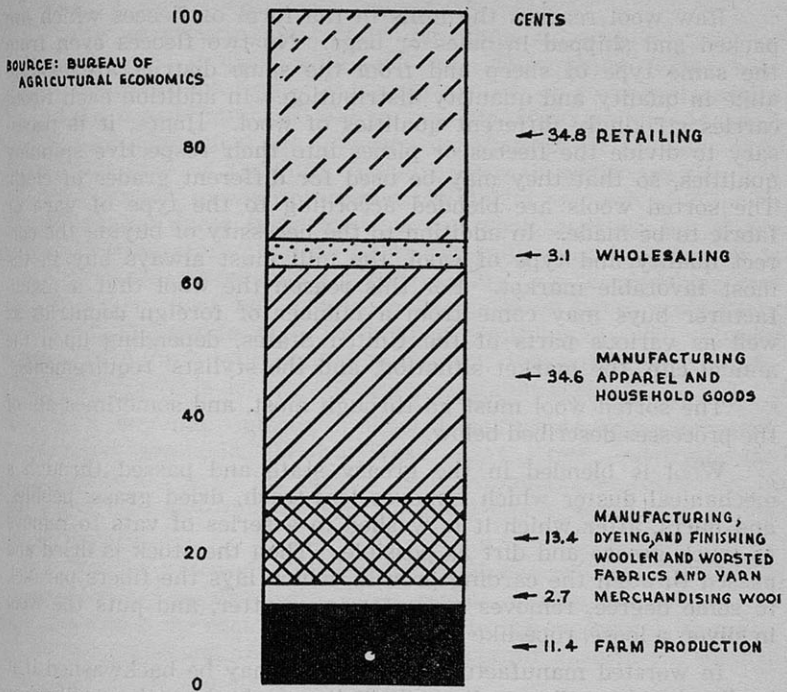
Ten reasons for decentralization are listed in the order of their importance, below: (1)

1. Proximity of important new markets.
2. Permits tapping new reservoirs of labor.
3. Small city or town location.
4. Small decentralization plant more efficient.
5. Desire to avoid dominating economic life of any one community.
6. Public relations value of being a local employer in important market areas.
7. Permits segregation of unlike operations.
8. Enables large companies to expand and yet retain features of small company.
9. Decentralized plants serve as training centers for future top executives.
10. Human relations likely to be better in smaller decentralized plants.

All of these are favorable to West Texas.

Any section which acquires a part of this migrating textile industry will be fortunate. The Bar chart, **Figure 2,** based on 1939 figures, is a vivid illustration of this fact. Of the total consumer's dollar paid for apparel and household goods made of wool, only 11.4 percent goes to the farmer, and 2.7 percent to the wool merchant. This is a total of 14.1 percent. Add to this the 34.8 per-

(1) Paul W. Dickson, **Decentralization in Industry,** National Industrial Conference Board, Inc. New York, (1948).



APPROXIMATE DISTRIBUTION OF THE CONSUMER'S DOLLAR PAID FOR APPAREL AND HOUSEHOLD GOODS MADE OF WOOL, BY OPERATIONS OR SERVICES, UNITED STATES, 1939, (BASED ON OFFICIAL AND OTHER DATA AND PARTIALLY ESTIMATED).

FIGURE 2

cent for retailing, or a total of 48.9 percent—West Texas' share of the consumer's dollar spent for apparel and household goods made of West Texas quality wool. The volumes of manufacturing, dyeing, and finishing woolen and worsted fabrics and yarns; manufacturing apparel and household goods; and wholesaling in West Texas are so small as to be almost negligible. Hence, 51.1 percent of the consumer's dollar spent for apparel and household goods made of West Texas or comparable wool is lost to the area.

West Texas is in a favorable position to expand its wool textile industry by being alert to prospective migration and making efforts to have industry locate here. Figures from the Bureau of Labor Statistics, of the U. S. Department of Labor, show a shift in the U. S. industrial employment of 3 percent from the Northeast to the South and West, 1939-1947. Indications are that more than half of the new industrial plants being built today are in the South and West, and that the migratory process is being speeded up beyond the average rate of the 1939-1947 period. An indication of this movement is borne out by recent movements of the wool industry to this area.

Manufacturing Processes

Raw wool reaches the mills in the form of fleeces which are packed and shipped in bales or bags. No two fleeces even from the same type of sheep and from the same district are exactly alike in quality and quantity distribution. In addition each fleece carries strikingly different qualities of wool. Hence, it is necessary to divide the fleeces or pieces into their respective spinning qualities, so that they may be used for different grades of cloth. The sorted wools are blended according to the type of yarn or fabric to be made. In addition to the necessity of buying the correct quality and type of wool, the mill must always buy in the most favorable market. For this reason the wool that a manufacturer buys may come from a number of foreign countries as well as various parts of the United States, depending upon the annual clip, the market situation, and the stylists' requirements.

The sorted wool must go through most, and sometimes all, of the processes described below.

Wool is blended in the greasy state and passed through a mechanical duster which removes leaf-trash, dried grass, pebbles, and burrs, after which it is washed in a series of vats to remove as much grease and dirt as possible. Then the stock is dried and passed through the carding process, which lays the fibers parallel, to some degree, removes some foreign matter, and puts the wool in sliver, a loose, rope-like form.

In worsted manufacturing the sliver may be backwashed if it is discolored or dirty, after which it passes through a gilling or drawing operation in which the sliver is attenuated and the fibers parallelized in preparation for the combing process. Usually two or three gilling processes precede combing. Combing removes all short, immature, undesirable fibers under a certain specified length, and lays all fibers parallel in the combed sliver or top. Usually two gilling processes also follow combing; and the finished sliver or top is drawn out and twisted slightly at the roving process to prepare it for spinning.

Roving is delivered to a series of spinning frames, or mules, which draw and twist it until the desired single-ply yarn has been obtained. After this, the single-ply yarn may be twisted into whatever multiples may be required.

Yarn for weaving is divided into two classes—warp yarn and filling yarn.

Warp yarn, which is the longitudinal element of the fabric, is wound on beams and sized with a starch solution at the slashing process.

Filling yarn, which makes up the transverse element of a fabric, is wound on bobbins and used in loom shuttles.

The goods are not ready for the market when they come from the loom. They must be bleached, dyed, or otherwise finished before they are ready for consumption. Most woolen and worsted mills have their own finishing plants.

Good Water Supply Necessary

For wool scouring and finishing, abundant local supplies of pure water are indispensable and area determining factor with respect to plant location. One scouring line or train will require an hourly consumption of 500 to possibly 3,000 gallons of fresh water, depending upon the type of wool scoured. It has been estimated that in wool finishing 70,000 gallons of water are required per 1,000 pounds of wool processed. Water of as much as 75 parts per million hardness is permissible for wool scouring, but if the water contains more than 86 parts per million of hardness, it is likely to cause processing difficulties. For use in bleaching and dyeing, water must not exceed in hardness 50 parts per million of calcium carbonate and one part per million of iron. Waters harder than these will require softening; but with modern softening methods this is not an insurmountable problem.

There are many places in West Texas where adequate water supplies are available. Within West Texas, itself, underlying the High Plains is one of the largest underground water reservoirs in the world. In addition there are several rivers, lakes, and potential dam-sites.

Any wool processing enterprise must concern itself with the problem of waste disposal. Most textile wastes are organic in character, and the cost of treating them is not excessive. In many places the structure of the ground will permit absorption, so that treatment might not be necessary.

Market Picture has Changed

The market picture has changed and continues to change from what it was in years past. At one time New York, by all odds, virtually dominated the market for men's and women's wool apparel textiles. This is no longer true, although that city still is the nation's largest marketing center for wool textiles. In the Farm West, the Southwest and the Far West, textile and apparel fields are providing more income and employment than ever before. In the Farm West, St. Louis is a leader in the manufacture of all kinds of clothing. Los Angeles is the principal center in the Far West and is the home of the distinctive California styles. In the Southwest the principal apparel manufacturing center is Dallas which produces all types of men's, women's, and children's clothing, and especially is coming to the fore as a sportswear producing spot. San Antonio, Austin, Fort Worth, and El Paso are other textile-apparel cities. Since the war, clothing plants have been located at Decatur, Abilene, Gainesville, Brownsville, Brownwood and Vernon. These indicate a trend toward further locations of the textile-apparel industries in West Texas as well as other parts of the Southwest.

In Texas and most western states, westernized styles seem to have become a part of the way of life, and are rooted in the traditions of the country. These styles lend themselves particularly to the use of light-weight, closely woven, fine worsteds in

solid colors, in keeping with climatic conditions. Also, worsted type fabrics containing blends of wool and synthetic fibers are used in these styles.

Significant Location Factors

Significant location factors which relate to the suitability of an area for textile manufacturing are listed below in a compari- of West Texas to the Northeast.

LOCATION FACTOR	SOUTHEAST	WEST TEXAS
1. Homogeneous English speaking population	About the same	About the same
2. Availability of experienced labor	Available	Limited
3. Productivity of labor	Good	Good
4. Wage scales		Slightly lower
5. Housing	About the same	About the same
6. Cost of living	Below average	Below average
7. Competition with high wage industries	Little	Little
8. Labor legislation	Fair	Good
9. Taxation	Below average	Below average; no state income tax, no corporate income tax, no sales tax, community property law
10. Attitude toward industry	Good	Good
11. Local capital available	Limited	Ample
12. Climate	Mild	Mild
13. Cost of power and fuel	Low enough	Low Enough
14. Quality and cost of water	Soft—low cost	Hard; moderate cost
15. Transportation	Adequate	Adequate
16. Accessibility to markets		
(a) East	Better	
(b) Middle West and Northwest		Better
(c) West and Southwest		Better
17. Accessibility to style centers		
New York	Better	
Dallas		Better
St. Louis		Better
Los Angeles		Better
18. Effect of buying habits	Favorable	
19. Convenience to executives and buyers	Nearer New York, Philadelphia and Boston	
20. Proximity to population center of U. S.		Nearer
21. In line with trend of population and buying power		Nearer
22. Accessibility to raw materials	About the same	About the same
23. Accessibility to existing finishing plants	Nearer	
24. Cost of building	About the same	About the same

It will be seen from the above that most of the advantages favoring the Northeast come from the industry's already being firmly entrenched there. When mills have been built more extensively in West Texas, part of these advantages will favor this section, in addition to those which it already has. This would give impetus to any movement of the industry here.

West Texas Has Much to Offer

Decentralization of industry, brought about mainly by the War, seems likely to continue. What started as a defensive measure, probably will continue as such and as a means of more efficiently serving the expanding markets in the West and the Southwest. Small towns furnish the best location for textile mills.

West Texas has a great many of these small cities, and is served by 12,972 miles of railroad, 9,451 miles of which is first line main track. The mileage exceeds the total of any state in the Union with the exception of all of Texas. There are seven Class-1 railroads.

Highway transportation has at its disposal 14,798 miles of paved roads, state and federally designated and maintained; also, 84,894 miles of improved secondary and farm-to-market roads. Twenty-four mainline federally designated highways serve and connect 95 percent of the area towns.

Commercial air lines blanket West Texas. This is of particular importance in view of the advent of air freight. Also, availability of air travel is an item of particular interest to textile executives and special personnel in New York, since this means of transportation will afford them less than a day's journey to this section. Often it is necessary for these men to travel to their mills and return to their offices in the East, within one or two day's time.

Freight rates for this section, from a competitive standpoint, are more favorable today than they ever have been. The Interstate Commerce Commission has boosted freight rates since before the War by 12 percent more for Eastern than for Western or Southwestern manufacturing in many lines.

The oil industry long has been big in this area. More recently the chemical industry has followed oil and other minerals here, but more especially to the Coastal region of Texas. Hope of the Southwest to become a great industrial area lies with future possibility of adding industries that will process the basic chemicals. The textile industry is one of the great users of chemicals.

Oil, also, is a basic raw material for synthetics; and a wool textile industry which wanted to diversify its line of products, better to meet competition, would have a convenient source of synthetic fibers.

Fuel and power, so essential to any form of manufacturing, are abundant in West Texas and at an economical cost. Of the U. S. natural gas reserve, 58 percent is in Texas and the major part is in West Texas. In 1947, 24 percent of the Nation's new generating capacity was installed in West Texas by a public utilities company serving only a part of this territory.

The terrain of West Texas lends itself to mechanized farming. With the complete mechanization of farming, including harvesting, a certain number of workers will be displaced and will be available for other work such as textile manufacturing.

As pointed out previously, there are many women available for work in wool mills, whose husbands are working in heavy industry, such as oil. As yet, there is no industry in West Texas to furnish occupation to large numbers of women. Woolen manufacturing normally employs 37 percent women, and worsted manufacturing, 52 percent. The work is light and not hazardous.

Latin-American labor available in West Texas, has been found highly satisfactory. These people are willing and competent workers, and work well in groups. They receive first preference in some lines of work. They are intelligent, uncomplaining, and are relatively easily trained to do manual tasks.

The Texas Legislature has enacted laws which go much farther than those of any other state toward the restoration of law, order, and fair dealing to labor-management relations. These laws set new and important limitations to union contracts, and they outlaw practices heretofore freely engaged in by labor unions.

This has been done to protect a way of life to which the people of this state are accustomed. Certainly in West Texas group labor disturbances are virtually unknown. The people here firmly believe in private initiative, and in protecting the property rights of free enterprise as well as the inherent rights of labor.

Texas has one of the most favorable tax structures of any state in the Union. Property taxes are below average; and in addition the state has no personal income tax, sales tax, nor corporate income tax, and has a community property law.

Essential to any textile industry is adequate commercial machine shop service to repair machinery and equipment. The entire West Texas area is dotted by many excellent machine shops, established mainly to serve the oil industry. These can adapt their services and facilities satisfactorily to textile industry requirements.

West Texas Has Valuable Source of Knowledge

Texas Technological College, one of the three major state schools and a center of cultural life in West Texas, was founded for the purposes of teaching textile engineering. The textile school is one of the better equipped schools of the country. In addition a textile engineering and manufacturing research program is carried on here. Although this is concerned with cotton chiefly, some of the findings may well apply to wool. Plans are under way to increase wool training and research facilities.

Since Texas Technological College opened in 1925, a considerable number of its textile graduates have gone into the industry. Most of these men are in high positions now, and most of them would return to Texas if they could find textile jobs here that would afford them the same high degree of success they have attained elsewhere. The school served the textile industry well and can serve even better a textile industry located in this area.

Special Inducements

Special forms of inducement have been used by communities, for the purpose of acquiring industry. Some of these may be bene-

ficial to both the town and the manufacturing establishment concerned. However, some investors and executives hold the view that an industry should stand on its own merits, and that special inducements, rather than an aid, are a hindrance to a plant which has been set up in a new location. An official of one state says that, while his state itself offers no gifts of sites or tax exemptions, some local counties and towns do make sites available and give tax exemptions for a certain portion of taxes for a five year period.

Mississippi gives five-year ad-valorem tax exemptions to new industries and Louisiana gives ten-year exemptions. An official of the former says that several industries have been established in his state with purely local participation in the capital structure, under purely local arrangements. He says Mississippi is the only state in the Union in which communities can, by law, issue bonds to construct buildings to house industries, with the buildings to be paid for through rent on a long term lease.

Interest and Intelligent Action are Best Inducement

One of the strongest inducements to industry is the interest and understanding of local bankers. Industry must have extension of credit to meet payrolls and buy raw materials. This may not be absolutely essential to an outsider investor with large capital; but the friendly, helpful attitude of local banks may be the deciding factor in persuading him to locate in a particular community.

A vigorous integrated education and research program, with the interest of bankers, businessmen, prospective employees, and other citizens of West Texas, will give a needed impetus to a movement of the textile industry to this section. Immediate, continuous, concerted action should be taken. The people here should not expect to reap a bonanza, but rather, to build a solidly founded industry, established on sound economic principles, which will grow by its own merits. Thus, they will avoid the inadvertent acceptance of any chance nostrums in the guise of guaranteed get-rich quick schemes.

The Report

Purpose and Scope of the Survey

This survey has been made to show why the manufacturing processes of wool have not been drawn closer to one of the principal sources of wool supply, West Texas, and to evaluate the possibilities of extensive wool processing in this area in the future. In order to accomplish the first of these objectives, it will be necessary to trace the background and describe the present organization of the wool textile industry. The following factors are most often cited in explanations of the continued concentration of wool processing in the Northeast: (1) Experienced labor supply (2) abundant supply of suitable water (3) marketing facilities (4) accessibility of raw materials (5) proximity to markets (6) transportation facilities and (7) banking or financial advantages. To determine the future possibilities for the wool textile industry in West Texas, each of these factors will be evaluated in terms of its West Texas potentialities.

The geographical West Texas area is the territory lying west of a line drawn from the Red River southward to the Rio Grande through Gainesville, Denton, Fort Worth, Cleburne, Waco and Lampasas to Del Rio. The entire area of 162,500 square miles comprises approximately two-thirds of the state of Texas. It is 600 miles from the extreme eastern boundary of West Texas at Fort Worth to the westernmost city of El Paso, and approximately the same distance from the northernmost Panhandle towns to Del Rio at the Southern tip. The boundary of West Texas has been indicated on each of the maps presented in this report, in addition, Eastern New Mexico is considered a part of the West Texas region.

Synopsis of the Cotton Textile Industry

The wool textile industry in the United States includes plants engaged in scouring and carbonizing wool and hair; combing wool and hair into tops; spinning, twisting, winding, or beaming yarns spun on woolen and worsted systems; weaving fabrics and related products other than carpets and rugs; and dyeing and finishing wool products. Each of these processes may be performed by separate plants, or two or more processes may be combined in one plant. Some companies in the wool industry are completely integrated, and perform all the processes of converting raw wool to finished products. These may include the additional step of fabricating garments, which is not a part of the wool textile industry.

The industry employed 173,000 workers in May, 1948, and ranked seventh in employment among United States industries in 1939. There are over 600 firms operating more than 700 plants engaged in some phase of wool manufacture in 31 states; but the major portion of the industry at the present time is located in Massachusetts, Rhode Island, Pennsylvania, and New Jersey. In 1945, 90 percent of the United States wool manufacturing capacity was still concentrated in the Northeast, and practically all the wool used was purchased in Boston and Philadelphia.

The status of the woolen and worsted industries at the time of the 1939 census is shown in the following table:

Woolen and Worsted Manufacturing in the United States, 1939

Number of establishments	722
Wage earners (Average for the year)	149,915
Wages	$143,494,078
Cost of materials, supplies, fuel, purchased electric energy and contract work	$451,400,050
Value of products	$735,905,278
Value added by manufacture	$284,505,228
Horsepower of prime movers	364,286

(2)

Wool and mohair are the major raw materials of the wool textile industry. Wool is produced in important quantities in every part of the United States, but mohair production is confined to seven Western states. Texas leads in the production of both raw materials for the wool industry; its annual wool production is 25 per cent of the domestic clip, and its mohair production is over 90 percent of the domestic supply.

The first main division of wool is the separation of carpet wool and apparel wool. Carpet wools are longer, coarser wools used mainly in the manufacture of floor coverings; the United

(2) Bureau of the Census, **Census of Manufacturers.** **Bulletin** of the National Association of Wool Manufacturers, 1947.

States does not produce carpet wools, and all these wools are imported, duty-free. The processing of carpet wool is not considered as part of the wool textile industry, and in discussing production and consumption of wool, this report does not include carpet wool.

Apparel wools are those suitable for manufacture into yarns and fabrics for apparel purposes. The apparel wool manufacturing industry consists of two major branches, worsted and woolen. The worsted branch uses about 70 percent, and the woolen branch about 30 percent of the virgin apparel wool consumed in the United States. Worsted manufactures sort, blend, and scour wool, convert it into semi-manufactured products known as tops, and spin the tops into yarn. Woolen manufacturers do not make tops, but they combine and mix the wool and other materials, if such are used, and card it and spin it into yarn.

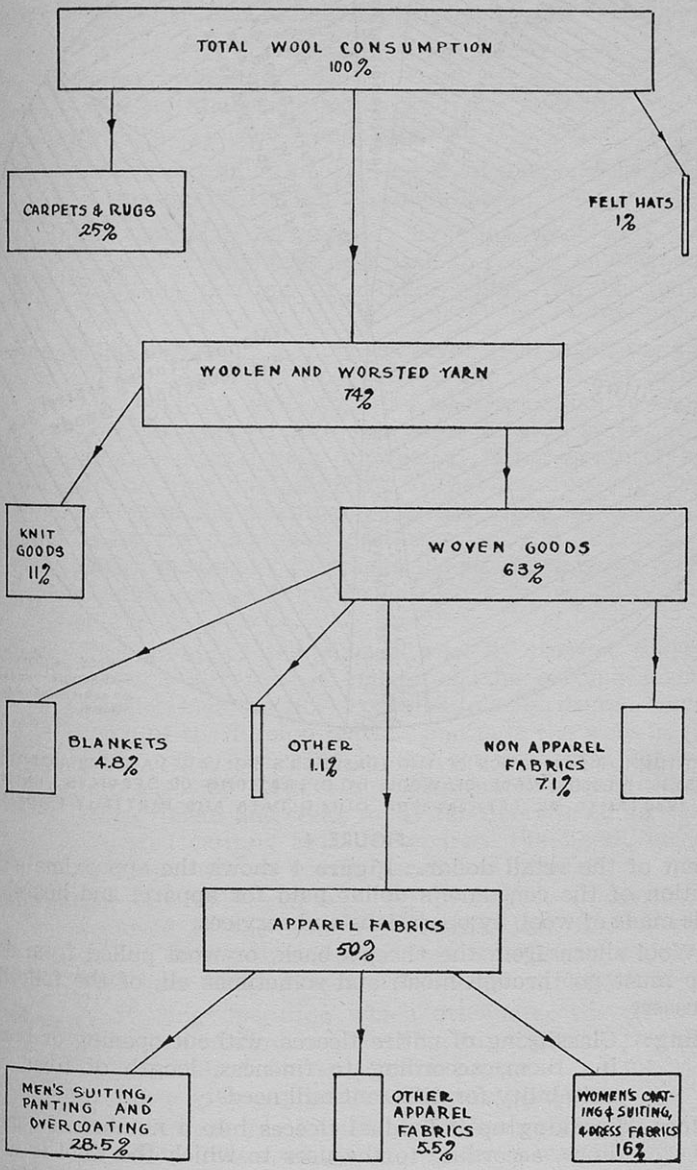
Most worsted and woolen cloths are dyed and finished by the manufacturers. The common method of coloring worsted is to dye the tops, but a large volume of worsted goods is dyed in the piece by applying dye to the woven fabric. Worsted fabrics usually are "clear finished" and have a smooth appearance. The finishing process applied to woolen goods, called "fulling", subjects the moistened fabric to heat, friction, and pressure, to shrink and thicken it and interlock the fibers in it. Then the fabric is napped and sheared; and it has a solidity and nap which is characteristic of woolen goods.

There are three principal methods of making fabrics and articles of wool; weaving, knitting, and felting. Weaving and knitting require that the fibers first be prepared and spun into yarn; felts are made by pressing masses of unspun fibers together; woven felts are made by combining both methods. **Figure 3** shows the approximate distribution of all wool consumed in the United States in 1939. This report is concerned only with the various processes of the woven goods industry. About 85 percent of the woolen and worsted yarns produced in the United States in 1939 were used in woven goods and about 15 percent in knit goods. Almost 80 percent of the woven goods were used in apparel fabrics. Of these apparel fabrics, 57 percent was used in men's suitings, pants goods, overcoating, and topcoating; about 22 percent in women's coating, suiting, and dress fabrics; and about 11 percent in other apparels, including bathrobes, shirts, snow suits and interlinings. (3)

The value added to wool by processing and manufacturing, and other services rendered, is so great that returns to growers for raw wool amount to a relatively small portion of the prices paid for finished wool products. During the years 1926-1941 returns to growers for raw wool averaged about 13 percent of retail prices of the finished products. In 1939 the cost of production was 11.4

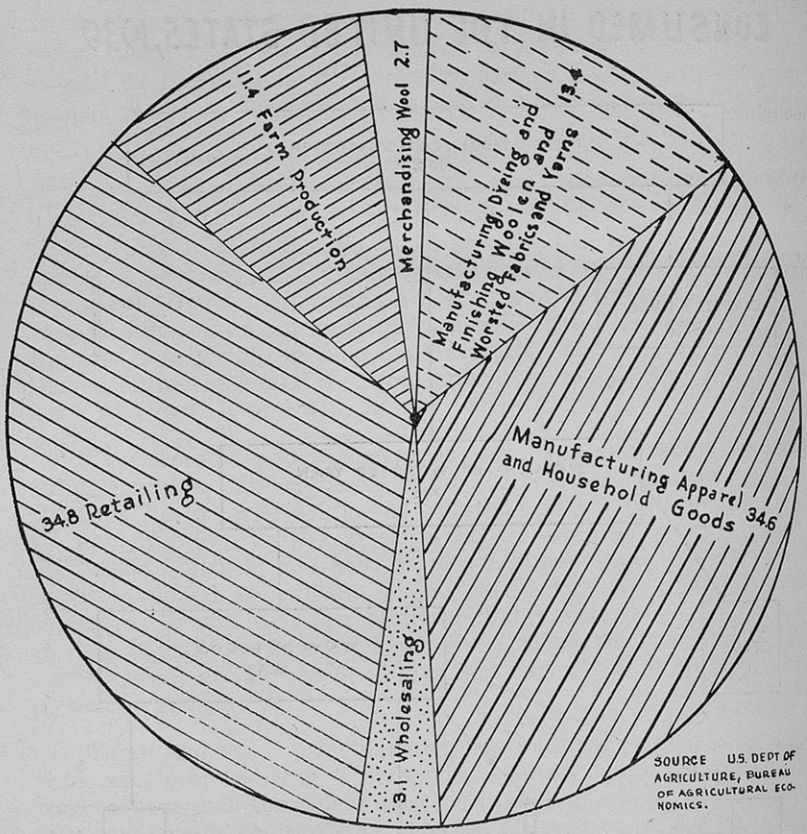
(3) L. D. Howell, **Marketing and Manufacturing Margins for Textiles**, Department of Agriculture (1945).

APPROXIMATE DISTRIBUTION OF WOOL CONSUMED IN THE UNITED STATES, 1939



SOURCE: U.S. DEPT OF AGRICULTURE AND BUREAU OF AGRICULTURAL ECONOMICS

FIGURE 3



APPROXIMATE DISTRIBUTION OF THE CONSUMER'S DOLLAR PAID FOR APPAREL AND HOUSEHOLD GOODS MADE OF WOOL, BY OPERATIONS OR SERVICES, UNITED STATES, 1939 (BASED ON OFFICIAL AND OTHER DATA AND PARTIALLY ESTIMATED).

FIGURE 4

percent of the retail dollar. **Figure 4** shows the approximate distribution of the consumer's dollar paid for apparel and household goods made of wool, by operations and services.

Wool shorn from the sheep's back, or wool pulled from dead sheep must go through most, and sometimes all, of the following processes:

Grading: Classifying of entire fleeces, without opening or breaking them, according to fineness, length of fiber, and suitability for different mill needs.

Sorting: Breaking up individual fleeces into a number of quality lines, according to the uses to which the wool is to be put in the mill and also according to the character of evenness of the fleece. Wool sorting requires a great deal of technical skill.

Blending: Initial stock combination of grease wools.

Dusting, willowing, picking: Mechanical operation that knocks out considerable portions of loose matter absorbed by the fleece in the year's growth, such as leaf, chaff, dried grass, pebbles, burrs.

Scouring: Washing and removing as much yolk, suint, grime and dirt as possible.

Hydro-extracting, whizzing: Taking out excess scouring and washing liquor and water from the wool that has been scoured. Leaves wool in damp condition.

Drying: Actual drying of wool at the right temperature to make it suitable for further manipulation.

Carbonizing: (optional operation): Treating wool with hydrochloric or sulphuric acid bath to reduce any remaining vegetable matter to carbon, which can be removed easily.

Blending, oiling, mixing: Making up, layer upon layer, the stocks to be used in the wool lot. If the mix is not to be an all-wool yarn or cloth, wool wastes, cotton, rayon, mohair, are placed into the blend at this stage. Oil is applied mechanically to wool by either brush or spray at the final mixing picker so that the wool will "work" better in the machine operations which follow. Mixing is for the purpose of getting a uniform distribution of fibers in the blend to make the stock ready for carding. Original colors begin to lose their individuality and to merge.

Carding: Opening-up of the matted wool by passing the stock through a series of rollers on the carding machine. Carding lays the fibers parallel to some degree, removes some of the foreign matter, and puts the wool in sliver form. The last card in the set condenses the sliver into a roving form. In woolen manufacture carding is more violent and seeks to lay the fibers in all directions. Worsted carding aims to separate the fibers, but also to keep them as nearly parallel as possible.

Backwashing: An additional washing to remove impurities not removed in the scouring process, and, impurities acquired during processing. This is necessary only when the sliver looks grayish, discolored or dirty.

Gilling: A drawing operation which attenuates the sliver and gives it a preliminary combing to parallelize the fibers, in preparation for the combing process. Usually two or three gilling processes precede combing.

Combing: (worsted only): Removes all the short, immature, undesirable fibers which are under a certain specified length. These short fibers are called noils and are used in spinning yarns used for woolens. The choice, long fibers are made parallel, and the combed stock, all the same fiber length, is in sliver, top or slub form.

Gilling: Usually two gilling processes follow combing and are performed as explained above.

Roving: Sliver is drawn out and twisted slightly in preparation for spinning.

Spinning: Final operation in making woolen or worsted yarn. Final drawing, drafting, twisting, and winding. Spun yarn is a more or less compact, solid, cohesive group of fibers that have enough strength to withstand friction and to give good commercial value in wear. Woolen yarn is spun on either the mule spinning frame or the frame; worsted yarn may be spun on one of four machines: mule frame, ring frame, cap spinning frame, flyer spinning frame.

Twisting: Two or more yarns are plied and twisted together.

Spooling: Yarn is wound onto spools for placing in the warper creel.

Warping: Yarn is wound onto section beams in sheets or banks for slashing.

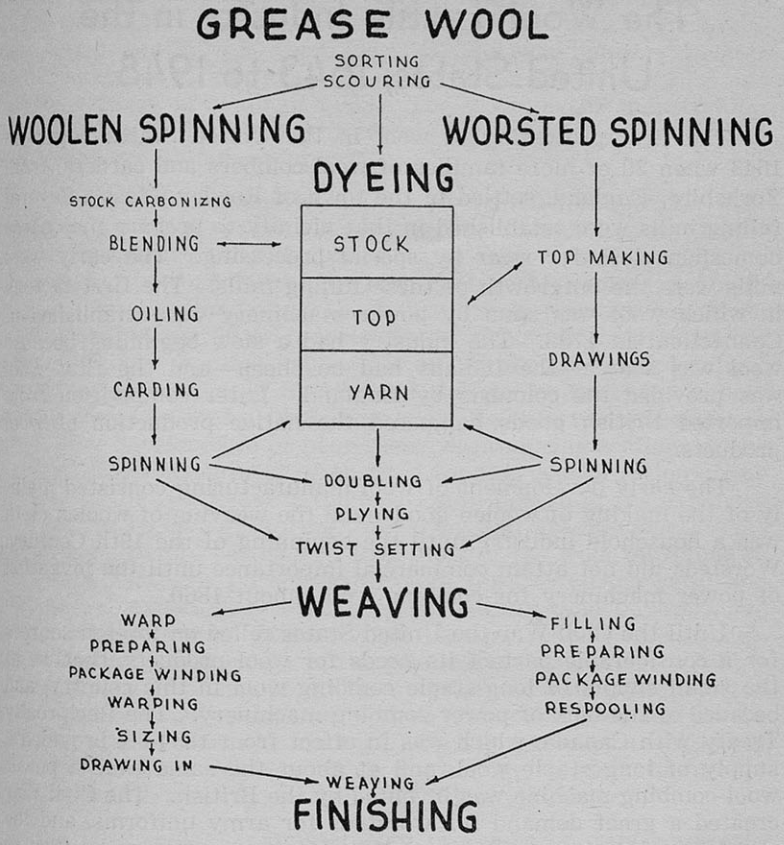
Slashing: Beamed or warped yarn is drawn through starch solution and wound onto loom beams for weaving.

Weaving: Weaving is the actual production of cloth or fabric from yarns. Narrow looms produce fabrics from 36 to 58 inches in width. Average length of piece of cloth is 60 yards. A worsted loom is among the more advanced pieces of machinery in the wool textile industry.

Dyeing: Wool may be dyed in any stage of manufacture—as loose scoured wool or stock, as slubbing or top, as yarn, or as piece goods.

Finishing: Finishing includes all processes to which woolen and worsted goods are subjected after they leave the looms and before they are sold. The primary object of finishing is to enhance the quality of the cloth. There is no gray goods market in wool, as in cotton, because it is the customary practice for the weaver to finish the cloth.

A flow chart of wool manufacture is shown in **Figure 5.**



FLOW CHART OF WOOL MANUFACTURE.

SOURCE "AMERICAN WOOL HANDBOOK"

FIGURE 5

The Wool Textile Industry in the United States, 1643 to 1948

The first processing of wool in the United States began in 1643 when 20 or more families of wool combers and carders, from Yorkshire, England, settled in the town of Rowley, Mass. Several fulling mills were established in that vicinity to prepare the coarse homespun cloth for wear by special processing. The early wool mills were the outgrowth of these fulling mills. The first factory in which wool was spun by power machinery was established in Connecticut in 1788. The industry had a slow beginning because wool was scarce—the Indians had no sheep—and the first wool was provided the colonists by England. Later competition from imported British goods hampered the native production of wool products.

The early development of wool manufacturing consisted mainly of the making of woolen goods, and the weaving of woolen cloth was a household industry until the beginning of the 19th Century. Worsteds did not attain commercial importance until the invention of power machinery for combing wool, about 1860.

Until the Civil War the United States relied on foreign sources for a considerable part of its needs for wool products, because of the small supply of long-staple combing wool in this country, and because of the lack of power combing machinery. The Reciprocity Treaty with Canada, which was in effect from 1854-66, provided a supply of long staple wool, and at about the same time a power wool combing machine was invented by the British. The Civil War created a great demand for worsteds for army uniforms, and the shortage of cotton made many New England cotton mills turn to manufacturing worsteds. With the development of improved machinery for cleaning wool, as well as the perfecting of combing machinery, almost all types of wool could be combed by 1900, and consequently could be used in the manufacture of worsteds, which were rapidly gaining consumer preference. The rise of the worsted industry, from 1870-1900 also was aided by upbreeding of sheep, tariff legislation, and the establishment of large mills with foreign capital. At the same time, hundreds of small woolen mills were closed down.

The effect of World War I was to stimulate the demand for woolens especially, but there was an increase in the consumption of both types of fabrics until 1920, when wool goods began to lose their popularity. After the middle 1920's there was a steady decline in wool production machinery, as indicated in **Table I,** (appendix) and a trend toward multiple shift operations. During the period 1926-1931, the industry attempted to adjust its productive capacity to the declining market. Most large mills reduced their equipment and closed their less efficient plants. The number of mills in operation declined from 365 in 1927 to 286 in 1930, and

the number of looms available for production was reduced from 65,261 to 42,620. Many mills during this period were using equipment which was 25 to 50 years old. (4) The wool industry, like the textile industry as a whole, was depressed during the 1930's, and did not recover until about 1938. The wool textile industry has been enjoying a period of prosperity, but many of its plants are still equipped with old machinery.

The conditions under which the wool industry operates were developed during a period when ownership, financial policy, transportation facilities, manufacturing experience, and buying habits all combined to concentrate the manufacture of woolens and worsteds in New England; and the industry has resisted decentralization longer than other industries formerly concentrated in the Northeast. The worsted industry is among the five most localized industries in the United States, and the woolen industry is only slightly less localized. (4a). Few wool manufacturing establishments have developed in or near the wool producing sections of the country. The reason most often cited for this concentration of the industry in the Northeast is the location in Boston of the extensive facilities for receiving, storing, preparing and grading wool. This system is so firmly entrenched that most of the wool consumed in the United States is purchased through the Boston markets; and most of the experienced wool graders, sorters, and buyers make their headquarters in Boston. The existing system also is supported by the buying habits of the garment making industry, which is the primary customer of woolen and worsted mills. The worsted industry is especially sensitive to style and, since most fabrics are styled by the weaver, manufacturers feel it necessary to maintain close contact with the New York market and give preference to locations within a few hours travel of this style center.

The intermediate manufacturing processes of wool were concentrated in New England almost completely in the 1930's. In 1936, there were 20 establishments engaged primarily in wool scouring, largely on commission; and all except a few which were operated in connection with wool pulleries at slaughter houses, were located in New England.

There were only 10 or 12 topmakers, who bought raw wool and had it combed to their specifications, and they all had their headquarters in Boston. There were only 12 commission combers, and all were located in Massachusetts and Rhode Island, within 150 miles of Boston. **Table II** (appendix) based on 1939 census, shows the number and location of wool establishments in the United States at that time. Only two Texas woolen mills are included; both of these mills, one of which was at Eldorado, in West Texas, were producing blankets.

In 1943, Massachusetts was still the most important state in terms of the amount of apparel wool machinery, as indicated by

(4) Cecil E. Fraser and George F. Doriot, **Analyzing Our Industries**, New York (1932).
(4a) P. Sargent Florence, **Investment, Location, and Size of Plant**, Macmillan Co., New York, (1948).

Table III (appendix). At that time, 70 percent of the 2,582 worsted combs in place in the United States were in the New England area, with approximately 44 percent of the total in Massachusetts. About 71 percent of the 1,957,593 worsted spindles in place were in New England, with about 35 percent of the total in Massachusetts. However, the distribution of the 1,635,550 woolen spindles in place was more widespread; only 52 percent of the woolen spindles were in New England, and only 20 percent were in Massachusetts. The Middle Atlantic States had about 25 percent of the total woolen spindles and the Southern, North Central, and Western regions had about 23 percent of the total. Of the 42,213 woolen and worsted looms in place, 59 percent were in New England, with about 25 percent in Massachusetts and about 23 percent in the Middle Atlantic States. (5).

These figures indicate that the manufacture of woolen goods is more widely distributed than the manufacture of worsted goods. There are several reasons for this relatively wide dispersion of woolen mills. First, raw materials for woolen mills are more readily available and are not subject to the intricate marketing and combing processes which characterize the worsted material's tops. The woolen mills use shorter and weaker wool fibers, and noils, which are obtained from the worsted top combing process. In addition, woolen mills use large quantities of waste, reused and reprocessed wool, as well as cotton and rayon.

Another reason for the relatively wide distribution of woolen mills is that they are operated on a much smaller scale than those for worsted manufacturing. In most of the worsted industry there is a concentration of equipment in large plants. For instance, more than half of the total worsted equipment in 1943 was located in less than 20 percent of the reporting establishments.

The products of woolen mills include many fabrics not subject to styling, such as blankets, and these can be manufactured on a quantity production basis. Woolen mills therefore do not need the proximity to their markets, nor as much skilled labor as is required by worsted mills.

There has been some movement of wool manufacturing to the Southeast in recent years. This movement has been attributed mainly to comparatively economical manufacturing costs, principally labor. The Southwest has no advantage over the Northeast in the cost of assembling raw materials nor in delivery to markets, but it has a reservoir of skilled labor trained in the extensive cotton manufacturing industry. Many Southern operators have the technical knowledge to operate wool spinning plants because the processes involved are similar to cotton spinning; in fact, it is possible to spin worsted yarns on cotton spinning machinery.

The Eldorado mill still purchases scoured wool, cards and spins woolen yarns, weaves blankets, and dyes and finishes them

(5) **Bulletin** of the National Association of Wool Manufacturers, Boston, (1947).

and makes sales direct. Within the last few years two scouring plants have been established in Texas, and both do commission scouring. One of these scouring plants also combs tops which are shipped to worsted spinning plants in the East. Furthermore, within the last two years, this plant has installed spinning machinery and now sells yarns also. Two woolen mills have made plans to move to West Texas this year, one to Brownwood and the other to Marble Falls. Both will purchase scoured wool and spin and weave it into woolen fabrics.

The Marketing of Wool and Wool Textiles

Marketing of raw wool. The marketing of wool probably is more concentrated than that of any other important commodity. Although the wool market in the United States handles from 500,000,000 to 700,000,000 pounds of wool annually, and the valuation may range from $112,000,000 to $350,000,000, there is no established public market, and practically all the wool is bought and sold by private agreement.

Boston is the leading wool market of this country and the second largest wool market in the world. Because Boston has a combination of port facilities and storage capacity for receiving both domestic and foreign wool, the city handles approximately 75 percent of the domestic wool and occasionally as much as 75 percent of the imported wool. Also, Philadelphia handles considerable quantities of domestic and foreign wools, and New York receives a large amount of imported wools.

The wool grower markets his wool by one of four principal methods:

1. Outright sale.
   The grower sells the short wool to the resident agent of the wool dealer or to the wool manufacturer. About 60 percent of the annual clip is handled by dealers otherwise than on consignment. From 5 to 10 percent of the annual clip is bought by manufacturers in the producing area.
2. Contracting.
   The wool dealer contracts for the wool before it is shorn. This method is used when the demand for wool is strong.
3. Consigning wool.
   The wool is shipped to a wool warehouse company which grades it and holds it for inspection and purchase by a dealer or mill agent; the grower receives the selling price less the handling charges. This method is used when prices at shearing time are unsatisfactory to the growers.
4. Cooperative marketing.
   Growers associate to sell wool cooperatively through a single agency. This system is used in ten major wool growing states, including Texas.

Most local marketing associations are members of the National Wool Marketing Corporation, in Boston, to which they consign their wool for sale. The corporation advances money on account, and the local organization distributes these partial payments to member growers. Direct buying by manufacturers is more general in Texas than in other states because of the uniformity of Texas wools, the high concentration of production in a limited area, and the fact that most Texas wool passes through well organized

warehouses where it readily may be inspected. However, nearly all Texas wools are sold through commission dealers who maintain large warehouses in the principal cities of the producing area. The commission charged usually is ½c per pound, although a few dealers charge 1c per pound. (6) Wool delivered to the warehouse usually is in the original bag approximately five feet long and weighing an average of 210 pounds. Fleeces are roughly sorted but not carefully graded. Three kinds of wool prices are quoted in Texas, 12 months, 8 months and fall wools. Wool is sold on a delivered basis, for cash, and the buyer estimates the probable shrinkage before offering a price.

The resident agent buys wool on instructions and within price limits given him either by the dealer whom he represents or by the traveling buyer of the dealer. If the Boston dealer already sold the wool to a consumer, the dealer has the wool shipped directly to the mill of the buyer; otherwise, the wool is shipped to the dealers' warehouse in Boston.

When fleece wool arrives at the warehouse it is graded for average fineness of fiber, strength, and length of fiber. Because of the great variation in grades of wool, not only between fleeces, but even in the same fleece, precise grading is necessary. The necessity for expert grading of varied stocks of wool is the reason most commonly given for the concentration of stocks in two or three wool centers. The dealers near the manufacturers perform the function of carefully grading the wool and maintaining large lots so that they can meet the manufacturers' requirements for particular grades and types of wool.

Actual inspection before purchase is the general practice in the wool market. The grade designations for wool are not as standardized as those for cotton, and the industry apparently has resisted complete acceptance of Government standards, which in the case of cotton permit wide scale purchasing without inspection.

The Boston wool market not only serves as a reservoir for supplying manufacturer's needs, which can be bought in small lots and trucked to individual manufacturers in an overnight haul from Boston, but Summer Street also finances a large part of the wool clip of the entire country. The wool dealers finance wool stock to the growers through Boston banks, and through these banks they also play an important part in financing manufacturers.

Boston dealers sell apparel wool to hundreds of consuming buyers. In 1939, for instance, there were 80 customers in the worsted branch and 400 in the woolen branch of the industry. At that time it was estimated that over half of the domestic clip was consumed by about 10 large companies. About 45 percent of the clip was taken by topmakers and about 55 percent was bought by woolen manufacturers and by worsted manufacturers who made their own tops. (7).

(6) T. R. Hamilton, **Trends in the Shop and Wool Industry,** Texas Agricultural Experiment Station, (1945).
(7) Alston H. Garside, **Wool and the Wool Trade,** New York, (1939).

Marketing of scoured wool. Scoured wool is wool that has been put through the cleaning process to remove the natural grease and impurities, but has not been processed further. The market for scoured wool is limited to woolen manufacturers, because it is the established practice of worsted manufacturers and topmakers all over the world to purchase wool in the grease and do the scouring themselves, or have the wool scoured to their specifications. Most worsted processors prefer to make the original examination of the lot of wool to determine grade length, character and uniformity before scouring. In 1939, 15 to 20 percent of the shorn wool and 40 to 50 percent of the pulled wool was scoured before it reached the consumer. Pulled wool usually constitutes about 20 percent of the annual production, and is incidental to the slaughter of sheep in the meat packing centers. Scoured wool, like raw wool, is sold for cash, to wool merchants and to some extent to wool manufacturers, for whom the scouring mills may do work on commission basis.

The separation of a distinct wool-scouring industry often has been suggested. To persons unfamiliar with the industry, this preliminary processing in the growing area would appear to have some advantages, because the sale of scoured wool would eliminate the paying of freight on grease and dirt which may constitute as much as 60 percent of the weight of grease wool, and because it would allow manufacturers to purchase only those sorts which they needed. These advantages apparently are outweighed by the manufacturer's desire to do his own sorting and scouring, or to have scouring done to his specifications; also advantages are mitigated by the fact that scoured wool has a tendency to mat when packed for shipment. In manufacturing operations, the matting of wool is believed to result in broken staple. For this reason, worsted top manufacturers will not accept it, but since length of staple is not important in manufacturing of woolens, manufacturers buy scoured wool. (8)

Marketing of Noils. Noils are the short or broken wool fibers removed in the combing process; and usually are sold by the topmakers or worsted manufacturers to woolen yarn spinners, who blend them with other fibers in the production of woolen yarns. The price of noils fluctuates according to source, cleanliness, and length. The price of Bradford noils generally is two-thirds of the price of the scoured wool used; the price of French noils is 55 percent of the scoured wool price. The Boston wool market also handles the sale of noils and tops.

Marketing of Tops. Wool tops are combed wool sliver from which the shorter fibers, or noils, have been removed by the combing process. Commercial tops usually range from 4 to 9 per 10 yards and are wound into balls ranging from 5 to 15 pounds. Tops, an intermediate product in making worsted yarn, are marketed in recognized grades, identical with the grades of wool from which they are made. Tops are produced from both the English, or Brad-

(8) Arthur H. Cole, **The American Wool Manufacture, Vol. II,** Cambridge, (1926).

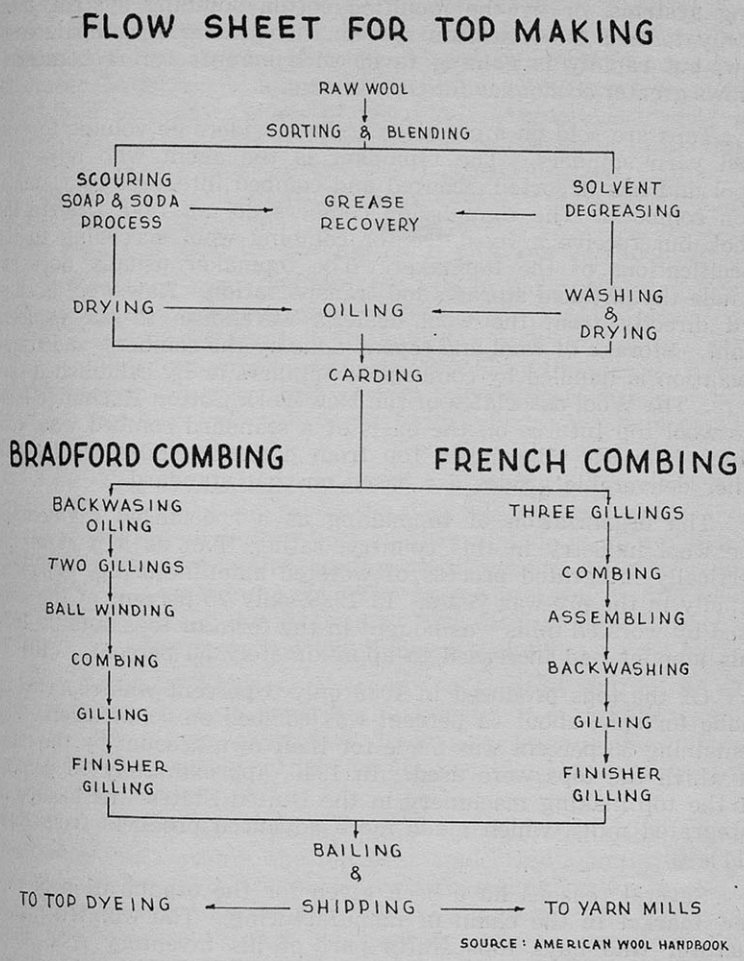


FIGURE 6

ford, and the French systems of worsted yarns preparation; that is, oiled combing and dry combing systems. See flow sheet **Figure 6).**

In the Bradford system, mineral or olive oil is added during the combing process, making the fiber more pliable and easier to handle, particularly with reference to the coarser grades of wool. The French system of dry combing ordinarily is used preparatory to spinning the finer grades of wool, which are used most frequently for women's wear. French spun yarn usually is more expensive. The worsted yarn for men's medium or better grade suitings is spun from tops produced on the English or Bradford system. (9) Tops can be processed into yarn by the conventional worsted spin-

(9) National Bureau of Economic Research, **Textile Markets,** New York, (1939).

ning systems, or by the modified cotton spinning system, commonly termed the American system. The latter is comparatively new, but rapidly is gaining favor with manufacturers because it allows greater economies for certain uses.

Tops are sold on a credit basis in considerable volume to worsted yarn spinners. The topmaker is the agent who buys raw wool and has it sorted, scoured and combed into tops by commission combers. The commission combers do not take title to the wool, but receive a fixed fee for combing wool according to the specifications of the topmaker. The topmaker usually does not handle the physical storage and transportation. Raw wool is shipped directly from the wool dealer's warehouse to the combers plant. Storage of wool and tops is done by the combers, and transportation is handled by combers or spinners or by established carriers. The Wool associates of the New York Cotton Exchange handle wool top futures on the basis of a standard combed wool top, which is a 64s oil combed top from domestic shorn wools. All other deliverable grades are based on that standard.

The organization of topmaking as a specialized segment of the wool industry in this country, rather than as a part of the vertically integrated process of worsted manufacturing, expanded rapidly in the pre-war years. In 1929, only 25 percent of the wool used by worsted mills was bought in the form of tops, and by 1939 this amount had increased to approximately 50 percent. (10)

Of the tops produced in 1939 only 3 percent was reported as made for sale, about 44 percent was combed on commission. The remaining 53 percent was made for their own account by the mills in which the tops were used. In 1946, approximately 75 percent of the top making machinery in the United States was located in integrated mills, which made more advanced products from tops. (11)

Several reasons have been given for the organization of this new market in the chain of manufacturing. The worsted manufacturer who buys tops shifts part of his inventory risk, since tops can be bought in smaller quantities than raw wool and can be bought nearer to the time of actual use. Specialist topmakers can produce desired qualities of tops at lower costs by selecting the right wools and blending them in the right proportions. Topmakers also can operate more economically, because they can keep the equipment of the commission combers operating at a steadier rate than that of mills with their own combing departments.

Marketing of yarn. Woolen spun yarn is made from fibers of varying lengths from less than one inch up to more than two inches; these fibers are twisted into a yarn with the fibers interlaced in every direction. In manufacturing woolen spun yarn, the so-called wool substitutes are almost as important as raw wool. Raw wool may be blended in varying amounts with reworked and

(10) National Bureau of Economic Research, **Textile Markets,** New York, (1939).
(11) Trade Agreement Digests, Vol. XI, **Wool and Manufacturers,** U. S. Tariff Commission, (1946).

reprocessed wool, noils, cotton, rayon, wool waste, and/or other wastes. Manufacturers of woolen cloth usually spin their own yarn, because woolen yarns vary considerably; worsted yarns, on the other hand, are a standardized product. Worsted sales yarn is made in a great variety of weights, constructions, colors, and grades, but spinners of sales yarn tend to specialize in making a relatively narrow range of types and grades of yarn. Almost all the woolen yarn and about 60 percent of the worsted yarn spun in the United States in 1946 was produced by integrated mills which used the yarn in weaving cloth on their own looms.

Yarn also is manufactured for sale by large integrated mills and by separate spinning mills. This yarn is sold in about equal amounts to worsted cloth manufacturers and to the knit goods industry. Weaving yarn customarily is sold by the spinner directly to the weaver, while knitting yarn is sold both direct and through jobbers, who also may dye yarns to specified colors and package them.

Marketing of blankets. Blankets are sold by the manufacturers directly to retailers or to wholesalers serving the retail trade. Blanket manufacturers on their own account do more advertising to stimulate public preference for their product than any other segment of the wool industry. The reason probably is that blankets comprise the only major product that reaches the ultimate consumer in the same form in which it leaves the mill.

Marketing of Fabrics. Because the greatest portion of wool woven goods is used in apparel, the industry is especially sensitive to style. The burden of rapid style changes falls on the manufacturers, because most wool fabrics are yarn-dyed and consequently are styled by the weaver.

Woven goods produced in woolen and worsted mills are sold directly to the clothing and garment trades for manufacture into apparel. These sales are made through selling offices owned or controlled by the mills, or through sales agencies which receive a commission. Sales through jobbers are more common in the women's wear trade; also jobbers sell retailers wool piece goods for over-the-counter sale. Credit risks may be assumed by the mill or the sales agency or they may be transferred to a factor, in which case the factor makes immediate payment of the account to the mill, less the service charge. The factor also may lend money to the mill for plant modernization, procurement of raw materials, or working funds.

Markets for the Industry's Products

Since the war the United States has consumed annually almost twice as much wool of all types as in pre-war years, and this country has become the largest wool consuming nation in the world. This remarkable doubling of wool consumption in ten years has been attributed to the following main causes : (1) the increase in population; (2) increased purchasing power; (3) the relative shortage of durable goods, freeing incomes for expenditures on clothing and textiles; (4) growing appreciation of the value of wool garments, from experience in the armed forces and from foreign travel during the war; (5) compulsory disclosure of the fiber content of wool fabrics under the Wool Products Labeling Act of 1939; and (6) effects of sustained wool promotion and publicity of trade organizations.

The consumption of apparel class wools has increased more than other types, and in 1947 consumption of apparel wools was more than 80 percent higher than before the war. Apparel wool consumption rose from the 1938 level of 220,000,000 pounds, scoured basis to 610,000,000 pounds in 1946, and fell to 526,000,000 pounds in 1947. (12)

The most marked change in apparel wool consumption has been in the proportion of foreign wools used. This country does not produce enough wool for its own needs, and a substantial quantity is imported each year. Between 1921 and 1930, approximately 35 percent of all of the apparel class wool consumed was imported. As shown in **Table IV** (appendix) by 1936-1939 the imports had dropped to 23 percent of total consumption, and that since early 1940, the proportion of wool imports has increased so much that they have exceeded domestic wool consumption. Foreign wool accounted for 82 percent of total consumption in 1946, but the proportion declined to about 60 percent in 1948. This shift from domestic to foreign wools was mainly a matter of relative prices. During most of the period 1942-1946, the Commodity Credit Corporation was purchasing the bulk of the domestic clip at guaranteed prices and, because it was prohibited by law from selling under parity, it built up stocks of wool which could not be disposed of in competition with the lower-priced foreign wool. In 1947, the prices of foreign wools became higher than prices for comparable domestic wool. (13)

Domestic wool production has declined since the beginning of the war. It was estimated that the 1948 wool clip will be 6 percent smaller than 1947 clip, 33 percent below the 1937-1946 average and the smallest production since 1923. Because of the continued demand for meat and the prevailing higher production costs, it is likely that the increased dependence on imported apparel wools will continue. The demand for fine wools has increased, and fine wools are accounting for a higher proportion of total consumption

(12) International Wool Secretariat, **The Wool Digest**, New York, (May 31, 1948).
(13) International Wool Secretariat, **The Wool Digest**, New York, (May 31, 1948).

than before the war. The normal wool clip of the United States is approximately 50 percent Fine, 64's and finer but the Texas clip is over 90 percent Fine. World consumption of Fine grade wools has increased 10 to 15 percent while production of the finer grades throughout the world has declined 42 percent.

Although the over-all demand for wool has increased, per capita consumption of wool in the United States has not increased as fast as per capita consumption of rayon and other synthetic fibers. Increase in consumption of the latter was due in part to stoppage of silk imports. Wool gains were made without the aid of elimination of competing fibers. The following table shows the per capita consumption of the major fibers since 1936.

U. S. CIVILIAN PER CAPITA FIBER CONSUMPTION
NET POUNDS PER PERSON

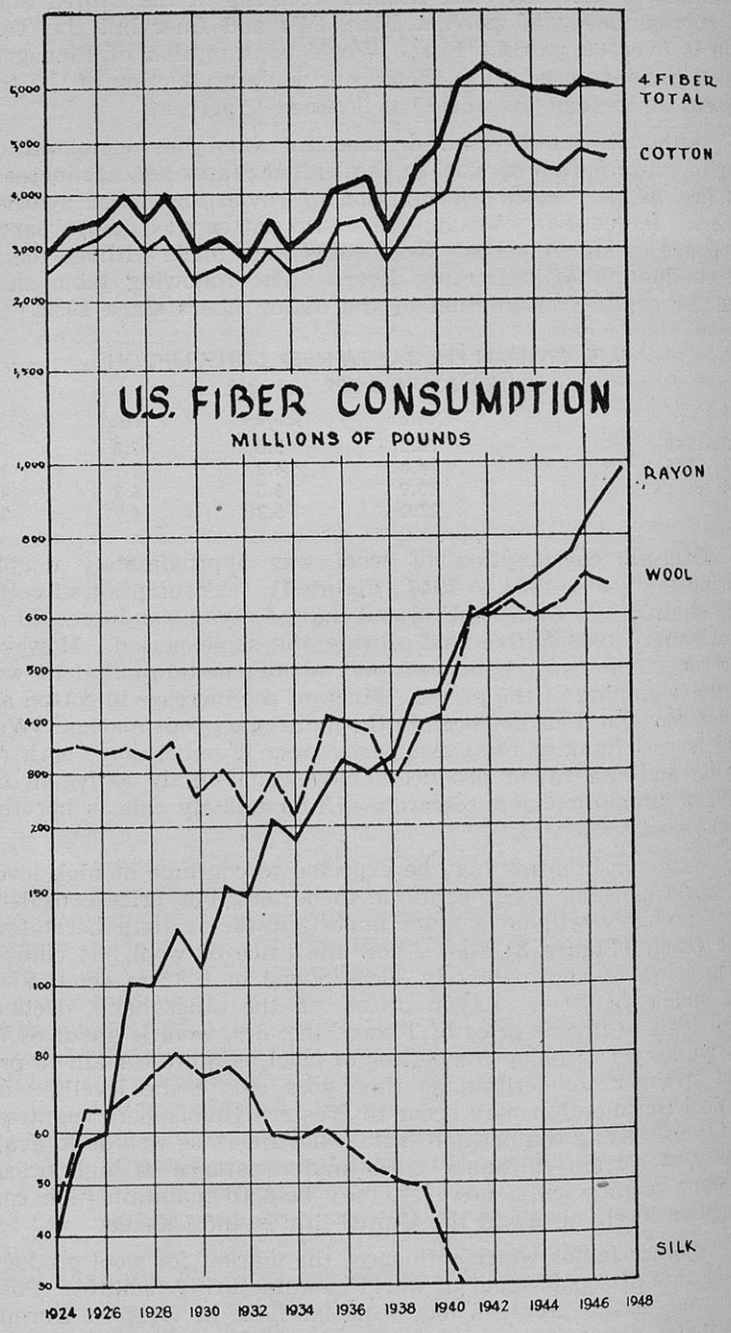
Period	Cotton	Rayon	Wool	Total
1936-1940	25.2	3.0	2.8	31.0
1941-1945	24.8	4.3	3.1	32.2
1946	30.9	6.0	5.3	42.2
1947	27.0	6.3	4.9	38.2

Over-all consumption of wool was approximately doubled during the years, 1924 to 1947 **(Figure 7)**. Consumption of cotton was slightly less than doubled and that of rayon was increased approximately twenty-five fold, during the same period. However, the consumption of rayon was only about one-tenth that of wool at the beginning of the period. Much of the increase in cotton and rayon consumptions has been in the industrial goods market. Wool still is used mainly for consumer goods. Furthermore, both the cotton and the rayon producers have been highly active in the field of promotion and research. Unfortunately this is not true of the wool producers.

Wool consumption may be expected to continue at high levels as world clothing needs continue to be met, but price considerations probably will be a more important factor than heretofore. The graph **(Figure 8)** shows how the price of wool has climbed from a low of approximately 36c a pound in 1932 to about $1.48 the middle of 1948. Rayon prices, on the other hand, declined until 1946. Current price of Texas Fine, 64s, wool is about $1.70. Rayon, as yet a minor competitor of wool, is quite certain to present stronger competition as time goes on. Some levelling off in wool consumption may occur in Western Hemisphere countries, due to increasing competition from other fibers as well as to availability of certain consumer goods and resistance to high prices. Military requirements, however, may help to maintain high consumption levels ahead in the United States and Canada.

Another factor which influences the market for wool products is the rate of replacement of world manufacturing facilities. Postwar wool-textile progress has been excellent in Western Europe, but it has not been uniform in war-damaged sections. According

(14) Textile Economics Bureau, Inc., **Rayon Organon,** (March, 1948).



SOURCE: RAYON ORGANON, TEXTILE ECONOMICS BUREAU INC.

FIGURE 7

to available reports, areas outside the iron curtain are ahead of those behind it. Behind the iron curtain, nationalization of wool industries and shortages of equipment, material and labor are delaying factors. In other areas, yarn and fabric production are beginning to compare favorably with prewar rates. In the occupied countries—Germany and Japan—raw material shortages, the need to reestablish foreign markets, political controls and other abnormal factors are retarding improvement. (15)

The most important factor affecting the market for wool textiles is the American buying power, determined by population growth and levels of income and prices. The population of the United States increased from 131,600,000 in 1940 to an estimated 145,300,000 by January 1, 1948. The greatest annual increase in population ever to occur in the United States took place in 1947. Texas population rose about 10 percent as compared to a 4 percent regional gain. (16) National per capita income increased from $539 in 1939 to $1200 in 1946; total income in Texas went up 150 percent as compared to 145 percent for the Southwest and 130 percent for the entire country.

Technological changes in the textile industry, including improved machinery, and wool research have resulted in better utility and greater usage for wool. Research has been along four closely related lines, especially with respect to military uses: improvement through fabric construction; increased resistance through finishing and after treatment; establishment of valid testing techniques; and improvement of garment design. New functional finishes such as water-repellents; fungicides; weather-resistant, wear-resistant and shrink-resistant treatments, and moth-proofing are being developed and applied to wool fabrics. Also, improved dye methods are receiving attention. (17) New developments in machinery include the new American system of worsted spinning, and improvements to conventional type worsted machinery.

The population center of the United States has been moving Westward, and the number of wholesale and retail outlets in Texas and the Western states has increased tremendously since before the war.

The market for the intermediate products of wool manufacturing, wool tops, and worsted sales yarn, is concentrated in the Northwest, where approximately 95 percent of the worsted spindles and 84 percent of the looms are located.

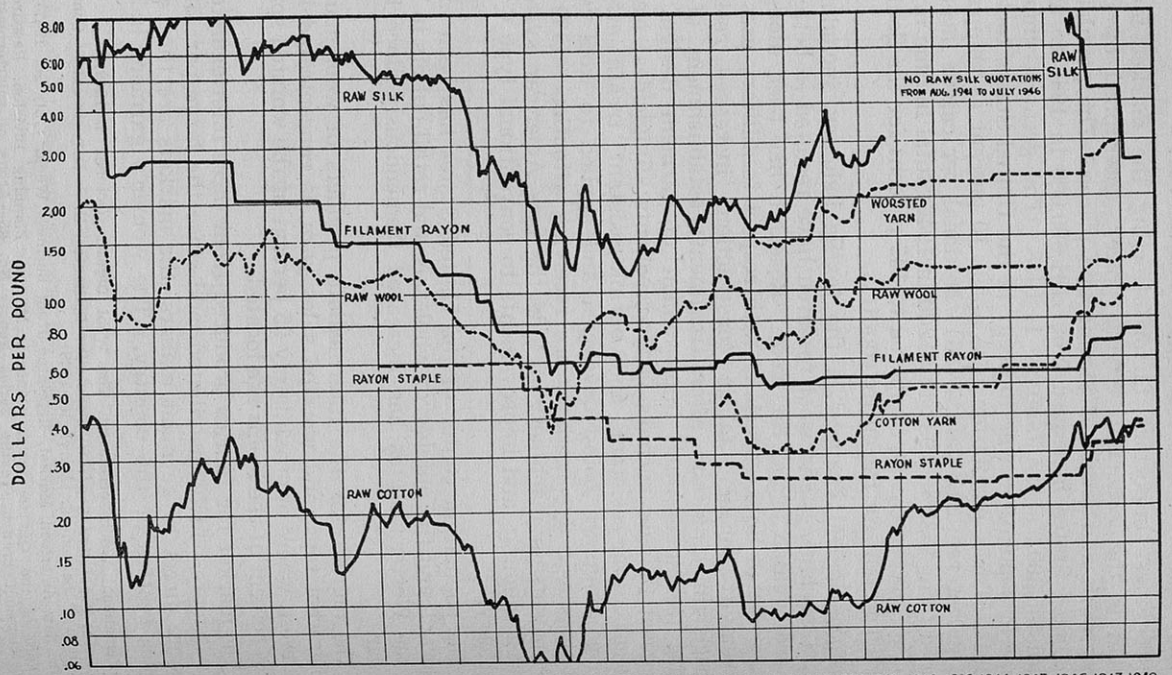
The market for fabrics produced from these intermediate products is more widely distributed, and since the large part of mill sales are direct to garment makers, the markets are the various clothing centers of the country. The women's garment industry

(15) International Wool Secretariat, **The Wool Digest,** (October 5, 1948).

(16) **Current Population Reports: Population Estimates,** U. S. Department of Commerce, Bureau of the Census, (March 10, 1948).
The New American Market, Reprinted from Business Week, (July 26, 1947).

(17) Office of the Quartermaster General, Military Planning Division, Research and Development Branch, **Textile Series Report No. 25**—Areas of Quartermaster Research in Textiles.

UNITED STATES FIBER AND YARN PRICES MONTHLY 1920 TO JUNE 1948 RATIO SCALE



RAW SILK
JAPAN'S 13/15 DENIER WHITE, "D" GRADE

RAW WOOL
FINE COMBING TERRITORY, CLEAN BASIS

WORSTED YARN
BRADFORD 3/30'S (64's) WEAVING, IN THE COLOR

FILAMENT RAYON
150 DENIER, FIRST QUALITY, MINIMUM COUNT, BRIGHT LUSTER VISCOSE CONES

RAYON STAPLE
1½ DENIER, 1½ INCH, BRIGHT VISCOSE

RAW COTTON
SPOT MIDDLING, 1⅛ INCH, 10 MARKET AVERAGE.

COTTON YARN
30/1 COMBED PEELER KNITTING CONES

SOURCE: RAYON ORGANON, TEXTILE ECONOMICS BUREAU INC.

FIGURE 8

is centered to a great extent in New York, but men's clothing is manufactured in large quantities in other centers, such as Philadelphia, Cleveland, etc. A clothing industry has developed in California, and fabrics purchased from mills in the East are manufactured into wool trousers, sport shirts, suits and coats. Los Angeles has become a major style center in the Far West and is the point of origin of the distinctive California styles. In the Southwest a major apparel center is Dallas, especially with reference to styled garments, and San Antonio with special reference to military clothes. St. Louis and Chicago are garment centers in the Midwest.

Wool textile manufacturing requires power and labor at competitive rates, with large manufacturing sites in localities where conditions permit reasonable living expenses. Large supplies of soft water are needed for wool scouring and finishing; and good transportation facilities from the mills to the market are required.

Power and labor at competitive rates can be supplied in any section of West Texas, and transportation facilities are adequate. Plentiful supplies of good water can be found in certain parts of this area. The technical problems of wool manufacturing are not too difficult to overcome. The marketing problems of a new segment of the industry outside the realm of present marketing practice of the industry should be examined thoroughly. The problem of providing wool in sufficient variety to attract miscellaneous woolen and worsted manufacturing is complicated, because the present system of marketing grease wool and blending it for manufacture is all set up to perpetuate the concentration of these industries in eastern seaboard markets.

To successfully operate a mill, it would be necessary to have someone connected with the organization who has an intimate knowledge of the wool market, both in buying the raw wool and in selling the finished product. However, this apparently does not present too great an obstacle since a worsted tops plant was established in Texas several years ago, subsequently expanded to make yarns, and is expected to produce finished fabrics eventually. Furthermore, a wool scouring plant and two woolen mills have been put into operation recently, or will be put into operation in the near future.

The wool textile industry in some respects would be more desirable than the cotton textile industry if a distinction is to be made; wages are higher; its products sell at higher prices; and Texas wool is suited to the highest quality goods whereas much of Texas cotton is not suited to top quality goods. However, there are certain requirements which must be discussed in greater detail in order that potential investors or industry-seeking localities may decide for themselves the suitability of various areas to certain wool manufacturing enterprises. Exact locational advantages or investment requirements cannot be presented in a survey of this type, but certain general requirements can be presented to provide a basis for further detailed industrial surveys.

FIGURE 8
SOURCE: RAYON ORGANON, TEXTILE ECONOMICS BUREAU INC.
1926 1921 1922 1923 1924 1925 1926 1927 1928 1929 1930 1931 1932 1933 1934

Capital Investment Requirements

Within a given area where conditions are favorable for development of an industry, the exact location of a plant may be determined less by technical advantages than by the residence of an individual who controls sufficient capital to promote local industry, or by the alertness of a locality in attracting industry by effective promotion. Familiar examples of how the location of industries has been affected by local residents with capital to invest, or with the ability to obtain capital, may be found in virtually every industrial center of the United States.

The capital needed to establish units of the woolen and worsted textile industry ranges from relatively small to comparatively large amounts, depending upon the size and type of manufacturing organization. In the woolen industry 50% of the total wage earners employed are in mills of 101 to 500 persons; and 50% of the total employees in the worsted industry are in plants of 500 to 1,000 workers. (18)

In 1939 only 64 of 583 regular woolen and worsted manufacturers and only 27 to 76 contract factories were non-corporate establishments. In 1946 most woolen and worsted firms had a capitalization of less than $1,000,000 but several were large corporations of which fewer than six accounted for about one-fourth of the total output of the industry. Worsted manufacturing is done on a larger scale than woolen production, and worsteds require a much greater capitalization than woolens. The first worsteds require a much greater capitalization than woolens. The first worsted mills erected in the United States were large ventures, capitalized at about $1,000,000 each. The average investment per worsted mill between 1870 and 1923 ranged from $100,000 to $500,000, while investment in individual woolen mills rarely exceeded $100,000. (19) Considerable foreign capital was invested in the production of worsteds in the United States.

The capitalization of individual plants for intermediate processing and manufacture of wool is considerably less than that of weaving mills or integrated establishments. A small plant for dry cleaning wool was established in 1947 to cost $1,000,000. In 1945, a wool scouring plant capable of producing 5,000 pounds of scoured wool per day was reported to cost $200,000. At the same time a commission scouring plant to produce 10,000 pounds of tops per day was reported to cost $1,000,000. (20) A Southeastern plant which will manufacture upholstery fabrics and employ 200 workers, is estimated to cost $500,000. (21)

One modern scouring train has a capacity to produce 1000

(18) P. Sargent Florence, **Investment, Location,** and **Size of Plant,** Macmillan Co., New York, (1948).

(19) Charles E. Artman, **Industrial Structure of New England,** U. S. Department of Commerce, Washington, (1930).

(20) Lockwood Greene Engineers, Inc. **"Woolen and Worsted Manufacturing in Missouri",** Report for the Missouri Department of Resources and Development, (1946).

(21) **News About Mills,** Textile World, (May, 1948).

pounds of clean wool per hour; based on 50 percent shrinkage, this would be 2000 pounds of grease wool. Assuming 250 working days and running the plant 24 hours a day, this would mean a capacity of 12,000,000 pounds per annum of grease wool. This machinery could be operated at three-quarters capacity economically, 9,000,000 pounds a year. (22) Operation at a lower capacity probably would not be economical. Cost of this machinery installed would be about $65,000, and delivery is 14 to 15 months. Lanolin recovery equipment would cost about $25,000 more.

A smaller scouring unit, which has a capacity of 500 pounds of clean wool per hour and which includes lanolin recovery equipment, is quoted at approximately $55,500 f.o.b. factory. Delivery is one year.

Equipment to produce 16,800 pounds of 64s Bradford tops, from scoured wool, per 80 hours will cost approximately $272,000 f.o.b. New York harbor. To produce this amount of Bradford tops from grease wool would require an outlay of approximately $327,500 plus freight and erection costs, for machinery. A Bradford drawing and spinning unit to produce 16,000 pounds of 1/30s yarn in 80 hours would cost approximately $451,000 f.o.b. New York harbor. Machinery to produce 16,000 pounds of 1/30s yarn from grease wool would cost approximately $778,500 plus freight and erection costs. Delivery on this equipment is from 2 to 2½ years.

A completely integrated mill for producing finished serge from grease wool, with the Bradford system, would entail a machinery cost of an estimated $1,125,000 plus freight and erection. A new mill of this capacity, with building and installation costs and costs of all necessary accessory equipment to begin operation, would cost possibly $1,750,000 to $2,000,000. This is a capital investment cost of approximately $110 to $125 per pound of production-per-week or $96 to $109 per yard of cloth-per week. For an estimated average service life of 25 years for the mill and equipment, initial capital investment cost chargeable to every yard of cloth produced would be approximately 7.65c - 8.76c.

A French type carding and combing unit to produce 24,000 pounds of tops from scoured wool would cost $363,505. To produce the same quantity of tops from grease wool would involve an expenditure of $419,000 for machinery. A French type drawing and spinning unit to produce 24,000 pounds of 1/30s yarn per 80 hours, from tops would cost approximately $527,300. Machinery to produce 24,000 pounds per 80 hours, from grease wool would cost approximately $946,300. No freight or erection costs are included in these figures, and delivery dates are approximately three years from receipt of orders. Complete machinery cost for producing this same quantity of finished serve is an estimated $1,390,000. Estimated cost of new mill is $2,100,000 to $2,350,000. Initial capital investment cost chargeable to every yard of goods produced would be approximately 6.12c - 6.85c.

(22) John W. Bartram, **Wool Scouring, Could It Be a Profitable Business in Colorado,** Bureau of Business Research, University of Colorado, Boulder, (December, 1946).

The American, or modified wool, system drawing and spinning machinery costs an estimated $75 a spindle. It is said that this system requires much more uniform tops than do the Bradford or French systems. In some respects it is simpler than either of the conventional systems of worsted spinning, and should allow certain labor economies. Cost of a new mill using this equipment is comparable to that of one using the French system.

These are fairly representative examples of worsted mills. However, the exact amount of capitalization required for a textile mill only can be approximated, since investment requirements vary according to size and location of the mill, products to be manufactured, business conditions at the time of building, and whether the plant is to be equipped with new or used machinery.

The woolen and worsted industries as presently set up have relatively small investments per wage earner. Two reasons for this are: multiple-shift operations have been common in recent years, so that more workers are employed for the same amount of machinery and accumulated depreciation of plant and equipment over several decades has resulted in a sharp write-down of the book values of many mills.

The argument that a new plant in an undeveloped area would be at a competitive disadvantage with existing plants is valid but this argument does not apply to the textile industry any more than to any other industry, and apparently industry in general has decided to decentralize. The greatest industrial expansion is taking place west of the Mississippi River; 1947 estimates showed that while 31.8 percent of the population of the United States was west of the Mississippi, 32.1 percent of the new plants and 39.9 percent of the new industrial investment were located in that area. Texas ranks sixth in population, but this state has had the greatest industrial investment since the war, with $230,800,000 spent for expansion. California, which now is the third ranking state in population, has had the second largest investment in new industry, a total of $141,400,000.

The greatest portion of new industrial capital is going into relatively undeveloped localities, and 46 percent of all major industrial expansion projects undertaken since 1945 are in cities under 50,000 population. (23) The preference of the textile industry has always been for locations in small communities. The most favorable locations for cotton mills are in comparatively small, well-housed communities of less than 25,000 population, where a labor force can be recruited without bringing in workers from other places, and where there is sufficient housing to relieve the mill of the necessity of building houses for its employees. In the North, most wage jobs in the textile industry are in the principal cities of industrial areas, peripheries of such areas, and in important industrial counties. In the South on the other hand, more than half of the textile wage earners are found in predominantly rural areas; and most of the remainder are found in industrial counties, outside

(23) Public Administration Clearing House, **News Bulletin**, (March 29, 1948).

industrial areas. Many textile plants recently moved to the Southeast have located in communities of less than 10,000 population. West Texas cities generally are small. One has a greater population than 200,000, one has more than 100,000, several are larger than 50,000 and approximately 12 are in the 10,000 to 20,000 class. The great majority of West Texas communities have less than 10,000 inhabitants.

Climatic conditions are not controlling factors in the location of manufacturing plants, but a factory located in a mild climate, such as is general in West Texas, has the advantage of operating with relatively low fuel and maintenance costs. One reason often cited for the location of the textile industry in New England is the existence of a cool, moist climate which makes the yarn more pliable and less likely to break. The manufacture of good yarn and cloth requires both humidity and temperature control, but the locational significance of temperature and relative humidity have been lessened by the introduction of air-conditioning, which permits year-round temperature control combined with air purification and humidity control. While climatic conditions have become less important, physical characteristics of industrial sites are more important now than formerly. Exact selection of a site may be determined by subsurface features, such as the strength of the strata for supporting the weight of buildings and equipment or for preventing vibration of machinery; floor and structure vibrations constitute a problem which requires considerable attention in the design of textile mill buildings. The character of the site affects the cost of plant building and the cost of installing machinery. Some factors which must be considered in choosing a site for textile manufacturing are drainage, foundations, accessibility to roadways, railway sidings, and availability of adequate room for plant expansion and parking space.

The best type of building for a textile mill is reinforced concrete, and this building material is readily available in West Texas. The reinforced concrete building, if used with steel sash and doors, is almost ideal for textile manufacturing, because it is fire resistant and affords an unyielding floor for machinery.

The old-fashioned textile mill was a long narrow building of several stories, to permit maximum light and ventilation. The use of fluorescent lighting and modern systems of air conditioning, combined with heating and humidification, have eliminated the necessity for old-style mill design, and now architects and engineers can design mills of any shape or size that is considered economical. The typical modern mill is a one-story rectangular concrete building which has from 1000 to 1200 square feet to each column, and which is of windowless construction. Glass brick is used extensively in lieu of windows. In the East present textile mill building cost is $8 per square foot. (24) The cost in West Texas would be an estimated $6 - $7 per square foot.

(24) C. W. Bendigo, **PTI Seminar Called Post Graduate Course,** Textile World, (June, 1948).

For a number of years before the war the industry was depressed, and needed replacements in equipment were not made. There are only three or four old line machinery manufacturers in the United States, who make woolen and worsted spinning and preparatory equipment; and there is no single manufacturer who produces a complete assortment of machinery for making worsted yarn for grease wool. All of the equipment and skilled labor of these manufacturers were used in the production of armaments, and the supply of repair parts and replacements for the textile industry was extremely short during the war. Now the industry is replacing its worn out equipment as rapidly as possible and many textile machinery manufacturers have sufficient orders on their books to operate at full capacity for at least three years.

There is at least one importer, and possibly more, of primarily English and Swiss woolen and worsted machinery. Then there are some machinery manufacturers who have gone into the textile machinery field since the war. Some of these are building conventional machinery, and others are producing equipment incorporating new principles.

An investor should weigh carefully the probable service life, before obsolescence, of any machine under consideration. At best, this only can be approximated, even with an intimate knowledge of the life history of a machine, or mechanical invention, and its competitors. In general there are six stages in the typical history of a mechanical innovation: (1) pre-commercial experimentation; (2) commercial trial; (3) rapid increase in use; (4) slackened increase; (5) saturation; and (6) decline (eventually). Typical ranges of these stages are 3-11 years for commercial trial; 4-11 years for rapid increase in use; and 3-6 years for slackened increase. (25) This rule serves only as a guide and should be used with discretion for any given machine or group of machines.

It seems likely that by the time the foundations for a textile industry in West Texas are completely laid, adequate machinery will be available—either newly built machinery, or equipment moved from existing plants.

In addition to physical equipment, the textile industry requires nearby machine shops to service machinery. The presence of oil field equipment and other machinery requiring mechanical maintenance has led to the development of an efficient and widely distributed machine shop industry throughout the West Texas area.

(25) George Terborgh, **The Bogey of Economics Maturity,** Machinery and Allied Products Institute, (Chicago, 1945).

Raw Materials

Raw materials used by the woolen and worsted industries include in addition to wool, and mohair, other specialty hair fibers and synthetic fibers. However, wool and mohair are the major raw materials and are the only ones that will be discussed in this report.

MOHAIR

Mohair, the second most important raw material of the wool industry and the main specialty hair fiber, forms the long, lustrous coat of the Angora goat. It is reported to be 2½ times as strong as wool, and it will outwear wool. Mohair is used principally in pile fabrics for upholstery, such as automobile and railroad car seats; another important use is in combination with worsteds for men's summer suitings. Mohair is also used to produce linings, fancy dress materials, braid, felt hats, drapery materials, imitation furs, rugs, and wigs and switches for theatrical purposes.

According to the 1939 Census, approximately 70 percent of the 19,000,000 pounds of mohair consumed in that year was processed in New England, with Massachusetts, the leading state, processing approximately 9,000,000 pounds.

MOHAIR CONSUMPTION 1939 (Scoured Weight)

Connecticut	535,577	2.8
Maine	2,695,321	14.2
Massachusetts	8,716,130	45.7
New Hampshire	1,003,057	5.3
New York	65,105	.3
Oregon	234,909	1.2
Pennsylvania	515,694	2.7
Other States—		
California, Iowa, Michigan, Minnesota, New Jersey, Ohio, Rhode Island, Tennessee, Texas, Utah, Vermont, Virginia, Washington, Wisconsin	5,297,143	27.8
(26)	19,062,936	100.0

The United States is the largest producer as well as the largest consumer of mohair. Seven states produce mohair, but Texas produces more than 90 percent of the total United States production, a total of 18,000,000 to 19,000,000 pounds annually. **Table V** (appendix) shows mohair production by states, 1926-47. Texas has produced more than 80 percent of the total clip every year since 1934, and since 1945, more than 90 percent of the total U. S. clip. Most of this mohair is grown in West Texas, since the greatest concentration of Angoras in the country is on the Edwards Pla-

(26) **16th Census of the United States,** 1940. **Woolen and Worsted Manufacturers, 1939.** U. S. Department of Commerce, Bureau of the Census, (1941).

teau. Texas ranch income from mohair is over $10,000,000 annually. Varrying amounts of mohair are imported from South Africa and Turkey, and some mohair finished products are exported. In 1939, 126,000 pounds were imported; this was increased to 6,673,000 pounds in 1944, and in 1946 the imports of mohair totaled 907,000. (27) Fleeces in Texas are obtained semi-annually; the hair will fall out if allowed a full year's growth. Mohair grown in Arizona, California, Oregon and Washington is centralized in San Francisco and Portland, where it is graded and shipped. Kerrville is the center of the mohair industry in Texas, and other principal markets are San Angelo, Del Rio, and Uvalde. Most mohair in Texas is sold through warehouses on a commission basis. The usual commission iis ½c per pound although a few warehouses charge 1c. There is a tendency for all warehouses to obtain the same price for a given clip in one season. For instance, in the spring of 1944 nearly all warehouses were selling mohair at 60c for adult hair and 80c for kid hair. (28)

WOOL

The United States apparel-wool-growing industry is second in worldwide importance, exceeded only by Australia, which is by far the greatest wool raising country. Wool grown in the United States is almost wholly from Merino and cross-bred sheep, ranging in quality from 46s upwards; there is no production of carpet wools in this country. Apparel wools is the common designation of wools as used in woven goods produced by woolen and worsted bills; also in goods produced by wool knitting mills. Breeds of sheep, the grades of wool they produce, and the end uses of the fiber are listed in **Table VI** (appendix). The shorter wools are known as woolen-type, carding, or clothing wools. Wools of sound staple longer than 2½ inches are known as worsted type, or combing wools. Worsteds are the lighter, smoother fabrics, such as serges; most fabrics used in women's dresses and men's suits are worsteds. Normally about one-third of the virgin apparel class wools are processed on the woolen system and about two-thirds on the worsted system.

ANNUAL MILL CONSUMPTION OF APPAREL CLASS WOOLS
(thousands of lb.—scoured basis)

Year	Woolen System	Per Cent	Worsted System	Per Cent	Total	Per Cent
1938-39 (average)	89,941	32.0	191,188	68.0	281,129	100.00
1946	262,994	43.1	346,596	56.9	609,590	100.0
1947	189,437	36.0	336,183	64.0	525,620	100.0

(29)

Typical woolens are broadcloths, uniform cloths, overcoating, flannels, blankets, and tweeds. The accompanying table shows tops and yarns made from various grades of domestic.

(27) **Bulletin of the National Association of Wool Manufacturers, Vol. LXXVII,** Boston, (1947).

(28) T. R. Hamilton, **Trends in the Production, Consumption, and Prices of Mohair in Texas,** Texas Agricultural Experiment Station, (April, 1945).

(29) Source: U. S. Department of Commerce, Bureau of the Census.

TOPS AND YARNS MADE FROM VARIOUS GRADES OF DOMESTIC WOOL

Wool Used		Tops Commonly Made	Yarns Commonly Spun and Their Uses
Blood Grade	Count Grade		
Fine	64s-70s-80s	64s and higher (Called Fine)	30s and higher and lower. Largely ply yarns. Weaving and Knitting
1/2 Blood	58s-60s-62s	60s and 62s (Called ½ Blood)	30s and higher and lower. Largely ply yarns. Weaving and knitting.
3/8 Blood	56s	56s and 58s (58s called 58s. 56s called Blood)	24s and higher and lower. Usually ply yarns. Weaving and knitting.
1/4 Blood	48s-50s	50s and 54s (Both called ¼ Blood)	18s and higher and lower. Usually ply yarns. Mostly knitting. Some weaving.
Low 1/4 Blood	46s	46s and 48s (Both called by numbers or called Low ¼ Blood)	18s and 20s. Usually ply yarns. Mostly weaving. Some knitting. Also papermakers' felts.*
Common and Braid	40s and 44s	36s and 44s (Called by Numbers)	10s and 12s. Largely weaving. Limited use for papersmakers' felts* and roller lapping. Very little produced.

*NOTE: For papermakers' felts the tops are spun to low number woolen yarns.

(30)

The army specifies the following grades of wool for the manufacture of its requirements:

64s Serges, elastique, shirting, covert cloth, light socks, doeskin
60/62 Worsted shirting, flannel
60s Knit cloth, undershirts, drawers
56/58s Blankets
56s Knit cloth, heavy socks, gloves
50s Melton suiting, 20 oz.
44/50s Melton overcoating, 32 oz.

(31)

The woolen system of manufacture uses, in addition to raw wool, wool wastes, recovered wool fiber, rags, clippings, human hair, raw cotton, rayon, silk and other fibers. However, most of these are not used in good quality apparel fabrics. The worsted system mainly uses blend of virgin wools, both foreign and domestic. **Table VII** (appendix) shows the quantities of raw fibers used by the woolen and worsted spinning and carpet yarn industries in 1939, 1946 and 1947. Although this report does not deal with the carpet industry, consumption figures for that industry are listed for comparative purposes.

Worsteds were formerly made only from the long "combing" wools, medium and short fiber all going to the woolen industry.

(30) Alston H. Garside, **Wool and the Wool Trade,** Frederick A. Stokes Co., New York, (1939).

(31) **Woolfacts,** American Wool Council, New York, (April, 1948).

Particularly during the last 40 years, improvements in mill machinery and practice have made possible the combing and use in worsteds of most of the fiber formerly suitable only for woolens. At the present time, Bradford combs can be set to handle fiber as short as 1½ to 1¾ inches in fine and half-blood wools, and 2 to 2½ inches in medium wools. French combs will work advantageously on fine wools but little over an inch in length.

Texas Fine wools are used in both men's wear and women's wear. The short fall wools are used in the manufacture of felts, and 12 months' wools are used in worsteds, such as gabardines and serges, and for higher grade woolens. To produce these fabrics, Texas wool is blended with other domestic and foreign wools. For this reason, Texas wool may constitute only 8 to 10 percent of the total apparel wool consumed in the United States. Since 1929, Texas has been the leading state in total number of sheep and in wool production. The chart **(Figure 9)** on the next page shows the number of sheep in the United States 1920-1948. In 1947 the total sheep population of the United States was 32,500,000, and the Texas sheep population was approximately 8,000,000, or 25 percent of the total. The sheep population of the United States has been declining and the 1948 population is the smallest in 82 years. This decline, in varying degrees, has been rather general throughout the world as illustrated by the table below. (32)

WORLD SHEEP NUMBERS AND WORLD WOOL PRODUCTION IN 1948, BY CONTINENTS, AND PERCENTAGE CHANGES FROM THE 1936-40 PERIOD

Continent	World Sheep Numbers (Millions)	World Wool Production (Mill. Lbs. Greasy)	% Change from 1936-40 Average	
			Sheep	Wool
Europe, excluding U.S.S.R.	103.1	420.2	—16.5	—18.3
North America	42.8	312.5	—28.2	—30.8
U.S.S.R.	64.8	285.0	— 1.8	4.8
Asia	147.4	332.5	4.3	— 3.4
South America	126.5	786.8	25.4	23.1
Africa	88.0	278.9	—11.4	—17.1
Oceania	138.5	1,410.1	— 3.8	3.2
World Total—	717.1	3,830.0	— 3.2	— 2.3

The decline in Texas sheep numbers, however, has not been so rapid as the decline in the country as a whole. Of the 57 principal sheep raising counties in 1939, 43 were in West Texas. (33) **Table VIII** (appendix) shows the sheep and lamb and goat and kid populations and wool shorn in West Texas counties for 1940 and 1945. The wool production for Texas counties in 1945 is illustrated graphically on the map **(Figure 10).**

The center of the sheep raising industry in Texas, the Edwards Plateau, includes 37 counties between the Pecos and Colorado

(32) U. S. Department of Agriculture, Office of Foreign Agriculture Relations.
(33) T. R. Hamilton, **Trends in the Sheep and Wool Industry in Texas,** Texas Agricultural Experiment Station, (1945).

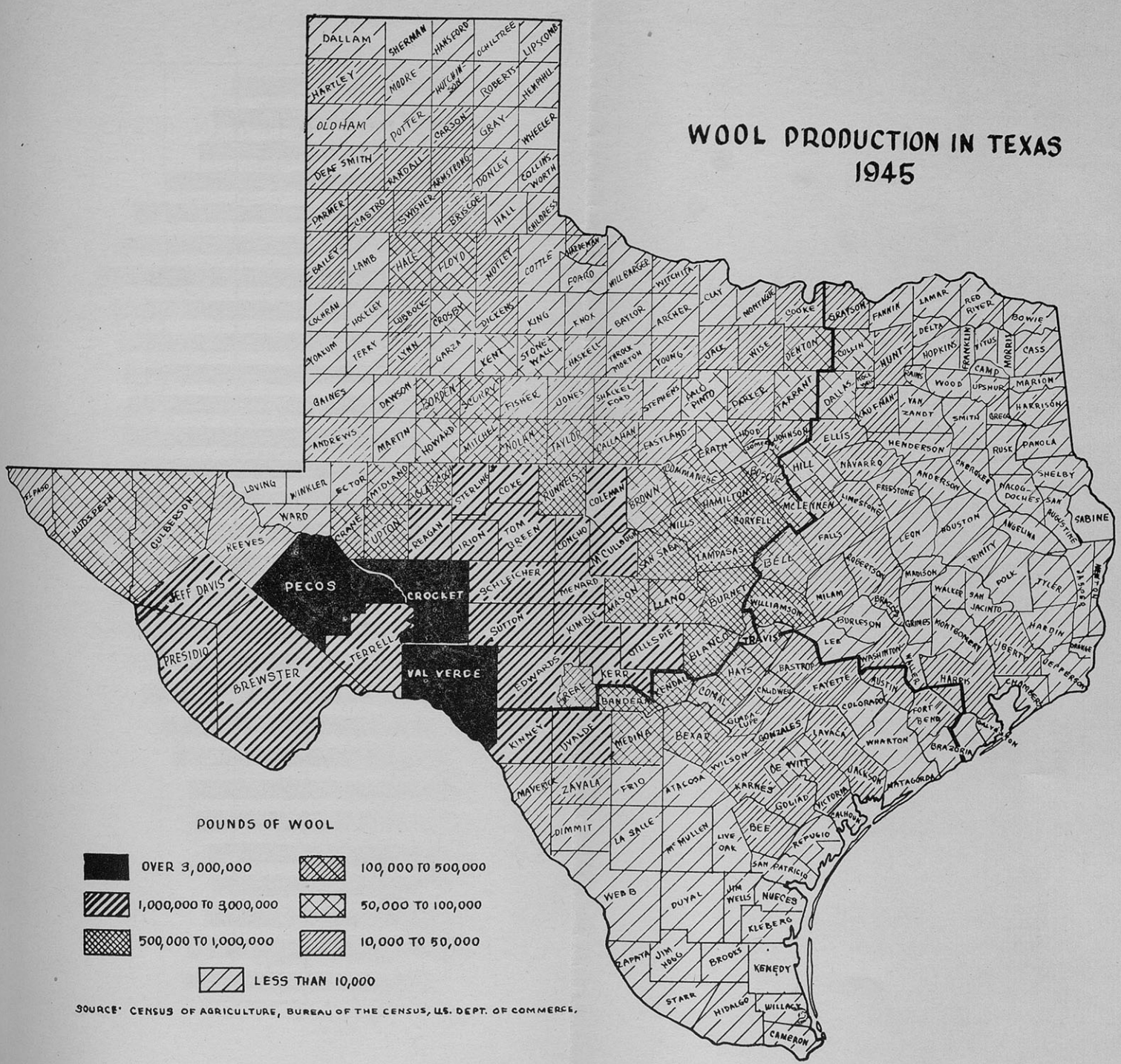
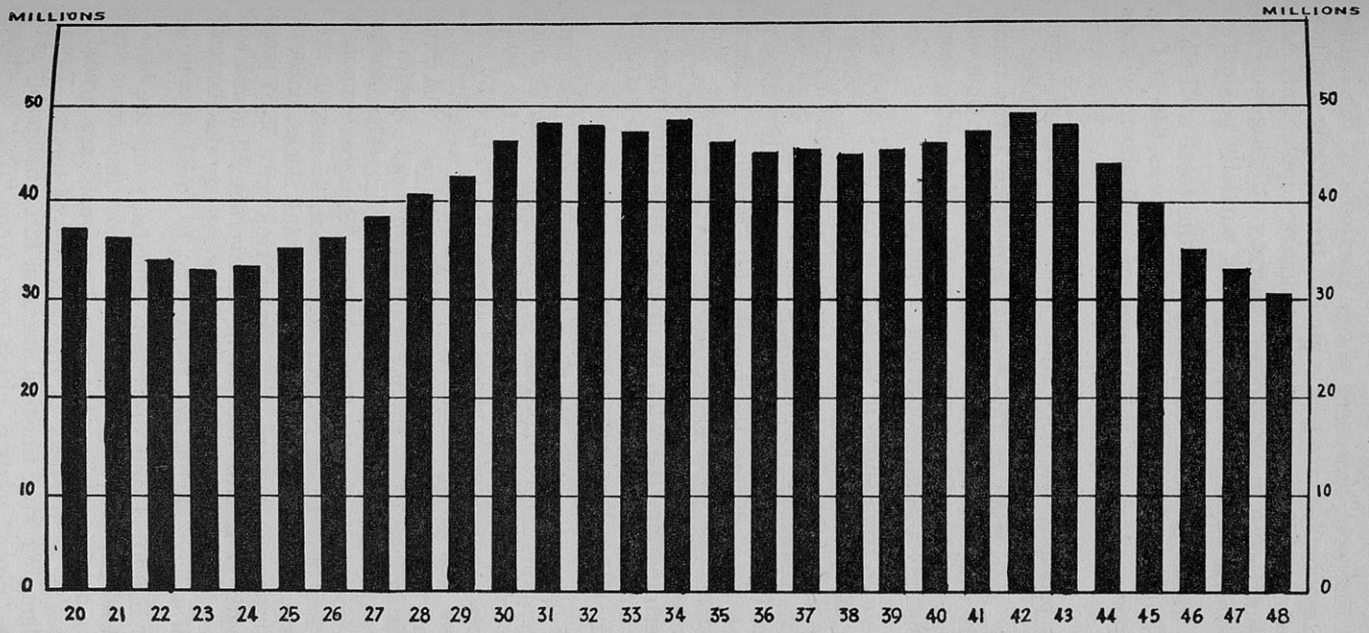

WOOL PRODUCTION IN TEXAS
1945
POUNDS OF WOOL
OVER 3,000,000
1,000,000 TO 3,000,000
500,000 TO 1,000,000
LESS THAN 10,000
100,000 TO 500,000
50,000 TO 100,000
10,000 TO 50,000
SOURCE: CENSUS OF AGRICULTURE, BUREAU OF THE CENSUS, U.S. DEPT. OF COMMERCE.
PECOS
CROCKET
VAL VERDE
DALLAM
SHERMAN
HANSFORD
OCHILTREE
LIPSCOMB
HARTLEY
MOORE
HUTCHINSON
ROBERTS
HEMPHILL
OLDHAM
POTTER
CARSON
GRAY
WHEELER
DEAF SMITH
RANDALL
ARMSTRONG
DONLEY
COLLINGSWORTH
PARMER
CASTRO
SWISHER
BRISCOE
HALL
CHILDRESS
BAILEY
LAMB
HALE
FLOYD
MOTLEY
COTTLE
FOARD
HARDEMAN
WILBARGER
WICHITA
CLAY
MONTAGUE
COOKE
GRAYSON
FANNIN
LAMAR
RED RIVER
BOWIE
COCHRAN
HOCKLEY
LUBBOCK
CROSBY
DICKENS
KING
KNOX
BAYLOR
ARCHER
YOAKUM
TERRY
LYNN
GARZA
KENT
STONEWALL
HASKELL
THROCKMORTON
YOUNG
JACK
WISE
DENTON
COLLIN
HUNT
DELTA
HOPKINS
FRANKLIN
TITUS
MORRIS
CASS
GAINES
DAWSON
BORDEN
SCURRY
FISHER
JONES
SHACKELFORD
STEPHENS
PALO PINTO
PARKER
TARRANT
DALLAS
KAUFMAN
RAINS
WOOD
UPSHUR
MARION
HARRISON
ANDREWS
MARTIN
HOWARD
MITCHELL
NOLAN
TAYLOR
CALLAHAN
EASTLAND
ERATH
HOOD
SOMERVELL
JOHNSON
ELLIS
VAN ZANDT
SMITH
GREGG
HENDERSON
RUSK
PANOLA
HILL
NAVARRO
FREESTONE
ANDERSON
CHEROKEE
NACOGDOCHES
SHELBY
SAN AUGUSTINE
SABINE
EL PASO
HUDSPETH
CULBERSON
LOVING
WINKLER
ECTOR
MIDLAND
GLASSCOCK
STERLING
COKE
RUNNELS
COLEMAN
BROWN
COMANCHE
HAMILTON
CORYELL
MCLENNEN
LIMESTONE
LEON
HOUSTON
ANGELINA
REEVES
WARD
CRANE
UPTON
REAGAN
IRION
TOM GREEN
CONCHO
MCCULLOCH
SAN SABA
MILLS
LAMPASAS
BELL
FALLS
ROBERTSON
MADISON
TRINITY
POLK
TYLER
JEFF DAVIS
PRESIDIO
BREWSTER
TERRELL
SCHLEICHER
MENARD
MASON
LLANO
BURNET
WILLIAMSON
MILAM
BRAZOS
WALKER
SAN JACINTO
JASPER
NEWTON
SUTTON
KIMBLE
GILLESPIE
BLANCO
TRAVIS
BURLESON
GRIMES
MONTGOMERY
LIBERTY
HARDIN
EDWARDS
REAL
KERR
KENDALL
HAYS
BASTROP
LEE
WASHINGTON
AUSTIN
WALLER
HARRIS
JEFFERSON
CHAMBERS
KINNEY
UVALDE
MEDINA
BANDERA
COMAL
CALDWELL
GUADALUPE
FAYETTE
COLORADO
FORT BEND
GALVESTON
BEXAR
GONZALES
LAVACA
WHARTON
BRAZORIA
MAVERICK
ZAVALA
FRIO
ATASCOSA
WILSON
DE WITT
KARNES
GOLIAD
VICTORIA
JACKSON
MATAGORDA
DIMMIT
LA SALLE
MCMULLEN
LIVE OAK
BEE
REFUGIO
CALHOUN
SAN PATRICIO
WEBB
DUVAL
JIM WELLS
NUECES
KLEBERG
ZAPATA
JIM HOGG
BROOKS
KENEDY
STARR
HIDALGO
WILLACY
CAMERON

FIGURE 10



NUMBER OF STOCK SHEEP AND LAMBS IN THE UNITED STATES AS OF JANUARY 1

SOURCE "CURRENT STATISTICS OF WOOL MANUFACTURE", NATIONAL ASSOCIATION OF WOOL MANUFACTURERS

FIGURE 9

Rivers. The fine-wool breeds of sheep, particularly the Delaine, Merino and Rambouillet, are best suited to the climatic conditions in this area where the sheep and wool industry supplements cattle and goat production on many ranches, thereby utilizing more efficiently land which would otherwise be only partially productive.

In 1947, Texas produced 25 percent of the total wool clip of the United States, and 95 percent of that clip was 64s or finer. **Table IX** (appendix) shows the amount of wool shorn by states 1940-1947.

Texas is probably the only state where 80s are produced in large amounts. Within the last few years, the Texas clip has had an increasing proportion of fine wools, and some Texas ranches produce wools which compare favorably with the best Ohio wools and Australian wools. Most of Texas wool is of combing length, carding wool is only a small proportion of the total.

Wool is shorn from sheep in some section of the United States every month of the year, but the bulk is shorn in the months of February through July. The usual practice is to shear only once a year, but in Texas and California some sheep are shorn twice annually. In Texas between 15 and 25 percent of the sheep are shorn twice a year, during the months of February, March and April and the months of August, September and October. Spring shearing is much larger than the fall shearing. For the purpose of price determination, the wool is divided into three types: 12 months, 8 months, and fall; 12 months wool is 60-75 percent of the total Texas clip.

Wool, as it is shorn from the sheep's back, is known as "grease wool," and contains large quantities of impurities, such as animal secretions, sand, dirt, and vegetable matter. Before the wool is useable in the manufacturing process, it must be cleaned by scouring to remove this foreign material. The loss of weight that occurs when the wool is scoured is termed "shrinkage". The shrinkage of wool is influenced by the breed of sheep, area in which they range, nature of the feed, and weather conditions. The shrinkage of domestic wools varies from 35 percent to 75 percent; in one lot of fleeces there may be 36 percent clean wool, 45 percent dirt, 5 percent moisture, and 14 percent grease. Texas flocks, under normal conditions, produce some clips that shrink only 55-57 percent for good length 12 month wools, but the average 12-month wools usually are estimated to shrink 60 to 64 percent; in the Panhandle, occasional clips have shrinkages as high as 70 to 80 percent.

Wool is classified and described principally on the basis of fineness and length of fiber, which are the most important considerations in manufacturing. Apparel class wools are graded according to degree of fineness, or the diameter of fibers. Two systems of designating wool fineness are used interchangeably in this country; the "blood" system which runs from "fine" to "braid", and the numerical system which runs from 80s, 70s, 64s to 36s.

The table below compares the two systems of designating grade, and shows the relative amount of each grade in the domestic wool clip.

GRADES OF WOOL ACCORDING TO BLOOD SYSTEM AND COUNT SYSTEM

Blood System Grades	Count System Grades	Production of Shorn Wool in United States in percentages of Total, Grease Basis
Fine	64s-70s-80s	52%
1/2 Blood	58s-60s	14
3/8 Blood	56s	18
1/4 Blood	48s-50s	13
Low 1/4 Blood	46s	3
Common and Braid	36s-40s-44s	1

(34)

Wool is paid for by price per pound greasy wool but the buyer estimates shrinkage before bidding. Market prices are quoted on scoured basis price. The local price is established by deducting from the Boston grease price the following—cartage, freight, storage, insurance, commissions, and grading. Usual commission is $2.00 per cwt., including four months' storage. If graded, there is an additional charge of approximately $.005 per pound. Charges are totalled and deducted from Boston price to arrive at local grease price. In order to determine what the charges will be, the seller must know (1) shrinkage of wool (2) classification and grade (3) scoured basis market price and (4) cost of marketing. (35)

Most imported wools are skirted and sorted and therefore are uniform in type and quality, while domestic wools are not. The U. S. Department of Agriculture has a pilot skirting and sorting project in Fort Worth, using Commodity Credit Corporation owned wool and funds. Imported wools carry a premium or "conversion cost differential" of 10-15c per pound, clean, 8-12 percent sale price. (36)

A mill may purchase wool directly from producers, from local wool merchants and brokers, or from brokers in foreign countries. There is no seasonal fluctuation in prices, since wool can be stored at least 12 months and goods are made up well in advance of the buying season.

(34) Alston H. Garside, **Wool and the Wool Trade,** Frederick A. Stokes Co., New York, (1939).

(35) Russel L. Burrus and James J. Window, **Shrinkage of Grease Wool in Relation to Prices,** U. S. Department of Agriculture, Agricultural Marketing Service, (1940).

(36) News Release, U. S. Department of Agriculture, Office of the Secretary, (September 23, 1947).

Labor Requirements

Labor costs constitute a relatively large portion of total costs in the wool manufacturing. The proportionate of labor costs is much greater for finer goods than for coarser fabrics. For instance, in 1946, one company had a labor cost which comprised 60 percent of the total cost for the production of 2-ply 60s yarn, whereas the labor cost for the production of 2-ply 16s yarn was only 25 percent of the total. Because the cost of labor is important, a major factor in the relocation of the wool textile industry will be the presence of a relatively abundant supply of reasonably priced contented labor.

Texas Technological College at Lubbock, opened in 1925, was founded for the purpose of teaching Textile Engineering. This is the only textile engineering school west of the Mississippi River and specializes in training men for managerial positions in the textile industry. Training is offered in textile engineering, chemistry and dyeing, and weaving and design, leading to Bachelor of Science degrees. The college can be an asset to industry locating in West Texas, both as a source of trained personnel and technical advice. Short courses for operating executives could be worked out here conveniently.

The average number of employees per mill in woolen and worsted manufacturing in the United States in 1939 was 257; in 1936 only 10 percent of the mills employed more than 500 workers, and almost 50 percent employed fewer than 100 workers. Men outnumber women in the woolen mills, where in 1946 they totaled about 63 percent of the labor force; in worsted manufacturing the male labor force was 48 percent of the total. (37)

Woolen and worsted mills employed an average of 176,000 production workers in the first half of 1948. This is about 2½ percent more than the average number employed in the corresponding period last year, 16 percent more than for the first half of 1939, and 6 percent less than the January-June employment in 1942 — the peak period. (38) **Table X** (appendix) shows the monthly averages and annual averages of the numbers of production workers employed in the wool industries, 1939-1947, with monthly averages for the first half of 1948. Average annual employment, after considerable fluctuation during the war years, seems to have levelled off at about 10 percent above that of 1939.

Skill requirements are relatively high in the wool industry, in comparison to the other textile industries. (39) Grading and sorting wool are highly skilled occupations; it may take several years for a wool sorter to become expert. The manufacture of tex-

(37) U. S. Department of Labor, Bureau of Labor Statistics, **Wage Structure—Woolen and Worsted Textiles,** (1946).

(38) **Current Statistics of Wool Manufacture,** National Association of Wool Manufacturers, (September, 1948).

(39) Robert E. Pent, **The Utilization of Wool and Mohair in Texas,** National Farm Chemergic Council, Columbus, Ohio, (1947).

tiles is a rather exacting industry. In almost no form of manufacturing are mistakes and imperfections more easily detected than they are in a piece of cloth. This necessity for training a new labor force, although not an unsurmountable obstacle, tends to offset some of the other advantages gained by textile mills in new locations.

Wages in the woolen and worsted industry are high in comparison to those in other textile industries. For instance, average weekly earnings in cotton manufacturing in April, 1948, were $43.08 as compared to $52.31 in woolen and worsted manufactures. The most significant factor contributing to some extent to the higher labor rates in the wool industry are the concentration of the industry in high wage areas, the large proportion of skilled and semi-skilled workers, and extensive unionization. About 60 percent of the plant work force of New England and Middle Atlantic mills were in union mills in 1946 and wages in those mills were from 5 to 11 percent above wages in non-union mills. In general, workers in men's wear mills and in integrated mills have higher earnings than workers in the rest of the industry. In 1946, the Southeastern wool manufacturers were at the low end of the wage scale, because of the higher proportion of small plants, lack of unionization, and the fact that the majority of mills were located in widely scattered small cities of less than 25,000 population. (40)

There is considerable variation in hourly earnings throughout the wool industry. There are variations between men's and women's pay in some instances, variations between woolen and worsted mills wages, variations between areas and sections of the country, variations between mills of different degrees of integration, and variations between unionized and non-unionized plants. **Table XI** (appendix) which shows the straight time hourly earnings for selected occupations in the woolen and worsted industry, gives a good cross-section of the various wage rates.

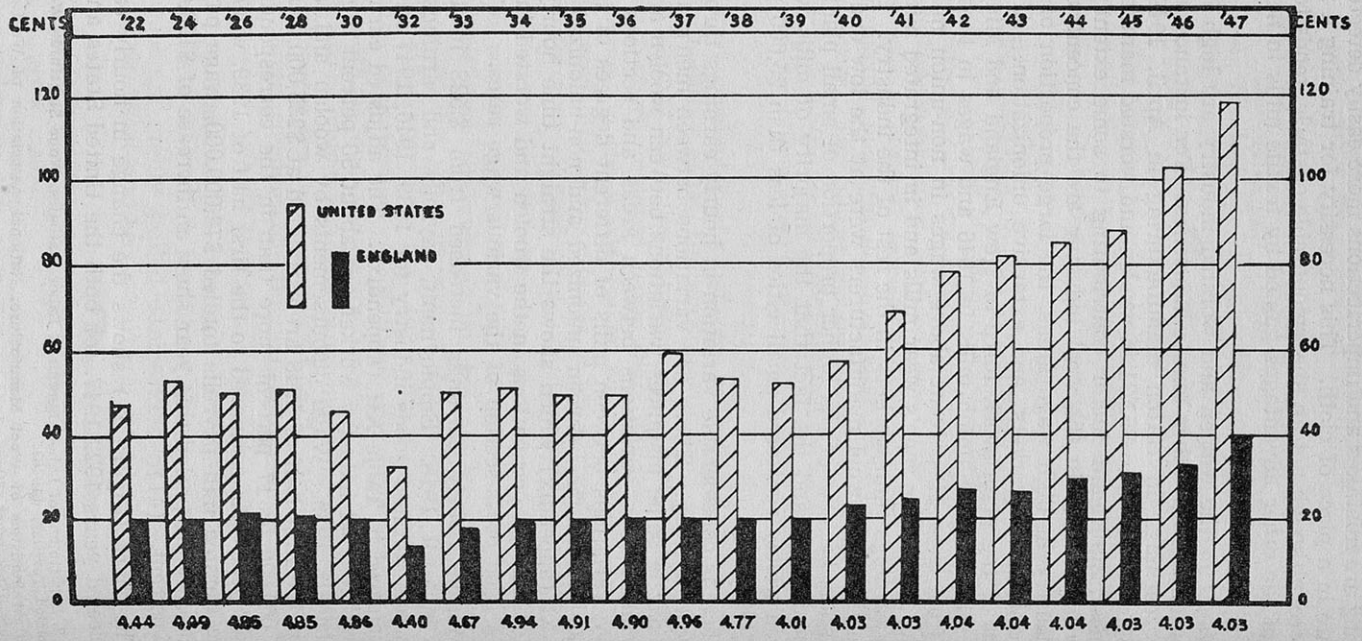
Average hourly earnings increased from $.528 in 1939 to $1.311 in April, 1948. Employment, payrolls, and earnings in the woolen and worsted goods industry for 1939, 1946, 1947 and 1948, are compared in **Table XII** (appendix). The adjusted earnings of the average wool industry worker are about 50 percent higher today than in 1939. Wage disbursements by woolen and worsted mills in the first half of 1948 are estimated at $235,000,000. This is $35,000,000 or 17 percent more than in the corresponding period last year. As compared to the first half of 1939, when woolen and worsted mill payrolls totaled $72,000,000, wage payments in January-June period this year show an increase of $163,000,000 or 225 percent. (41)

The chart **(Figure 11)** shows the change in hourly earnings for selected years 1922-1947, for both the United States and Eng-

(40) U. S. Department of Labor, Bureau of Labor Statistics, **Wage Structure—Woolen and Worsted Textiles,** (1946).

(41) **Current Statistics of Wool Manufacture,** National Association of Wool Manufacturers, (September, 1948).

AVERAGE YEARLY EARNINGS IN ENGLAND AND UNITED STATES WOOL TEXTILES



SOURCE : 'CURRENT STATISTICS OF WOOL MANUFACTURE', NATIONAL ASSOCIATION OF WOOL MANUFACTURERS

FIGURE 11

land, the world's next largest producer of wool textiles. Earnings in the United States, which were more than twice those of England at the beginning of the period, have increased at a much greater rate than the latter, so that the difference in earnings for the two countries is more today than at any time in the past.

The Texas Legislature has enacted laws which go much farther than those of any other state toward the restoration of law, order, and fair dealing to labor-management relations. These laws set new and important limitations to union contracts, and they outlaw practices heretofore freely engaged in by labor unions. This has been done to protect a way of life to which the people of this state are accustomed. Group labor disturbances in West Texas are virtually unknown. The people here firmly believe in private initiative, and in protecting the property rights of free enterprise as well as the inherent rights of labor.

Although markets and distribution facilities may replace labor supply as the primary location factors in the textile industry, it is certain that the industry will locate only where there is an adequate and stable labor supply. The South has the greatest potential rate of labor force growth in the country, and there is a predominance of rural workers, displaced by mechanical farming; Texas has the largest part of the South's labor force. West Texas has a potentially desirable labor source in Latin Americans. It has been the experience of Texas employers that Latin Americans are contented and competent employees and that they work well in groups.

Water Requirements

Originally the location of textile plants was determined mainly by the quality and quantity of water supply available, but decline in water power and developments in the art of water purification have made the textile industry independent of naturally pure water supplies by assuring high-quality water at low cost. Practical experience in the manufacture of textile products has demonstrated that improvement in water quality is one of the most important factors in producing high-quality fabrics. It has been found that great economies, and improvement in quality, can be effected by further purification of water supplies which were previously thought satisfactory in their natural state.

Three qualities, turbidity or cloudiness, hardness, and iron are the main sources of trouble and irregularity in water for textile processing. Many ground supplies contain large amounts of iron and a little manganese. This water, if allowed to stand in open basins, usually will deposit a good portion of these elements. Water containing considerable sediment frequently can be treated and purified by flocculation, sedimentation and filtration, at a cost which is not prohibitive.

Hardness in water is due mainly to the presence of calcium and magnesium salts. Hardness determinations in a water analysis are always reported in terms of calcium carbonate and are given in three different manners, carbonate hardness, non-carbonate hardness, and total hardness. Carbonate hardness, due to the presence of carbonate and bicarbonate salts of calcium and magnesium, also is called "temporary hardness." Carbonate hardness can be partially removed by boiling, and further softening processes use lime and soda softener. Non-carbonate hardness, also called "permanent hardness," is due to the presence in the water of salts other than the bicarbonates, such as calcium sulphate; non-carbonate hardness is incapable of being destroyed by the action of heat, and more elaborate softening methods are required.

Most laboratories in the United States report hardness of water in parts per million, or p.p.m. Some water analyses, however, report hardness in grains per U. S. gallon, or g.p.g.; one grain per gallon is equivalent to 17.1 parts per million. The following general classification is used to describe natural waters:

GENERAL CLASSIFICATION OF NATURAL WATERS

Hardness	Classification
Less than 15 p.p.m	Very soft water
15 to 50 p.p.m.	Soft water
50 to 100 p.p.m.	Medium hard water
100 to 200 p.p.m.	Hard water
Greater than 200 p.p.m.	Very hard water

(42)

(42) W. H. and L. D. Betz, **Water Handbook,** Philadelphia, (1942).

Water of as much as 75 parts per million is permissible for wool scouring, but if the water contains more than 86 parts per million of hardness, it is likely to cause processing difficulties. For use in bleaching and dyeing, water must not exceed in hardness fifty parts per million of calcium carbonate and one part per million of iron. Hardness, like turbidity, may vary considerably over a short space of time, but unlike the latter, changes are not visible and may be unsuspected until trouble occurs.

The removal of hardness has been effected in several ways and various methods are in use, depending on the nature of the raw water, the amount consumed, and the use for which the water is intended. When moderate amounts of water of maximum softness are desired from moderately hard or relatively soft water, the zeolite type of softening is almost universally used. Water of Zero hardness is commonly claimed to be obtainable with this system, and can be obtained with proper operations. Water containing up to 150 parts per million can be softened by the zeolite method; above this amount, either the lime-soda ash method or a combination of this with the zeolite is commonly used.

The scouring of wool to remove its impurities is one of the most intricate and important operations in wool textile manufacturing. Improperly or over-scoured wool causes innumerable difficulties in subsequent operations, such as dyeing, carding, combing, drawing, spinning, and finishing. In the scouring operation, raw wool passes through a series of vats or bowls with intervening squeeze rollers, and then through a hot-air dryer; the equipment for scouring may be over 200 feet in length. The volume capacity of an average scouring line may run between 5,000 and 10,000 gallons, and this volume of water must be available each time the water is changed, which may be once every eight hours or only once a week. Replenishment, rinsing, and operational losses in the bowls necessitates an additional hourly consumption of from 500 to 2,000 gallons of fresh water depending upon the type of wool scoured. (43) Other processes in wool manufacturing, also, require considerable quantities of water. It has been estimated that in wool finishing 70,000 gallons of water are required per 1,000 pounds of wool processed. (44)

The scouring process referred to above is the soap-alkali process, and 90 percent of the wool scoured in the United States is scoured by this method. Another method of wool scouring is the solvent process, which uses organic solvents such as benzene, naphtha, and carbon tetrachloride, and uses water only for the final washing process. This process is said to produce tops and yarns of superior processing quality, and resultant finished goods of superior strength and softness. The wool leaves the scouring process in a more open state and can be carded with less fiber breakage. Although the solvent process is considered to be superior from a physical and chemical standpoint, it has not been

(43) **American Wool Handbook,** New York, (1948).
(44) **Water Quality Essential to Textile Processes,** U. S. Calise, Textile World, (July, 1948).

adopted generally because of the high cost of installation and maintenance and because it requires the handling of inflammable solvents in large quantities. A new method of solvent scouring recently has been announced. This method uses a nitrated-kerosene and is said to eliminate many dangers and disadvantages found in other solvents, because the solvent agent is less inflammable and is less subject to explosion.

The solvent scouring process also is reported to provide a greater yield of wool grease, which is an important by-product of the scouring operation. Lanolin, which is used in detergents, ointments, and cosmetics, is extracted from wool grease. In 1946, for instance, 19,959,000 pounds of wool grease were recovered in wool scouring in the United States.

Besides the quantity of water for textile processing, industrial development requires additional supplies of water for commercial and domestic uses which may necessitate expensive enlargements of local water and other utility systems. Larger communities are more likely to have water supplies adequate for population additions; but in arid parts of the country the reservation of major portions of available water for agricultural and domestic use may leave an inadequate supply for industrial development.

It often has been said that the future prosperity of Texas depends in large part upon conservation and utilization of water resources of the state, surface and underground, for irrigation, municipal and industrial use. In 1947, 2,400,000 acres of land in Texas were under irrigation from surface and ground water sources. The State Board of Water Engineers has pointed out that adequate water supplies are not now available in many areas that in practically all other respects have attracted industrial possibilities. This can be remedied in many localities by proper development of water resources, by means of storage reservoirs for surface waters and further development of ground water resources. Surface water supplies are being increased and improved by construction of dams and reservoirs; **Table XIII** (appendix) lists the lakes and dams in West Texas, and proposed improvements. Ground water resources, also, are being measured and tapped; the High Plains section of West Texas has one of the largest underground water reservoirs in the world. (45)

Most sections of the Southwest depend upon water from ground sources. In Texas, 681 of the 837 communities dependent upon public water supplies, obtained water entirely from ground sources in 1945. (46) Ground water is nearly constant in temperature, seldom varies in chemical character from season to season or from year to year, and usually is free from sediment. Ground water is relatively inexpensive, can be developed quickly, but tends to be more highly mineralized than surface water. In some places

(45) State Board of Water Engineers, **Progress Report,** (Austin, 1946).

(46) William A. Faught, "Problems Associated with the Utilization, Conservation, and Control of Water Resources in the Southwest," in **Monthly Business Review,** (August 1948).

it is not suitable for irrigation, public supply, or industrial use, and in some localities, the quality is good but the quantity is inadequate.

Industries planning to establish plants in Texas in localities where ground water is available would require specific information concerning water supply, and it would be necessary for individual communities to supply this information. Questions most frequently asked by industrial engineers concern temperature and quality of water, depth necessary to drill, quantity of water available, decline in pumping levels likely after large withdrawals, and possibilities of salt water invasion. (47)

Individual communities also must see that proper provision is made for textile waste disposal. Textiles and dye works produce organic wastes, and most areas have water pollution regulations requiring the installation of waste treatment plants to remove or neutralize waste of this type. The textile waste treatment problem is more complex than other industrial waste purification because no two textile wastes are alike in character, and no two wastes are purified by exactly the same treatment. Combined waste from each mill continually changes with the introduction of new processes or changes in market demands. Wastes are as varied as the kinds and colors of goods produced.

(47) State Board of Water Engineers, **Progress Report,** Austin (1946).

Power and Fuel Requirements

In the early days of the textile industry, power dictated the site of textile plants, and the record of change and growth in the textile industry is tied closely to the history of the availability and application of power. The first woolen mills were located on water-power sites within mechanical transmission distance of the power source. The development of the steam engine was the first step in moving mills away from streams. As high voltage transmission of power became practical and economical and as the building of generating and distribution facilities increased, the availability of labor and the proximity to raw materials became the more important locational factors in the building of textile plants.

Mills entirely equipped with individually driven equipment ordinarily have an over-all power factor of 75 to 80 percent; those with a large share of line shaft drives average 82 to 86 percent. Some power companies in the Southeast have very attractive power factor rates, making the installation of capacitors to correct power factor a high return investment, and most such applications pay for the capacitors in one to two years. Other utilities provide an optional penalty which they may enforce if the maximum power drops below 85 percent. (48) A breakdown of power consumption in an average mill shows a large share, about 50 percent of the total, is used in spinning; 20 percent for weaving; the remaining 30 percent is divided between opening, picking, carding, drawing, roving, warping, slashing and miscellaneous uses such as lighting, ventilation, pumps and elevators.

Almost all manufacturing plants must be located where they can be assured of a dependable and continuing supply of power. As long as this need can be met, relatively low power rates alone do not constitute a strong locational inducement, since power often is a minor cost element. In 1939, for instance, power cost for the country as a whole represented 2.3 percent of the value of textile mill products. The national average for the textile industry was 1.03 cents per kilowatt hour. The Edison Electric Institute states that it has been its observation that the cost of purchased power is not a major factor in determining the location of textile plants. (49)

The map opposite **(Figure 12)** shows the principal generating plants and transmission facilities in the State of Texas. As this map indicates, West Texas now is adequately supplied with power facilities. In addition, important improvements and additions are being planned; in 1947, for instance, 24 percent of the Nation's new generating capacity was installed by one public utilities company serving only part of the West Texas area. These develop-

(48) American Institute of Electrical Engineers, **Electrical Power Applications in the Textile Industry**, New York (1947).

(49) Edison Electric Institute, letter, May 5, 1948.

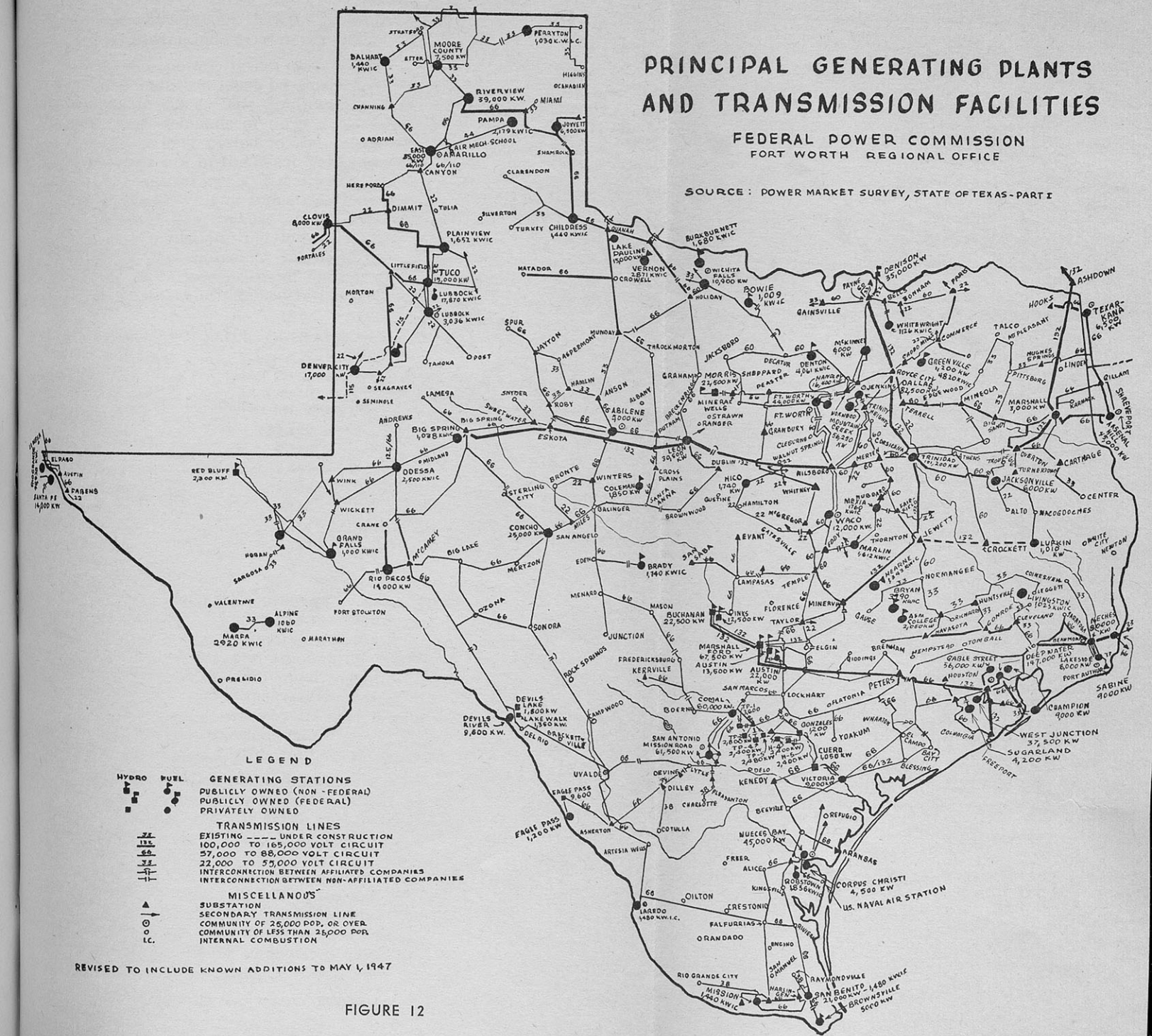
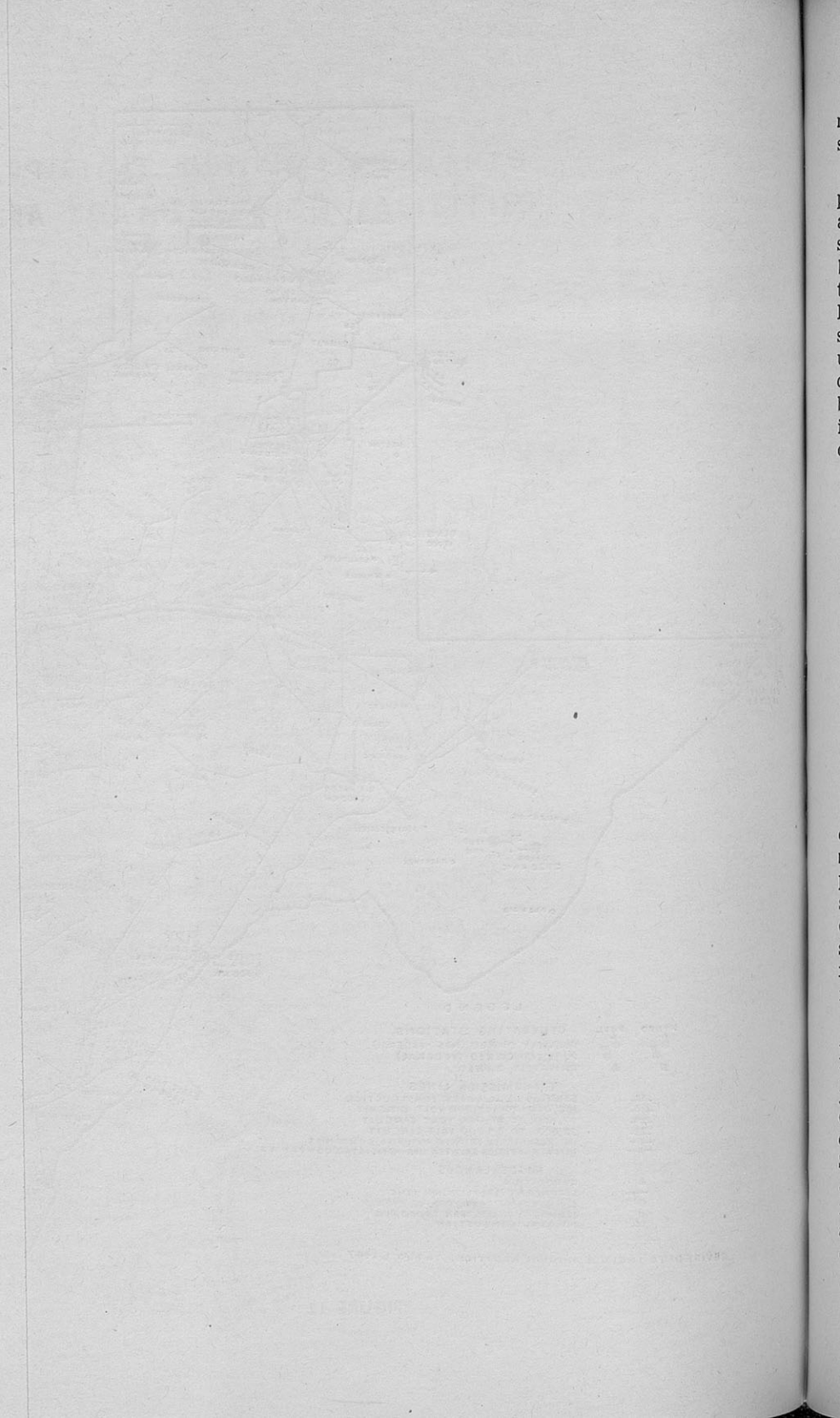

PRINCIPAL GENERATING PLANTS
AND TRANSMISSION FACILITIES
FEDERAL POWER COMMISSION
FORT WORTH REGIONAL OFFICE
SOURCE: POWER MARKET SURVEY, STATE OF TEXAS - PART I
LEGEND
HYDRO
FUEL
GENERATING STATIONS
PUBLICLY OWNED (NON-FEDERAL)
PUBLICLY OWNED (FEDERAL)
PRIVATELY OWNED
TRANSMISSION LINES
EXISTING ____ UNDER CONSTRUCTION
100,000 TO 165,000 VOLT CIRCUIT
57,000 TO 88,000 VOLT CIRCUIT
22,000 TO 55,000 VOLT CIRCUIT
INTERCONNECTION BETWEEN AFFILIATED COMPANIES
INTERCONNECTION BETWEEN NON-AFFILIATED COMPANIES
MISCELLANOUS
SUBSTATION
SECONDARY TRANSMISSION LINE
COMMUNITY OF 25,000 POP. OR OVER
COMMUNITY OF LESS THAN 25,000 POP.
I.C. INTERNAL COMBUSTION
REVISED TO INCLUDE KNOWN ADDITIONS TO MAY 1, 1947

FIGURE 12



ments leave little doubt that the power system of West Texas will support a growing industrial development.

Fuel, like power, is not a determining locational factor, but prospective industry must be assured of an adequate fuel supply at reasonable rates. The Southwest has reserves of natural gas so great that demands of large scale industrial consumption can be met for a long period in the future and the greater part of these reserves are in the West Texas area. Besides the relatively low cost of natural gas, especially when it is consumed close to the source of supply, many industries have found advantages in the use of natural gas because of the ease of handling, cleanliness, control of compustion, and low furnace maintenance. The table below shows the equivalent values of heat content in Texas fuels in relation to various prices of natural gas, based on heat content only and exclusive of transportation and handling charges.

EQUIVALENT VALUES OF HEAT CONTENT IN TEXAS FUELS

Natural Gas 1007 B.t.u. per cubic foot Dollars per M. Cu. Ft.	Texas Company Petrol Coke 15,050 B.t.u. per pound Dollars per Short Ton	Texas Company Residium Gr. at 60F.—8.O.H.W. 17,500 B.t.u. per 1.b Dollars per Barrel
$0.10	$2,990	$0.643
0.11	3.288	0.708
0.12	3.587	0.772
0.13	3.886	0.836
0.14	4.185	0.901
0.15	4.484	0.965
0.16	4.783	1.029

(50)

Most large industrial users of natural gas have special price contracts whereby the cost per thousand-cubic-feet is reduced for monthly consumption beyond certain fixed quantities. The initial price, fixed quantities, and amounts of reduction depend upon the size and nature of the individual industry. For example a small cotton mill in West Texas, which makes bleached goods has a sliding-scale contract whereby its cost beyond a certain minimum figure is 12c per thousand-cubic-feet. The estimated average monthly cost of fuel in this mill would be about 17c per M.

The natural gas pipeline network is limited in extent, as compared to the tremendous distances which oil and coal are transported. For this reason a large volume of surplus gas in the major producing areas is available for industrial uses at very low cost. The table below represents the total fuel consumption in equivalent heat units in manufacturing industries in the United States in 1939. Geographical areas and certain individual states are arranged in order by ascending unit cost of fuel. This table illustrates the fact that Texas with a fuel cost lower than that of any other state, has an undisputed advantage over other sections of the country in this respect.

(50) Data from Houston Pipe Line Company, Houston, Texas.

CONSUMPTION OF FUELS IN MANUFACTURING INDUSTRIES, 1939

	Consumption of Fuels Billion B.t.u.	Cost per Million B.t.u. Cents
UNITED STATES	5,367,386	15.8
Geographical Divisions		
1. West South Central	510,948	6.6
2. East South Central	309,013	12.1
3. Mountain	123,612	14.9
4. Middle Atlantic	1,565,601	16.1
5. South Atlantic	452,176	16.3
6. West North Central	218,370	16.8
7. East North Central	1,715,751	17.7
8. Pacific	186,368	18.4
9. New England	285,518	20.8
States		
1. Texas	336,974	5.1
2. Alabama	182,439	11.2
3. Tennessee	59,843	13.6
4. Rhode Island	32,725	16.7
5. New York	392,241	17.5
6. New Jersey	224,578	18.5
7. Georgia	28,290	19.4
8. South Carolina	29,469	19.4
9. Massachusetts	139,856	19.9
10. Connecticut	66,404	20.9
11. North Carolina	36,270	21.4
12. New Hampshire	13,700	27.6

(51)

(51) National Resources Planning Board, **Industrial Location and National Resources.**

Transportation

All raw materials used in the manufacture of textile fabrics can be shipped considerable distances economically, and therefore, location of textile plants has been governed more by economical manufacturing conditions and accessibility to markets than by location of the sheep range, the cotton field, or the synthetic fiber plant. Traditionally, the freight rate structure of the United States has made it more economical to ship raw materials than finished products. However, transportation agencies are alert to the needs of industries and in instances where new industries have located in the Southwest and Texas, they have been provided with basic freight rates that do not hinder their growth and expansion. This transportation policy will be a contributing factor to the more intensive processing of the Southwest's natural resources into marketable goods.

Wool generally can be produced more cheaply in "frontier country" or regions that are undeveloped agriculturally, and because of its relatively high value per pound, it can be transported long distances and still be grown profitably. Wool probably is transported over greater distances than any other important commodity. Since wool is sold on a delivered basis, the grower pays freight on dirt and grease which constitute at least 50 per cent of the total weight of the fleece. However, the saving in freight that would be realized by shipping scoured wool instead of grease wool is not as great as it would appear to be, because the rate on scoured wool is considerably higher than that on grease wool. It takes 1.1 pounds of scoured wool to make a pound of woolen yarn; and 1.35 pounds of scoured wool are required for a pound of worsted yarn. One reason for the higher rate on scoured wool is that it requires considerably more space per unit of weight than does grease wool.

Wool normally moves to Gulf ports by rail or motor truck and then by water to the Eastern seaboard, principally Boston. There it is graded, scoured, combed and shipped to mills, most of which are within overnight trucking distances of Boston. Wool may not be shipped as soon as it is shorn; some seasons it stays in the producing area for months before it is shipped. Certain points on the journey to the mill, have "transit privileges", and at those cities wool may be unloaded, warehoused, graded, sorted and reshipped with only a slight extra charge over through rate.

There are two principal kinds of freight rates, class and commodity. A class rate is a base rate from which rates on various commodities can be determined on a percentage basis. Almost every commodity is classified; that is, related to first class rates on a percentage basis, and there are lawfully published class rates for almost any commodity between any two points. In many instances the lawfully-published class rate will not apply because of the lower lawfully-published commodity rate. A commodity rate

is applicable only to a specifically named commodity, and may or may not be based on distance. Commodity rates usually are designed to meet the demands of each particular situation. These rates, based on shipper-carried negotiations are published after they have been approved by state or interstate regulatory bodies.

There are five major freight rate territories in the United States, the Eastern or Official Territory, Southern Territory, Western Trunk Line Territory, Southwestern Territory and Mountain-Pacific Territory. The Southwestern Territory includes the states of Texas, Arkansas, Oklahoma and Louisiana west of the Mississippi River. Each freight-rate territory has its own system of rates, and each has a separate and distinct structure of rates applying intraterritorially. This sometimes results in variations between the intraterritorial and interterritorial rate levels on the same commodity.

After investigation and hearings by the ICC, it was ordered that a uniform freight classification and complete class rate parity for all territories be established and this was upheld by the Supreme Court on May 12, 1947.

Important changes in the entire freight-moving system of the United States may result from the recent Supreme Court decision which outlawed the "basing point" system of pricing, a system which disregarded the cost of transportation based on distance.

Table XIV (appendix) shows comparative freight rates to different sections of the country from Sweetwater, Texas, Boston, Mass., and Atlanta, Ga. West Texas has a great advantage in freight costs to Denver and to the West Coast, but rates are generally higher for West Texas shipments to Chicago.

If West Texas mills were producing finished woolen and worsted goods, these could find markets at clothing factories within the Southwestern Territory, in Missouri and other Middle Western states and at clothing factories on the West Coast. For finished woolen and worsted goods, West Texas has a transportation advantage over the Southeast.

West Texas has adequate transportation facilities to move raw material to mills and to move the products of these mills to their markets. The area is served by seven Class 1 railroads, and five major commercial airlines. At least 100 common-carrier lines and 125 contract carriers operate on West Texas highways, which total 14,798 miles of paved state and federal roads, and 84,894 miles of improved secondary and farm-to-market roads.

Taxation

Local tax rates in different sections of the country are difficult to compare because of the variance between assessment and variance in local policies regarding determination of market values of property. The same property might be listed at a wide range of market values in various communities, depending upon local policy. In addition, actual tax rates include rates levied per $1,000 assessed valuation for total of city, school, county, and state taxes, and the assessed valuation varies from 13 percent to 100 percent of "true value." Below are listed the comparative 1947 adjusted tax rates for selected textile manufacturing cities in the Southeast and in New England, and for cities in West Texas of more than 30,000 population in the 1940 census. The tax rate listed for each city is the adjusted rate, that is, the rate on 100 percent basis of assessment. Assessed valuation in these cities varies from 13 percent to 100 percent of "true value."

SOME COMPARATIVE TAX RATES FOR WEST TEXAS, SOUTHEAST, AND NORTHEAST

West Texas		Southeast		Northeast	
Amarillo	$14.08	Greensboro, N. C.	$24.82	Philidelphia, Pa.	$28.75
Austin	21.20	Winston Salem, N. C.	21.20	Boston, Mass.	46.50
El Paso	28.60	Greenville, S. C.	20.88	Worcester, Mass.	40.00
Ft. Worth	28.01	Atlanta, Ga.	24.98	Passaic, N. J.	52.40
Lubbock	22.26	Knoxville, Tenn.	32.40	Holyoke, Mass.	24.30
Waco	27.21	Danville, Va.	13.50	Woonsocket, R. I.	25.00
Wichita Falls	28.54			Jamestown, N. Y.	37.04
				Lawrence, Mass.	39.80
				Lowell, Mass.	45.80
Average W. Tex.	24.27	Average S. E.	22.96	Average N. E.	37.73

(53)

In Amarillo, for instance, the total tax rate per $1,000 in 1947, including city, school, county, and state taxes, was $42.80 but the estimated ratio of assessed value to true value was only 33 percent; the adjusted tax rate on 100 percent basis of assessment therefore is only $14.08.

In addition to the difficulty of comparing local tax rates, an analysis of the tax factor is incomplete unless it takes into consideration the amount and standards of governmental service offered by the city, county, and state. A manufacturing enterprise requires adequate municipal facilities, such as utility, water, police protection, road maintenance, and if these services are not satisfactorily filled, lower taxes are no savings. Many Southern mills were built in rural areas to avoid city taxes, but this policy made it necessary for mill owners to build their own communities,

(53) Bureau of Governmental Research, Detroit, "Tax Rates of American Cities," **National Municipal Review**, (January, 1948).

supplying among other things housing, lighting, and recreational facilities which in other parts of the country were supplied by governmental agencies.

Some states have adopted a policy of granting tax exemptions to manufacturers as an inducement to relocation, and seven states offer tax concessions in their advertising. For instance, Mississippi grants a five year advalorum tax exemption to new industries and Louisiana grants a ten year tax exemption. Opinion is sharply divided on the over-all benefit to be derived by local communities, or by relocating industries, from such a policy. The Council of State Governments, for instance, states: "sound, responsible industries locate on a basis of fact, and not solely because they are offered a few dollars annual savings on taxes or free use of a factory building. Many states maintain that subsidies, tax concessions, and various other concessions are unsound in principal and often self-defeating. The main objective in an industrial development program is to provide greater economic opportunities which will result in over-all state benefits. If an industry cannot assume its portion of the tax burden, if it cannot provide its own plants, if it cannot pay decent wages, it will be a burden rather than benefit to the state and community." (54)

Texas does have certain definite tax advantages to offer potential industries. The state has no corporate income tax, no sales tax, no state income tax, and a community property law which in effect reduces federal income tax.

(54) Council of State Governments, **Advertising by States, Chicago,** (May, 1948).

Conclusion

The study of each of the major requirements for textile manufacturing—capital, machinery and equipment, raw materials, labor, water, power and fuel, and transportation facilities—has indicated that the requirements now are available in West Texas, or that they can be made available economically. In some instances, such as supply of raw materials and potential labor supply, West Texas has a definite advantage over other sections of the country; in others, such as water supply and quality, power and fuel, West Texas can offer facilities at least equal to other sections of the country. In certain localities the quantity and/or quality of water is inadequate for large scale industrial use; and in such localities the establishing of wool plants with scouring facilities will be precluded. The only locational factor which finds West Texas at a relative disadvantage is the cost of transportation to markets. This disadvantage long has been recognized, and determined and effective steps are being taken to overcome the present unfavorable position of West Texas in this respect.

It is true that transportation costs from West Texas mills to markets equidistant from New England and Southeastern competitors are greater, that transportation costs are higher on a mileage basis, and that West Texas products must travel greater distances to compete in the same markets with Southeastern mills. However, there are definite indications that West Texas mills can find adequate markets in localities to which this section would have a freight cost advantage over the Southeast, such as the West Coast and the Southwest.

West Texas has a definite advantage over other sections of the country, because of its source of high-quality fine combing wools. Also, it is not far from sources of coarser territory wools which can be used in blends; thus it is suited to the manufacture of a wide variety of wool fabrics. Houston has a good seaport for the shipping in of any foreign wools that might be needed, although raw wool warehousing and marketing facilities would have to be developed. On the other hand, a certain disadvantage arises due to the control of the raw wool market by the Boston Wool Trade. Control has been set up to perpetuate all the processing of wool in the Northeast.

Since wool is sold on a delivered basis, the grower pays freight on dirt and grease which constitute at least 50 per cent of the wool shipped. Therefore, it would seem economical to have the wool scoured before shipping. The advantages of scouring at the source of supply are (1) saving in freight, (2) greater ease in scouring, before the grease has time to set in the fleece; (3) improvement in color of wool, and (4) lower wage cost for grading and sorting. These advantages apparently have been outweighed by disadvantages of local scouring. Competition with Boston is most often cited as the principal block to local scouring activity.

Since Summer Street in Boston controls the purchasing and sale of all wool in this country, it would appear that the cooperation of some Boston wool dealers would be necessary in order to assure a market for scoured wool.

Another factor which prohibits local scouring is the preference of worsted manufacturers and top-makers for purchasing wool in the grease and either scouring it themselves, or having it scoured to their own specifications. A variety of wools must be available to the manufacturer and he must be able to fill his manufacturing requirements quickly. The logical place for a scouring plant, according to a recent survey, is some point where a large variety of wool can be concentrated in transit, because manufacturers' blends are secret and the manufacturer wants to buy wool without revealing varieties or proportions purchased. The control of quality in scouring operations requires considerable experience and skill, and a knowledge of the use to which the wool is to be put.

The locational factor of accessibility to markets will have varying degrees of importance, depending upon the products to be manufactured. The survey indicates that the products best suited to West Texas manufacture are worsted fabrics for both men's and women's wear, since over 90 percent of the Texas clip is Fine wool—64s and finer. A new mill to produce 30,000 yards of men's finished serge suiting would employ about 500 persons and would cost at least $2,500,00.

Worsted fabrics for the most part are styled goods, and constant contact between mills making such goods, and the New York market, is highly important. In this respect West Texas is at some disadvantage as compared to the New England states. However, there is a fair-sized market for fine worsteds to be used in casual and sport clothing like that featured by the Los Angeles and Fort Worth-Dallas clothing manufacturers; and here West Texas has a definite advantage. The exact location of mills will be determined not only by the availability of textile manufacturing requirements, but by effective factual presentation of local facilities by local groups. The Department of Commerce has pointed out that "There is a rather widespread misconception that obtaining new industry for a community or area merely means going out and persuading some industry that the area is so desirable that the industry would have economic advantages there which would more than offset the cost of moving. In order that a city may offer adequate inducement for the creation of new industries or persuade outside industries to establish plants in the areas, such inducement must include well-analyzed facts showing that location within the area is economically advantageous for such industries". (55) A great many agencies in many states are presently engaging in gathering all available information concerning their areas' resources and potentialities and in bringing this information to the attention of potential investors. This work is being done

(55) U. S. Department of Commerce, **Basic Industrial Location Factors,** (Rev. June, 1947).

by state and local development agencies and planning boards, local and regional chambers of commerce, state and local governments, and by railroads and private utilities companies.

The major themes used in advertising for industrial development are plant and site facilities, expanding markets, labor supply, raw materials, transportation facilities, and tax concessions. To provide a sound basis for negotiating with prospective investors or with relocating industry, a community should assemble indisputable facts concerning its resources. An industrial survey should be made for each community, showing (1) general information concerning the city, its population and climate, (2) available site locations, total acreage, acreage suitable for construction, and estimated value per acre, (3) labor supply, quality and cost, (4) developed and undeveloped water resources and water analysis (5) electric power supplies, nearest electric power line, amount and cost of power, (6) quality and cost of fuel, extent of fuel supply, means of bringing fuel from its source, (7) transportation facilities, railroads, highways, motor freight lines, airlines.

Appendix

(Follows)

Table 1

AMOUNT OF VARIOUS TYPES OF WOOL TEXTILE MACHINERY IN PLACE, UNITED STATES

Year	Worsted Combs	Woolen Spindles	Worsted Spindles	Broad Looms
1925	2,787	2,460,000	2,757,000	64,434
1930	2,712	2,265,000	2,510,000	54,307
1935	2,631	1,916,000	2,265,000	44,830
1938	2,609	1,826,000	2,147,000	43,075
1941	2,494	1,634,000	1,956,000	38,989
1944	2,608	1,640,000	1,932,000	38,752
1945	2,596	1,609,000	1,941,000	37,874
1946	2,601	1,600,000	1,917,000	37,369
1947	*2,656	*1,561,198	*1,920,000	36,906

Sources: **Wool In the United States,** National Association of Wool Manufacturers (1947).

* **Fewer Machines - Greater Output,** Textile Industries, (July, 1948).

Table II

NUMBER AND LOCATION OF WOOL AND MOHAIR MANUFACTURING ESTABLISHMENTS* IN UNITED STATES, 1939

LOCATION	Regular Factories† or Jobbers Engaging Contractors	Contract† Factories†	Dyeing and Finishing Woolen and Worsted	Total
United States	583	76	63	722
California	9	2	4	15
Connecticut	35	2	2	39
Delaware	1			1
Georgia	6			6
Illinois	7	1	1	9
Indiana	4			4
Iowa	3	1		4
Kentucky	1			1
Louisiana	1			1
Maine	40	2		42
Maryland	3			3
Massachusetts	109	29	13	151
Michigan	6			6
Minnesota	4	1		5
Missouri	2			2
New Hampshire	34	1		35
New Jersey	19	6	3	28
New Mexico	3			3
New York	37	3	9	49
North Carolina	7			7
Ohio	11	1	1	13
Oregon	9			9
Pennsylvania	91	13	18	122
Rhode Island	86	12	11	109
South Carolina	2			2
Tennessee	7			7
Texas	2			2
Utah	2			2
Vermont	12			12
Virginia	10		1	11
Washington	1			1
West Virginia	8			8
Wisconsin	11	2		13

* As defined in 1939 Census of Manufactures. As a rule, each single plant or factory is counted as an establishment. The following types of establishments are omitted:

1. Establishments idle.
2. Establishments with an annual production valued at less than $5,000.
3. Establishments of educational, eleemosynary, and penal institutions.

† Factories manufacturing products for sale or for interplant transfer.

† Contract or commission factories processing materials owned by others.

Source: Bureau of the Census; Bulletin of the National Association of Wool Manufacturers, Vol. LXXVI.

Table III

GEOGRAPHIC DISTRIBUTION OF KEY WOOL MACHINERY IN PLACE — MAY, 1943

State or Area	Worsted Combs (Percent)	Spinning Spindles Worsteds (Percent)	Spinning Spindles Woolens* (Percent)	Woolen & Worsted Looms (Percent)
Maine	2	9	5	8
New Hampshire	2	7	3	6
Vermont	0	3	1	2
Massachusetts	44	20	36	26
Rhode Island	22	5	25	13
Connecticut	Negligible	8	1	6
Total Northeast	70	52	71	61
New York	2	13	4	6
New Jersey	16	4	8	6
Pennsylvania	8	8	11	11
Total Middle Atlantic	26	25	23	23
Southern States)		11	3	8
North Central States)	4	10	2	6
Western States)		2	1	2

* Includes spindles in knitting and carpet mills.

Source: **Wool In the United States,** National Association of Wool Manufacturers, (1947).

Table IV

MILL CONSUMPTION OF DOMESTIC AND FOREIGN APPAREL WOOL BY GRADES SCOURED BASIS, UNITED STATES, 1936-49

(Million Pounds)

	64s & Finer (Fine)	58s-60s (½ blood)	56s (3/8 blood)	48s-50s (¼ blood)	46s (Low ¼ blood)	44s	40s & Coarser	Total	& Domestic % Foreign
1936-1939 (Average)									
Domestic	91.3	31.0	49.6	31.7	4.6	1.9		210.1	77.3
Foreign	16.3	5.8	9.2	9.9	4.8	15.6		61.6	22.7
Total	107.8	36.8	58.8	41.6	9.4	17.5		271.7	100.0
1940									
Domestic	98.4	31.9	45.6	33.0	4.0	2.3		215.2	69.4
Foreign	39.2	14.4	13.7	10.3	4.4	13.0		95.0	30.6
Total	137.6	46.3	59.3	43.3	8.4	15.3		310.2	100.0
1941									
Domestic	82.5	34.6	55.9	40.6	9.5*	**		223.1	43.3
Foreign	140.6	43.2	39.8	25.7	43.4*	**		292.7	56.7
Total	223.1	77.8	95.7	66.3	52.9			515.8	100.0
1942									
Domestic	82.3	41.7	71.9	32.7	11.4	3.8	0.7	244.5	42.8
Foreign	134.2	41.7	69.4	22.6	17.4	24.1	17.6	322.0	57.2
Total	216.5	83.4	141.3	55.3	28.8	27.9	18.3	571.5	100.0
1943									
Domestic	49.1	31.6	77.3	31.8	10.1	3.0	0.7	203.6	34.4
Foreign	132.5	62.1	106.1	35.6	13.7	25.8	12.4	388.2	65.6
Total	181.6	93.7	183.4	67.4	23.8	28.8	13.1	591.8	100.0

Table IV—Continued

MILL CONSUMPTION OF DOMESTIC AND FOREIGN APPAREL WOOL BY GRADES SCOURED BASIS, UNITED STATES, 1936-49

(Million Pounds)

	64s & Finer (Fine)	58s-60s (½ blood)	56s (3/8 blood)	48s-50s (¼ blood)	46s (Low ¼ blood)	44s	40s & Coarser	Total	% Foreign & Domestic
1944									
Domestic	41.4	15.7	59.7	26.8	5.1	1.4	0.8	150.9	26.1
Foreign	143.7	68.0	113.6	41.7	11.8	28.4	19.1	426.3	78.9
Total	185.1	83.7	173.3	68.5	16.9	29.8	19.9	577.2	100.0
1945									
Domestic	29.4	21.1	47.8	16.1	4.0	1.6	0.4	120.4	20.4
Foreign	151.6	79.5	129.7	53.5	13.5	24.9	16.2	468.9	79.6
Total	181.0	100.6	177.5	69.6	17.5	26.5	16.6	589.3	100.0
1946									
Domestic	39.7	20.4	25.2	18.2	1.9	1.5		106.9	17.5
Foreign	187.7	86.6	102.6	44.5	14.6	66.6*		502.6	82.5
Total	227.4	107.0	127.8	62.7	16.5	68.1		609.5	100.0
1947									
Domestic	86.9	30.1	26.5	13.9	2.1	1.5		161.0	30.6
Foreign	141.8	68.3	65.1	29.1	10.4	49.9*		364.6	69.6
Total	228.7	98.4	91.6	43.0	12.5	51.4		525.6	100.0

* Includes grades 44's and coarser

**Included with low ¼ blood (46s)

Source: U. S. Department of Agriculture, Bureau of Agricultural Economics, **The Wool Situation** (March, 1948)

Table V

MOHAIR SHORN IN UNITED STATES, BY STATES

(In thousands of pounds)

YEAR	TEXAS	NEW. MEX.	ARIZ.	ORE.	UTAH	MO.	CALIF.	TOTAL	% TEXAS TO TOTAL
1926	10,700	473	594	483	175	171	207	12,803	83.6
1927	11,600	611	703	483	200	176	187	13,960	83.1
1928	13,500	629	741	525	225	178	158	15,956	84.6
1929	14,155	717	800	492	260	165	147	16,736	84.6
1930	14,800	815	900	480	280	168	140	17,583	84.2
1931	16,400	933	960	472	305	170	136	19,376	84.6
1932	14,000	1,000	900	460	285	160	130	16,935	82.7
1933	13,700	1,020	780	455	270	202	112	16,539	82.8
1934	13,500	925	750	450	250	195	112	16,182	83.4
1935	13,000	920	736	410	280	259	115	15,720	82.7
1936	13,400	860	741	440	290	285	108	16,124	83.1
1937	13,760	892	791	456	269	265	95	16,528	83.3
1938	14,040	982	771	504	219	214	97	16,827	83.4
1939	15,960	1,005	824	529	165	198	104	18,785	85.0
1940	18,250	1,089	833	516	154	206	96	21,144	86.3
1941	18,750	1,130	931	504	160	192	99	21,766	86.1
1942	17,856	1,040	928	440	123	190	99	20,676	86.4
1943	17,612	916	824	424	110	180	90	20,156	87.4
1944	18,200	855	730	323	73	203	83	20,467	88.9
1945	20,190	675	560	270	62	202	79	22,038	91.6
1946	17,880	516	420	203	44	194	72	19,329	92.5
1947	17,407	368	232	217	12	177	63	18,476	94.2

Source: National Association of Wool Manufacturers, Vol. LXXVII U. S. Department of Agriculture; Bulletin of the

Table VI

BREEDS OF SHEEP, GRADES OF WOOL AND END USES OF FIBER

BREED	AMERICAN GRADES OF WOOL	NUMERICAL GRADES OF WOOL	USES
Merino & Rambouillet	Fine and half blood	58s and finer	Used in making fine dress goods and flannel
Southdown	Half and three-eighths blood combing and clothing (chiefly 3/8 blood clothing)	58s and 60s in the half blood; 56s in the three-eighths blood.	Half-blood wool used mostly for fine dress goods, three-eighths blood for manufacture of cloth such as serges, twills, whipcords, herringbones, and other material used for coatings and suitings.
Corriedale, Dorset, Hampshire, Shropshire, Suffolk	Mainly 3/8 blood combing or clothing and some ¼ blood (both fine and coarse classes of medium wool)	56s in the 3/8 blood. 48s and 50s in the ¼ blood.	Used mostly in the manufacture of suitings.
Cheviot	Usually ¼ blood combing (that is the coarse side of medium wool)	48s and 50s	Used mostly in the manufacture of suitings.
Oxford	Quarter blood and low quarter blood combing (that is, the coarse side of medium and the fine side of coarse wool)	46s and 48s	¼ blood is used in manufacture of suitings, and the low quarter blood is used in making such materials as heavy overcoats, blankets, and carpets.
Cotswold, Leicester, Lincoln, Romney, Morse	Low quarter blood, common and braid	Chiefly 46s, 44s, 40s and 36s; a small percentage produce finer than 40s	Used mostly in the manufacture of heavy overcoatings, blankets and carpets.

Source: Yearbook of Agriculture (1936)

Table VII

RAW FIBERS CONSUMED IN THE UNITED STATES WOOLEN AND WORSTED SPINNING AND CARPET YARN INDUSTRIES IN 1939, 1946, 1947

(Millions of lb. — scoured basis)

Fibers	1939		1946			1947		
	Woolen and Worsted	Carpet	Woolen	Worsted	Carpet	Woolen	Worsted	Carpet
Virgin Wool or Wool Tops	297	111	263	252	125	189	246	169
Recovered Wool, etc.	87	4				134		
Animal Hair or Tops from it	26	7	230	15	18	13	17	30
Rayon and Staple Fiber	22	(a)	38	6	3	21	5	2
Cotton	9	4	39			39		
Jute		1			2			1
Other Fibers	(a)	(a)	5	2	2	3	3	3
TOTAL—	441	127	575	275	150	399	271	205

(a) Negligible

Source: U. S. Bureau of Census

Table VIII

SHEEP AND LAMB AND GOAT AND KID POPULATION AND WOOL PRODUCTION OF WEST TEXAS COUNTIES, 1940 AND 1945

COUNTIES	Sheep and Lamb		Goats and Kids		Wool Shorn Pounds	
	1940	1945	1940	1945	1940	1945
Andrews	2,150	1,001	29	25	15,000	10,000
Archer	22	16	50	44	8,559	9,419
Armstrong	52	39	57	5	48,852	27,071
Bailey	11,376	1,266	26	17	70,952	14,000
Baylor	1,218	715	178	35	7,545	2,021
Blanco	89,949	82,462	67,398	54,297	704,293	593,539
Borden	27,029	26,878	199	126	174,161	166,096
Bosque	64,788	50,462	29,078	32,802	401,423	331,895
Brewster	144,153	169,666	74,837	68,032	1,125,791	1,379,064
Briscoe	4,209	4,648	9	69	48,816	28,440
Brown	80,065	48,303	23,317	21,458	537,632	240,893
Burnet	133,399	144,120	54,205	54,939	936,031	977,217
Callahan	31,945	35,834	8,283	12,729	214,347	243,489
Carson	3,896	4,327	6	6	17,423	14,294
Castro	10,200	4,633	18	1	78,626	35,646
Childress	457	321	34	20	4,558	1,845
Clay	2,590	551	911	424	19,341	3,238
Cochran	7,158	1,323		3	42,449	3,244
Coke	137,835	144,587	17,213	18,684	1,079,186	1,026,378
Coleman	213,936	231,275	9,511	9,778	1,693,164	1,367,504
Collinsworth	2,215	1,008	34	50	18,910	6,570
Comanche	67,534	43,564	18,509	17,142	463,407	305,596
Concho	245,339	263,198	17,089	18,658	1,933,315	1,775,113
Cooke	9,197	7,411	795	1,045	60,234	38,643
Coryell	104,211	81,027	33,396	20,831	665,743	535,644
Cottle	703	40	24	6	9,938	860
Crane	8,729	33,'568	285	1,341	76,371	260,384

Table VIII—Continued

SHEEP AND LAMB AND GOAT AND KID POPULATION AND WOOL PRODUCTION OF WEST TEXAS COUNTIES, 1940 AND 1945

COUNTIES	Sheep and Lamb		Goats and Kids		Wool Shorn Pounds	
	1940	1945	1940	1945	1940	1945
Crockett	390,280	388,110	31,128	50,388	3,234,149	3,030,915
Crosby	6,138	12,013	79	64	49,531	91,988
Culberson	43,238	64,075	2,200	396	330,529	485,900
Dallam	2,478	1,024		118	20,719	6,000
Dawson	9,114	1,612	28	11	46,471	7,953
Deaf Smith	14,887	5,232	88	21	73,955	37,632
Denton	41,490	32,543	667	862	244,411	163,157
Dickens	3,698	2,045	23	35	34,127	10,742
Donley	481	82	22	7	2,622	140
Eastland	6,569	8,399	14,991	27,108	39,438	47,314
Ector	1,541	2,150	61	120	12,940	850
Edwards	239,852	207,399	277,605	268,836	1,688,702	1,407,752
El Paso	4,890	3,506	3,907	334	24,132	25,186
Erath	33,582	14,923	18,824	20,729	228,440	86,608
Fisher	13,884	5,888	85	308	110,494	29,477
Floyd	10,392	26,257	23	364	107,107	137,321
Foard	977	107	13	19	13,177	2,858
Gaines	1,907	6	3,809	143	14,070	10
Garza	1,118	295	855	14	8,807	1,000
Gillespie	171,495	206,449	106,689	94,964	1,514,575	1,607,893
Glasscock	104,851	82,500	1,068	865	966,138	748,057
Gray	2,881	727	56	23	20,075	1,331
Hale	19,380	39,457	51	38	138,417	218,106
Hall	608	8	40	35	5,783	100
Hamilton	85,472	85,325	28,868	24,691	588,974	539,483
Hansford	3,971	3,757	20	20	34,869	5,750
Hardeman	2,236	3,326	16	7	15,635	19,550

Table VIII—Continued

SHEEP AND LAMB AND GOAT AND KID POPULATION AND WOOL PRODUCTION OF WEST TEXAS COUNTIES, 1940 AND 1945

COUNTIES	Sheep and Lamb		Goats and Kids		Wool Shorn Pounds	
	1940	1945	1940	1945	1940	1945
Hartley	1,076	3,283	1	11	801	12,843
Haskell	59,782	4,529	160	23	43,327	24,046
Hemphill	264	350	13	5	2,250	1,803
Hockley	3,826	233	68	69	20,408	1,785
Hood	10,736	4,707	16,777	11,696	59,244	36,911
Howard	23,659	14,453	385	212	133,617	90,092
Hudspeth	31,338	39,297	5,350	5,765	169,648	322,301
Hutchinson	1,270	2,528	10	3	4,410	6,800
Irion	210,213	190,772	6,292	10,425	1,730,221	1,541,032
Jack	4,566	3,365	11,652	10,732	26,436	12,543
Jeff Davis	65,811	139,546	11,803	33,019	480,614	1,024,648
Johnson	9,015	6,431	2,099	309	45,510	38,050
Jones	6,698	3,890	555	399	41,550	28,810
Kent	10,954	5,647	23	1	115,344	39,611
Kerr	168,890	204,000	145,893	141,837	1,315,607	1,713,009
Kimble	180,549	241,134	123,764	159,521	1,564,659	1,983,495
King	359	94	9	96	2,360	400
Knox	2,142	1,015	10	53	21,791	5,113
Lamb	4,656	1,445	72	1,527	34,746	8,886
Lampasas	180,731	135,060	28,262	32,971	1,229,547	864,912
Lipscomb	1,150	80	8		4,422	350
Llano	18,596	23,259	34,132	41,092	123,696	128,523
Loving			33	3		
Lubbock	12,463	8,638	53	103	70,484	38,793
Lynn	6,511	8,529	42	28	43,662	35,404
McCulloch	208,407	208,932	47,852	47,133	1,470,587	1,224,149
McLennan	31,450	27,583	4,630	4,294	160,657	142,999

Table VIII—Continued

SHEEP AND LAMB AND GOAT AND KID POPULATION AND WOOL PRODUCTION OF WEST TEXAS COUNTIES, 1940 AND 1945

COUNTIES	Sheep and Lamb		Goats and Kids		Wool Shorn Pounds	
	1940	1945	1940	1945	1940	1945
Martin	20,300	9,438	288	225	131,696	65,683
Mason	101,278	86,788	88,027	90,801	732,189	586,787
Menard	238,143	239,887	77,276	66,714	1.853,075	1,822,857
Midland	44,863	25,636	298	160	300,387	292,181
Mills	133,737	124,012	70,676	69,599	924,998	798,818
Mitchell	26,845	22,067	465	953	198,895	133,331
Montague	1,327	588	2,654	966	7,501	2,828
Moore	1,834	306		6	35	774
Motley	2,059	4,373	65	34	14,148	10,270
Nolan	98,041	90,728	24,596	30,505	735,659	517,869
Ochiltree	8,302	8,520	11	22	27,843	47,172
Oldham	1,088	278			12,625	560
Palo Pinto	22,954	9,864	20,160	48,917	130,751	64,252
Parker	10,554	6,417	13,412	19,051	43,182	28,405
Parmer	10,110	4,695	8	18	71,158	25,200
Pecos	328,032	398,409	18,388	36,424	2,435,322	3,374,667
Potter	1,571	6,663	146	65	7,210	1,000
Presidio	25,362	186,140	20,783	46,443	146,510	1,368,689
Randall	7,738	3018	27	4	51,543	22,230
Reagan	157,440	148,664	1,739	2,216	1,317,217	1,290,353
Real	39,931	51,746	98,289	109,601	266,298	454,516
Reeves	5,802	8,079	72	138	34,580	48,789
Roberts	402	487	9	3	3,637	3,770
Runnels	117,075	126,915	1,369	1,779	921,745	802,334
San Saba	127,207	87,081	63,911	49,874	777,749	517,902
Schleicher	259,490	215,174	31,164	21,768	1,971,264	1,777,254
Scurry	20,065	15,627	159	221	150,676	101,671

Table VIII—Continued

SHEEP AND LAMB AND GOAT AND KID POPULATION AND WOOL PRODUCTION OF WEST TEXAS COUNTIES, 1940 AND 1945

COUNTIES	Sheep and Lamb		Goats and Kids		Wool Shorn Pounds	
	1940	1945	1940	1945	1940	1945
Shackelford	16,050	1,745	233	61	75,345	49,443
Sherman	7,548		4		46,105	
Somervell	1,832	497	2,927	1,327	15,021	367
Stephens	9,136	8,483	7,376	13,099	55,426	28,521
Sterling	147,060	136,592	9,098	10,121	1,293,223	1,234,352
Stonewall	4,771	11,950	286	382	38,987	55,934
Sutton	281,703	265,433	107,071	105,616	2,135,170	1,989,567
Swisher	6,440	12,268	24	8	50,397	42,627
Tarrant	19,780	20,293	4,114	2,507	122,271	77,298
Taylor	41,392	33,924	21,120	29,638	315,134	191,986
Terrell	274,145	292,203	47,827	52,811	2,291,223	2,145,957
Terry	774	225	41	31	6,905	1,643
Throckmorton	1,672	1,197	21	20	10,052	6,946
Tom Green	338,422	299,774	19,386	23,617	2,548,538	2,028,875
Travis	20,863	27,057	25,443	41,573	120,445	158,961
Upton	119,794	102,117	2,945	3,044	1,054,331	857,157
Val Verde	510,980	555,208	132,564	134,124	3,924,923	4,626,456
Ward	910	611	38	39	80	270
Wheeler	1,392	27	50	38	8,948	
Wichita	1,541	2,435	122	600	11,886	13,558
Wilbarger	1,819	1,716	67	15	13,385	9,301
Winkler	8					
Wise	11,300	3,422	2,685	3,930	62,487	23,464
Yoakum	2,897	700	1,230	1,800	25,860	5,400
Young	8,955	4,195	1,541	1,197	73,729	25,553
Total—	7,519,611	7,521,960	2,206,860	2,345,519	56,507,716	55,154,282

Source: U. S. Department of Commerce, U. S. Census of Agriculture

Table IX

WOOL SHORN IN THE UNITED STATES, BY STATES

(In thousands of pounds, as shorn)

STATE	1940	1941	1942	1943	1944	1945	1946	1947
Maine	248	236	243	252	240	205	183	162
New Hampshire	49	49	56	61	61	48	46	46
Vermont	127	124	124	119	117	90	86	73
Massachusetts	42	42	42	48	42	42	41	43
Rhode Island	12	12	12	12	12	12	12	12
Connecticut	28	24	24	30	36	30	30	30
New York	2,037	2,002	2,065	2,009	1,828	1,569	1,354	1,195
New Jersey	38	40	40	40	48	38	41	39
Pennsylvania	2,526	2,398	2,595	2,572	2,468	1,905	1,786	1,642
Ohio	15,824	15,706	16,575	16,084	12,675	11,583	10,441	9,396
Indiana	4,662	4,920	5,490	4,979	4,126	3,648	3,315	3,253
Illinois	5,189	6,155	6,644	6,621	4,785	5,039	3,954	3,766
Michigan	7,314	6,849	6,448	5,975	5,265	4,535	3,912	3,403
Wisconsin	2,857	2,797	3,102	3,149	2,736	2,310	2,141	1,967
Minnesota	8,058	8,769	9,298	9,298	8,071	6,802	5,729	5,184
Iowa	10,001	10,967	12,172	10,704	8,736	7,722	6,304	6,781
Missouri	10,122	10,621	11,052	10,711	9,596	8,619	7,631	8,047
North Dakota	7,348	8,491	8,976	8,406	7,578	6,226	5,159	4,333
South Dakota	11,854	15,019	16,423	15,473	13,385	10,820	9,181	7,880
Nebraska	3,489	3,496	4,086	4,744	3,149	2,724	2,154	1,835
Kansas	4,507	5,665	5,921	6,755	5,148	4,718	3,583	3,209
Delaware	13	13	13	13	13	13	13	13
Maryland	365	340	351	298	277	268	254	256
Virginia	1,760	1,760	1,724	1,632	1,545	1,469	1,423	1,409
West Virginia	2,275	2,162	2,178	2,054	1,775	1,596	1,595	1,532
North Carolina	221	225	230	244	230	214	196	180

Table IX—Continued

WOOL SHORN IN THE UNITED STATES, BY STATES

(In thousands of pounds, as shorn)

STATE	1940	1941	1942	1943	1944	1945	1946	1947
South Carolina	35	30	25	25	20	20	20	20
Georgia	77	70	70	69	69	69	62	57
Florida	79	73	69	61	49	38	38	40
Kentucky	5,308	5,546	6,256	5,638	4,850	4,443	4,434	4,561
Tennessee	1,665	1,870	1,870	1,890	1,685	1,561	1,550	1,485
Alabama	132	131	131	130	119	101	106	99
Mississippi	190	194	204	231	259	276	269	300
Arkansas	394	447	460	451	402	320	281	250
Louisiana	792	826	816	707	627	634	614	554
Oklahoma	2,720	2,652	2,739	2,746	1,733	1,536	1,223	1,218
Texas	79,900	80,250	74,994	80,713	78,689	74,816	71,263	61,946
Montana	29,624	33,149	32,964	30,945	27,866	23,707	21,485	17,317
Idaho	16,627	16,963	16,863	14,814	13,551	11,825	10,754	10,425
Wyoming	31,718	33,379	33,320	32,997	27,000	24,700	23,950	21,810
Colorado	14,170	13,561	14,896	15,458	13,229	12,885	12,118	10,890
New Mexico	16,446	17,349	16,399	15,719	14,591	13,868	12,141	11,361
Arizona	4,371	4,303	4,362	4,043	4,056	3,567	3,187	3,027
Utah	18,507	17,910	18,081	16,845	14,869	14,229	14,266	13,120
Nevada	5,416	5,484	5,521	5,100	4,998	4,424	4,190	3,818
Washington	5,446	5,778	5,496	5,132	4,555	3,977	3,565	3,556
Oregon	14,016	14,058	12,923	10,471	9,654	8,300	6,800	6,204
California	23,415	24,615	23,954	22,375	21,505	20,408	17,607	15,054
UNITED STATES	372,014	387,520	388,297	378,843	338,318	307,949	280,487	252,798

Sources: United States Department of Agriculture;
National Association of Wool Manufacturers

Table X

NUMBER OF PRODUCTION WORKERS EMPLOYED IN THE WOOLEN AND WORSTED MANUFACTURING INDUSTRIES

(In Thousands)

Period	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948
January	165.2	157.8	180.8	194.2	181.3	167.4	158.8	163.6	180.2	177.4
February	161.5	154.7	185.6	185.8	181.0	168.5	158.4	169.3	179.4	179.5
March	149.6	130.1	185.7	184.8	180.6	167.7	157.7	173.9	175.1	178.3
April	134.1	121.4	188.3	186.6	177.4	165.1	154.5	175.1	169.9	175.0
May	146.5	130.6	192.8	189.0	176.6	162.4	153.2	175.2	164.3	173.2
June	155.2	137.6	194.7	189.1	175.0	161.8	153.2	176.2	162.9	173.8
July	158.8	151.4	196.5	188.7	172.1	156.4	147.6	170.9	158.1	E171.5
August	159.4	157.8	196.2	186.7	169.1	155.6	147.0	172.0	162.9	
September	152.1	161.2	199.0	184.9	168.1	157.0	149.3	176.1	168.7	
October	167.9	170.7	197.3	182.5	168.9	157.4	152.9	177.0	170.9	
November	174.9	178.9	196.7	181.5	169.4	158.6	156.8	179.2	174.2	
December	166.6	182.8	198.9	182.0	169.3	160.4	161.8	181.7	177.3	
Year	157.7	152.9	192.7	186.3	174.1	161.5	154.3	174.2	170.3	

Source: Bureau of Labor Statistics, Current Statistics of Wool Manufacture, National Association of Wool Manufacturers, Vol. 14, No. 4, p. 52 E—Estimated

Table XI

STRAIGHT-TIME HOURLY EARNINGS[1] FOR SELECTED OCCUPATIONS IN THE WOOLEN AND WORSTED INDUSTRY, APRIL 1948

Occupation and System	Northern New England		Lawrence, Mass.		Rhode Island		Philadelphia-Camden		Patterson, New Jersey		Virginia & N. Carolina	
	No. of Emp.	Ave. Hourly Earn.	No. of Emp.	Ave. Hourly Earn.	No. of Emp.	Ave. Hourly Earn.	No. of Emp.	Ave. Hourly Earn.	No. of Emp.	Ave. Hourly Earn.	No. of Emp.	Ave. Hourly Earn.
		$		$		$		$		$		$
MEN												
Card Tenders, Bradford			61	1.10							39	.93
Card Tenders, French			33	1.29			(56a)	(1.06a)				
Card Tenders, Woolen	71	1.17	48	1.31	328	1.08	27	1.08	33	1.25		
Comber Tenders, Worsted			51	1.21							184	.93
Doffers, Frame, Woolen									88	1.15		
Dyeing Machine Tenders,												
Cloth - - - Woolen	18	1.17	7	1.28	168	1.12					22	.90
- - - Worsted	84	1.21	33	1.27	30	1.21			85	1.31		
Fuller Tenders, Woolen	14	1.23	8	1.21	133	1.12					28	.98
Fuller Tenders, Worsted			34	1.39			(9b)	(1.30b)				
Loom Fixers, Woolen*	31	1.71	10	1.62	234	1.60	17	1.60	80	1.79	82	1.20
Loom Fixers, Worsted*	167	1.82	204	1.76			67	1.63	130	1.84	10	1.33
Machinists, maintenance	78	1.52	47	1.51	29	1.46	9	1.43	105	1.56	29	1.11
Mechanics, maintenance			60	1.46	95	1.35	11	1.29	7	1.57		
Spinners, Mule, French			127	1.74			25	1.59				
Spinners, Mule, Woolen	126	1.66	63	1.54	665	1.53			(189c)	(1.56c)	95	1.04
Truckers, hand	383	1.17	173	1.14	143	1.09	9	1.01	313	1.21	74	.85
Weavers, Woolen*	146	1.63	78	1.45	849	1.49	(346b)	(1.44b)	(391b)	(1.60b)	300	1.11
Weavers, Worsted	551	1.59	670	1.64	267	1.49	285	1.43	227	1.61	25	1.20

Table XI—Continued

STRAIGHT-TIME HOURLY EARNINGS[1] FOR SELECTED OCCUPATIONS IN THE WOOLEN AND WORSTED INDUSTRY, APRIL 1948

Occupation and System	Northern New England		Lawrence, Mass.		Rhode Island		Philadelphia-Camden		Patterson, New Jersey		Virginia & N. Carolina	
	No. of Emp.	Ave. Hourly Earn.	No. of Emp.	Ave. Hourly Earn.	No. of Emp.	Ave. Hourly Earn.	No. of Emp.	Ave. Hourly Earn.	No. of Emp.	Ave. Hourly Earn.	No. of Emp.	Ave. Hourly Earn.
		$		$		$		$		$		$
WOMEN												
Comber Tenders, Worsted			133	1.14			40	1.04				
Doffers, Frame, Bradford	197	1.13	351	1.07	348	1.07	97	.91			33	.90
Doffers, Frame, French									(172a)	(1.14a)		
Doffers, Frame, Woolen												
Spinners, Frame, Bradford	1,101	1.20	705	1.18	516	1.13	194	.98			32	.95
Spinners, Frame, French							(253a)	(.99a)	(393a)	(1.23a)		
Spinners, Frame, Woolen			55	1.22	337	1.17					169	.96
Weavers, Woolen*					462	1.41	26	1.20	(414b)	(1.58b)	166	.99
Weavers, Worsted	211	1.57			147	1.36	106	1.35	244	1.55		
Winders, Cone, High Speed	82	1.24	376	1.21	250	1.14	56	1.02	109	1.30		
Winders, Cone, Slow Speed			53	1.12	90	1.12	79	1.02				
Winders, Filling, Auto.	331	1.20	88	1.29	142	1.16	70	1.03	164	1.18	82	.87
Winders, Filling, Non-Auto.			101	1.18	57	1.14	37	.99	(401d)	(1.29d)	24	.85

* Other than Jacquard.

1. Straight-time hourly earnings, excluding premium overtime payments and shift differentials.

a. Bradford, French and Woolen systems combined.

b. Woolen and Worsted systems combined.

c. French and Woolen systems combined.

d. Winders, Cone, high and slow speeds, and Winders, Filling, automatic and non-automatic.

Source: Bureau of Labor Statistics, Current Statistics of Wool Manufacture, National Association of Wool Manufacturers, Vol. 14, No. 4, p. 55.

Table XII

EMPLOYMENT, PAYROLLS AND EARNINGS IN THE WOOLEN AND WORSTED GOODS INDUSTRY

Period	Employment Index*	Payroll Index*	Average Weekly Hours	Average Hourly Earnings	Average Weekly Earnings	Purchasing Power of Dollar**	Adjusted Weekly Earnings†
1939 Average	100.0	100.0	36.4	$0.528	$19.22	1.000	$19.22
1946 Average	110.5	245.7	41.1	1.012	41.55	.717	27.79
1947 Average	108.0	264.9	39.7	1.156	45.89	.625	28.68
1947 August	103.3	233.6	36.6	1.156	42.31	.620	26.23
September	107.0	268.5	40.2	1.169	46.99	.607	28.52
October	108.4	270.4	39.7	1.178	46.77	.607	28.39
November	110.5	276.6	39.6	1.188	47.04	.603	28.37
December	112.4	294.4	41.2	1.192	49.11	.595	29.22
1948 January	112.5	292.0	40.8	1.195	48.76	.589	28.72
February	113.9	321.1	40.8	1.303	53.16	.593	31.52
March	113.1	322.1	40.8	1.317	53.73	.596	32.02
April	111.0	308.6	39.9	1.311	52.31	.587	30.71
May	109.9	307.9	40.1	1.314	52.69	.583	30.72
June	110.3	311.5	40.3	1.320	53.20	.579	30.80
July	106.0	294.9	39.5	1.327	52.42	.572	29.98
August	107.4	297.1	39.6	1.317	52.15	.570	29.73

* 1939—100 **—1.000

† Average weekly earnings adjusted by purchasing power dollar.

Source: Bureau of Labor Statistics; Current Statistics of Wool Manufacture, National Association of Wool Manufacturers, Vol. 14, No. 5, p. 69.

Table XIII

SOME LAKES AND DAMS IN WEST TEXAS

Existing and Proposed

COUNTY	RIVER	NAME	SIZE	USES	COMMENTS
Archer	Little Wichita	City of Wichita Falls	50 ft. dam; 5,700 acre lake; 100,000 acre ft. storage	Irrigation, Municipal	Proposed, Surveys and estimates made, 1945
Baylor	Wichita	Lake Kemp	100 ft. dam; 22,827 acre lake; 600,000 storage	Irrigation, Municipal, Industrial	Wichita County Water Imp. Dist. No. 1
Baylor-Archer Wichita	Wichita	Lake Kemp	50 ft. dam; 16,000 acre lake; 40,000 acre ft. storage	Irrigation, Municipal, Industrial	Wichita County Water Imp. Dist. No. 1
Bosque-Johnson Hood-Somervell	Brazos	Bee Mountain	100 ft. dam; 7,000 acre lake; 230,00 acre ft. storage	Irrigation, Flood Control	Proposed, Survey made
Bosque-Hill	Brazos	Whitney	80 ft. dam; 5,000 acre lake; 100,000 acre ft. storage	Irrigation, Flood Control	Proposed, Survey made. Congress authorized construction by Corps of Engineers (1946)
Brown	Pecan Bayou (Branch of Colorado)	Brownwood	125 ft. dam; 4,500 acre lake; 125,000 acre ft. storage	Municipal, Irrigation, Flood Control	Plans for raising dam to provide additional storage (1946)
Burnet	Colorado	Inks	17,100	Power	
Burnet-Llano	Colorado	Buchanan	137 ft. dam; 23,240 acre lake; 1,000,000 acre ft. storage	Flood Control, Power, Irrigation, Water Supply	Part constructed

Table XIII—Continued

SOME LAKES AND DAMS IN WEST TEXAS

Existing and Proposed

COUNTY	RIVER	NAME	SIZE	USES	COMMENTS
Burnet-Llano	Colorado	Inks	45 ft. dam; 1,850 acre lake; 28,750 acre ft. storage	Flood Control, Power, irrigation	State permit granted
Burnet	Colorado		70 ft. dam; 1,200 acre lake; 23,646 acre ft. storage	Flood Control, Power, Irrigation	State permit granted Municipal
Coke	Colorado	Robert Lee		Municipal supply, Irrigation,	Upper Colorado River Authority cooperating with Bureau of Reclamation in construction, 1946
Coke-Runnels	Colorado	Bronte	100 ft. dam; 46,080 acre lake; 750,000 acre ft. storage	Municipal Irrigation	Proposed, surveys made, Prelim. filing
Coleman	Hords Creek	Coleman			Congress authorized and appropriated funds for construction under supv. Corps of Eng., 1946
Denison-Cooke & Oklahoma	Red River	Denison	165 ft. dam; 250,000 acre lake; 12,750,000 acre ft. storage	Flood Control, Power, Navigation	
Coryell-Bell	Leon	Leon-Belton	115 ft. dam; 10,300 acre lake; 340,000 acre ft. storage	Irrigation, Flood Control, Power, Municipal	Proposed survey
Dalham	Rita Blanca Creek	Rita Blanca	12,100 acre ft. capacity	Recreational	

Table XIII—Continued

SOME LAKES AND DAMS IN WEST TEXAS

Existing and Proposed

COUNTY	RIVER	NAME	SIZE	USES	COMMENTS
Deaf Smith	Tierra Blanco Creek	Umbarger	18,150 acre ft. when constructed	Recreational	
Denton	Elm Creek	Lake Dallas	65 ft. dam; 11,000 acre lake; 214,000 acre ft. storage	Municipal	City of Dallas
Eastland	Sandy Creek	Lake Cisco	118.5 ft. dam; 1,000 acre lake; 45,000 acre ft. storage	Irrigation, Municipal	
Eastland	Leon River	Lake Belsford	35 ft. dam; 200 acre lake; 4,900 acre ft. storage	Industrial	
Foard-Hardeman	Pease River	Pease Project	92 ft. dam; 11,000 acre lake; 350,000 acre ft. storage	Irrigation, 60,000 acre flood control	Proposed surveys and estimates made
Hardeman	Wanderers Creek	Lake Pauline	60 ft. dam; 345 acre lake; 7,000 acre ft. storage	Industrial, 1928	
Hood-Parker	Brazos	Cordova Bend	85 ft. dam; 8,300 acre lake; 127,000 acre ft. storage	Irrigation, Flood Control, Municipal	Proposed, survey made
Jones	Elm Creek	Phantom Hill	74,000 acre ft. storage	Flood Control, Municipal	Proposed, survey made 1943
Kimble	South Llano	South Llano	110 ft. dam; 2,500 acre lake; 1,000,000 acre ft. storage	Irrigation, Flood Control	Proposed, surveys made, preliminary filing

Table XIII—Continued

SOME LAKES AND DAMS IN WEST TEXAS

Existing and Proposed

COUNTY	RIVER	NAME	SIZE	USES	COMMENTS
Lampasas-San Saba	Colorado	Bronte	137 ft. dam; 26,500 acre lake; 769,000 acre ft. storage	Flood Control, Power, Irrigation	Proposed, survey made
McLennan	N. Bosque	Lake Waco	50 ft. dam; 1,850 acre lake; 30,000 acre ft. storage	Municipal	City of Waco
Mitchell	Colorado		6 mo. above Colorado City	Flood Control, Municipal, Industrial	Five W. Texas Cities planning joint water supply project, in construction of reservoir, 1946
Nolan	Bitter Creek	Sweetwater	78 ft. dam; 405 acre lake; 10,000 acre ft. storage	Municipal	City of Sweetwater
Oldham	Canadian		500,000 acre ft. storage capacity	Irrigation, 100,000 acres Flood Control	Dam sites examined and geological investigation made, proposed project
Palo Pinto-Stephens-Young	Brazos	Possum Kingdom	125 ft. dam; 21,300 acre lake; 750,000 acre ft. storage	Irrigation, Flood Control, Power, Municipal	
Palo Pinto	Brazos	Little Keechie	45 ft. dam; 2,100 acre lake; 30,000 acre ft. storage	Irrigation, Flood Control, Power, Municipal	Proposed, survey made
Palo Pinto	Brazos	Inspiration Point	90 ft. dam; 10,800 acre lake; 300,000 acre ft. storage	Irrigation, Flood Control, Power, Municipal	Proposed, survey made

Table XIII—Continued

SOME LAKES AND DAMS IN WEST TEXAS

Existing and Proposed

COUNTY	RIVER	NAME	SIZE	USES	COMMENTS
Parker	Rock Creek	Mineral Wells	68.5 ft. dam; 1,000 acre lake; 7,300 acre ft. storage	Municipal	
Potter	Canadian		500,000 acre ft storage capacity	Irrigation of about 100,000 acres, Flood Control	Dam site examined and geological investigation made, proposed project
Presidio	Alamita Creek	San Estaban	80 ft. dam; 762 acre lake; 18,770 acre ft. storage	Irrigation of 8,500 acres	
Reeves	Toyah Creek	Balmorhea	50 ft. dam; 530 acre lake; 5,165 acre ft. storage	Irrigation of 12,500 acres	
Reeves-Loving	Pecos	Red Bluff	112 ft. dam; 11,500 lake; 285,000 acre ft. storage	Irrigation of 100,000 acres, Flood Control, Power	Dist. organized, contract let, Federal aid granted
San Saba	San Saba	San Saba	110 ft. dam; 1,725 acre lake; 57,000 acre ft. storage	Irrigation, Flood Control	Proposed, surveys made, 40,000 acres irrigated
Stonewall-Haskell	Salt Fork	Seymour	61 ft. dam; 12,000 acre lake; 300,000 acre ft. storage	Irrigation, Flood Control, Power, Municipal	Proposed, survey made
Tarrant-Denton	Denton Creek	Grapevine	105 ft. dam; 8,650 acre lake; 310,000 acre ft. storage		Trinity River Reclamation Study, Vol. 1, Part II.

Table XIII—Continued

SOME LAKES AND DAMS IN WEST TEXAS

Existing and Proposed

COUNTY	RIVER	NAME	SIZE	USES	COMMENTS
Tarrant-Wise	W. Fork Trinity	Eagle Mountain	60 ft. dam; 9,500 acre lake; 210,000-420,000 acre ft. storage	Municipal, Flood Control, Irrigation, 1931	Tarrant County Water Control & Imp. Dist. No. 1
Tarrant	W. Fork Trinity	Lake Worth	3,720 acre lake; 27,000 acre ft. storage capacity	Municipal, City of Ft. Worth	
Tarrant	Clear Fork		125 ft. dam; 10,000 acre lake; 380,000 acre ft. storage	Municipal, Flood Control	Proposed, surveys made
Tarrant	W. Fork Trinity	Grand Prairie Mountain Creek	95 ft. dam; 8,800 acre lake; 124,000 acre ft. storage	Industrial	Trinity River Reclamation Study; Williams, Myers & Powell, Vol. I, Part II.
Taylor	Elm Creek	Lake Abilene	80 ft. dam; 20,000 acre ft. storage	Municipal	City of Abilene
Taylor	Lytle Creek	Lytle Creek	32 ft. dam; 6,500 acre ft. storage	Industrial	West Texas Utilities
Taylor	Cedar Creek	Lake Kirby	50 ft. dam; 700 acre lake, 8,500 acre ft. storage	Municipal, 1928	
Throckmorton	Clear Fork	Breckenridge	115 ft. dam; 12,900 acre lake; 460,000 acre ft. storage	Irrigation, Flood Control, Power, Municipal	Proposed; survey made

Table XIII—Continued

SOME LAKES AND DAMS IN WEST TEXAS

Existing and Proposed

COUNTY	RIVER	NAME	SIZE	USES	COMMENTS
Tom Green	S. Concho River	Nasworthy	45 ft. dam; 2,000 acre lake; 10,500 acre ft. storage	Municipal, Industrial Irrigation,	
Tom Green	N. Concho River	San Angelo		Irrigation, Municipal, Industrial, Flood Control	Congress authorized Corp. of Engineers to investigate and to construct, 1946
Tom Green	Concho	Nasworthy	86 ft. dam; 10,000 acre lake; 200,000 acre ft. storage	Irrigation	State permit granted for increase in height, 25,000 acres to be irrigated
Travis	Colorado	Lake Austin	66 ft. dam; 1,500 acre ft. storage	Power, Municipal	
Travis	Colorado	Lake Travis (Marshall Ford)	1,950,000 acre ft. storage	Flood control, Power, Irrigation, Water Supply	
Travis	Colorado		75 ft. dam; 4,800 acre lake; 196,000 acre ft. storage	Flood control, Power, Irrigation	State permit granted
Travis-Burnet	Colorado		125 ft. dam; 14,700 acre lake; 718,000 acre ft. storage	Flood control, Power, Irrigation	State permit granted
Travis	Onion Creek	McKinney Falls	75 ft. dam; 2,875 acre lake; 46,875 acre ft. storage	Irrigation, Flood Control	

Table XIII—Continued

SOME LAKES AND DAMS IN WEST TEXAS

Existing and Proposed

COUNTY	RIVER	NAME	SIZE	USES	COMMENTS
Val Verde	Devils River		37 ft. dam; 460 acre lake; 8,460 acre ft. storage		Proposed State permit granted
Val Verde	Devils River		98 ft. dam; 45,700 acre ft. storage		Proposed state permit granted
Val Verde	Devils River		34 ft. dam; 250 acre lake; 3,500 acre ft. storage	Power	Central Power & Light Co.
Val Verde	Devils River		40 ft. dam; 440 acre lake; 10,750 acre ft. storage	Power	Central Power & Light Co.
Val Verde	Pecos River	Pecos River Project		Municipal	Proposed tunnel from dam to Rio Grande River
Wichita-Archer	Holliday Creek	Lake Wichita	36 ft. dam, 2,050 acre lake; 13,500 acre ft. storage	Municipal,	
Wise	W. Fork Trinity	Bridgeport	110 ft. dam; 9,600 acre lake; 290,000-580,000 acre ft. storage	Municipal Flood control	Tarrant County Water Control & Imp. District No. 1
Young	Flint Creek	Lake Graham	35 ft. dam; 290 acre lake; 4,500 acre ft. storage	Municipal	

TABLE XIV

SELECTED FREIGHT RATE COMPARISONS FOR WOOL PIECE GOODS
AUGUST 23, 1948

—Rates Are in Cents Per 100 Pounds—

From	To	Rates	Tariff Authority
(In Original Piece - Carloads)			
Sweetwater, Texas	Chicago, Ill.	340	2nd class— ICC Dkt. 28300 - SWL 251-B.
Sweetwater, Texas	Denver, Colo.	275	2nd class— ICC Dkt. 28300 - SWL 61-E.
Sweetwater, Texas	San Francisco, Calif.	516	Item 1250, TCFB 39-H.
Boston, Mass.	Chicago, Ill.	160	NEFA Tariff 26-E.
Boston, Mass.	Denver, Colo.	465	Trunk Lines' Tariff 107-C.
Boston, Mass.	San Francisco, Calif.	809	TCFB Tariff 39-H.
Atlanta, Ga.	Chicago, Ill.	225	No specific carload rate; LCL Class 70, IFA 15.
Atlanta, Ga.	Denver, Colo.	428	Western Trunk Lines' 385.
Atlanta, Ga.	San Francisco, Calif.	768	TCFB 39-H.
(In Original Piece - Less Carload)			
Sweetwater, Texas	Chicago, Ill.	400	1st class - ICC Dkt. 28300 - SWL 251-B.
Sweetwater, Texas	Denver, Colo.	324	1st class - ICC Dkt. 28300 - SWL 61-E.
Sweetwater, Texas	San Francisco, Calif.	575	Item 1250, TCFB Tariff 39-H.
Boston, Mass.	Chicago, Ill.	289	NEFA Tariff 20-C.
Boston, Mass.	Denver, Colo.	549	Trunk Lines' Tariff 107-C.
Boston, Mass.	San Francisco, Calif.	809	Item 4395 - TCFB Tariff 1-Z.
Atlanta, Ga.	Chicago, Ill.	225	IFA Tariff 15-E.
Atlanta, Ga.	Denver, Colo.	503	WTL Tariff 385.
Atlanta, Ga.	San Francisco, Calif.	726	Item 4395 - TCFB Tariff 1-Z.

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