

TEXTILE INDUSTRY

market opening up before them. The desire to retain and increase that market for textiles, in the manufacture of which England already led the world, was far more prominent among the causes leading up to the American Revolution than its historians have yet discovered.

Colonial Homespun.—The homespun garments of colonial days were plain, and wore like iron; their ingredients were indicated in the name commonly applied to the cloth—"linsey woolsey." It was a fabric of woolen weft, woven on a linen warp. Linen was much more commonly produced in the household than cotton fabrics, and wool was more in use than all other fibres combined. Cotton was a scarce commodity in colonial America until long after the Revolution. It possessed a value equal to that of wool, and sometimes very much higher. What little of it was used prior to the 19th century was mostly imported from Barbados. When Samuel Slater started the first American cotton-mill at Pawtucket, in 1793, he insisted upon using cotton from the Indies, because of the poor quality of the cotton then raised at home. No one dreamed, when the "Shipping and Commercial List and New York Price Current" first made its appearance, that America was destined to become the cotton-producing country of the world; nor did Slater's little mill of 250 spindles, which had then been in operation five years, give signs that it was the germ of an American industry which would consume annually within 100 years more cotton than all the world was then growing. The history of the textile industries during the colonial period is nowhere suggestive of the development which confronts and amazes the student at the opening of the 20th century, who finds them, with their subsidiary industries, employing more capital and creating a greater value of annual product than any other group, except iron and steel.

Expedients of the Colonists.—Our forefathers realized how important it was that the colonists should learn to clothe themselves. They resorted to all sorts of expedients, some of which smack strongly of state socialisms, to overcome the difficulties in the way. They offered bounties to increase the number of sheep and promote the growth of flax. In Massachusetts laws were passed making it compulsory that each family should spin a given quantity of yarn every year, under penalties of heavy fines. Gradually the household textile industries assumed an importance which alarmed the mother country, and the lords of trade attempted by various restrictive orders to prevent and harass a development which threatened to destroy the colonial market for the chief products of British industry. Parliament passed an act in 1774—which was shortly after the Arkwright inventions had inaugurated the modern factory system—forbidding the exportation, under heavy penalties, of any of the machines used in the cotton, silk, woolen, or linen manufacture. This statute, which remained in force, with certain modifications, until 1845, was evidence of a puerile hope that the English people could keep the fruits of inventive genius bottled up in their little island, while England permitted her sons to carry their brains across the water.

First Woolen Factory.—Slater brought his spinning machinery in his head; in the same way Arthur Scholfield, three years later, brought

Textile Industry, American. In 1800 there were no textile mills, as the term is now understood, in the United States. Whatever the American people did in the way of manufacturing their own clothing was mostly done in the household; the spinning wheel and the handloom were utensils as familiar in the old-fashioned kitchens as the pots and kettles of the housewife. The homespun garments worn by our forefathers were fashioned out of wool grown on the home farm, carded by hand-cards, washed in tubs, spun and woven by hand, fulled and finished at home, cut up and sewed—all by the joint labor of husband, wife, sons and daughters. The finer clothes worn in those days were all imported; and as the colonies grew and multiplied, and their consumption of English textiles increased, the manufacturers of the mother country foresaw a wondrous new

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the first wool-carding machine, which he built and put into operation at Byfield, Mass., in 1794, thus fixing the date of the beginning of the factory manufacture of wool by machinery operated by power in the United States. American machinists and inventors did the rest. It is not to be denied, however, that the English statute did retard, embarrass, and make trebly difficult the early development of our textile factories. A century ago the American textile industries were easily 100 years behind those of Great Britain.

Steps of Evolution.—It would be interesting to follow the evolution of the household industry, by slow and gradual steps, into the highly organized factory system of America to-day. First came the neighborhood fulling-mill utilizing the friendly services of the adjacent stream, and relieving the housewife of the labor of fulling and finishing the cloths and blankets accumulated by the busy shuttle during the long winter evenings. Then the carding-machine was added to the fulling-mill; the farmers for miles about brought their wool to be converted into rolls ready for the spinning-wheel. After Slater had successfully applied the Arkwright invention to the spinning of cotton at Pawtucket, here and there throughout New England little mills gradually appeared which spun both cotton and woolen yarns by water-power. Handlooms were still used in all these mills until 1813, when the invention of a power-loom by Francis C. Lowell led to the building of the Waltham cotton-factory by the Boston Manufacturing Company, and the American textile mill first took on the characteristics which have since increasingly distinguished it. Power spinning and weaving machines were rapidly applied to the manufacture of woolens, and it began to be seen that the household manufacture of textiles was disappearing before the greater economy and efficiency of the factory system. The transition was not rapid, and the ups and downs of our first textile mills were numerous and discouraging.

War of 1812.—The outbreak of the War of 1812, and the non-intercourse acts and embargo which preceded it, were the most potent factors in completing the transition. The total suspension of importations threw our people suddenly upon their own resources for their entire supply of clothing. Cotton and woolen mills were quickly built. High prices and the promise of quick fortunes drew many men with little or no knowledge of manufacturing into the business. All went well enough until the war ended; then followed collapse and ruin. The work of laying the solid foundations of textile manufacturing had all to be done over again. Imported cottons and woolens again invaded the market with a rush, and the domestic manufacturers found it impossible to compete with them either in quality or in price. Labor was unskilled and hard to get; knowledge and experience were sadly wanting; machinery was clumsy and defective; the country was poverty-stricken, and trade and the national finances thoroughly demoralized.

First Protective Tariff.—Then first began the great battle in Congress, which has waged more or less intermittently ever since, for the protection of the domestic manufactures by means of tariff laws. The Tariff Act of 1816

—the first of the series in which the principle of protection was recognized in the rates fixed as a distinct purpose of the law, conjointly with the raising of revenue—was much more favorable to the cotton than to the wool manufacture, because it applied the minimum principle to cotton cloths, which was in effect a specific duty of 6¼ cents a yard, while the simple ad valorem rate of 25 per cent was applied generally to woolen goods. From the date of that law the cotton manufacture began a healthy development, and it naturally grew much faster than the wool manufacture. The later tariffs were in like degree, as a rule, more favorable to cottons than to woolens; partly owing to this fact and partly to other causes, such as the much more delicate, complicated, and expensive operations incident to the latter, the cotton manufacture has at all times except during the Civil War shown a greater prosperity and on the whole a more rapid development than its sister industry. But in both industries for many years it was an up-hill struggle against great odds. Few fortunes were made; many were lost; and the courage and tenacity of those early textile manufacturers deserve to be remembered.

From 1850.—In the last half of the 19th century there was an increase in the value of products of about six times, and not less than ten times if it were possible to measure this product by quantity instead of by value. Even the largest figures convey an inadequate idea of the relative importance of our textile mills in the industrial economy of the nation, for these mills supply the materials for a great group of subsidiary factory industries, such as the wholesale clothing manufacture, the shirt manufacture, etc. When we aggregate these, and add to them the value of the products of the linen, jute, hemp, and bagging mills of the country, we find that the product of our textile mills is larger in value than that of any single line of related industries, iron and steel excepted. The total most nearly approaching it is that of the iron and steel industries. The products of the textile mills and the factory products growing out of them are equal in value to more than one ninth of all our manufactures.

Machinery and Diminished Cost.—The decrease in the cost of goods during the last half century has been one of the most striking phases of the development. This decrease is due in some measure, of course, to the decreased price of the raw materials from which they are made; but in even larger measure is it due to the remarkable advance in the methods of manufacture—to the new and more perfect machinery employed, in the invention of which American mechanical genius has contributed certainly as much as that of any other people, and perhaps more. All the fundamental inventions in spinning-machinery were of English origin; so was the combing-machine and the power-loom. The English have a remarkable record in this respect, and the French and the Germans have also done much in the invention of labor-saving textile machinery. But the American record may be shown to surpass them all. The wool-carding machinery of all countries owes its chief improvement over the machines of a century ago to the invention of John Goulding of Worcester, Mass., whose patent, dated 1826, dispensed with the splicing-billy and

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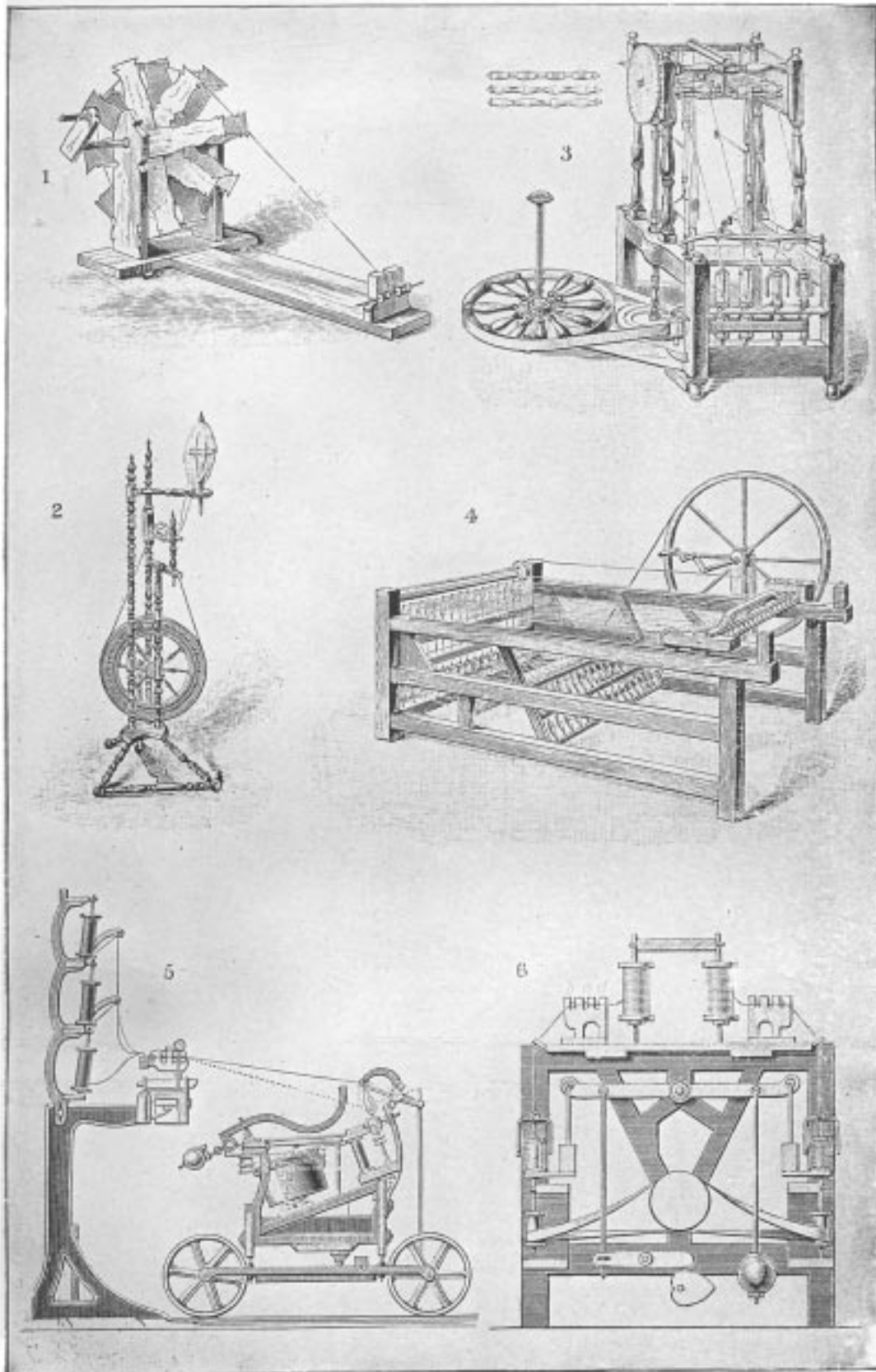
produced the endless roll or sliver. Michel Alcan, the distinguished French writer, describes it as "the most important advance in the wool manufacture of the 19th century." "It was not a step," he says, "but a flight." The modern cotton-spindle, making 10,000 revolutions a minute, is an evolution of our own mechanics. It has been shown that the saving effected by the new forms of spindle invented and adopted in the United States since 1870, when 5,000 revolutions a minute was the average speed, has been more than equal to the capacity of all the warp-spinning machinery in use in this country in that year, and to-day more than three times as much warp-yarn is spun in the United States as in 1870, a rate of increase without parallel since the earliest introduction of the cotton manufacture. The Lowell loom was the first successful application of power to the weaving of cotton, the Crompton loom to the weaving of fancy woolens, and the Bigelow loom to the weaving of carpets. "Not a yard of fancy woolens," wrote Samuel Lawrence, "had ever been woven by power-looms in any country until it was done by George Crompton at the Middlesex Mills in 1840." Every carpet ever woven was woven by hand until the power loom of Erastus Brigham Bigelow revolutionized the industry. Beyond these fundamental machines the American mechanisms for expediting processes, for automatic devices, for dispensing with intermediate help, have been so numerous that they have completely transformed the modus operandi of textile mills throughout the world. These mechanisms are more generally in use to-day in the best American textile mills than in those of any other country. So far as mechanical equipment is concerned, our best mills, whether cotton or woolen, are fairly equal to the best in any foreign country. It does not follow that textile manufacturing is done here, as a rule, with equal economy in cost.

Mills and Equipments.—In structural equipment the modern American mill is in some respects superior to the average foreign mill. It is not so massive a structure, nor so solidly built, brick being used here, while the English generally use stone; but in the lightness and airiness of its rooms, in economy of arrangement and in general completeness of equipment and care for the comfort and convenience of the operatives, it is usually superior. The lesson is fast being learned by our textile manufacturers that in these days of close competition and small profits successful manufacturing requires that buildings shall be of the latest design and the most approved management, and that machinery shall not only be modern in make, with every latest improvement, but must also be kept in perfect condition by constant renewal. Many parts of the machinery required for the equipment of our textile mills are still necessarily imported from England, because not made, or less perfectly made, in the United States. This is true of some varieties of cotton machinery, and of most of the preparatory machinery of the worsted manufacture. Our machine manufacturers have been advancing as rapidly in recent years as the textile mills themselves, and the time cannot now be far distant when every new mill built in America will be equipped throughout with American-made machinery.

Variety of Fabrics.—The American textile

mills now supply practically every variety of fabric made in the world, with the exception of lins and the very finest grades of other fabrics. Except crash goods, there are now no linen fabrics of any moment manufactured here. Great sums of money have from time to time been invested by daring manufacturers in constructing plants for the manufacture of linen fabrics. The result has invariably been disappointment and failure. If the obstacles were of a kind that ingenuity and perseverance could overcome, they would have been conquered. These obstacles are climatic in the first instance, flax being a fibre which requires more moisture than any other for its successful manipulation. Again, there is difficulty in obtaining a home supply of suitable raw material. Years of high protection have failed to persuade the American farmer into growing flax for fibre. The history of the linen manufacture in other countries seems to establish the fact that it is the one textile manufacture likely to remain segregated in a few localities like Holland and Ireland, where the fibre is grown on the spot, where the climate is peculiarly adapted, and where the help has acquired an expertness born of generations of experience. Moreover, linen is the one textile the consumption of which has not appreciably increased with the growing perfection of textile machinery. The quantity of linen fabrics made to-day is hardly larger than a century ago. The other fibres, less difficult to handle, more susceptible to cheap manipulation, continually encroach upon its uses. Turning from this single failure, we find extraordinary success in every other department of textile manufacturing.

Silk Industry.—Perhaps the most striking contrast to our experience with linen is that afforded by the silk manufacture. At first sight it would appear that this must be the particular textile industry which could not flourish in America. Since the whirlwind of speculative excitement over the culture of the silkworm which swept New England in the thirties, and wrecked the fortunes of many too credulous farmers, we have settled down to the conviction that America cannot grow raw silk in competition with China, Japan and Italy. Moreover, the silk manufacture, like the linen, has always been highly specialized and localized. The city of Lyons, in France, had well nigh monopolized the manufacture, so far as it had escaped from the hand processes of the Eastern nations. The skill and taste of generations have been concentrated upon the production at these centres, of fabrics which in beauty of design, in richness of coloring, in delicacy of workmanship, alone among the fabrics made by modern machinery, rival the splendors of mediæval textile art. England has for centuries struggled in vain to place her silk manufacture on equal terms with it. Nevertheless we have built up in America, in the last 45 years, a silk industry which among machine-using nations is second only to that of France, and is to-day supplying our people with the bulk of the silken fabrics consumed by them. We owe this great achievement largely to the energy and the genius of the Cheney family, father and sons, of South Manchester, Conn. The Cheneys began the manufacture of spun silk, nearly half a century ago. About the same time, John Ryle, sometimes called the father of the American silk industry, had become



DEVELOPMENT OF SPINNING MACHINERY.

1. Indian Spinning-Wheel. 2. Saxony Spinning-Wheel. 3. Arkwright's Water-Frame.
 4. Hargreaves' Spinning-Jenny. 5. Crompton's Mule. 6. Throstle.

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superintendent of a little silk-mill in Paterson, N. J., which he afterward purchased and gradually enlarged. At first sewing silks only were made, then ribbons were added, and in 1842 Mr. Ryle built a number of looms for silk piece-goods—the first to be successfully operated in America; and the industry in all its branches has since developed so rapidly there that Paterson, which calls itself the Lyons of America, now occupies to this industry the same relation that Fall River does to the cotton manufacture, and Philadelphia to the wool manufacture. During the Civil War the high duties stimulated the silk industry and diversified its product. The making of plain gros-grain dress silks was then started, and at the present time brocaded silks and satins are manufactured on a large scale; indeed there is no form of fabric into which silk enters which is not now produced in great variety. Especially noteworthy has been the recent development in the manufacture of silk plushes and all varieties of upholstery goods. The value of home-made silk goods was in 1880 just about equal to the foreign value of the goods imported. In 1890 the product had so grown that it was nearly double the value of the imports, and more than double the value of the product in 1880. During the next decade the rate of increase was accelerated. In Paterson is the largest silk-ribbon mill in the world. Another mill in that city, an outgrowth of the little mill operated by John Ryle, covers an acre and a half, and can nowhere be surpassed for size or completeness of equipment. See *SILK AND SILK INDUSTRY (Manufacture in the United States)*.

Cotton.—The cotton manufacture must, on the whole, be taken as the textile industry which best illustrates the possibilities of this group of manufactures in the United States. The number of cotton-spindles in operation is over 21,000,000, the last ten years having shown a large increase, particularly in new mills at the South. The business is there conducted under so many advantages—particularly the cheapness of fuel and labor—that careful students of economic conditions predict that the manufacture of the coarser grades of cotton goods is destined to gravitate more and more to the Southern States. New England, and especially Massachusetts (which is the largest cotton-manufacturing State, containing about one third of the spindles in operation), has perhaps hastened such a transfer by the enactment of stringent labor laws and by increased taxation. Her manufacturers have looked with some apprehension upon the rapid growth of the industry in the South, chiefly through the aid of New England capital. Still thus far there has been no diminution in her machinery capacity, but, on the contrary, a steady increase, which, while relatively smaller than the increase in the South, continues to be actually greater. This is due primarily to the increased production of the finer grades of goods in New England, and secondarily to the rapid development of the country, with its enlargement of a market in which the South can share largely without injuring New England. Nevertheless the economic forces at work are of such a character that eventually a marked change in the geographical status of the industry seems inevitable.

Comparison with England.—From the national point of view, the important fact is that

the growth of the American cotton manufacture for the last 25 years, both relatively and actually, has been greater than its growth in Great Britain. As compared with that of other countries the American cotton manufacture comes easily next to that of England, and shows a steady gain even upon the island which manufactures cotton for all the world except the United States. The American market for American cottons constantly expands with the growth of our own country, while our foreign markets show little gain. The English market as steadily contracts, as English and native capital builds new cotton-mills in India and Japan for the supply of the vast markets of the East. The casual student of first-class English and American cotton-mills, while he will observe certain differences, will not be able to detect any point of superiority in the former over the latter. He will find the English mills much more closely specialized, and he will find a larger proportion of them engaged upon the finer grades of goods. He will observe, also, that in the English mill mule-spinning is the predominating method, especially for fine numbers; while in the United States ring-spinning strongly predominates. This is due to the extraordinary advances in the mechanism of the ring-spinning frame, advances which are wholly of American origin, and which greatly cheapen the cost of production by increasing the product in proportion to the increased speed of the spindle. In mule-spinning, also, great advances have been made during the last 20 or 25 years. Whichever method is employed, the development of the industry has reached that stage where success depends upon the saving of a fraction of a cent in the price of a pound of cotton, and the economy of another small fraction of a cent in converting that cotton into yarn and cloth. To realize these fractions, which mean profit or loss, machinery must be kept in the highest state of efficiency.

Improved Spinning.—The improvements in spinning have been so rapid since 1870 that most of our large corporations have been compelled to replace their spinning-frames two or three times in that interval. A similar statement can be made regarding no other branch of textile manufacture; and it is probably true that if the American woolen mills had been forced, as the cotton mills have been, to abandon machinery as soon as it became in any degree obsolete, their ability to face foreign competition would be more nearly in keeping with that shown by our cotton manufacturers.

Large Corporations.—The conditions here narrated have thrown the cotton manufacture more and more into the hands of large corporations, which now almost universally conduct it. The wool manufacture, on the other hand, while it numbers some of the greatest corporations in the land, is still largely in the hands of individuals and partnerships, and the bulk of the mills are comparatively small in capacity. The more recent tendency in the wool manufacture, for obvious reasons, is strongly in the direction of the corporate form of management.

Fine Cottons.—The quantity of fine cotton goods made in American mills continues to be very small in comparison with the whole production, and the bulk of our consumption of this class of cottons is still imported. So there is ample room remaining for further development

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of the American cotton manufacture. Into this field we are entering with characteristic Yankee energy. Within comparatively few years mills have been successfully established in New England which spin yarns as fine as Nos. 150 or 200; and there are mills at New Bedford, Taunton, and elsewhere which make, in wonderful variety, fabrics as delicate in texture and as artistic in design and coloring as any which reach this country from the machine-using nations of Europe.

Wool.—The range of products made in American wool factories is as wide as the multi-form uses to which this most valuable of all the fibres is put. They divide themselves naturally into four great groups, leaving the hosiery and knit goods out of the classification: woolen-mills, worsted-mills, carpet-mills and felting-mills. There are the various sub-classifications of spinning, weaving, dyeing, and finishing mills, although, as a rule, all these separate processes of the manufacture of wool continue to be carried on jointly in this country, as the related parts of the one operation of manufacturing. In this statement is embodied the chief point of difference existing to-day between the woolen-mills of America, in fact, between all our textile mills and those of England and the Continent. The reasons for it lie on the surface of things. The fact remains that American textile mills can never expect—the great body of them, at least,—to compete successfully with foreign mills on terms which are fairly equal apart from the difference in wages, until they have passed through the same evolution and approximated to the same methods which prevail abroad.

Specialization.—In the wool manufacture, as in the cotton and silk manufacture, we have many establishments which, in completeness of structure, in perfection of machinery, in all the details of mechanical equipment, and in sagacity of management, are nowhere in the world surpassed. Indeed, it is only in this country that we find, on a very large scale, textile mills in which are performed all the separate processes for the manufacture of great varieties of goods. Elsewhere they have learned that the greatest economy and the best practical results are secured by specializing the processes. Thus in Bradford, England, are enormous establishments which do nothing but comb wool into tops, either on commission or for sale. Other great mills do nothing but spin tops into yarn, and generally they confine their operations to a limited variety of yarns. Still others, buying their yarn, devote themselves exclusively to weaving. And, finally, a fourth class of establishments take the woven goods and dye and finish them for the merchants, who are the men who find the ultimate market for all the specialists who have been thus employed upon the goods. In this specialization of the different branches of the work exists the characteristic distinction between the American and the foreign textile mills of to-day. Investigation appears to show that the English method is far superior to the American, and that ultimately we must gravitate into the former, if we are to cut any figure in competition for the world's market. The manufacturer who devotes his whole energies to one particular thing, and studies to do that one thing as cheaply and as well as it can be done, can do it better and more cheaply than the man-

ufacturer who is doing half a dozen different things at the same time. This is not a theoretical deduction, but an axiom founded upon prolonged experiment and experience. Bradford manufacturers who have tried both methods say there is always a gain in economy when the weaver buys his yarns, instead of spinning them himself. Obviously the English method requires a smaller investment in plant, secures a simpler and more perfect autonomy in operation, involves less waste, and avoids the accumulation of superfluous raw material. The American woolen mill was evolved from conditions which rendered specialization originally impossible. It was situated in some isolated spot, drawn thither by a superior water-power, with no railroad to facilitate quick transportation, and was necessarily a complete mechanical entity, however crude its machinery. In a word, it must perform under one roof all the processes necessary to convert the greasy wool into the finished cloth ready for the market. Thus there sprang up all over the country little woolen mills, each one independent in itself; as the country grew some of these little mills became large mills; other large mills grew up beside them; gradually grew centres in which the wool manufacture predominated; but conditions were long in appearing which tended to that specialization of processes which has marked the English method from the very introduction of automatic machinery. It followed that the American mill owner, even of a small mill, was compelled to make a variety of goods, in order to use up advantageously all the grades of material which grew out of the sorting of his wool. Naturally he could not produce a variety of products as cheaply and as successfully as he could have manufactured one particular line upon which his whole attention was centred. These habits of manufacturing, forced upon us originally by the logic of the situation, are tenacious. We have been slowly breaking away from them, but it will be years yet before it is possible fully to outgrow them. In Philadelphia, which is the largest centre of wool manufacture, the progress of the evolution is very perceptible. There they have top-makers, yarn-makers, dyers, and finishers, who do nothing else. And the result is apparent in the large number of small manufacturers in that city. The small amount of capital required to equip a little weave-shed permits enterprising superintendents and operatives to start in business for themselves. The comparative cheapness of production under such conditions enables them to hold their own against the big establishments with unlimited capital at their back.

American Woolen Specialties.—The bulk of the small wool manufacturing establishments in the United States are woolen mills proper, as distinguished from worsted mills. It is noticeable that the number and product of these woolen mills decrease from census to census as the worsted manufacture gets more firmly established here, and the more popular worsted fabric comes into wider use. But there are certain lines of woolen goods in the manufacture of which American mills have earned a worldwide pre-eminence. Prominent among them are flannels and blankets of every grade and variety. The American wools are peculiarly suited for these goods, and for many years past our Amer-

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ican mills have practically supplied the home market. Other mills make a specialty of woolen dress goods for ladies' wear with equal success. The bulk of our woolen mills are, however, engaged upon the manufacture of cloths for the million—cassimeres, beavers, satinets, cheviots, etc., the cheaper grades which enter into the consumption of the wholesale clothing houses, goods in which, under the weight duties of recent tariffs, our American manufacturers have controlled the home market, and of which their production has been enormous. Many of these goods are woven upon a cotton warp, and into some of them enters more or less of the re-vamped wool known as "shoddy." We have much to learn, however, in the handling of this class of materials, before we shall equal the expertness of foreign manufacturers. It is to the success of our manufacturers in producing a handsome, durable cloth at cheap prices, that our people chiefly owe their reputation of being the best-dressed people on the globe.

Worsted.—The worsted manufacture was late in getting lodgment in the United States, and has been slow in assuming proportions commensurate with its importance abroad. Early in the forties there were two or three large worsted mills erected in New England for the production of worsted fabrics or stuff goods for women's wear; but the manufacturer made little headway until after the close of the Civil War, and it was not until about 1870 that we began making men's wear worsted goods. Since then the development of the manufacture along both lines has been phenomenal. In the manufacture of fine men's wear goods, both in woolens and worsteds, a few of our mills have been equally successful; their products sell side by side with the best makes of foreign goods, notwithstanding the lingering prejudice among fashionable Americans that only foreign-made cloths are fit to wear. Another obstacle is the high cost of labor, which counts more strongly in fine wool goods than in the cheaper grades, or in cottons and silks, because of the much greater care and skill and labor that must be bestowed upon their finishing.

Felted Wool.—The manufacture of felted wool is comparatively small here and elsewhere and the importations are comparatively insignificant in volume. Felted wool was the earliest form into which this fibre was manufactured, the primitive races discovering, before they learned to spin and weave, that peculiar characteristic of wool which causes it to mat together, by the application of heat, moisture, and pressure, into a firm and smooth texture, susceptible of a great variety of uses. Modern machinery has utilized this peculiarity for many purposes which, while limited, are economically important. Table-cloths and floor-coverings, and hats for men's and women's wear, are the most ordinary; but they are also used for shoe linings, sheathing materials, polishing purposes, etc. The hat manufacture, formerly confined to wool for its raw material, has found that fur is better suited for this use; and the processes of manufacture are so different from those employed in spinning and weaving mills that the hat-manufacturing establishments, in which the United States has always been pre-eminent, are not ordinarily classed among the textile mills.

Carpets.—Perhaps our most notable achieve-

ment in the textile line has been in the carpet manufacture. Beyond question the United States is the greatest carpet-manufacturing nation in the world; if we leave out of account the hand-loom productions of the Eastern countries we excel all others not only in the quantity of our production, but in the variety of our carpets, in the excellence of design and workmanship, and in general adaptability to popular needs. The production includes two-ply and three-ply ingrains, Brussels, moquettes, tapestries, velvets, Smyrnas, and the higher grades of Axminsters and Aubussons. The annual consumption of this product by the American people is close upon 100,000,000 square yards. The popular reason assigned for this unique development is the general prosperity of our people, the high wages earned permitting families of all grades of life to indulge in the luxury of floor-coverings to an extent elsewhere unknown. Stimulated by the lucrative market thus offered, American manufacturers have made larger and more important contributions to the mechanism of the carpet manufacture than those of all other nations combined. The real development of the machine industry dates from the successful application of power to the weaving of ingrain carpets by the late Erastus B. Bigelow in 1844. Subsequently he invented Jacquard looms for weaving Brussels and Wiltons, which produced carpets pronounced by the jury at the London Exposition of 1851 to be "better and more perfectly woven than any hand-loom carpets that have ever come under the notice of the jury." A still later invention of Bigelow's was for weaving tapestry carpets. His inventions are at the base of all the power-loom carpet-weaving now done in Europe. Subsequent inventors have greatly improved them, and have added new inventions, such as those for weaving Axminsters, and Smyrna rugs. By their skill and enterprise the American carpet manufacturers have not only retained the control of their own market, except in the matter of the Eastern hand-made rugs, but they have in some instances successfully forced their products upon the European markets.

Hosiery and Knit Goods.—In one other branch of the textile industry progress in the United States has outstripped the world—the hosiery and knit-goods manufacture. More machine-made knitted goods are turned out annually here than in all other countries combined. The explanation is somewhat the same as in the case of carpets. Our people wear more underwear than other people; they are not only obliged to wear more for climatic reasons, but they can afford to wear more; and the general desire for personal comfort in wearing apparel results in an enormous distribution of the products of these mills. The beginnings of the industry are well within the lifetime of many manufacturers still living. Until 1832 the knitting of socks and stockings remained mostly a household industry—the only form of textile work which the machine had not wrested from the housewife. In that year Egbert Egberts successfully applied the principle of knitting by power, at Cohoes, N. Y. His machine was simply the square stocking-frame of William Lee adapted to power. From that adaptation dates a revolution in underwear, which had previously consisted wholly of flannel, fashioned and

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sewed at home, according to the individual needs. The revolution gathered momentum gradually, as invention after invention—almost all of American origin—perfected the knitting-machine; but once the new industry was fairly and firmly established, it spread with amazing rapidity. The great variety of goods made facilitates the tendency, peculiar to this industry, toward the building of comparatively small mills, requiring but moderate capital; and it happens in consequence that these mills spring up all over the country, and can now be found in nearly every State. Many of them employ only cotton as a raw material; others use chiefly wool; and still others manufacture what are known as merino knit goods or mixed goods—cotton mixed with wool in proportions varying from 50 to 75 and 90 per cent of cotton, according to the particular market sought. The tendency to the larger use of cotton in these goods is perceptible, not necessarily because of greater cheapness or a desire to adulterate, but because the liability of wool to shrink, and its excessive warmth, lead many to prefer undergarments in which cotton is an equal or predominating material. In 1858 E. E. Kilbourne invented a machine for automatically knitting full-fashioned underwear: and this machine has gradually wrought a second revolution in the industry. The amount of hand labor now done is reduced to the minimum—to the mere sewing on of buttons, so to speak.

Statistics.—The value of all textile products in the United States for 1850 was \$128,769,971 and this had increased to \$931,494,566 in 1900. The census report for 1900 shows the following:

valued at \$2,880,341 in 1890. These products were chiefly thread and twine, the latter for use in the shoe manufacture, although the manufacture of linen toweling shows the greatest expansion of any branch of linen manufacture during the decade from 1890 to 1900.

Future Needs.—The American textile manufacturers have left little to be desired in the direction of cheapening textile products without deteriorating quality. They have built and equipped mills which rank with any in the world. They have planted on this continent machinery enough to supply all the textile wants of our people, except in a comparatively few lines of very fine fabrics. They have managed these mills with rare business sagacity, and as a rule with notable financial success. They have taken one specialty after another which had never been attempted here, and transported its manufacture from across the water, literally inventing anew the necessary machinery, as in the case of braids and plush goods, when they could not obtain it otherwise. They have taken these several textile industries, which have been localized and specialized in Europe for generations, and in half a century have made them one of the chief corner-stones of our national wealth. They have contributed far more than their share to the mechanical development which makes the labor of a single operative stand for that of a regiment of hand-workers in the 18th century. They have fallen short only in contributing to the artistic side of textile industry. They have been imitators instead of originators, although there are among them many striking and gratifying exceptions to this rule. But American-made

Industries	Year	Number of establishments	Capital	Wage-earners		Cost of materials used	Value of products
				Average number	Total wages		
Cotton manufacture:							
Cotton goods	1900	973	\$460,842,772	297,929	\$85,126,310	\$173,441,390	\$332,806,156
Cotton small wares	1900	82	6,397,385	4,932	1,503,442	3,110,137	6,394,164
Wool manufacture ...	1900	1,414	310,179,749	159,108	57,933,817	181,159,127	296,990,484
Silk manufacture ...	1900	483	81,082,201	65,416	20,982,194	62,406,665	107,256,258
Hosiery and knit goods	1900	921	81,860,604	83,387	24,358,627	51,071,859	95,482,566
Flax, hemp, and jute.	1900	141	41,991,762	20,903	6,331,741	32,197,885	47,601,607
Dyeing and finishing textiles	1900	298	60,643,104	29,776	12,726,316	17,958,137	44,963,331
Combined textiles ...	1900	4,312	\$1,042,997,577	661,451	\$209,022,447	\$521,345,200	\$931,494,566

The number of cotton spindles in operation in 1900 was 19,008,352, as compared with 14,188,103 in 1890, and 10,653,435 in 1880. This striking increase is due in a large measure to the wonderful growth of the industry in the South since 1880, as before that date the cotton manufacturing industry existed there only on a most restricted scale. In fact, the growth of the industry in the South may be regarded as the one great fact in its history during the past decade. It has been fairly continuous and remarkably steady.

In a single branch of textile manufacturing—flax—our efforts have not been as successful as could be desired. The industry has expanded greatly, however, since 1890, as is evidenced by the fact that for the last census there were reported 18 establishments, with a capital of \$5,688,999 and products valued at \$4,368,159, as compared with 5 establishments showing a capital of \$2,734,130, and products

goods do not bear, generally speaking, any distinctive artistic characteristics which distinguish them as American-made; and, generally speaking, they are inferior in this respect to the best products of foreign looms. All this is natural—natural to a new country in which utility everywhere predominates over the ornamental. The next great forward step in our textile manufactures must be in the artistic rather than the mechanical direction, for there we recognize its weakest point. In the designing of patterns, in the use and application of dyes, in all that goes to impart to fabrics the artistic element, to lift the manufacture into an art, our textile mills are still far from the top of the ladder. This deficiency is not in any sense peculiar to the textile industries. It is an educational deficiency in which our people as a whole may be said to share. It is incidental to a crude country of limited facilities in art directions. What needs to be done is to supply those facilities; and the

time is at hand when our manufacturers should themselves take the initiative in that work. There should exist in this country as in Europe technical schools for the training of textile workers — weaving schools, designing schools, dyeing schools — in which those who manufacture goods are trained by the best instructors; and the result will be not only better workmanship, but more beautiful and more artistic tissues.

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