KNIT'TING (from the verb *knit*, AS. *cnyttan*, Ger. *knütten*). The art of building up a solid fabric from yarn by looping with knitting needles or by machinery modeled on the knitting-needle process. *Crocheting* resembles knitting, except that it is executed with the crochet hook. *Netting* is a more ancient art. (See NETS.) In *braiding*, the threads or braids, all longitudinal, are twisted diagonally over and under one another. *Weaving* is more formal than any of these processes, having two complete sets of threads that intersect at right angles to each other, except in lace and leno weaves. The qualities that distinguish *knit goods* are their superior elasticity, that makes them fit irregular shapes snugly, and their porousness, that makes them particularly suitable for use as underwear.

Hand Knitting. In knitting by hand the yarn is formed on a knitting needle in a row of loops, through each of which a second row of loops is successively passed by means of a second needle, which then adds a third row to the second row, and so on till the fabric is completed. The needles used are of steel, wood, bone, or rubber. Those of steel are usually slender and pointed at each end, while those of other materials are thicker, and pointed at one end with a round knob at the other. Technical terms of hand knitting are: To *cast on* is to make the first row of loops. To *cast off* is to knit two stitches and then pass the first over the second, securing the last stitch by drawing the yarn through it. A *purl*, *seam*, or *rib* is formed by bringing the yarn in front of the needle. To *slip a stitch* is to take it off the needle without either knitting or purling.

Hand Machine. The first knitting machine was invented in 1589 by the Rev. William Lee (q.v.), of Nottinghamshire, and by the middle of the eighteenth century had become so widely used as to be an important feeder of British commerce. It was a very simple affair, modeled

after the process whose work it attempted to reproduce; but its complicated modern successor depends for its efficiency on the same essential principle.

In Lee's stocking frame, instead of one needle to hold the stationary loop while those of the moving row are being inserted, there are as many needles as there are to be loops in the breadth of the web, and these are so made as to form and give off the loops alternately. Each needle terminates in a hook or small indentation. The other end of the needle is fixed into a casting formed to fit into a frame and be securely fastened, side by side with the rest of the needles. Between the needles are placed thin plates, called *sinkers*, in two rows; in one row the sinkers move freely on an axis, in the other they are all fixed to a bar and move with it. The object of the loose ones, or *jack sinkers*, is to make loops by pressing the thread down beneath the needles. The other row on the bar, or *lead sinkers*, is brought down so as to press simultaneously on the hooks of the needles and press their points down into the little depression so that they will pass through the loops without catching one way, and take them up when opened and drawn in the contrary direction. The great ingenuity of Lee's invention lies in this arrangement for closing the hook in the needle so that one loop can be drawn through another.

Like many inventors, Lee failed to profit largely by his genius, although, in the expectation of realizing a fortune, he resigned his activities as clergyman, giving up his living at Calverton that paid him £40 a year. His own freehold enabled him to meet the cost of experiments. In the portrait, now lost but copied in the arms of the London Framework Knitters Company, he appears in the gown and cap of a master of arts, pointing to a hose on his stocking frame; while on the other side a female is showing her empty and therefore useless knitting pins. The original painting was inscribed: "In the year 1589, the ingenious William Lee, M.A. of St. John's College, Cambridge, devised the profitable art for stockings (but being despised went to France), yet of iron to himself, but to us and to others of good; in memory of which this is painted."

Accompanied by his brother James, who had helped him much in the construction of the machine, and who was always his most skillful operator, Lee took the frame to London in the hope of winning the patronage of the sovereign. Queen Elizabeth's kinsman Hunsdon thought it was a miraculous invention and brought her to see it at Lee's lodgings in Bunhill Row. She expressed her approval of its ingenious construction, but was disappointed because the product was a coarse worsted stocking instead of fine silk hose. Lord Hunsdon begged her to give Lee a patent for its use, but she refused. In order to please the Queen Lee constructed a frame, with 20 needles to the inch instead of the previous eight, on which in 1598 was made a pair of silk stockings, which the Queen was gracious enough to accept and praise, but that was all. After her death, not receiving any encouragement from King James or the English court, Lee accepted the invitation of Sully, Ambassador of Henry IV, to transfer himself and his invention to France. He settled in Rouen, with James Lee and eight other operators and eight frames, and "wrought there with great applause." But his expectations of a special patent were ended by the assassination of the French King, and he died, a disappointed man, in 1610.

On his death his brother James and six workmen with seven of the machines returned to London, the other two workmen with the machine continuing to work at Rouen. Before long the London Framework Knitters Company was formed for regulating wages and production and in 1657 was incorporated by Cromwell. By 1695 there were 1500 machines active in and near London. The first stockings of cotton yarn were made in 1730.

No important improvement was made in Lee's machine until 1758, when Jedediah Strutt added a second series of needles, by the use of which it became possible to produce ribbed fabrics. In 1816 Marc L. Brunel invented a circular machine that produced a tubular web instead of the previous flat one.

Power Machine. Power was first applied to the knitting machine by Bailey in 1831. The machinery used in power knitting is noteworthy. While the spindle is necessary in the preparation of yarn for either weaving or knitting, there is no comparison between the simplicity of looms—even such looms as work on the most elaborate fabrics—and the complexity of knitting machines. In the weaving industry only one loom is required to produce a particular fabric. In statements of the capacity of knitting mills it would be clearer to specify, not the number of machines, but the number of *sets of machines*, since as many as five are often required in the production of a single garment. Furthermore, the work of every three knitting machines has to be supplemented by that of a sewing machine. Then, too, improvements in knitting machinery are frequent and important, and machines but little worn often have to be replaced by newer inventions. Unfortunately the patents on knitting machinery are in a confused state, and some manufacturers operate their new machines secretly, without taking out patents, in order to avoid infringement by rivals.

The latch needle was first patented in France in 1806 by Jandeau, and a modification of it in the United States in 1863 by Hibbert. In the latch-needle machine a hinged latch folds back on the needle so that the hook may take up the thread, and then closes down over the hook so that it may pass the hoop through the preceding loop. The movement of the latch is regulated by the movement of the yarn as it passes through.

On account of their greater speed and capacity circular machines have largely superseded all others. In these machines "a circular series of vertical parallel needles slide in grooves in a cylinder and are raised and lowered successively by an external rotating cylinder, that has on the inner side cams acting on the needles." In 1909 the total number of knitting machines in the United States was 115,019, over 96 per cent of which were power machines and 81 per cent circular and circular-hosiery machines. Of the total, 15 per cent were spring-beard-needle machines, and 85 per cent latch-needle machines. The remarkable increase in popularity of all kinds of knitted fabrics—"hosiery and knit goods," as they are termed popularly and in the census reports—including underwear, sweaters and cardigan jackets, gloves and mittens, hoods, scarfs and nubias, shawls, leggings and gaiters, fancy knit goods, wristers, jerseys and tights,

stockings, and astrakhan fabrics, is shown not only by the number of machines invented to produce them (over 3000), but also by the enormous increase in production. In 1849 there were only 49 establishments in the United States, with an annual product of $1,028,102. During the next decade the annual product increased 700 per cent, and in succeeding decades 61, 128, 42, 43, 46, and 108 per cent respectively. In 1909 the number of factories producing knit goods was 1374, with an annual product valued at $200,143,527. In 1869 the number of knitting machines reported was 5625; 69,047 in 1889; 88,374 in 1904; 115,019 in 1909. In the early days of the industry in the United States wool was used almost exclusively. But in 1909 the value of the cotton yarn purchased was $48,165,749; of woolen yarn, $3,834,094; of worsted, $10,116,325; of merino (cotton mixed), $2,667,051; of silk, $3,606,599; of linen, jute and other, $180,818. This serves as a fair basis of comparison, as most of the mills buy their yarn instead of spinning it for themselves, the amount of cotton purchased in the form of yarn being three times that purchased unspun. Among the States New York leads, with a production of knit goods in 1909 of $67,130,296; Pennsylvania being second, with $49,657,506; Massachusetts, third, with $14,736,025.

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