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## Silk yarns for knitting and their use in Britain

From the medieval period until the mid-twentieth century, silk has been the primary luxury fibre for knitting, whether used on its own or as the core for precious metal yarns. Yet very little has been recorded about the preparation of silk yarns specifically for knitting use, either in historical documents or through later research.

We know that yarns suitable for knitting differ in character from those for weaving. Broadly speaking, knitting yarns should be full and soft so as to cover the interstices of the knitted loop. To this end, they are not hard twisted or tightly doubled; neither are they heavily sized or polished.<sup>1</sup> Equally important, knitting yarns must possess a certain degree of pliability as well as strength. To achieve this, the yarn may be treated with a lubricant, such as an oil or wax, that can be removed by scouring after knitting.

Yarns that do not possess these properties can be knitted, but generally speaking softness and pliability are sought after. It would be possible to knit with weft yarns prepared for weaving, but difficulties would probably be encountered. Conversely, yarns suitable for knitting will not always suit weaving. In the 1920s, the newly fashionable rayon yarns knitted up easily, but still gave difficulties when used as weft threads.<sup>2</sup>

### *Historic documentation*

Historical references to knitters often neglect to mention the fibre being knit. For example, the *Returns of Aliens Dwelling in the City and Suburbs of London*, list for Bysshoppsgate in 1571, "Peter Grue and Jacamyn his wyfe, Burgonions, and he a knitter of caules and sleves, came into Englande [7] monthes nowe past, and in this warde. Katheryne Mysore, widowe, with ...her children, being of the same nacion, and all knitters of caules and sleves, cam into England three years nowe past, and have sojourned these two monthes within the saide Peter Grues house."<sup>3</sup>

Alternatively, the fibre is mentioned but little else, as in Philip Stubbes' delightful tirade against knitted stockings in his *Anatomie of Abuses*. "Then have they nether-stocks to these gaie hosen, not of cloth... for that is thought too base, but of yarnsey, worsted, crewell, silke, thred, and such like, or else at the least of the finest yearne that can be got, and so curiously knitte with open seam down the legge, with quirks and clocks about the ankles, and sometimes (haply) interlaced with golde or silver threds, as is wonderfull to behold. And to such impudent insolence and shameful outrage it is now grown that every one (almost), though otherwise very poore, having scarce forty shyllinges of wages by the yeare, will not sticke to have two or three payre of these silke nether-stockes, or else of the finest yearne that may bee got, though the price of them be a ryall, or twenty shillings, or more, as commonly it is; for how can they be lesse, when as the very knitting of them is worth a noble or a ryall, and some much more? The time hath bene when one might have clothed all his

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<sup>1</sup> John Chamberlain and James Henry Quilter. *Knitted Fabrics* (Pitman's Common Commodities and Industries), Sir Isaac Pitman & Sons Ltd, London: 1924, p.15.

<sup>2</sup> Ibid., p.18.

<sup>3</sup> R.E.G. Kirk and E.F. Kirk. *Returns of aliens dwelling in the city and suburbs of London from the reign of Henry VIII to that of James I, Part I 1523-1591*. Aberdeen, 1900, p.429.

body well for less then a payre of these nether-stockes will cost.”<sup>4</sup> It is pleasing to know at any rate that the knitting itself was valued as well as the yarn.

While documentary sources such as these may help to trace the historical development of knitting, they are unlikely to supply technological details about the construction and finishing of knitting yarns. Even when such information was available to manufacturers, it would not have been written down, but closely guarded as a trade secret. Since reliable early sources of technical information about silk preparation are scarce, the next best choice is to examine records from more recent centuries that describe hand-controlled manufactures. Looking at this information in conjunction with what we know about earlier knitters, interpolations can be made about techniques that would apply to the earlier periods.

### *Sources and varieties of raw material*

Silk imported to Britain in the late medieval and early modern periods originated in Italy, Persia, India and China. Each geographical area produced silk of different characters, and in a range of grades. These became available and reached the market in different seasons.

Richard Blome's *Britannica*, published in 1673, describes the trade of the Levant or Turkey Company of Merchants, the first company to trade with Venice, and "the Dominions of the Grand Signior, and including the trade of East-India which as then was undiscovered by Sea." Among the textile imports, he specifies "the raw silks of Persia, Damascus, Tripoli, &c., also, chamblets, grosgrains, grosgrain yarn, mohairs of Angor, wools, cottons, [and] cotton-yarn of Smyrna and Cyprus."<sup>5</sup>

Postlethwayt's *Universal Dictionary of Trade and Commerce*, published between 1751 and 1755, and drawn from Savary des Brûlons' contemporary text as well as earlier sources, explained the types of silk then imported and their sources. "Thrown silk comes chiefly from Leghorn, Genoa, Naples and Messina. Raw silk from Turkey, that is Persia by way of Turkey, Bengal in India and China." Quoting from Joshua Gee's *British Merchant* written about 1713, the types of imported silk are named. Supplies of *ardass* or coarse Persia silk had been abated because of high duties, and in their place came grosgrain yarns, *bellandine* and *sherbassee*. These were all coarse silks, *ardass* used in Europe for embroidery, and *bellandine* for

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<sup>4</sup> Philip Stubbes. *The Anatomie of Abuses*. Reprinted from the 3rd edition of 1585, London: 1836, p.46.

<sup>5</sup> Richard Blome. *Britannia, or a geographical description of the kingdoms of England, Scotland and Ireland...* 1673. "The Levant or Turkey Company of Merchants, which by their discovery, made the first trade into the Signory of Venice, and then into the Dominions of the Grand Signior, and including the trade of the East-Indies, which as then was undiscovered unto us by Sea, their goods being brought upon Camels and Ass-negroes to Aleppo, and other parts of Turkey; but since the discovery of the Indies by Sea, the East-India Company doth somewhat eclipse the trade of this Noble Fellowship for those commodities.

The commodities at present by them usually exported are cloths both drest and dyed, at the least 30,000 pieces yearly, kersies...indico, logwood, couchaneil, callicoes...and several Indian commodities. And for these they import the raw silks of Persia, Damascus, Tripoli, &c. also, chamblets, grosgrains, grosgrain yarn, mohairs of Angor, wools, cottons, cotton-yarn of Smyrna and Cyprus, galls of Mosol and Toccat...The druggs of Egypt and Arabia, also Turkey carpets...and several other rich commodities." p.158.

sewing silk.<sup>6</sup> Further light is thrown on the terminology: "Raw silk [...] is not all the immediate produce of the Grand Seignior's dominions, but of the Persians also [...] The silk, thus brought raw in bales from Persia, is sherbass [...] When this sherbass silk is landed here, and comes into the hands of our manufacturers, it is called [...] legee. Besides this, the Levant or Turkey merchants import another sort of raw silk, which they call white silk, and our workmen bellandine. [...] It] is produced in several distant parts of the Turkish dominions [...] Cyprus, Antioch, Tripoli [...] and several islands [Andros, Naxos, Zea, Thermia, Syra, Santorini, &c].<sup>7</sup> Postlethwayt specifically mentions silk stockings as an end use of the imported silk, produced for both the home trade and export, but the particular origin of the silk employed for knitting is not given.

Both raw and thrown silks were imported from the Piedmont region of Italy. However, the removal of high import duties on eastern imports meant that Bengal raw silk and China silk had in the latter part of the eighteenth century become cheaper than Piedmontese silk.<sup>8</sup>

*How different were these various silks, and were they differently suited to knitting?*

There are many species of silk producing moths, historically and commercially the most important being *Bombyx mori*, the mulberry silkworm. This is cultivated in Europe, the Middle East and Asia. In temperate climates, the silk moth breeds only once a year, hatching of its eggs co-inciding with the springtime growth of the mulberry tree. However, in tropical climates, silkworms breed more than once a year.<sup>9</sup> "The strongest and finest silk is obtained from the cocoons of the species of silk moths found in temperate climates. The cold weather that prevents the larvae from hatching too soon, also hardens them [...] Even in the species which breed several times a year, the first crop of cocoons, after the cold weather is invariably the strongest and produces the best silk."<sup>10</sup> The author of the article on silk in Rees' *Cyclopaedia*<sup>11</sup> speaks of the advantage of Levant silks over Sicilian silks, pointing out that Levant silks can be bought at all times. "The principal place of commerce, especially for the silks of Persia, is Smyrna. The silks are brought hither in caravans, from the month of January to September. The caravans in January are laden with the finest silks; those of February and March being indifferent ones; the rest, the coarsest."<sup>12</sup>

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<sup>6</sup> Florence M. Montgomery. *Textiles in America 1650-1870*. W.W. Norton & Co, New York, 1984, pp. 150 and 161.

<sup>7</sup> Malachy Postlethwayt (ed.) *The universal dictionary of trade and commerce, translated from the French of the celebrated Monsieur Savary...* London, [1751-55], Vol. 1, p.73.

<sup>8</sup> R. March stated that before Bengal silk was improved by the East-India Company, it was of poor quality and when worn had the appearance of cotton. He recommends China silk for its natural quality and beauty when the price is reasonable. *A treatise on silk, wool, worsted, cotton and thread...* London, printed for the author, 1779, pp.10-11.

<sup>9</sup> R. March, a London hosier, states than in Bengal, there are six crops of silk a year. *A treatise on silk, wool, worsted, cotton and thread...* London, printed for the author, 1779, p.8

<sup>10</sup> R. March, 1779, *ibid*.

<sup>11</sup> Possibly John Duncan. See: N.B. Harte. "On Rees's *Cyclopaedia* as a source for the history of the textile industries in the early nineteenth century", *Textile History*, Vol. 5, 1974, pp.124-25.

<sup>12</sup> "Silk" in Abraham Rees. *The cyclopaedia, or universal directory of arts, sciences and literature* Vol.32., London: 1802-19 [not paginated].

As a rule, when speaking of cultivated silks, the silk fibre of temperate climates is distinguished for strength and evenness, while that of tropical ones is soft and bright, but lacking in strength.<sup>13</sup> This suggests that the softer second crop silks (softness being a desirable property for knitting silk) less suited to warp production, may be those which found a ready market in knitting yarns.

Before they can be processed, the silk cocoons are sorted into various grades. The best, classed as 'reale', are uniform in shape, with a hard wall, and golden yellow to white in colour. Next comes 'realino', more weakly constructed. Then 'morti' and 'cartella' where the larva has died or been diseased. These can all be reeled but the silk of the lower grades is not so strong and elastic. Below these grades are 'doppi' where two worms have spun together, and 'bucata' where the moth has emerged. These cannot be reeled and are usually converted into spun or 'floss' silk.

The wild varieties of silk moth that feed largely on oak leaves produce cocoons that are brown in colour, and resistant to bleaching. Their hard gum makes them difficult to reel, and unreceptive to dyeing. Wild silks were generally carded and spun, and used in their natural colour in India and Africa, but are unlikely to have found a significant export market in Europe before the nineteenth century. It was not until Thomas Wardle's experiments of the 1870s that reeling and dyeing *tussah* silks was achieved.<sup>14</sup> One exception among wild silks is the *yama-mai* silkworm of Japan that produces a pale green reelable cocoon yielding a silk like mulberry silk. However, export of the eggs was for a long time forbidden, and this is unlikely to have been an item of European commerce until the twentieth century.

### *Reeling*

After the raising of the silk cocoon, the next production stage for cultivated silk is reeling. Unless the silkworm or chrysalis be killed, no time must be lost in reeling off the silk. When thus reeled from the live cocoon, the silk is found to be more lustrous than is the case when the creature is previously killed. This accounts for the superior lustre of the raw silk exported from China in the early modern period. Chinese silk farmers reeled their silk from the live cocoons to sell directly to merchants who travelled around the country districts. The same system used to prevail in France and Italy, but in these countries and also in modern China and Japan, it has been superseded by the system of factory-reeling (where the cocoons are fumed at the farm to kill the chrysalis). Factory reeling allows the manufacturer to meet the requirement of evenness in size so vitally necessary for power loom weaving.<sup>15</sup> Thus live reeling can account for some differences in character between ancient and modern silks.

The silk fibre as produced by the silkworm is cemented together with sericin or silk gum, and before the fibre can be reeled, it is necessary to soften the gum. "Very dry. old cocoons are first steeped and then treated with hot water, but with ordinary cocoons immersion in water at 80° to 90°C for thirty seconds is sufficient to soften the outer layer of the cocoon so that the end of the thread can be found. The softening of

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<sup>13</sup> Luther Hooper. *Silk: Its Production and Manufacture*, Pitman's Common Commodities and Industries Series, Sir Isaac Pitman & Sons, London: n.d., p27

<sup>14</sup> See, for instance: Anne Jacques. *The Wardle story: Sir Thomas and Lady Wardle, a Victorian enterprise*. Churnet Valley Books, Leek: 1996, pp21-32.

<sup>15</sup> A.Jacques, *ibid.*, p33.

the inner layers should take place gradually during the reeling, as a premature disintegration would cause much waste and would give an uneven thread."<sup>16</sup> The woman reeling the silk cocoons kept by her a bowl of cold water with which to regulate the temperature of the water in the basin containing the cocoons. If the water was too hot, the silk would come off entangled, and if it was too cold, the filament would break frequently.

The author of the article on silk in Rees' *Cyclopaedia* explains, "The water must be just in a proper degree of heat; for when it is too hot, the thread is dead, and has no body."<sup>17</sup> What is meant by this is that the silk must be reeled under a certain tension to maintain in the yarn a lively quality. In modern times, the Japanese developed a special system of slow reeling. Steaming and soaking the cocoons saturated them with water, and the water within the cocoon allowed the proper tension to be maintained at a slower reeling speed. This gave a silk of superlative evenness for hosiery use, but with the individual ends less firmly consolidated together making it less suitable for weaving.<sup>18</sup> It is quite possible that earlier silk throwsters also had traditions of cocoon soaking peculiar to their region in order to produce yarn with particular characteristics, more or less suited to knitting.

A cocoon thread is approximately 3 deniers which is far too fine to knit or weave by itself, so 5 or 6 cocoon filaments are usually reeled together giving a resultant denier of 13 to 15. In the modern hosiery trade this is known as 'hosiery one thread'.<sup>19</sup> Thicker yarns with more filaments can be reeled but it is difficult to control more than 20 cocoons at once. The object of the reeler is to produce a smooth yarn of even thickness throughout. Because the silk filament gradually gets thinner toward the end, and the filament lengths of various cocoons differ widely, the reeler must continually splice new ends into the group of filaments being reeled. These are deftly laid in place and instantly attached by the silk gum. Keeping the same number or thickness of ends in action to produce an even thread is a highly skilled job.<sup>20</sup> Skilled workers must have been in short supply by the twentieth century, as Luther Hooper complains, "This is where domestic reeling is said to fail. In a factory the reelers are strictly overlooked, and there is trouble if a winder be caught reeling less than the proper number of cocoons. Factory-reeled silk is therefore found to be much more reliable as to size than that which is still, as China silk for the most part is, reeled by the silk farmer and his family."<sup>21</sup>

The humidity and temperature at which the reeling is carried out have a great effect on the quality of the resultant raw silk. "The warm, sunny climate of Italy is particularly suited to silk reeling, and in northern countries can be approximated to only with difficulty by artificial means."<sup>22</sup> This is because the wet silk filaments must be consolidated together and the gum of the silk dried to the extent that the threads

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<sup>16</sup> Joseph Schober. *Silk and the silk industry*. (trans. by R. Cuthill). Constable & Co., London: 1930, pp.55-56.

<sup>17</sup> Rees' *Cyclopaedia*, op.cit.

<sup>18</sup> P.W. Gaddum. *Silk: how and where it is produced*. H.T. Gaddum & Co, Manchester: 1948, pp.44-45.

<sup>19</sup> Eley, A.W. *Stockings: silk, cotton, rayon, nylon*. Leicester: 1946, p.16.

<sup>20</sup> Neglect of this splicing in would produce thick and thin areas in the knitted product, a fault noted by R. March, op.cit., p.8.

<sup>21</sup> L. Hooper, op.cit., p.36.

<sup>22</sup> J. Schober, op.cit., p.58.

will not stick together on the reel. The importance of this detail was so important that the Piedmontese were required by law to have a distance of 38 French inches between the guide holes above the cocoon basin and the centre of the reel.<sup>23</sup> It is easy to see how factors such as this begat a significant variation in the end products of the various silk production centres.

### *Throwing*

Silk was imported to Britain either in a raw reeled state or already thrown. Italy was the main source for thrown silk, and the Italians maintained a close monopoly on their best grade of silk for throwing. Rees' author states, "Owing to the difficulties that were experienced in procuring raw Italian silk of the proper size for organzine (the exportation of which was prohibited by the Italians), the quantities worked into organzine [in Britain] for many years bore scarcely any proportion to the imports from Italy."<sup>24</sup>

The throwing of raw silk consists of winding and cleansing of the reeled yarn, followed by a first twisting. This can be followed by doubling and a second twisting operation, according to the type of yarn being made. So called 'dumb singles', merely wound and cleaned, are used in gauze weaving; and thrown singles are used for ribbon weaving.<sup>25</sup> However most silk yarns are made up of several singles twisted together. Six major types are used in modern hosiery; these constructional types have been developed to satisfy the demand for hosiery with a matte appearance. They were diagrammed and explained by Eley in his pamphlet on stockings published in 1946. However, he states that "Until a few years ago, most silk stockings were knitted from tram silk, producing hose which not only had a fuzzy appearance, but also snagged easily."<sup>26</sup>

'Tram silk' consisted of two or more [single] threads doubled together and given a slight twist, usually about 5 turns to the inch.<sup>27</sup> Fairly simple constructions such as this could have been employed by earlier silk knitters. The yarn employed by the 'stocking weaver' [frame knitter] is mentioned several times in the *Cyclopaedia* account of 1816. It is said to be of the same quality [as weft] but composed of a greater number of [single] threads, according to the thickness desired. Yarns for 'weaving' stockings receive a reverse twist similar to the first stage of making warp yarns. So, as far as can be gathered from written accounts, knitting yarn seems to have been distinguished by a greater thickness and slighter twist than weaving yarns.

Modern thrown yarns for use in knitting are softened and made more pliable by the use of soaking oils compounded from sulphonated vegetable oils.<sup>28</sup> If this technique has historic precedent, it may be that the Spaniards and Italians had an advantage in silk knitting from the ample availability of olive oil products. Oiling could well have been an aid in consolidating the loosely twisted yarns while knitting was in progress.

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<sup>23</sup> Rees' *Cyclopaedia*, op.cit.

<sup>24</sup> Rees' *Cyclopaedia*, op.cit.

<sup>25</sup> *Knight's Pictorial Gallery of Arts*, Vol. 1, Useful Arts., c1851, p.103.

<sup>26</sup> A.W. Eley, op. cit., p.17.

<sup>27</sup> *Ibid.*, p.17.

<sup>28</sup> F.O. Howitt. *Bibliography of the technical literature on silk*. Hutchinson's Scientific and Technical Publications. London: 1947, p.175.

## *Spun silk*

Small amounts of silk wastes were imported into England during the seventeenth and eighteenth centuries and were used for padding and stuffing clothing and household textiles, as well as for the production of floret silk by a process of hand carding and spinning. In 1671, Edmond Blood was granted a patent for the production of a silk shag from silk waste. The silk waste was carded and spun in a similar manner to that of cotton spinning.<sup>29</sup>

The London hosier, R. March, writing in 1779, states that spun silk is “carded and spun from the waste of fine silk, it is doubled two and some three threads for hose; there may be from twenty to thirty threads of fine silk in one thread of spun silk, which accounts for its durability.”<sup>30</sup> The author of the article on silk published in 1816 in Rees' *Cyclopaedia*, states that "The waste raw silk, or refuse in reeling, &c. is collected, carded and spun, and called floss silk; this is doubled and thrown, and often made into a cheap sort of silk-stockings, which are very strong and durable."<sup>31</sup> However, not all spun silks were the cheap products of waste material. The author reports that, "The spun silks of the Levant, whence most of our's come, are exceedingly fine and beautiful [...] in the Levant, there is no such thing as reeling or winding on the fire, but the silks are sent in bales, or packs, as they are drawn from off the balls; so that they are only distinguished by their quality of fine, middling and coarse."<sup>32</sup> These fine quality spun silks from Persia may have had desirable knitting qualities. It is interesting that Japan, to supply wartime shortages, made a yarn that may have been similar by mechanised production. A simple drum revolving in a trough of hot water unreeling the cocoons. No skill was required; when the drum was full, the staple was cut off in lengths to suit either cotton, woollen or silk spinning machinery.<sup>33</sup>

## *Conclusion*

During the period of hand controlled manufacture of silk yarns, there were a large number of factors that made the silk products of different centres and regions distinctive in quality, and more or less fit for particular purposes. Silkworm breeding and climatic conditions affected the raw material and when it was available on the market. The degree of selection of cocoons and restrictions on exportation of the best qualities contributed another factor. Methods of reeling: live vs. dead, tepid vs. hot, and fast vs. slow, each gave yarns of individual character. Techniques of throwing and spinning, including the use of lubricating oils, further distinguished the end products. Silk knitters seeking yarns suited to their use had a large range of possible choices. Presumably they would have avoided the expensive thrown warp yarns which would have been too hard for knitting. Reasonably priced alternatives could

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<sup>29</sup> Ibid., p.112.

<sup>30</sup> R. March, op.cit. p.38. The problem with spun silk, according to March was that it “wears rougher than any other manufacture.” But he claims that all silk is subject to this to some extent. “There is a flossy skin on all silk, which rises on the surface of hose, &c. on the first wearing, and which in a little time rolls off...” p.37.

<sup>31</sup> Rees' *Cyclopaedia*, op.cit.

<sup>32</sup> Rees' *Cyclopaedia*, op.cit.

<sup>33</sup> P.W. Gaddum, op.cit., p.45.



have been found among qualities used for weft yarns. As mentioned in Rees' *Cyclopaedia*, these may have been specifically thrown with more ends to give a thicker yarn. Another possibility lay among the fine spun silks available from Persia through the Levant trade, which do not have a ready modern equivalent. It remains to more closely examine the surviving historic knitted objects themselves to relate yarn structure and fibre choice to end use.

*A pilot survey at the Gallery of Costume, Manchester*

In October 2010, four pairs of eighteenth century stockings in the collection at the Gallery of Costume, Platt Hall, were examined. Three of these are closely related in design and construction, matching types dated in the 1750s and 1760s in other museum collections.<sup>34</sup> The gauge of stitches per unit length does not vary greatly between the three Platt Hall examples, but the number of rows per unit length distinguishes a 'fine' from an 'ordinary' grade.

<b>1947.1917</b>	<b>1958.21/3</b>	<b>1976.125</b>
Coral with green clocks	Blue with ivory clocks	Green with pink clocks
10 stitches per cm	9 stitches per cm	9½ stitches per cm
14 rows per cm	10½ rows per cm	13 rows per cm

All three pairs employ two colours of silk yarn, one forming the ground, and another the decoration of the clocks. The ornament follows a formulaic arrangement with a trailing border outlining the gusset, and above this a stylised sprig surmounted by a rosette and topped by a coronet. The ornamental colour largely, but not completely, obscures the ground colour. Under magnification, the two yarns can be seen to run together where the ornament shows on the surface, but the position of the yarns in knitting is controlled so that the ground colour is carried beneath the contrasting ornamental shade. This is a technique characteristic of frame knitting. Another indicator of frame knitting is the presence of small tufts of yarn seen on the inside of the stocking at the centre front. These appear to mark the rows at which the knitter begins decreasing, or starts the ankle gusset.

These three frame-knitted stockings also hold in common the fact that the individual stockings of each pair are differently coloured at the upper hem. Presumably, this allowed the wearer to separately identify the members of the pair, and to alternate wear on left and right feet.

One of the stockings of finer gauge appears to be more accomplished in workmanship, with more accurate coverage of the ground yarn in the decorated areas. On the reverse, it can be seen that the knitter allowed extra yarn of the ornamental colour to pass loosely at the back in these areas, thus reducing the tension on the pattern knitting to allow better cover. This presumably added to the cost of the work. This same pair has the heels invisibly reinforced by hand darning on the inside with 2 S-ply silk thread. The darning is quite accomplished, but it is uncertain whether this would have been domestic or professional work.

<sup>34</sup> Gallery of Costume, Manchester: 1947.1917, 1958.21/3, and 1976.125. For other collections, see for example, Colonial Williamsburg 1991-446: frame-knitted linen with pink silk clocks, worn in England around 1750. L. Baumgarten. *What Clothes Reveal*, Colonial Williamsburg Foundation, 2002, p.93.

A fourth pair of stockings is knitted in green silk patterned at the clocks and back seam with metallic thread.<sup>35</sup> The yarns are carried separately on the reverse as with hand knitting, and it would probably have been difficult to manage the disparate tensions of the silk and metallic yarns on the knitting frame. However, it has not been established conclusively that the stockings have been hand knitted. The gauge of knitting is coarser than the other stockings described above, about 7½ stitches per cm. by 8½ rows per cm. The clock and back seam decoration appear to derive from earlier embroidered styles, but here worked solely in knitted loops. The embroidered stockings worn for the Swedish coronation of 1617<sup>36</sup> may represent a lavish exemplar of the type that this pair imitates in a somewhat reduced manner.

Apart from the metallic thread, the silk yarns used in all the stockings possess only a slight twist. This is too little to establish clearly whether the twist is in an S or Z direction. In both last-mentioned pairs of stockings, it is possible to distinguish under magnification that the yarns have been built up to the desired thickness by the combination of three or more strands of silk. This recalls the engraving of the framework knitter seen in Diderot's *Encyclopédie*. A woman at the right of the picture appears to be combining yarns from three skein holders into one, and she is carrying the yarns horizontally in a way that imparts no additional twist.<sup>37</sup> This seems to be the characteristic form of reeled silk yarn for knitting, that is multiple stranded with little appreciable twist. Such a yarn would have required treatment with oil or wax to make it manageable for knitting.

In the European tradition of silk manufacture, the soaking oil used for silk throwing was made from the third pressing of olive oil after the production of edible oil, but was still a product of high quality. This oil was emulsified with soap for use. The olive oil had to be low in free acid, unsaponifiable matter, and any colouring matter; and the soap, pure and free from alkali. This enabled the oil to be rinsed out afterward with no lingering stain or odour.<sup>38</sup>

E.A. Posselt, writing in the early twentieth century stressed above all the importance of evenness in yarns prepared for knitting.<sup>39</sup> This must have become very important with the development of frame-work knitting. The stranding together of yarns would have evened out disparities in thickness to some extent, but it would still have been necessary to begin with good quality singles to achieve a good end product. The eighteenth century stockings in the collection at Platt Hall all show a great uniformity of yarn observable in the even gauge of stitches and rows. These are luxury goods that have survived by virtue of relatively light wear, and a larger survey would be required to establish how typical these are of their type.

P.A. Sykas, 5 November 2010

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<sup>35</sup> Gallery of Costume, Manchester 1966.156.

<sup>36</sup> G.Ekstrand, "Some early silk stockings in Sweden" in: *Textile History*, vol. 13, no. 2, 1982, pp.165-182.

<sup>37</sup> Diderot & d'Alembert. *Receuil de planches sur les sciences... Art des Textiles*. Paris, Bibliothèque de l'Image, 2002, "Faiseur de bas au métier" Planche 1.

<sup>38</sup> E.A. Posselt. *Silk Throwing*. Philadelphia:Textile Publishing Company, 1920, pp.169-175.

<sup>39</sup> E.A. Posselt, *ibid*, p.151.