HISTORY OF WEAVING.

LONDON:
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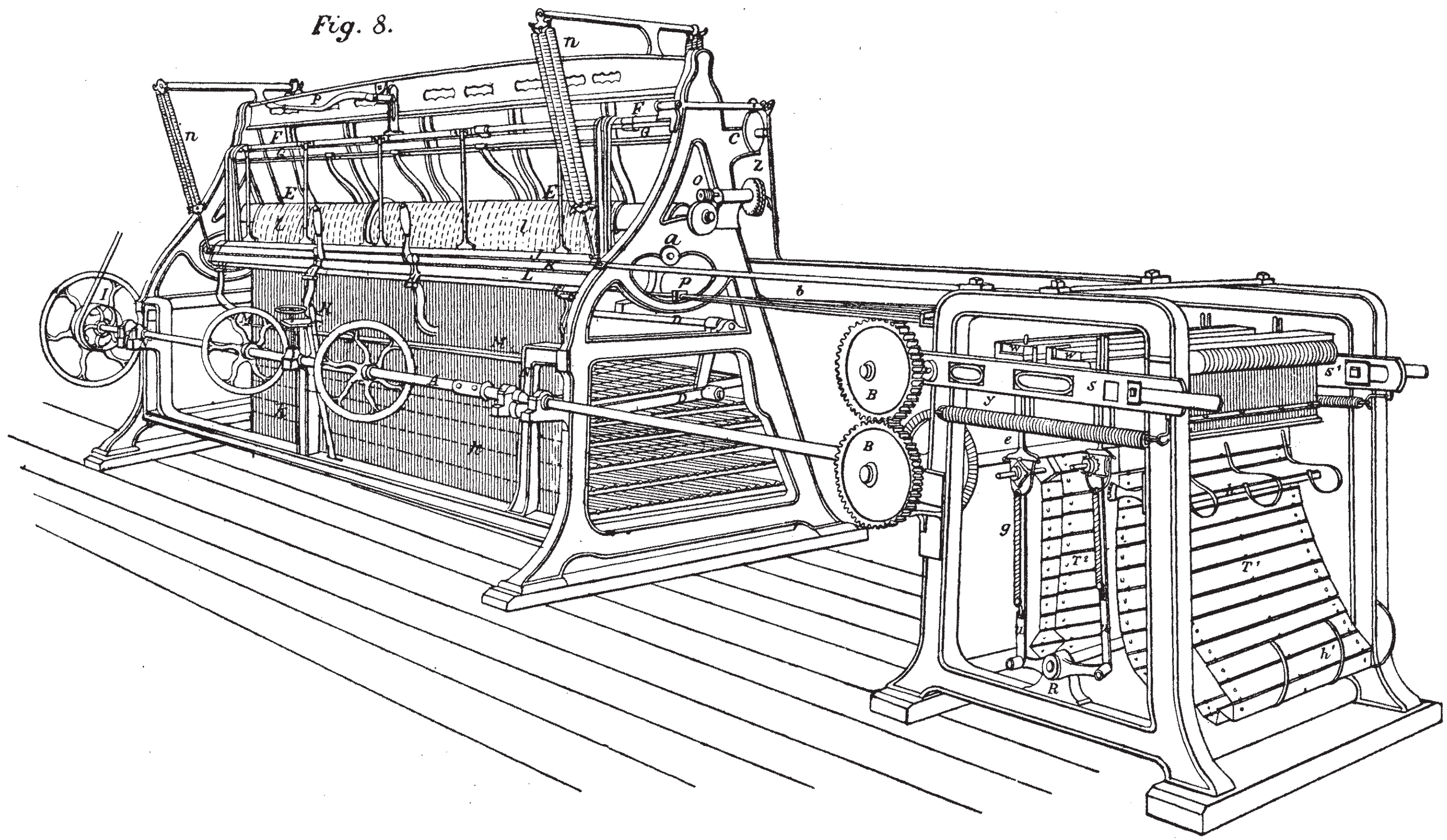
Fig. 8.



THE LEVERS LACE FRAME, WITH DOUBLE ACTION JACQUARD APPARATUS.

See Chapter XXXII., p. 333.

THE

HISTORY AND PRINCIPLES

OF

WEAVING

BY HAND AND BY POWER.

Reprinted, with considerable Additions, from "Engineering," with a Chapter on Lace-Making Machinery, reprinted from the "Journal of the Society of Arts."

BY ALFRED BARLOW.

"—— That honest, best, and most beneficiall Trade in the kingdome."—SPEED.

WITH SEVERAL HUNDRED ILLUSTRATIONS.

London:
SAMPSON LOW, MARSTON, SEARLE, & RIVINGTON.
CROWN BUILDINGS, 188, FLEET STREET.
1878.

PREFACE.

The Art of Weaving forms the most extensive and important part of the Textile Manufactures, whether considered on account of its commercial value or for its usefulness, variety, or beauty of its products. It also calls forth a greater number of mechanical appliances and ingenious contrivances than any other Art, and is on that account alone always a source of interest to the Engineer and the Mechanician, as well as to the Manufacturer and the Weaver.

Formerly the Art depended almost entirely upon the handicraft skill of the weaver, and his contrivances were limited in their combinations to produce designs of any considerable extent. They were, also, cumbersome and complicated, and entailed an amount of labour and patience that would much astonish the weaver of the present day. But, by the introduction of the Jacquard Machine and the Power Loom during the present century, the whole system of weaving, with some few exceptions, has been changed, and practically become a New Art.

During the same period the Lace Frame has been invented, and by the application of the Jacquard apparatus to it for the production of figured lace, it has created an entirely new and important branch of manufacture. The numerous inventions that have led to this result seem to have culminated in this admirable machine, which for ingenuity is unsurpassed in the whole range of mechanism.

Yet the Loom with its products, "wherein the wealth of our Nation is folded up," and upon which we are so dependent for personal comfort, health, and cleanliness, is far behind other important Arts and Manufactures in respect to treatises upon its varied processes. The few works that have appeared are intended for technical readers, and are either confined to certain branches of the Art or limited in extent, and do not treat upon the subject generally.

To supply this deficiency is the object of the present work, which is based upon and includes a series of Articles written for the Proprietors of "Engineering."

The part which is devoted to the Lace Manufacture includes, by permission, a description, written for the "Journal of the Society of Arts," of the Levers Lace Frame which was exhibited in the International Exhibition, Kensington, 1874, by the Nottingham Chamber of Commerce.

As many of the machines and processes are now for the first time illustrated and described in this work, a few defects may possibly occur, inseparable perhaps from so varied and complicated a subject, and which can scarcely be avoided. But if there be any, it is believed they will not materially affect the chief object intended—namely, to give in as clear a manner as possible the "HISTORY AND PRINCIPLES OF WEAVING."

A. B.

London, 1878.

CONTENTS.

Page 84, *line* 39. *For* "is eleven inches in length and" *read* "eleven inches in length and is."

Page 109, *line* 24. *For* "headle" *read* "treadle."

Page 170. *Add the following paragraph after line* 39 :—

The "shaft monture" is to dispense with the front harness altogether by forming loops in the leashes below the comber board, and inserting in them thin iron shafts, by means of which the ground could be worked without the aid of separate headles.

Page 172. *Add to line* 25 :—Preferably the 1st and 3rd and 2nd and 4th may be connected so that the hooks can draw or weave tabby independently of the shafts.

Page 281, *line* 34. *For* "*a* and *b*" *read* "*d* and *e*."

Page 321, *line* 7. *For* "card" *read* "cord."

Page 336, *line* 8. *For* "on" *read* "or."

THE

HISTORY AND PRINCIPLES

OF

WEAVING.

CHAPTER I.

CHRONOLOGICAL ACCOUNT OF WEAVING, ETC.

A chronological account, comprising a description of ancient processes and materials used in weaving—Its early history—Introduction into England—The Weavers' Company—The immigration of foreign weavers—With notices of the principal inventions and other matters connected with weaving, from the earliest period to the year of the Great Exhibition, 1851, compiled from various sources.

WEAVING is an art by which threads of any substances are crossed and interlaced so as to be arranged into a perfectly expanded form, and thus be adapted for covering other bodies.[1]

It would, perhaps, be impossible to assign the origin of any of the useful arts upon which the necessities and comforts of mankind depend to any particular nation or race. Any attempt to do so would at best prove unsatisfactory and fruitless.

The means adopted by uncivilized nations or tribes of the present age for the production of clothing is probably the same as that which was practised in prehistoric times, and it would be more reasonable to assume that such was the case than to surmise, in place of proof, the history of an art that may be almost coeval with the existence of man himself.

The earliest records of the art of weaving are to be found in the Old Testament, where frequent allusion is made to the loom and its products, "of curtains of fine twined linen, and blue and purple

[1] Johnson.

and scarlet, with cherubims of cunning work." In the Book of Genesis it is related that Pharaoh arrayed Joseph in "vestures of fine linen;" and as this refers to a period nearly 4000 years ago, it is believed to be the earliest historical allusion to the art.

That it was held in great esteem in ancient times cannot be doubted, and Job did not disdain to draw a comparison of his troubled life from the loom when he lamented that his "days are swifter than the weaver's shuttle, and are spent without hope."

The oldest remains of woven materials that have hitherto been discovered were found some years ago in the ancient Swiss lake dwellings, which are supposed to have belonged to the stone age. Abundant evidence of fishing-gear, consisting of cord, hooks, &c., were found, also the remains of a kind of cloth, which appeared to be of flax, not woven but plaited, have been detected. Some specimens of these are in the Museum at Kensington.

Within the last few centuries nearly the whole surface of that portion of the earth which was unknown to the ancients has been explored, and many races of men have been found that were not known even in somewhat recent times. Nearly all of them, when first visited, were found to have more or less skill in weaving and spinning, mat-making, plaiting, netting, and the making of paper cloth. Since they have become acquainted with civilized nations they have been able to obtain better and more suitable articles than they could possibly make for themselves, and, in consequence, they neglect their own mode of manufacture. But there are numerous specimens of their workmanship in various ethnographical museums, as well as the descriptions given by travellers of the methods adopted for the production of such articles that they were accustomed to make for their own use. As there was a great resemblance in the method of working amongst the various tribes, a few instances will be sufficient to show the state of the art, which was probably the same as it was amongst all races of men in the most remote ages.

On the discovery of Otaheite, about a century ago, the natives were found to be extensively employed in making matting, not only for the purpose of sitting upon by day and sleeping upon at night, but the finer sort they used as garments in rainy weather. Grass rushes, and the bark of trees, and the plant called wharran were the materials used for the purpose; some of their mats were better and finer than any produced in Europe. They had no hemp, but the want of it was supplied by the bark of a tree, of which they made ropes and lines, and thus provided themselves with fishing-nets.

But the principal and most curious manufacture carried on by them and other similar races was a kind of paper cloth. For this purpose the bark of trees was used to make the pulp. Three descriptions of trees furnished the necessary bark, viz., the Chinese paper mulberry-tree, the bread-fruit-tree, and a tree resembling the wild fig-tree of the West Indies.

The best cloth was made from the mulberry-tree, being finer, softer, and whiter, and better adapted for taking colours. The bread-fruit-tree produces a much coarser texture, and the last-mentioned tree is very coarse, and in colour similar to brown paper but this last description is the only one of the three that will withstand water. The shrub was cultivated round the houses of the natives, and when it was two years old it was cut down, when a new one sprang from its roots, the tree being one of the most prolific in nature. The bark was always taken from young trees, which were carefully drawn into long stems without any branches except at the top. When the bark was stripped off it was laid for some time in a stream to moisten, and women-servants separated the inner part from the outside, for which purpose they went naked into the water. The fine inner coat, thus prepared, was spread out on plantain leaves. A square piece of hard wood, fluted on its four sides by furrows of different sizes, was then used in beating the bark on a smooth board; and, by sprinkling some water upon it during the operation, it at last formed a very equal and fine cloth of the nature of paper, but much more pliable and less apt to be torn, and which could be made of considerable length and breadth—sometimes two or three yards wide and fifty yards long.[2] In the process they used a kind of glutinous water to make the bark cohere together. The whole operation was performed by women, who afterwards dyed the cloth of different colours and patterns.

In Loango the weavers make their cloth of a grass about two feet high, which grows untilled in the desert plains, and needs no preparation to be put to work. The length of the grass is the length of the web, and they make the cloth rather narrower than long. This cloth is woven like ours; but they make it on their knees *without shuttle or loom*, having the patience to pass the woof through the web with their fingers in the same way that our basket-makers

[2] Hawkesworth.

weave their hurdles. Although they work with such quickness that one can scarcely follow their fingers with our eyes, they get but slowly forward, and the best workmen do not make more than the length of an ell of cloth in the space of eight days.[3]

In Mandingo the women prepare the cotton for spinning by laying it in small quantities at a time upon a smooth stone or piece of wood, and roll the seeds out with a thick iron spindle, and they spin it with a distaff. The thread is not fine, but is well twisted, and makes a very durable cloth. The weaving is performed by the men. The loom is made exactly upon the same principle as that of Europe, but so small and narrow that the web is seldom more than four inches broad. The shuttle is of the common construction, but, as the thread is coarse, the chamber is somewhat larger than the European.[4]

In the ethnological department of the British Museum may be seen numerous specimens of paper cloth, skin dresses, mats, nets, plaited work of various kinds, cords, and ropes made by uncivilized nations. On the other hand, there are various specimens of cloth made by the ancient Peruvians and Egyptians. These articles, as might be expected from more cultivated races, exhibit a far more advanced state of the art. The cloth is not only composed of better spun threads, but the weaving is of a higher quality, showing at once that the ancient Peruvians and Egyptians were far more advanced in these arts than any of the uncivilized nations of the present age.

The Peruvians were greatly skilled in weaving, and they made shawls, robes, carpets, coverlets, hangings for the imperial palaces and the temples. Their cloth was finished on both sides alike, and the finest was made of the wood of the huanacos and vicūnas.

When Pizarro exhibited the llama to Charles V., as the only animal of burden known on the new continent, and the fine fabrics of woollen cloth which were made from its shaggy sides, the latter gave it a much higher value in the eyes of the monarch than what it possessed as an animal for domestic labour.[5]

The Peruvians, at the appointed season, sheared their flocks, and the wool was deposited in the public magazines. It was then dealt out to each family in such quantities as sufficed for its wants, and

[3] Proyart's "History of Loango."
[4] Mungo Park's "Account of the Mandingos."
[5] Prescott's "History of Peru."

the spinning and weaving was performed by the female part of the households, who were well instructed in the business.

In very recent times, if not actually at the present, it was not uncommon for women in the north of England and in the Highlands to weave at home many coarse articles of domestic use, and the cloth so woven was more durable, it is said, than that which is made by the regular manufacture.

A writer who accompanied the troops in the late Ashantee war states that "the Fantee weaver uses a loom of a very primitive construction, but is marvellously quick at his work, throwing the shuttle from side to side with his hands, and working the treadles with his toes. The thread used is extremely fine, and of the brightest colours, but the pattern is not of a very elaborate nature. The material is very dear, being a dollar a yard, at least double the price of English fabric, but is very strong and lasts much longer. Few natives, however, can afford the price, so that our merchants have it all their own way."

The animal substances used by the ancients for the purpose of weaving[6] were as follows:—sheep's wool, goat's hair, beaver's wool, camel's hair, fibres of the pinna, silk. The vegetable substances were—flax, hemp, mallows, broom, and cotton. Mineral substances —gold, silver, and asbestos. The last-named material being used for lamp-wicks, and for the process of cremation. In recent times, various other materials have been used, such as jute, alpaca wool, and glass. Amongst the ancient Egyptians the clothing of the poorer classes was composed of woollen cloth, and cotton and wool were used by the rich. The priests wore linen in accordance with their idea of its purity, for they were not allowed to enter the temples with any articles of dress composed of wool, and on no account were they allowed to wear it for under-clothing, that material being considered unclean, owing to its property of breeding or being liable to become infested with worms and insects. Allusion to this fact is made by Isaiah: "They shall wax old as a garment; the moth shall eat them up." "For the moth shall eat them up like a garment, and the worm shall eat them like wool."[7] In Anglo-Saxon times advantage was taken of this defect, for a cloth woven of goat's hair was used by the clergy for bedding, and occasionally for shirts by devotees, which were noted to be difficult to keep free from vermin.

Although woollen and cotton cloth have always been most com-

6 Yates's "Textrinum Antiquorum." 7 Isaiah l. 9; li. 8.

monly used for clothing and other purposes, it is fortunate that the Egyptians did not enshroud their dead with either of these materials, and particularly so with wool. Thus linen was chosen for shrouds, and was always used for that purpose solely on account of its cleanliness and lasting qualities.[8] The dead were encased in its folds, so that the bodies should be preserved uninjured, for a space of 3000 years, when it was believed that the former spirit would return after its transition state and habitation of the bodies of various animals, to resume its former existence.

It was from this circumstance that what actual knowledge is now possessed of Egyptian weaving is owing, and the preservation of numerous specimens found in the mummy pits of Egypt. Some of the fragments of linen cloths so found were sent to England by Mr. Salt, and were deposited in the British Museum. They were very fine, and the finest appeared to be woven with threads of about 100 hanks to the pound, with 140 threads to the inch in the warp and 64 in the woof. The Egyptian priests were partial to cotton dresses, and they were supplied to them by the Government, which is distinctly mentioned on the Rosetta stone.

Notwithstanding the allusion to silk in the English version of the Old Testament, it was declared by Braunius, and his statement is not disputed, that there is no mention of it in the whole of the Sacred Book, and that it was unknown to the Hebrews in ancient times. The first ancient author who gives any evidence respecting it is Aristotle, and the great estimation in which it was held in Mahomet's time cannot be more evident than the fact of its being the only material used for human clothing which Mahomet introduced amongst the luxuries of Paradise.

Amongst the ancient Greeks and Romans weaving was not only carried on as a domestic employment, but also on a large scale similar to other extensive branches of trade. Descriptions of banners, and the robes of emperors and priests, are frequently to be found in ancient authors, but unfortunately there is a total absence of any description of the process adopted by the weaver for their production. An idea of them may be obtained from ancient sculptures and the figures portrayed on vases, but no remains of the clothing itself are to be found. In more recent times, from the tenth to the thirteenth centuries, numerous specimens of Syrian, Greek, Saracenic, Spanish, Sicilian, Oriental, and Italian weaving

[8] Sir G. Wilkinson's "Ancient Egyptians."

remain, examples of which are shown in the Kensington Museum. They display a high degree of skill on the part of the weaver, and the draw-loom was probably used in their production.

Therefore, as far as can be at present ascertained, the history of weaving from ancient to medieval times depends solely upon the few samples of cloth that have been preserved, and the representations of ancient looms that will be hereafter shown. It is evident, however, that the art progressed gradually and slowly. From the embroidered work of the ancients it proceeded step by step, until not only plain and figured velvets were produced, but "velvet upon velvet," viz. a velvet figure raised upon a velvet ground, and tissue work of great richness were achieved. Still nothing is known regarding the origin of these improvements, nor is the time of their introduction into England, at various periods, in any way clear. Some branches of the art seem to have been introduced, and after being carried on to a great extent, to have been disused, forgotten, and again introduced. This was the case with tapestry work. But when the importance of the art became evident to Englishmen, it gradually took firm hold, and progressed with varied degrees of success until within the present century, when so vast and important have the textile manufactures become, that the wealth and prosperity of the country are almost entirely dependent upon them.

There were three great events which led to this result by introducing numerous artisans skilled in their business, by whose means the manufacturing arts were established. The first event was the encouragement given by Edward III. to the Flemings to come and establish themselves under his protection. He had observed the great wealth that had accrued to neighbouring potentates by their fostering the textile manufactures, and he determined to take advantage of it himself for the benefit of his country. He therefore took every means to bring skilled workmen from abroad, and establish them here.

The second and third events arose from quite another cause, namely, the immigration of Flemish and French workmen to escape the persecution they were subjected to in their own countries.

In addition to these it may be remarked that the Crusaders, during the Twelfth Century, are reputed to have brought back with them a knowledge of many of the Eastern arts, and it is by no means improbable that damask weaving (named from Damascus) may have been one of them.

The woollen manufactures of Flanders are said to have commenced about the middle of the Tenth Century, during the years 958 and 960, and it is to that country that England is so much indebted for the early introduction of their improved method of manufactures.

It has been frequently asserted that the ancient Britons had no knowledge of the art, and that it was first introduced into Britain by the Romans in the reign of Claudius, when they established factories at Winchester and other places for the making of cloth for the use of their army, and sailcloth for their navy, then located here. They also made embroidery for the imperial use, and other textile manufactures. But there can be little doubt that the Britons did know how to weave, for pieces of coarse cloth resembling baize have been found in ancient British Barrows, and but recently a shroud was found in a Celtic Barrow in Yorkshire, which was plaited, and formed a loose, coarse fabric; and Boadicea is said to have worn under her cloak a motley tunic, checkered over with many colours, which was probably of native workmanship.

The example set by the Romans would soon be followed by the Britons, and probably they would be taught and employed in the factories to assist the Roman operatives. Nothing, however, is definitely known respecting the art during the Roman occupation, but it appears to have been carried on and to have grown to considerable importance at the Anglo-Saxon period. Embroidery was also practised, and the Anglo-Saxon women were famous for their skill in using threads of coloured silk as well as of gold and silver. Their work was called "English work," as in previous times a similar fabric was called "Phrygian." The ladies at that time were brought up to spin; thus Edward the Elder sent his "son to scole and his daughter to work wole," viz. to learn the use of the distaff and the needle.

The Anglo-Norman ladies also excelled in the art, and tapestry came to be used as an ornament to the walls of the barons, which was probably made by the ladies of the household. William of Malmesbury says, "The shuttle is not filled with purple only, but with various colours, moved here and there among the thick spreading threads, and by the embroidery art they adorn all the woven work with various groups of figures." An ornamental cloth called "baudekin" was made, and was long in great repute.

A few specimens still exist of weaving and embroidery that were worked in Anglo-Saxon and Anglo-Norman times, and perhaps the most interesting one is the well-known Bayeux Tapestry, representing the Conquest of England, which is said to have been the work of Matilda, the wife of the Conqueror, and her assistants. Not only an excellent copy in photography of this interesting work may be seen in the Museum at Kensington, but a small piece of the cloth itself, which was brought home by Mrs. Stothard when her husband was employed in making drawings of the work. It is now believed that it was not the work of Matilda, but that it was done by English hands, perhaps in London, by order of one of the three knights who came from Bayeux.[9]

Long before the Conquest the weavers had formed themselves into a Fraternity or Company, as was also done by artisans following other trades, but they had no power of incorporation. On this account they were opprobriously denominated "Adulterine Gilds," and were amerced to the king for their illegal and presumptuous proceedings.[1]

Gild, Guild, or Geld, primarily means a payment. It signified a tax, tribute, or mulct.[2] As explained by Johnson, it is a Fraternity originally contributing funds to a common stock or corporation. They were, as above stated, in existence so early as in Anglo-Saxon times, although little is known of them during that age. The commissioners appointed in Charles the Second's reign to report on the City Companies asserted that the Weavers' Company was the oldest, and that opinion is still maintained. During the Anglo-Norman period, there is an account, says Herbert, of only one Guild, namely that of "Tellaij," or woollen cloth weavers, although there must have been others at that time in existence.

Henry I., to whom they paid an annual rent of sixteen pounds for their immunities, granted them a charter, which does not appear to be now in existence, but it was renewed or confirmed by Henry II. This charter seems to establish the fact of some of the Guilds having enjoyed immunities immediately after the conquest, which could only have been acquired from long previous usage. The charter, still in the Company's possession, granted by Henry II., is as follows:—

"Henry, King of England, Duke of Normandy and of Guian, Earl of Anjou,

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[9] Rev. D. Rock.

[1] Maitland's "History of London."

[2] Herbert's "History of the Twelve Great City Companies."

to the Bishops, Justices, Sheriffs, Barons, Ministers, and all his true Lieges of London, sendeth greeting, Know ye that we have granted to the Weavers in London their Guild to be had in London, with all the Freedoms and Customs that they had in the time of King Henry, my Grandfather. So that none but they intromit within the City of their Craft, but he be of their Guild; neither in Southwark, or other places pertaining to London, otherwise than it was done in the Time of King Henry, my Grandfather. Wherefore I will and straightly command that over all lawfully they may treat, and have all aforesaid; as well in Peace, free, worshipful, and wholly, as they had it freer, better, worshipfullier, and whollier than in the Time of King Henry, my Grandfather. So that they yield yearly to me two Marks in Gold at the Feast of St. Michael, and I forbid that any man to them do any unright or Disease, upon Pain of ten Pounds.

Witness Thomas of Canterbury, Warwick fil Gar. Chamberlaine, at Winchester."

The king established the cloth fair in the churchyard of the Priory of St. Bartholomew, Smithfield, and the place still retains its name.

Henry also, in the thirty-first year of his reign, confirmed their charter to the Weavers in London that made Woollen Cloth; and, amongst other articles, decreed that if any man made cloth of Spanish wool mixed with English wool, the Portgrave, or Chief Magistrate of London, "ought to burn it"!

The Guilds at this time had power to hold meetings, elect annual officers, keep accounts, make bye-laws, and govern the several trades with almost absolute sway.[3] They alone had power to sell without control in London all things belonging to their "mystery," and the Weavers' Guild allowed none of their craft to work between Christmas and the Purification, or at night by candlelight, and at other times proscribed.

King John, in the third year of his reign, granted the city a charter, which, at the request of the mayor and citizens, confirmed "that the Guild of Weavers shall not from henceforth be in the City of London, neither shall it be at all maintained. But because we have been accustomed yearly to receive eighteen marks in money, every year of the said guild, our said citizens shall pay unto us and our heirs twenty marks in money for a gift at the Feast of St. Michael at our exchequer."

By this charter the Guild of Weavers were expelled the city, but for what offence is not mentioned, although the crime must have been very considerable to occasion the expulsion of the whole body. Still in those days, and under such a reign, persecution and extortion, in the absence of evidence, may have had something to do with the matter.

[3] Herbert.

The company originally consisted of the cloth and tapestry weavers, who by Act of Parliament of Henry IV., were put under the government and correction of the Lord Mayor and Aldermen of the City. They consist of two wardens and sixteen assistants, with a livery of no definite number. The number, according to a recent list of those members who were eligible to vote, was about eighty.

The original purpose of the Weavers' Guild was simply that of a trade union, and was intended for the protection and encouragement of the business. There were weavers' guilds in other cities besides London, such as Winchester and Salisbury, and they paid fines to the king for their privileges of making cloth. To London was accorded the sole right of exporting woollen cloths, but clandestine attempts at exportation were frequently made. The privileges

of the companies included many meddlesome and ridiculous enactments, interfering with the personal liberty of the weaver, so that the free course of trade was prevented. As above stated, the domestic life of the weavers, the width and quality of the cloth to be produced, and the price at which it was to be sold, were all regulated by law. These companies at the present time no longer retain or carry out the purposes for which they were intended, and little else than the bare name of the trade is now connected with them, and their endowments, meant originally for the fostering of the business, are said to be applied to other purposes.

The arms of the weavers of London are—Azure, on a chevron arg. between three leopard's-heads or, and having in the mouth a shuttle of the last, as many roses gules.[4]

During the Conqueror's time some of the English wool was

[4] Sir Richard Hoare's "Modern Wiltshire"—Old and New Sarum. Vol. vi.

exported, and returned in cloth of a better quality than that made at home. The Flemings were noted for their skill in cloth-making, which was so great, that "it seemed in them to be almost a gift or instinct in nature." An inundation of the sea having driven a number of these artisans out of their own country, they sought refuge in England under the protection of William, from the circumstance of the Queen being their countrywoman. This invaluable colony were the founders of the woollen trade in England. The Conqueror settled them at Carlisle, but the ill-will and jealousy of their semi-barbarous neighbours constantly involved them in broils, and they were removed in the year 1111 by Henry I. to Ros, now a part of Pembroke, where their posterity can be distinguished to this day.[5]

As very little is known respecting the condition of clothiers, it may be interesting to note the position held by the mercer, a kindred trade, at this period. In Edward the First's reign, according to the tax-gatherers of that day, the person who united the trade of mercer and spicery-seller seemed to correspond very much with the country dealer, and it is probable from the value of his stock, which did not exceed 3*l.*, that his wares were not more numerous than a modern pedlar.[6] The stock of one consisted of the following articles, viz.:—

	£	*s.*	*d.*
A piece of Woollen Cloth valued at	0	7	0
Silk and fine linen	1	0	0
Flannel and Silk purses	1	4	0
Gloves, Girdles, Leather purses, and Needlework . . .	0	6	8
Other small things	0	3	0
	£3	0	8

This stock, together with the household furniture and utensils, is valued at 5*l.* 9*s.* 3*d.* Another mercer's goods were valued at 6*s.* 8*d.* The dealer was called mercator, which may be translated mercer, as it seems to correspond both in name and trade with the Scotch merchant. The difference in the value of money, however, at that and the present time is very considerable—perhaps fifteen times as much as it now represents.

1100. If tradition may be trusted, it appears that in the reign of Henry I. the cloth manufacture must have been exceedingly prosperous, and foremost amongst the manufacturers was the redoubtable Thomas Cole, the rich clothier of Reading, "whose wains filled with cloth crowded the highway between that town

[5] Fuller, 1662. [6] Sir F. M. Eden's "State of the Poor," 1797.

and London." Henry gratified Cole and his fraternity with the set measure of a yard, by making his own arm the standard thereof.

1199. Cloth was worked at Nottingham at this date, and all persons within ten miles of the town were forbidden to work dyed cloth except in the borough. White and red cloth made in Ireland was much used in England.

1236. At this time the Scots made their own flax into linen, and their wool into coarse cloth, and the Flemings had a factory at Berwick-on-Tweed.

1261. The barons enacted that no wool was henceforth to be exported.

1305. According to Anderson's History of Commerce, there were at this time 4000 woollen drapers and 150,000 journeyman weavers in Louvaine!

1307. The linen manufacture became well established in Norfolk, and Aylesham became noted for its flaxen fabrics. "The fine Cloth of Aylesham," "The Aylesham Linens," and the "Aylesham Webs," are frequently mentioned in old records. English weavers, it is said, knew how to work artificially designed and well figured webs.

1329. The woollen trade settled at Worsted in Norfolk. The manufacturers were enjoined by Parliament to work their cloth better than they had done.

It was in this reign, Edward the Third's, that the woollen manufacture was firmly established. Before this time the statutes take no cognizance of clothing, as being of inconsiderable importance, and needing no rules to regulate it. Wool was exported, and 100,000 sacks per annum paid an export duty of fifty shillings per sack; but the king discovering the great advantages that would accrue to the nation by fostering the clothing manufacture, strictly prohibited the exportation of it, and enacted that no foreign-made cloth should be brought into England, and that none but English cloth should be worn, except by the king and queen and other privileged persons. He therefore proclaimed "that all clothworkers of strange lands of whatsoever country they be, which will come into England, Ireland, Wales, and Scotland, within the king's power shall come safely and surely, and shall be in the king's protection to dwell in the same lands, dwelling where they will, and exercise their trades and have sundry privileges; by which invitation many were drawn, so was it the principal cause of advancing that honest, best and most beneficial trade in the kingdom, to the great enrichment, strength, and honour thereof."[7]

Edward became surety for the immigrants till they could gain by their occupation. Rymer has preserved a document, in which the king takes John Kempe, together with his apprentices bred to the business, servants, goods and chattels, upwards of sixty persons, under his protection. These appear to have been fine woollen weavers. Another colony of Walloons came over shortly afterwards, who were followed in succeeding years by many others of their countrymen.

While the king was thus laudably employed so far in peopling towns and villages with these ingenious and industrious workmen, the magistrates of Bristol were busy in thwarting them. In 1342 they persecuted with exactions Thomas Blanket and some other citizens, who, taking advantage of the influx of the immigrant Flemings, had set up looms in their own houses and hired weavers and other workmen to commence making woollen cloth. Blanket appealed to the king. In the king's letter to the corporation he says, "considering that the manufactures may turn out to the great advantage of us and all the people of our kingdom, you (the mayor) are to permit the machines to be erected in their houses at their choice, without making on that account any reproach, hindrance, or undue exaction." This mandate put a stop to the rapacity of the corporation. From this Thomas Blanket the name of the well-known fabric is supposed to have been taken.

1353. The first staple of wool held in England at Westminster. So great were the advantages conferred upon the country by Edward that they were long remembered; and Fuller, writing three centuries later, speaks of them as fresh as though it had been in his own time, and quaintly remarks, that—

> The king observing the great gain to the Netherlands by the export of this wool, in memory whereof the Duke of Burgundy instituted the order of the Golden Fleece—where indeed the fleece was ours, the gold theirs, so vast was their emolument by the trade of clothing. The king therefore resolved if possible to reduce the trade to this country, for

[7] Speed.

Englishmen at this time knew no more what to do with the wool than the sheep that wear it, as to any artificial or curious drapery, their best clothes being no better than Friezes—such their coarseness from want of skill in the making. Unsuspected emissaries were employed by our king in those countries, who wrought themselves into familiarity with those Dutchmen as were absolute masters of their trade, but not masters of themselves, as journeymen and apprentices; these bemoaned the slavishness of these poor servants, whom their masters used rather like heathens than Christians—yea rather like horses than men; early up and late in bed, and all day hard work, and harder fare, as a few herrings and mouldy cheese, and all to enrich the churles their masters without profit to themselves. But, oh, how happy should they be if they would but come into England, bringing their mystery with them, which would provide their welcome in all places! Here they should feed on fat beef and mutton till nothing but their fulness should stint their stomachs. Yea they should feed on the labours of their own hands, enjoying a proportionable profit of their gains to themselves: their beds should be good, and their bedfellows better, seeing the richest yeomen in England would not disdain to marry their daughters unto them, and such the English beauties that the most envious foreigner could not but commend them. Many Dutch servants left their masters and brought over their trade and tools, such which could not yet be made in England; and happy the yeoman's house into which one of these Dutchmen did enter, bringing industry and wealth along with them. Such who came in strangers within, soon after went out bridegrooms and returned sons-in-law. Yea those yeomen in whose houses they harboured soon proceeded gentlemen, gaining great estates to themselves, arms and worship to their families. The king sprinkled them throughout the country, though, generally, when left to themselves, they preferred a maritime habitation."

As soon as the great value of the woollen manufacture became known and understood, England became very jealous of anything that might be detrimental to its progress. Laws were repeatedly passed to prevent the exportation of wool, and it is said that the woolsacks still used in the House of Lords were originally placed there as seats to remind the Peers of the importance of the wool trade, the great staple at that time of England. The earliest mention[8] of them is said to be in Act 31 Henry VIII., cap. 10, "For placing the Lords," the eighth section of which directs that the Lord Chancellor, Lord Treasurer, or any other officer, who shall be under the degree of a Baron of Parliament, shall sit and be placed at the uppermost part of the sack, in the midst of the said Parliament Chamber, either there to sit upon one form or upon the uppermost sack. D'Ewes in his journal, speaking of the Parliament of Elizabeth, 1558 and 1559, says that the Lord Keeper, Sir Nicolas Bacon,

[8] From "Notes and Queries."

when her Majesty was absent, sat on the first Woolsack which is placed athwart the House, the seal and mace by him. The other woolsacks were then, as now, allotted to the judges. In the standing order of the House of Lords, 1621, it is declared, "That the Lord Chancellor sitteth on the Woolsack as Speaker to the House." But it is believed they were first placed there in the reign of Edward III.

The various branches of manufacture settled, according to "Fuller's Church History," at the following places, namely:—

Westmoreland—Kendal cloth.
Lancashire—Manchester cotton.
Yorkshire—Halifax cloth.
Devonshire—Kersey.
Gloucestershire—cloth.
Worcestershire—cloth.
Wales—Welsh friezes.
Norfolk—Norwich fustians.
Suffolk—Sudbury bayes.
Essex—Colchester sayes and serges.
Kent—Kentish broadcloths.
Somersetshire—Taunton serges.
Hampshire—cloth.
Berkshire—cloth.
Sussex—cloth.

Some of the manufacturers had great renown in their day, and their memories still live. In the North of England there were Cuthbert of Kendal, Hodgeskins of Halifax, and Martin Byram of Manchester. In the West there were Thomas Cole of Reading, Jack of Newbury, Fitzallen of Worcester, Sutton of Salisbury, Gray of Gloucester, Tom Dove of Exeter, and Simon, or Subroath, of Southampton. A famous Dutch cloth-maker in Gloucester had a new name, "Web," given to him by King Edward III.

The Poet Chaucer lived in this reign. In his "Canterbury Tales" he thus describes the dress of the knight: "Of Fustian he weared a Gipon." The Serjeant-at-Law wore a coat of mixed stuff; the Canon was dressed in a cloak, and the Friar, "Of double worstede was his semicope."

When speaking of the county of Suffolk, Weever, the Antiquary, alludes to the prosperity that had existed through the introduction of the cloth manufacture at this period, as follows:—

"Otherwise I should not find so many marbles richly inlaid with brass to the memory of clothiers in foregoing ages, and not one in these later seasons. All the monuments in the Church of Newland which bear any face of comeliness and antiquity are erected to the memory of clothiers, and such as belong to that mystery."

The encouragement given by Edward III. for the introduction of cloth manufacture, therefore, may be considered as the first important step that was made towards the firm establishment of the manufacturing arts into England.

1354. The following statement of the foreign trade of the country at this period is of interest, and contrasts favourably with the trade nearly three centuries later (see 1622) in James the First's reign. It appears, however, that the king had again allowed wool to be exported, probably because more was produced in the country than could be used in the home manufacture.

State or balance of the English trade in the twenty-eighth year of Edward III.:—

EXPORTS.	£	*s.*	*d.*
One and thirty thousand, six hundred, and fifty-one sacks and a half of wool, at 6*l.* value each, amount to	189,909	0	0
Three thousand, thirty-six hundred, and sixty-five felts, at 40*s.* value each hundred at six score, amount to	6,073	1	8
Whereof the custom amounts to	81,624	1	1
Fourteen last, seventeen dicker, and five hides of leather, after 6*l.* value the last	89	5	0
Whereof the custom amounts to	6	17	6
Four thousand, seven hundred, and seventy-four cloths and a half, after 40*s.* value the cloth, is	9,549	0	0
Eight thousand and sixty-one and a half of worsted, after 16*s.* 8*d.* value the piece, is	6,717	18	4
Whereof the custom amounts to	215	13	7
Sum of the out-carried commodities in value and custom	£294,184	17	2
IMPORTS.			
One thousand, eight hundred, and thirty-two cloths, after 6*l.* value the cloth	10,992	0	0
Whereof the custom amounts to	91	12	0
Three hundred and ninety-seven quintals and three quarters of wax, after the value of 40*s.* the hundred of quintal	795	10	0
Whereof the custom is	19	17	0
One thousand, eight hundred, and twenty-nine tuns and a half of wine, after 40*s.* value per tun	3,659	0	0
Whereof the custom is	182	0	0
Linen cloth, mercery, and grocery wares, and all other manner of merchandise	22,943	6	10
Whereof the custom is	285	18	3
	£38,969	4	1
Sum of the inplusage of the out-carried above the in-bought commodities amounteth to	£255,215	13	1

1360. In Ireland a woollen stuff called Sayes was extensively made and exported. It was greatly admired abroad, and imitated by foreign manufacturers.

1369. Perhaps the most important of the immigrants at this period was John Kempe, and the host of ingenious Flemings who followed him. They established the manufacture of fine woollen cloth on a foundation that has not once been shaken for five hundred years. But neither their skill, industry, nor the knowledge they had spread of a valuable manufacture, nor their misfortunes, could save them from the persecution of the native clothmakers and weavers, who were become skilful and were growing rich, from following their examples and instructions. They were at all times the objects of vulgar hatred and malice, and their lives were in danger.

In the summer of this year, more particularly, they became the victims of popular fury, and gross outrages were committed upon them, until Edward issued a proclamation declaring them to be under his especial protection. A short time after his death, the ill-will of the native workmen again broke out into open violence against the "cursede forrainers."

1379. Richard II. acted as a mediator, and an agreement in 1379 was effected between the native and foreign interests, which was confirmed by the royal authority.

The foreign workmen were now so numerous in London, that places were assigned to them in which they could deliberate on the affairs of their communities. The churchyard of St. Lawrence Poulteney was appropriated to the Flemings, and that of St. Mary Somerset to the Hollanders.

Richard II. was fond of fine clothes, he had one coat of gold and precious stones which cost 31,000 marks. In his reign a decree was enacted, that "no merchant shall stretch before his shop a red or black cloth, or anything by which the choice of the buyer is frequently deceived."

1421. Mohair cloth, called Baracani, manufactured in Perugia, was in great demand in the southern countries.

1436. Coventry celebrated for woollen cloth caps and bonnets.

1455. The art of spinning and throwing silk had been introduced by a company of silk women, of what country is not known. In a petition to Parliament they stated that the Lombards and other Italians imported such quantities of threads and rib-bands, and other silk things, that they were impoverished. To protect them an Act was passed prohibiting the importation of the articles which they fabricated.

1473. Cloths of silver and gold were manufactured in London.

After this period not only were woollen fabrics manufactured in sufficient quantities to supply the demand at home, but also to provide a large amount for exportation.

1480. The silk manufacture introduced into France by workmen from Italy.

1486. Henry VII., observing that the woollen manufacture had become languid and was declining owing to the unsettled state of the country under his immediate predecessors, drew over a great number of the best cloth-workers from the Netherlands, which gave a new vigour to cloth-making operations.

1494. Improvements made in Fustian cutting.

1500. Coventry celebrated for blue thread called "Coventry true blue."

1510. In the reign of Henry VIII. the manufacture of broad cloth made with broad looms is said to have been introduced. They required two men to work one, and John Winscombe, better known as "Jack of Newbury," is asserted to have been the first to adopt them. This famous clothier, as manufacturers were then called, was another example of enterprise and energy, which was appreciated so highly, perhaps from its rarity, in former times. This worthy man was then, and long afterwards, considered as the greatest clothier England ever beheld. He had a hundred looms "in his house," each managed by a man and a boy. He feasted the king and queen on one occasion, and in the expedition to Scotland against James IV., who was defeated at Flodden Field, he marched with a hundred of his own men. He died in the year 1520, and his house was afterwards converted into sixteen separate houses or tenements.

Tapestry weaving, which appears to have become neglected and forgotten, was reintroduced into England about this time by William Sheldon, the founder of Weston House, Warwickshire. Under his direction were woven a curious series of maps, which formerly ornamented the hall of Weston House. A portion of them represented the counties of Hereford, Salop, Stafford, Worcester, &c. They ultimately came into the possession of Richard Gough, the Antiquary, and are now in the Bodleian Library.

Shakespeare makes frequent mention of weavers and matters pertaining to them. The passage in Henry VIII. Act i. where Wolsey is charged with taxation refers to this period. To keep up his semi-regal state he is said to be the "putter on of these exactions," and Queen Katherine tells the king that his subjects are almost in loud rebellion against the taxation they were subjected to. Thus the Duke of Norfolk states :—

> "Not almost appears,
> It doth appear ; for upon these taxations
> The clothiers all, not able to maintain
> The many to their longing, have put off
> The spinsters, carders, fullers, weavers, who,
> Unfit for other life, compell'd by hunger
> And lack of other means, in desperate manner
> Daring the event to the teeth, are all in uproar,
> And Danger serves among them."

1519. When circumnavigating the globe in this year, Magellan found the Brazillians using "this vegetable down" (cotton) in making their beds.

Cotton fabrics were sent by Cortes from Mexico to Spain.

Cotton was cultivated and manufactured at this time on the coast of Guinea.

1528. The Company of Clothworkers incorporated.

1530. The art of knitting known in England.

The spinning-wheel known or invented about this time.

1536. De Vica found the cotton plant in Texas.

1542. First Act of Parliament relating to the linen trade in Ireland.

1552. An Act passed directing that all cottons called Manchester, Lancashire, and Cheshire cottons full wrought to the sale shall be in length 22 yards, and breadth three quarters of a yard in the water, and shall weigh thirty pounds in the piece at least. Also that cloth called Manchester Rugs and Friezes, shall contain thirty-six yards, and be three quarters of a yard wide when in the water, and weigh forty-eight pounds at least.

1554. Fustians of Naples made at Norwich.

1558. An Act of this time relates that—

> "Certain evil-disposed persons, who buy and engross great store of linen cloth, do cast the pieces of cloth over a beam or piece of timber made

for their purpose, and do by sundry devices rack, stretch, and draw the same both of length and breadth, and that done do then with battledores, pieces of timber and wood, and other things sore beat the same, ever casting thereupon certain deceitful liquors mingled with chalk and other things, whereby the said cloth is not only made to seem much thicker and finer to the eye than it is indeed, but also the thread thereof being so loosed and made weak, that after three or four washings it will hardly hold together, to the great loss and hindrance of the natives."

These practices were forbidden.

1560. Cotton was imported from Antwerp into England.

"Mrs. Montague, Her Highness's silk-woman, presented the queen with a pair of black silk knit stockings, which after a few days wearing pleased Her Highness so much that she sent to Mrs. Montague for more. The queen, who was not ignorant of the attraction of a smart-looking foot and ankle, liked them so that she would not henceforth wear any more cloth hose."

1561. Barbara, the wife of Christopher Uttmann, at the castle of St. Annaberg, on the borders of Saxony, invented the art of making pillow lace.

1567. The second great event which did so much to establish the manufacturing arts in England, occurred at this period owing to the persecutions of the Duke of Alva.

The Netherlands at this time were an assemblage of separate states, and were all subject to Philip II. of Spain. The Lutheran and Calvinistic opinions had made great progress in those quarters at that time, and Philip, being an intolerant bigot by nature, was determined to repress them, and for that purpose sent the Duke of Alva to Flanders at the head of Spanish and Italian troops, to enforce implicit submission. An inquisition was established, new bishops appointed, and in a short time 18,000 persons perished by the hands of the executioner. The Duke of Alva's government lasted five years. The minds of the people, who had previously received Philip as their protector, now became alienated, and the Prince of Orange, who was himself under sentence of the Inquisition, raised an army, and was proclaimed Stadtholder of Holland and Zealand in 1570. He succeeded in abolishing the Romish religion and throwing off the Spanish yoke, but Philip offered 25,000 crowns for his head, and this illustrious man fell a victim to an assassin in 1584,[9] which circumstance was known as "the crime of the times."

[9] Tytler.

In consideration of the services of the Duke of Alva, the Pope called him "his beloved son," and presented him with a sword wrought with gold and precious stones.

During this period of persecution, thousands of the Hollanders came to England, which was the only sanctuary they had left. Queen Elizabeth was offered the sovereignty of their province, but she contented herself with relieving her distressed neighbours, and took them under her protection (1585), and concluded to send 5000 foot and 1000 horse into the Netherlands to fight for them.

The King of Spain from this and other circumstances became incensed thereat (1588), and sent his Invincible Armada against England, and raised a rebellion in Ireland against the queen.[1]

The refugees who came to England brought with them their several arts, many of which had not been practised or known in England before that time, and it is probable that the draw loom for Damask weaving was then introduced.

The citizens of Norwich appear to have been the first to have taken advantage of the Duke of Alva's persecutions, for the city at that time being in a very depressed state, owing to the decay of the worsted manufacture, many were forced to leave their houses, and go into the country to get their bread. The Mayor and corporation, being anxious to restore the prosperity of the community, waited upon the Duke of Norfolk, who was then at his palace in that city, and it was decided to invite some strangers of the Low Countries, who, by leave of the queen, had come to Sandwich and London for refuge from the Duke of Alva.[2] Upon application to the queen by the Duke of Norfolk, she gave letters patent to thirty master workmen each with ten servants to settle in the city, who set up the making of baizes, serges, arras-mochades, curelles and such-like goods mingled with silk and linen yarn, which gave employment to a great many hands. Houses which had fallen into decay were now repaired and inhabited, and both city and county grew rich—the latter by the great demand for farm produce, and the former by the profits from this new introduction of manufactures.

In like manner other places benefited, as the following interesting account of the time will show.

[1] "The Wicked Plots, &c., of the Spaniards" (Harleian Miscellany).
Blomefield's "History of Norfolk."

When the Dutch came and introduced Bay and Saye making the bailiffs of Colchester, Robert Northern and Richard Northey wrote to the Lords of the Privy Council, informing them of the arrival of certain Dutchmen from Sandwich, viz., "Whereas of late a number of Dutchmen have come to this town of Colchester, about eleven households to the number of fifty persons, small and great, where they made their abode longer than other strangers have been accustomed. We therefore called the best of them to know the cause of their coming, who answered they were part of the dispersed flock of late driven out of Flanders for that their consciences were offended with the Masse, and for fear of the tyranny of the Duke of Alva—they came into this realm for protection, and that there were more of them at Sandwich who wished to be permitted to come also—with such sciences as are not usual with us, but weave sackcloth, make needles, parchment, weavours and such-like, so that they shall not be any hindrance to any man or occupation here. We dare not presume to give them licens of ourselves, but great profit might arise to the common estate of this town, greatly decayed &c., and therefore we have given them friendly entertainment until we might signifie the same to your Honours. And we cannot but greatly commend them—to be very honest, Godly, civil, and well-ordered people not given to outrage or excess, &c."

To this a reply was given (24th March, 1570), which states,—"As ye do acknowledge your towne to be benefited by their being there, we are right glad that we first commended them unto you, and cannot but allow their conformity, your gentle handling of them, and the concord betwixt you, the which we trust God will encrease with benefits towards you, &c." Signed by N. Bacon, C.S., T. Sussex, R. Leicester, and dated from Greenwich.

King James I. in his time gave them particular care and protection, and granted them letters patent in 1612, for their better security, for it appears that the English weavers had persecuted them, "notwithstanding they had set to work many of the poor people, to the benefit of the towne, and henceforth they were of great advantage to the town." [3]

1567. A patent was granted to Charles Hastings, Esq., that in consideration that he brought in the skill of making frisadoes as

[3] Morant's "History of Essex."

they were made at Harlem and Amsterdam, being not used in England, that therefore he should have the sole trade thereof for divers years, &c. Some clothiers of Coxfall having made frisadoes, were proceeded against by Hastings, but they "demurred," says Noy, "that it was *against* law to have such penalties of the goods, and 100 pounds to be forfeited by *force* of a letters patent." Hastings went no further, but found that the clothiers did make baizes very like to Hastings' frisadoes, and had done so before Hastings' patent.

1569. Gaspar Campion published "A Discourse of the Trade of Chio," in which he says there is cotton, wool, &c., also coarse wool to make beds.

1570. A conspiracy was formed by John Throgmorton and others, to drive the Flemish out of Norwich, but it was disclosed in time, and many were arrested and condemned. It was their intention to proceed, after collecting forces at Harlestone fair and at Bungay and Beccles, "to Norwiche in such a sodeyne as at the Mayre's feaste to have taken the whole cupboorde of plate to have maynteyned the enterpryse," and then by sound of trumpet and beat of drum, to have expelled the strangers from the city and the realm.

"The strangers applied to the Queen, who issued a letter to the Corporation, minding them of the poor men who had to fly from their own nation through religious persecution, but it was not without a second interposition that matters were quietened."

1573. John Tice attained to the perfection of making all sorts of tufted taffaties, cloth of tissues, wrought velvets, branched satins, and other kinds of curious silk stuffs.

1575. Bombazines first made at Norwich in this year.

1578. At the pageant exhibited to Queen Elizabeth, at Norwich, the following varieties of looms were "pourtrayed:" "Looms for worsteds, for russets, for darnix, for mockads, for lace, for caffa, and for fringe; and upon the stage at one end stood eight small women children spinning worsted yarn, and at the other end many knitting worsted hose."

1579. Morgan Hubblethorne, a dyer, was sent to Persia to learn the art of making and dyeing carpets.

Naipery or table linen, in general use, but was imported.

Cloth called mildernix, or powledavis, of which the sail-cloth for the navy was made before this time, was "altogether brought out of France and other parts beyond sea, and the skill and art of weaving the cloths was never known or used in England, until about this year, when perfect art was attained thereto."

1582. A second return made of the "strangers" that had recently settled in Norwich, shows that there were 1128 men; 1358 women; 815 children, strangers born, and 1378 English born —in all 4679.

Abul Fazel celebrates the town of Sinnergan, in India, for the manufacture of cotton cloth named cassas.

1583. Mr. Ralph Fitch, an English traveller, visited Sinnergan, a town near Senapore, "where there is the finest cloth made of cotton that is in all India."

1589. About this time William Lee, curate of Calverton, invented the stocking frame.

Cotton cloth imported into London from the Bight of Benin. The Dutch engine or ribbon loom, is said to have been invented about this time, in Germany.

1590. Camden, speaking of Manchester, says, "This town excels the towns immediately around it for handsomeness, &c., but did much more excel them in the last age, as well by the glory of its woollen cloths, which they call Manchester cottons."

1605. James I. joined himself unto the Clothworkers' Company, as men dealing in the principal and noblest staple ware of all these islands. "Beeing in the open hall, he asked who was the master of the Company, and the Lord Mayor answered, 'Sir William Stone;' unto whom the king said, 'Wilt thou make me free of the Clothworkers?' 'Yea,' quoth the master, 'and think myself a happy man that I live to see the day.' Then the king said, 'Stone, give me thy hand, and now I am a Clothworker.'"

1610. William Lee died neglected and broken-hearted in France.

1620. The stocking-frame firmly established, and made in great numbers.

1621. This year is generally regarded as the birth-year of cotton culture in the United States. It had previously been found growing in a wild state in various parts of the South. A volume called "Purchas's Pilgrims," says, "Cotton seeds were first planted as an experiment in 1621, and their plentiful coming up was at that early day a subject of interest in America and England."

A tract called "A Declaration of the State of Virginia," published in London in 1620, mentions cotton wool as one of the commodities of that "collony." In 1621 cotton wool was 8*d*. per pound in Virginia.

		£	*s*.	*d*.
1622.	Total amount of exports from England .	2,320,436	12	10
	,, ,, imports including customs, 191,059*l*. 11*s*. 7*d*.	2,619,315	0	0
	Balance lost to England by foreign commerce	£298,878	0	0

1629. The silk-throwsters of London incorporated. A few years previously, Mr. Burlamach, a London merchant, introduced silk-throwing on a considerable scale.

1631. The Company of Silkmen incorporated.

1631. Calicoes first brought into England, from Calicut, India.

1638. A company of Yorkshiremen, about twenty families, settled at Rowley, Massachusetts, and established the manufacture of cloth. Here they built the first fulling-mill, which is said to have been erected by John Pearson, in 1643, and it was in operation so late as 1809. It then contained a cedar tenter-post brought by them from England, which remained perfectly sound. The second fulling-mill was built at Watertown, in 1662.

1641. In a curious pamphlet published at this date the following remarks relating to manufactures are made, which show the state of the trade at that time:—

> "The Dutch likewise buyes his Woolls in Spaine, carries it home to his owne house, there spins it, weaves it, and workes it to perfection, then brings it back into Spaine in Sarges, Sayes, and such-like Stuffes; and so there againe sels the same to good profit and vents it.
>
> "The towne of Manchester, in Lancashire, must be also herein remembered, and worthily, and for their industry commended, who buy the yarne of the Irish in great quantity, and weaving it returne the same againe in Linnen, into Ireland to sell; neither doth the industry end here, for they buy Cotton Wooll in London, that comes first from Cyprus and Smyrna, and at home worke the same, and perfit into Fustians, Vermilions, Dymities, and other such Stuffes, and then returne it to London, where the same is vented and sold, and not seldome sent into forraine parts, who have meanes at far easier termes to provide themselves of the said first materials."[4]

[4] "The Treasure of Traffike," by Lewes Roberts, 1641.

Mr. Baines, in his "History of the Cotton Manufacture," says that no mention of the cotton manufacture has been found earlier than the above. In this year it had become well established in Manchester. What before this time went under the name of Manchester cotton fabrics were really composed of wool.

1650. After the annihilation of the royal authority, or between that and the Protectorate, the City of London became the grand focus of the Parliamentary Government. Guildhall was a second House of Commons—Goldsmiths' Hall their bank, Haberdashers' Hall their court for adjustment of claims, Clothworkers' Hall for sequestration. Weaver's Hall might be denominated their Exchequer. From this place Parliament was accustomed to issue bills about and before 1652 in the nature of our Exchequer, and which were commonly known under the name of "Weavers' Hall Bills."

1657. The Stocking Weavers' Company incorporated.

1660. The manufactures carried on in Manchester about this time are thus quaintly described:[5]—

> "As for Manchester the Cottons thereof carry away the credit of our nation, and soe they did an hundred and fifty years agoe. For when learned Leland on the cost of King Henry the Eighth, with his guide travailed Lancashire, he called Manchester the fairest and quickest town in this country; and sure I am it hath lost neither spruceness nor spirits since that time.
>
> "Other commodities made in Manchester are so small in themselves and various in their kinds, they will fill the shop of an Haberdasher of small wares. Being therefore too many for me to reckon up or remember, it will be the safest way to wrap them altogether in some Manchester-Tickin and so to fasten them with the *Pinns* (to prevent their falling out and scattering) or tye them with the *Tape*, and also (because sure *bind* sure *find*) to bind them about with *Points* and Laces, all made in the same place."

1664. "Sir Martin Noel told us," says Pepys in his Diary, "the dispute between him as framer of the additional duty, and the East India Company whether calico be linen or no, which he says it is, having been ever entered so. They say it is made of cotton wool and grows upon trees."

On the 26th of July in this year Pepys also relates that "Great discourse of the fray yesterday in Moorfields, how the butchers at first did beat the weavers (between whom there hath

[5] Fuller's "Worthies."

been ever an old competition for mastery), but at last the weavers rallied and beat them. At first the butchers knocked down all for weavers that had green or blue aprons, till they were fain to pull them off and put them in their breeches. At last the butchers were fain to pull off their sleeves that they might not be known, and were soundly beaten out of the field, and some deeply wounded and bruised, till at last the weavers went out tryumphing, calling one hundred pounds for a Butcher."

1665. An Act passed, 12th Charles II., making it a felony to export wool. Thomas Telham, of Warwickshire, and 2000 others, left the kingdom to escape such restrictions, and were followed by many others from Hampshire.

1667. The Gobelins Manufactory established at Paris for the making of Tapestry, and other furniture, for the use of the Crown. The factory was built by two brothers, Giles and John Gobelin, in the reign of Francis I., and was called the "Gobelins folly" till 1667, when the name was changed to Hôtel Royal des Gobelins, and it has ever since been the first manufactory of the kind in the world.

1668. A number of Walloons, under encouragement of the king, came and established themselves.

1671. A patent was obtained by Edmund Blood for carding and weaving waste silk, which was probably the first attempt to spin waste silk similar to cotton-spinning.

1676. Calico-printing commenced in London in a very imperfect manner.

The Dutch engine loom introduced into London from Holland.

1677. Samuel Pepys was elected Master of the Clothworkers' Company this year, and presented a richly-chased "Loving Cup," still used on all festive occasions.

1678. The East India Company had imported Indian muslins, chintzes, and calicoes in such quantities into Great Britain, and they were so cheap and popular that those interested in the ancient woollen manufacture loudly complained against further importation. A pamphlet entitled "The Ancient Trades Decayed and Repaired Again," was published in London, in which the author laments the interference of cotton with woollen fabrics.

M. De Gennes presented his model of a "machine for making woollen cloths without the aid of a workman," to the French Royal Academy.

An Act passed by the Lord Mayor and Common Council of London for regulating the cloth-markets of the city and preventing foreigners from buying and selling.

1685. The third and by far the most important event tending to the thorough establishment of the industrial arts in England arose from another act of persecution on the part of the Catholics, but this time it was against the Protestants of France. During the reign of Henry IV. (the great), King of France, an Act was granted in 1598 for the toleration of the Protestants, the massacre of St. Bartholomew having occurred in a preceding reign. This Act was revoked in the year 1685 by Lewis XIV., and is now well known as the "Revocation of the Edict of Nantes." The Protestant worship was suppressed, their churches demolished, and their ministers banished. The Protestant laity were forbidden under the most rigorous penalties to quit the kingdom. But by this measure France lost above 500,000 of her most industrious and useful subjects, who eagerly transferred their property, talents, and industry to Prussia, Holland, and other Protestant States. It is said that 70,000 of them came and established themselves in various parts of the United Kingdom, and introduced many arts previously unknown in this country or not practised at that time.

1686. Abraham Opdengrafe claimed from the Governor of the State of Pennsylvania the premium offered to him who should make the first and finest piece of linen cloth.

Velvet-weaving introduced in Spitalfields.

The value of silk imported into England at this time was 700,000*l.* per annum.

1687. Joseph Mason obtained a patent for an engine, by the help of which the weaver may do without the assistance of a draught boy, "which engine hath beene tryed and found out to be of greate use to the said weaveing trade."

1688. The price for weaving linen in America at this time was 10*d.* and 12*d.* per yard, the width being half-yard.

1690. A print ground established by a Frenchman on the banks of the Thames at Richmond.

1691. John Barkstead obtained a patent for "making of callicoes, muslines, and other fine cloathes of the sort out of cotton wooll of the growth of our Plantations in the West Indies."

An Act passed prohibiting the importation of European manufactured silks.

1696. A pamphlet entitled "The Naked Truth in an Essay upon Trade," bewailing the introduction of cotton fabrics, was published, in which it states they were "becoming the general wear in England."

1697. Cotton imported into Great Britain, 1,976,359 lbs.

1698. Francis Pousset obtained a patent for the true art of making "black silke crape and white silke crape."

1700. In consequence of the great dissatisfaction and opposition to the introduction of cotton fabrics into Great Britain during the 17th century an Act was passed prohibiting the introduction of printed calicoes for domestic use as apparel or furniture under a penalty of 200*l.* on the wearer or seller. But it did not prevent the use of them, quantities of which were smuggled into the country, and De Foe relates that weavers did not hesitate to tear such dresses off those who wore them.

Population of Lancashire, 166,200.

About 1,000,000 lbs. of cotton used in Great Britain, employing 25,000 persons.

1701. Cotton imported, 1,985,856 lbs. Cotton goods exported, 23,253*l.*

An Act passed prohibiting the importation of manufactured silks from India and China.

1702. A weaver in Dunfermline made a seamless shirt—a feat frequently done since that time.

Mr. Crotchett of Derby established a silk-mill, but it proved unsuccessful.

1708. De Foe, in the "Weekly Review," January 31, deplores the growing popularity of cotton goods, and attributes to it the loss of above half of the woollen manufactures, and the people employed therein.

Spinning schools established in Ireland.

1710. Cotton imported, 715,008 lbs. Cotton goods exported, 5690*l.* Joseph Beaumont, a London merchant, went to Ireland by order of the House of Commons, and the Trustees for the Improvement of the Linen Manufacture, to report on the same.

1712. The excise duty of 3*d.* per square yard on printed calicoes was raised to 6*d.*

During the time of the South Sea Bubbles, numerous petitions praying for Letters Patent for carrying on all manner of trade were applied for by the dishonest schemers of that period. Amongst them may be mentioned schemes

For sowing hemp and flax;

For making sail cloth;

For making sail cloth and fine holland;

For making linen and sail cloth, with powers to carry on the cotton and silk manufactures.

The following were carried on without application for patents or charters:—

For the clothing trade—Colchester bays; Puckle's machine for making muslin; Irish sail cloth; improving the silk manufacture; for making stockings; woollen manufacture in the North of England, &c., &c.

An order was granted by the Lords Justices for prosecuting certain of these companies, some of them being of a scandalous nature, which at once put a stop to them.

At this time a Bill was sent by the House of Commons to the Lords, for the preservation of the woollen and silk manufactures; but the Lords having heard counsel, put off the bill for six weeks for further consideration. The weavers taking this to be a rejection of the bill, some thousands of them, with their wives and children, went in a tumultuous manner from Spitalfields to Westminster, and demanded justice of their Lordships as they passed to the House. Detachments of the Horse Guards being sent for, the weavers returned home without committing damage of any consequence. But the "hot fit returning," they threatened to demolish the house of a French weaver, and to rifle that of the East India Company; but the Horse and Foot Guards, as well as the Trained Bands being sent for, their designs were happily prevented.

1718. The successful establishment of the silk-throwing business at Derby, by Mr. Thomas Lombe, and commencement of the modern factory system.

1720. Cotton imported, 1,972,805 lbs. Cotton goods exported, 16,200*l.* Ribbon-weaving introduced into Coventry about this time.

An Act passed prohibiting the use or wear, in Great Britain, of any apparel whatsoever of any printed or dyed calico, under a penalty of 5*l.* And a penalty of 20*l.* if such goods were used as household stuff or furniture. In the following year another Act was passed, prohibiting the use of printed calico, whether printed in England or elsewhere.

These restrictions were brought about by the complaints of the Norwich manufacturers, who stated that the weaving of printed calicoes and linen were destructive of the woollen and silk manufactures. The Manchester manufacturers resorted to making other fabrics in order to avoid the Acts, and made new cloths resembling the ancient fustians, which along with muslins and neckcloths of cotton were exempt. They were made of cotton and linen mixed, and became much in vogue.

According to the statement of a Norwich weaver as set forth in his "case" against the Manchester calicoes, it appears that 12lbs. of wool manufactured into woollen stuffs was a week's work for one of their looms, and the cost of workmanship was as follows:—

	£	*s.*	*d.*
Wool sorting	0	0	3
,, picking	0	0	8
,, combing	0	2	0
,, spinning	1	4	0
,, throwing . . .	0	4	0
,, dying	0	4	0
,, winding	0	1	0
,, warping	0	0	6
,, weaving	0	12	0
,, calendering . . .	0	0	6
,, pressing	0	1	6
	£2	10	5

From the same source it appears that every hundred weavers required the services of other trades as follows:—

Weavers	100
Wool sorters	4
,, pickers	10
,, combers	20
Spinners	900

Throwers	4
Turners of the throwing mill .	4
Thread makers . . .	4
Doublers	50
Bobbin winders . . .	12
Back-throw winders .	12
Quill boys	50
Warpers	5
Dyers	6
Pressers	6
Total .	1187

1725. M. Bonchon invented the application of perforated paper for working the draw-loom, being the origin of the Jacquard Machine.

1727. James Le Blon obtained a patent for the art of weaving tapestry in the loom, "a secret never known or practised before."

1728. M. Falcon substituted a chain of cards to turn on a prism or cylinder, in lieu of the paper band of M. Bonchon.

1730. John Wyatt, then living at a village near Lichfield, first conceived the plan of spinning by means of rollers, and prepared to carry the same into effect.

1732. Richard Arkwright, born at Preston, December 23rd.

1733. John Wyatt constructed a "model about two feet square, by means of which, in a small building at Sutton Coldfield, without a single witness to the performance, was spun the first thread of cotton ever produced without the intervention of the human fingers. The wool had been carded the common way, and was passed between two cylinders, from whence the bobbin drew it by means of the turit."

John Kay obtained a patent for his invention of the "fly shuttle."

1734. Cotton was planted in Georgia from seed sent to the trustees, by Philip Miller of Chelsea.

1736. The prohibition to use cotton in the manufacture of mixed goods repealed.

1738. A patent was granted to Lewis Paul, a partner of John Wyatt, for spinning by rollers. Wyatt is supposed to have been the inventor, and Paul to have supplied the capital required.

1739. On the 6th November a great number of weavers assembled before the house of an eminent master weaver in Spital Square, and endeavoured to destroy it, upon a report being sent to bring the rest of the master weavers into a combination for the journeymen weavers to wind their silk gratis. The Guards were sent and the Riot Act read; but as they did not disperse within the limited time, great numbers were taken prisoners, some of whom escaped, but ten were secured and committed to Newgate, but soon bailed out. Several soldiers were dangerously wounded by bricks and tiles thrown on them from the tops of the houses. Riots also occurred in the years 1765, 1767 and 1769.

1741. Cotton imported into Great Britain, 1,645,031 lbs. Value of cotton goods exported, 20,709*l*.

Mr. Baines, in his "History of the Cotton Manufacture," says, "I have before me hanks of cotton yarn spun about 1741 and wrapped in a piece of paper, on which is written the following in the handwriting of Mr. Wyatt:—'The enclosed yarn spun by the spinning engine (without hands) about the year 1741. The movement was at that time turned by two, or more, asses walking round an axis in a large warehouse near the mill in the Upper Priory, Birmingham. It owed the condition it was then in to the superintendency of John Wyatt. The above was wrote June 3rd, 1756.'"

1742. M. Dubreuil, a French planter in Louisiana, invented a machine for separating the seed from the cotton fibre. The seed had hitherto been picked out of the fibres by hand.

1745. John Kay and Joseph Stell obtain a patent for applying tappets to the Dutch engine loom for weaving narrow goods to be worked by means of "hands, water, or any other force."

M. Vancanson applied the griffe to M. Falcon's invention, and placed the apparatus on the top of the loom in the position now occupied by the Jacquard machine.

1748. Lewis Paul of Birmingham, gentleman, procured a patent for two carding machines, one a flat, and the other a cylindrical arrangement.

1750. The population of Lancashire, 297,400.

1751. Cotton imported into Great Britain, 2,976,610 lbs. Value of all kinds of cotton goods exported, 45,986*l*.

1753. The Society of Arts founded. (Charter 1847.)

1758. Jedediah Strutt, of Derby, patented the Derby-rib machine, being the first important modification of the stocking frame.

1760. Robert Kay, of Bury, son of John Kay, invented the "drop-box" about this time.

Joseph Stell obtained a patent for the application of "sundry toppets" for weaving figures in the narrow or Dutch loom, and for applying two boys or Jacks instead of the old drawing engine.

Richard Arkwright established himself as a barber at Bolton. It is related that his wife burned the models he was making, which act he looked upon as "a sin and a crime." He never forgave her, and when in his greatest prosperity he only allowed her a pittance of four shillings per week—being all she could legally claim from him at that time.

Lewis Paul's carding machine introduced at Wigan by a gentleman named Morris.

A considerable share of the calico printing business was removed from London to Lancashire.

1762. George Glasgow patented a method of weaving two, three, or four pieces of single cloth combined together by a "stitching shaft" in imitation of stitched women's stays.

1764. James Hargreaves, a weaver of Sland Hill, near Blackburn, invented a spinning jenny to spin without the use of rollers.

Richard Arkwright went to Nottingham with an improvement upon the jenny of Hargreaves.

Calico printing introduced by Messrs. Clayton at Bramber Bridge, near Preston, afterwards carried on by Robert Peel.

Eight bags of cotton imported into Liverpool from the United States.

Morris and Betts patented the eyelet-hole machine, surreptitiously obtained from its inventor, Butterworth.

1765. A weaving factory filled with swivel looms established at Manchester by Mr. Gartside.

1767. Arkwright employed a clockmaker named Kay, of Warrington, to make a model of a spinning frame with rollers, that had been previously invented by Thomas Highs (or Hayes), for whom Kay had made the original model.

James Hargreaves completed his spinning jenny.

1768. Coarse cloth and "linsey-woolsey" made in nearly every family in the States, the carding and spinning being done by members of the family, and the weaving by itinerant weavers, who travelled through the country, nearly every family being provided with a loom.

1769. Arkwright patented his machine for spinning by rollers (see 1773).

James Watt took out a patent for his steam engine.

Robert Frost made the first figured lace web.

J. Crane, and J. P. Porter applied the draw-boy and slides to the stocking frame for brocading and flowering gloves, aprons, &c.

1770. James Hargreaves obtained a patent for his spinning jenny.

Mr. Crawford, a London merchant, patented the silk doubling frame, containing probably the first self-acting stopping motion when a thread breaks.

1771. Arkwright's first mill was built at Crumford. Marsh and Horton patent their invention for making knitted or knotted hosiery.

The stocking frame introduced into Scotland.

Mr. Almond was awarded 50 guineas for his improved loom. (see Fig. 262).

1772. Thomas Highs received a present of 200 guineas from the manufacturers of Manchester for the invention of a double jenny which was publicly exhibited in the Exchange.

Richard Williams patented a new method of manufacturing goods with "cotton whoofs or woollen linen or cotton warps and dressing such goods with a long shag on their surface." They were finished by having a long shag drawn upon them by means of teasles or wire cards.

1773. Previous to this time cotton was only used as weft.

The invention of the "stripper" to the carding engine claimed by both Arkwright and Hargreaves.

The first attempt to work a power loom at Glasgow was made this year, and a Newfoundland dog working in a race wheel or drum supplied the necessary power.

The "Spitalfields Act" passed, fixing the price at which weavers should be paid. The business in consequence went to Macclesfield, Manchester, Norwich, Paisley, &c.

1774. A law passed sanctioning the manufacture of cotton goods, hitherto prohibited under heavy penalties, subject to a duty of 3*d.* per square yard, on being printed and stamped. It was death to counterfeit the stamp or to sell goods knowing them to have the counterfeit stamp thereon.

The population of Manchester was 41,032.

Robert and Thomas Barber obtained a patent for a power loom in which the cone pick is used.

Cloth made entirely of cotton sanctioned.

Thomas Wood invented the so-called endless carding by nailing the cards on the cylinder spirally instead of longitudinally.

1775. Arkwright took out a patent for a series of machines.

Crane of Edmonton invented the Warp lace machine.

The first spinning jenny seen in America was exhibited in Philadelphia in this year, made by Christopher Tully.

A company for promoting American manufactures was formed this year at Philadelphia.

1776. Deacon Barber erected a fulling-mill at Pitsfield, Mass.

A cotton-mill erected in Philadelphia.

1778. James Hargreaves, inventor of the spinning jenny, died April 22, at Nottingham, in great distress.

Average amount of cotton imported into England, 6,766,613 lbs.

1779. Oliver Evans, of Philadelphia, invented a machine for making card-teeth, which it did efficiently at the rate of 1500 per minute.

Samuel Crompton, of Bolton, aged twenty-one, invented the "mule" jenny. It is a combination of Wyatt's and Hargreaves' spinning machines—hence the name.

William Cheape obtained a patent for a new way of arranging the simple, so that the weaver can draw it without the use of a draw-boy, or draw-boy machine. The simple being carried down in front of the batten.

1780. Attempts made in Lancashire and in Glasgow to manufacture muslin with weft spun by the jenny, but failed, owing to the coarseness of the yarn.

Benjamin Blackmore obtained a patent for weaving bolling cloths without seams.

Corduroy made at Worster, Massachusetts.

An Act passed to prevent the exportation of machinery in any form used in the textile manufactures, under a penalty of 200*l.*, and imprisonment for twelve months.

Sir Richard Arkwright had twenty factories, either his own property, or paying for permission to use his machinery.

Mr. J. Wilson was made a burgess of Dunfermline, on account of the benefit he had conferred on the town by his invention of a draw-boy machine.

1781. Sir Richard Arkwright brought an action against Colonel Mordaunt for an invasion of his patent. He also brought other similar actions against other persons.

Muslins were first made in England this year.

1782. Sir Richard Arkwright had nearly 5000 persons employed at his mills in Nottingham. He presented to Parliament his "case," or claim for important inventions, &c., in which he acknowledged Paul's patent.

The whole produce of the cotton manufacture of Great Britain did not exceed 2,000,000*l.* There were 143 cotton factories, giving employment to 60,000 persons.

1783. Above a thousand looms were set up in Glasgow this year, for the manufacture of muslins.

Cylinder printing invented and patented by Thomas Bell, of Glasgow.

1784. Fourteen bales of cotton were shipped to Liverpool, of which eight were seized as being improperly entered, on the ground that so much cotton could not have been produced in the United States.

1785. Trial concerning the validity of Arkwright's patents. The counsel opposed to Arkwright states that 30,000 people were employed in the establishments set up in defiance of the patents, and that nearly 300,000*l.* had been expended on the factories. Arkwright's patents were set aside, and the inventions thrown open to the public.

Dr. Cartwright obtained a patent for a vertical loom.

The first steam-engine applied for driving cotton machines was erected by Messrs. Boulton and Watt, at the works of Messrs. Robinsons, of Popplewick, Notts.

1786. Dr. Cartwright obtained a second patent for a "Weaving Machine," or loom, in which warp and weft stop motions are attempted.

In Lancaster, then the largest inland town in the U.S., there were at this date twenty-five weavers of woollen, linen, and cotton cloth; also three stocking weavers and four dyers.

A complete set of brass models of Arkwright's machines were made this year for transmission to the United States, but were seized on the evening before being shipped.

At this period one-third of the cotton consumed in England was brought from the British West Indies, one-third from the foreign West Indies, one quarter from Brazil, and the remainder from the Levant.

1787. Dr. Cartwright obtained a third patent for improvements in his power-loom, which comprised spring-picking motion. Stop-motion when shuttle fails to enter the box, plyers, temples, &c.

Cotton used for candle-wicks this year amounted to 1,500,000 lbs., or nearly as much as the whole importation of cotton in 1701.

An Act passed to encourage the art of designing original patterns for calico printing.

Number of cotton-mills in Great Britain, 143, as follows:—Lancashire, 41; Derbyshire, 22; Nottinghamshire, 17; Yorkshire, 11; Cheshire, 8; Staffordshire, 7; Westmoreland, 5; Berkshire, 2. Rest of England, 6.—Flintshire, 3; Pembrokeshire, 1; Lanarkshire, 4; Renfrewshire, 4; Perthshire, 3; Edinburghshire, 2; Rest of Scotland, 6.—Isle of Man, 1. There were 550 mules, and 20,700 jennies, containing, with the water frames, a total of 1,951,000 spindles, representing capital invested of 1,000,000*l*. They gave employment to 26,000 men, 31,000 women, and 53,000 children, or taken together with those employed in the subsequent processes of manufacture, a total of 350,000.

Cotton machinery first introduced into France.

1788. Joseph Alexander and James McKevin, weavers from Scotland, who understood the use of the fly shuttle, went to Providence, Rhode Island, to weave corduroy. A loom was put up in the market-house with the first fly shuttle probably ever used in America.

Thomas Clarke obtained a patent for the application of false beams, which gave way when the shuttle was trapped. Also for attaching the pickers to a rod passing under the shuttle race from one picker to the other.

The first loom in Philadelphia was built and worked this year.

Dr. Cartwright obtained a fourth patent for the use of eccentrical wheels (cams) to drive the batten with variable motion.

The first steam-engine used for cotton-spinning in Manchester was erected by Boulton and Watt for Mr. Drinkwater's Mill.

1788. Numerous grants were given about this time by the legislature of various states in America for the introduction of cotton machinery, and several experienced workmen from England were encouraged.

A large manufactory established in Boston, U.S., where sail cloth was made.

Patrick Walsh, in a letter to Dr. Meare, thus describes the origin of the celebrated Sea Island Cotton:—"I had settled in Kingston, Jamaica, some years ago, when, finding my friend Frank Leavet with his family and all his negroes in a distressed situation, he applied to me for advice as to what steps he should take, having no employment for his slaves. I advised him to go to Georgia and settle on some of the Islands, and plant provisions until something better turned up. I sent him a large quantity of various seeds of Jamaica, and Mr. Moss and Colonel Brown requested me to get some of the Pernambuco cotton seed, of which I sent him three large sacks, of which he made no use but by accident. In a letter to me during the year 1789 he said, 'Being in want of the sacks for gathering in my provisions, I shook their contents on the dunghill, and it happening to be a very wet season in the spring, multitudes of plants covered the place. These I drew out and transplanted into two acres of ground, and was highly gratified to find an abundant crop. This encouraged me to plant more. I used all my strength in cleaning and planting, and have succeeded beyond my most sanguine expectations."

1789. Dr. Cartwright obtained a patent for combing and spinning machinery.

1790. Mr. W. Kelley, of Lanark Mills, was the first to turn the "mule" by water power, and Mr. Wright, a merchant of Manchester, made a double mule.

The price for jeans in America was at this date 7*d.* per yard, exclusive of warping and winding. The weaver could weave seven yards per day.

The first steam-engine used by Arkwright was erected in his mill at Nottingham by Boulton and Watt.

Messrs. Grimshaw, of Gorton, erected a weaving factory at Knot Mills, Manchester, for the use of Dr. Cartwright's looms under a licence. The mill was burned down by a mob before it was completed.

The first sheetings, shirtings, checks, and ginghams made in America were made this year.

1791. A Mr. Felix Crawford made "flying shuttles" at No. 364, South Second Street, Philadelphia.

Richard Gorton patented a loom worked by a crank, and a "piece of square iron" is provided which strikes against a stop when the shuttle is not in the box.

Stephen Dolignon obtained a patent for a loom to weave by a machine rocking to and fro by gravity.

S. T. Wood patented a method of passing the shuttle through the shed by means of levers in a similar manner to De Gennes's loom.

1792. Dr. Cartwright obtained a fifth patent for a change shuttle box and an engine for raising a pile, and circular knives for cutting the same.

Sir Richard Arkwright died at his house at Cromford, aged sixty. He was knighted in 1786.

1793. Eli Whitney in this year invented the famous cotton or saw gin. He was a native of Massachusetts, and was employed as teacher in the family of General Green. On one occasion Mrs. Green remarked to Whitney, who was an ingenious man, that if any one could invent a machine that would clean or separate the seed from the cotton lint, no doubt he could. She urged him to make the attempt, and he proved successful.

Andrew Kinlock, with the assistance of a joiner and clock-maker, set up a power loom in Glasgow to be worked by hand power. After expending about 100*l.* upon it, he managed to weave ninety yards of cloth. His loss was made good by four members of the Glasgow chamber of commerce. Shortly afterwards he erected forty looms on the same principle, which looms, with the exception of a few slight improvements, were working in 1845 at Pollockshaws and Paisley, at which time Andrew was still living and was then eighty-five years of age. In the year 1800 he went to Staley Bridge to set up looms. In 1812, when the hand-loom weavers burned a mill down with 170 looms, Andrew had a narrow escape of his life.

In Spitalfields there were 4000 looms idle.

Messrs. Strutt of Derby erected the first fire-proof mill in England.

1794. A power-loom invented by Mr. Bell, of Glasgow, but was abandoned.

Whitney's cotton-gin patented March 14th.

1795. The second cotton-mill in the United States erected in Rhode Island.

Thomas Hofland patented a loom for giving a double blow with the batten.

1796. Mr. Robert Miller, of Glasgow, took out a patent for a power-loom, long known as the "wiper" loom from the circumstance that the picking and treadle motions were worked by cams which were called "wipers." There was a stop rod, said to be the first ever used, attached to the loom, to stop the loom when the shuttle failed to enter the box, and on this account its inventor termed it the "protector." (See 1791.)

1797. The scutching machine invented by Mr. Snodgrass, of Glasgow.

1798. Mr. Tennant, of Glasgow, patented the application of chloride of lime for bleaching purposes.

First cotton-mill and machinery in Switzerland erected.

No duty upon raw cotton imported up to this year. The following tariff was passed, which lasted to the end of the year 1800:—

	£	*s.*	*d.*	
On cotton, imported by the East India Company	4	0	0	per cwt.
,, British Colonies and Plantations	0	8	9	per 100lbs.
,, Turkey and the United States	0	6	6	,,
,, Other parts	0	12	6	,,

1799. Cotton machinery first introduced into Saxony.

1800. Michael Greenwood, a weaver of Leeds, fixed a number of wires, called a false reed, at the back of the reed of the woollen loom, which had the effect of breaking the stickiness of the warp and preventing, in a great degree, the shuttle being thrown out of its course.

1801. Mr. Monteith, of Pollockshaws, erected 200 power looms of Robert Miller's patent.

Dr. Cartwright's patent-right prolonged.

Jacquard exhibited his loom at the French Exhibition.

Population of Lancashire 762,565.

1802. William Redcliffe invented the "Dandy Loom"—a compact hand-loom with take-up motion attached.

Robert Brown, of New Radford, obtained a patent for a fishing-net making machine.

Copper wire inserted into wood-blocks for printing calicoes.

M. I. Brunel (afterwards Sir M. I. Brunel) patented a method of weaving artificial selvages to cloth, that would not unravel when being washed.

Sir Robert Peel, of Bury, was the first to print calicoes on the *resist* work system. It consisted in printing various mordants on those parts of the cloth intended to be coloured, and a paste or *resist* on such parts as were intended to remain white. The plan was discovered by a commercial traveller named Grouse, who sold the process for 5*l.*

Bandana handkerchiefs and cloths were first made this year at Glasgow.

New tariff on cotton imposed.

1803. Thomas Highs, the inventor, died, aged eighty-four.

William Radcliffe obtained a patent for his dressing machine in the name of his assistant, Thomas Johnson.

John Todd patented a loom with worm and wheel take-up motion and stop-rod.

J. Hall obtained a patent for a take-up motion for hand looms, in which the take-up roller was partly covered with "card."

William Horrocks patented a loom which afterwards came into very general use.

D. Bonner obtained a patent in Scotland for the comb draw-loom. It had one comb and lever only, and lifted wires; but shortly afterwards John Philip made one with four combs and levers, with knotted cords in lieu of wires. This had an advantage so great that it is said 600*l.* was paid to Bonner not to interfere with Philip's improvement.

1804. William Radcliffe (Thomas Johnson) obtained a second patent for further improvements in his dressing machine.

1805. A large weaving factory erected by James Finlay and Co. at Catrine, in Ayrshire.

Peter Marsland patented a plan for sizing cotton yarn in an air-tight receiver, from which the air was withdrawn by a pump.

Thomas Johnson and James Kay obtained a patent for revolving temples, formed like bevelled wheels, with pins in the edges to hold the cloth as it passes through them; also the application of projections on the picking cams.

1806. Mr. Peter Marsland, of Stockport, patented a crank motion to the batten by which the motion was caused to be slow during the passing of the shuttle.

S. Williamson patented a loom to weave two pieces of cloth side by side, with a shuttle box in centre of the batten.

1807. Mr. John Duncan, author of an "Essay on the Art of Weaving," invented and patented a tambouring machine of very ingenious construction, and containing a number of needles.

William Atkins patented a plan for weaving the selvages of shawls with separate shuttles, having boxes on each side for the purpose in addition to the boxes for the ground-work.

Estimated number of spindles in operation in the United States at this date was 4000.

1808. Snodgrass's scutching machine introduced into England, for beating and opening up cotton ready for carding.

John Heathcote took out his first patent for a bobbin-net machine.

1809. Dr. Edmund Cartwright obtained a grant of 10,000*l*.

Mr. John Heathcote obtained his second patent for a bobbin-net machine.

1810. The art of dyeing "Turkey red" discovered and practised by M. Krechlin, of Mulhausen.

William Cotton patented a let-off motion by which the warp was held between two rollers pressed together, one of which is actuated by a worm and wheel.

The throstle frame introduced into the United States.

1811. Number of spindles in operation in the United States estimated at 80,000.

1812. Samuel Crompton, the inventor of the "mule jenny," was granted 5000*l*. by Parliament. The invention not having been patented, Crompton had been unable to reap any advantage from it.

John Webb patented a loom for weaving rugs, in which the reed was open at the lower edge, and by means of "conductors" the threads from a separate beam might be moved horizontally so as to form a figure, after the manner of lappet weaving.

The number of spindles in operation in Great Britain estimated at between 4,000,0000 and 5,000,000 on the principle of Crompton's mule jenny.

Thomas Lee obtained a patent for weaving Kidderminster or Scotch carpet, with three or more warps of distinct colours. (Three-ply carpets.)

John Levers, of Nottingham, invented the lace machine known by his name.

1813. The first factory in America (if not in the world), where a power loom was used and spinning and weaving were carried on under the same roof, was erected at Waltham, Massachusetts, by Messrs. Lowell, Jackson, and Moody. This factory is still in operation.

Peter Ewart obtained a patent for a loom to be worked by air or steam by means of bellows, or a cylinder attached to the loom.

Mr. Benjamin Law commenced the shoddy, or rag wool manufacture, at Batly.

At this date there were but 100 dressing machines and 2400 power looms in operation in Great Britain. Hitherto they had shown no advantage over the hand-loom, and it was the opinion of a writer (Lees) of that time that, "whenever the great current of English twist flows unrestrictedly into the Indian market all the exertions to improve the steam loom will become futile, and all the capital and machinery employed in working it a ruinous speculation. The Indian will obtain our twist, weave it into cloth, return it to England, and with all our boasted machinery—all our steam looms and their subordinate preparatory machines, undersell us in our own market."

1815. P. and J. Taylor patented a method of giving two beats with the batten with only one revolution of the cranks.

1816. Mr. Brunel (afterwards Sir M. I. Brunel) invented and patented the first circular knitting machine.

Two thirds of the Spitalfields weavers out of employment.

1817. The number of power-looms in Lancashire was estimated this year at 2000, only one half of which were said to be in operation.

Benjamin Taylor patented a draw loom worked by a barrel studded with pegs, and causing one shed to rise while another was falling, and thereby counterpoise each other.

J. A. Wilkinson applied power to reed-making machinery.

1819. Kirk Boot, Esq., a Boston merchant, explored the wilds, as a hunter, where the city of Lowell now stands, "the Manchester of America," and discovering its resources, in company with others purchased the land and water privileges under the name of "The Proprietors of the Locks and Canals on Merrimac River."

W. Sawbridge applied a draw-boy machine on the top of a ribbon loom, and worked by two treadles.

1820. In England there were 12,150 power looms in operation, and in Scotland 2000.

Francis Lambert obtained a patent for a new method of producing the figure in weaving gold and silver lace, &c., which is simply an application of the Jacquard machine, being the first appearance of it in the patent list.

Robert Bowman patented a tappet motion by which the headles were made to rise and fall.

John Paterson, formerly a cooper of Musselburg, invented a machine for making fishing-nets, which he patented in Scotland in this year, and established a factory. Messrs. Stuart have since acquired Mr. Paterson's works and patent rights—have also improved the machines, and still carry on the business to a large extent.

1821. Stephen Wilson obtained a patent for a reading-in machine and punching apparatus for preparing cards for the Jacquard loom.

1822. The first cotton-mill erected at Lowell, Massachusetts.

William Goodman patented a narrow loom with two tiers of shuttles.

Mr. Richard Roberts obtained a patent for a tappet wheel by which the headles could be raised and lowered. Also for a let-off motion and a method of using several tiers of shuttles in the narrow loom.

Aza Arnold, a native of Rhode Island, said to have applied and put into operation this year the train of three bevel wheels (Houldsworth's equational box) to regulate the bobbin of the roving frame.

Mr. Thomas Nash, of Dundee, received a small consignment of Jute from London, and tried to get some of the manufacturers to spin it, but none would make the attempt, and after lying aside for four or five years, it was sold for making doormats. Another consignment was placed in the hands of Messrs Balfour and Meldrum, who succeeded in spinning it, and thereby laid the foundation of the Jute trade in Dundee. In 1838 the import of Jute was 1136 tons, and in 1865 it amounted to 71,702 tons.

1823. Robert Guest estimated that there were 10,000 power looms this year in operation in England.

Five Jacquard machines at work in Coventry. The first was introduced some short time previously by Mrs. Dresser. In 1832 there were 600, and in 1838 there were no less than 2228.

Aza Arnold obtained a patent in America for his bevel wheel combination or equational motion. It was patented in England by Mr. Houldsworth in 1826. This valuable contrivance is said to have been originally invented by one Johnson, of Manchester, in his search after perpetual motion. He believed that if he could obtain a multiplying power by means of wheels of the same diameter, that force also would be multiplied. The contrivance may be said to be a modification of the sun and planet motion, and is of singular merit. It is used for the purpose of giving the same number of twists per inch in the length of thread wound upon a bobbin, for as the bobbin increases in diameter at each additional layer of thread wound upon it, an alteration in the speed of the spindle must be made to correspond with it—hence Mr. Houldsworth gave the name of "equational" to the motion. (See 1826.)

1824. George Dauforth, of Massachusetts, invented the tube frame, or "Taunton speeder."

Stephen Wilson obtained a patent for weaving two pieces of velvet face to face and cutting them asunder afterwards.

P. Gasset patented a shuttle with one or more bobbins placed upon spindles fixed vertically.

Stephen Wilson patented a method of printing the warp before weaving so that figures are thrown up on the surface of the cloth.

John Potter used two cylinders with pegs fitted in a "swinging frame."

The "Spitalfields Act" repealed. (See 1773.) At this time there were 17,000 looms in Spitalfields.

In Manchester 10,000 hands employed in the silk manufacture.

1825. Mr. Richard Roberts, of Manchester, obtained a patent for his self-acting "mule."

5325 silk looms at work in Macclesfield.

Mr. Henry Houldsworth, of Manchester, took out a patent for a combination of wheels to regulate the bobbin and spindle.

The Jacquard machine introduced into Scotland.

Mr. Dyer, of Manchester, introduced the Dauforth tube frame.

Eli Whitney, inventor of the cotton-gin died, aged sixty.

30,000 power looms said to be in operation in England, and 250,000 hand looms in Great Britain.

1826. Mr. Henry Houldsworth, jun., of Manchester, obtained a patent for a "differential or equation box"—a similar combination to Arnold's previously patented in America. (See 1823.)

The Prohibition Act of Manufactured Silk Goods repealed, and an *ad valorem* duty of 30 per cent. substituted.

A power-loom weaver, about fifteen years of age, is said to be able at this time, by attending two looms, to weave twelve pieces 9-8 shirtings per week, and some could weave fifteen pieces.

At this date there were 9700 looms in Coventry, of which number 7500 were owned by the operative weavers.

1827. Samuel Crompton, inventor of the mule, died, January 26th, at Bolton.

1828. The cap-spinner was invented and patented by Charles Daufroth, of Paterson, N.J.

The use of leather belts in place of wheel-gearing to main shafting was introduced by Mr. P. Moody, at Lowell.

1829. Gilbert Brewster, of Poughkeepsie, N.Y., patented the "Eclipse Speeder."

Josué Heilmann, of Mulhouse, patented his embroidering machine, which contained from 80 to 140 needles, governed by a pantograph, to which was attached a pointer to trace over the surface of any given design. The needles, by means of the pantograph, reduced the size of the figure. They had an eye in the middle of their length, and were passed to and fro through the cloth by means of pincers. The work produced was similar in effect to hand-embroidery of small figures—at the present time more effectually done by means of swivels and circles.

16,000 looms in Spitalfields, 7000 of which were unemployed, and in Macclesfield only 3000 were employed. This was attributed to the admission of foreign silks, which had been prohibited from 1765 to 1826.

1830. J. H. Sadler obtained a patent for a loom to be worked by means of a pendulum set in motion by the hand.

The power loom applied to weaving cloth in Scotland.

1831. The "Ring" spinning frame was invented this year by John Sharp, of Providence, R.I.

In the United States in this year there were—

Mills	801
Looms	33,433
Males employed	18,590
Females "	38,727
Children "	4,091

Messrs. Watson, of Hawick, sent to a merchant, Mr. J. Locke, in London, a quantity of *tweels* (twilled cloth), which word was misread as "tweeds." On sending for more goods Mr. Locke ordered them as "tweeds," which name is still adopted.

1832. In Glasgow there were at this date sixty-three weaving factories and 14,127 looms, and in Lancashire there were 80,000 power looms.

Mr. R. Whytock, of Edinburgh, patented the system of printing figures upon the warp for weaving Brussels carpets, called tapestry carpets, which effected a great saving in materials. The process has been very extensively used at Halifax.

The stop motion in the drawing-frame invented by Samuel Batchelder, and used at Saco, Maine, and patented in England by H. Houldsworth.

1833.

The number of power looms in Great Britain	In England	85,000
	In Scotland	15,000
		100,000

The number of hand looms employed in the cotton manufacture being estimated at 250,000.

Josué Heilmann invented a measuring and folding machine for piece goods.

A power-loom weaver, with the assistance of a girl about twelve years of age, could attend four looms, and weave eighteen pieces of 9-8 shirting per week. A hand-loom weaver could weave only two such pieces.

J. F. Gerard obtained a patent for a method of using perforated paper instead of cards to the Jacquard machine.

1834. Messrs. Hornby and Kenworthy patent a method of applying a friction pulley and face plate, for altering the speed of the take-up motion—the rate of speed being regulated by the friction pulley being brought nearer to, or farther from, the centre of the plate. Also for a "vibrating or fly reed," together with a system of levers to throw the loom out of action when the weft thread breaks.

L. and J. Smith obtain a patent for a method of picking from the crank shaft by means of inclined planes fixed on the periphery of a fly-wheel on each end of the crank shaft, and each of these inclined planes are made to operate upon its respective picking stick at every second revolution of the shaft. This was the forerunner of the scroll-picking motion.

John Ramsbottom and Richard Holt patented a loom, to which they applied a weft-stop motion, consisting of several slight wires attached to a lever, which, in the absence of the weft thread, caused a spring to act upon the driving strap, and move it from the fast to the loose pulley. This invention was the forerunner of the present system.

Jacquard died August 7th.

A Committee was appointed this year by order of the House of Commons to inquire into the case of the hand-loom weavers who had become greatly impoverished by the introduction of the power loom, the evidence showing their sad condition.

1835. Messrs. Cropper and Milnes obtained a patent for applying lace machine bobbins and carriages for producing figures on the surface of cloth, as in swivel weaving.

John Osbaldeston patented a method of making healds of fine brass wire so twisted together that an eyelet-hole was left in the middle.

Mr. John Heathcoat, the inventor of the bobbin-net frame, obtained a patent for weaving narrow articles, such as tapes, standing edgewise, their faces being parallel to each other.

Mr. Samuel Draper, of Nottingham, tried to adapt the Jacquard machine to the lace frame (see Chapter 32).

1836. James Morison applied the Jacquard machine to drop boxes. Alpaca wool introduced.

1837. Cotton warps introduced into the Bradford stuff manufacture, a step that has proved of the greatest advantage to that trade.

1838. Mr. Woodcroft obtained a patent for a shedding motion, with rising and falling shed; also for a tappet motion in which movable segments are used to raise or lower the headles.

1839. John Rostron obtained a patent for a continuous chain of tappets, formed by a succession of side links connected by transverse bolts or spindles, upon which are placed small bowls or rollers, as tappets, of various widths, &c.

F. Vouillon patented his method of drawing glass, of various colours, into fine fibres, and weaving the same in damask work.

Peter Lomax employed the Jacquard machine to raise the knobs on counterpanes by means of hooks for raising the same.

James Smith patented a revolving temple with points.

C. Gilroy patented a fork and grid weft stop motion.

1840. George Clarke patented a flexible rack or endless band, on which tappets could be fixed for actuating the headles.

Charles Parker obtained a patent for changing the shuttle when the weft thread is broken or the bobbin empty. This was to be effected by using a drawer with two compartments, each of the width of a shuttle, and by means of a lever and spring barrel, the other compartment is moved into the place of the one with expended weft.

Miles Berry patented a carpet loom with shuttle boxes fixed to the side of the loom instead of to the batten.

1841. Messrs. Kenworthy and Bullough obtained a patent for a roller-temple, which is still in use, and is a most effectual contrivance. Also for a weft stop-motion, as at present used. This patent, in addition to the above important improvements, included a stop motion to the cloth beam when the weft thread broke, or became exhausted.

Mr. Horton Deverill applied Jacquard apparatus to the lace frame, it is said for the first time successfully. He adopted two griffe bars. Several patents had been taken out previously (see 1835).

1842. John Railton obtained a patent for a temple consisting of two or more small metal rollers or bars upon which a right and a left handed thread is formed, and then fluted, so that they form a series of points or pins. As the cloth passes over it is distended by the right and left handed screws acting in opposite directions.

R. W. Sievier patented a method of weaving terry velvet or looped surfaces by varying the length of the stroke of the batten, and loosening the pile beam to beat the loop forward after it had been held by binding shoots, and thereby dispensing with wires.

James Bullough patented a loose reed motion to prevent the shuttle when trapped from injuring the warp. Also a Jacquard with a separate motion to work the cylinder from the crank shaft.

Thomas Thompson patented a method of inserting and withdrawing wires or tags as used in weaving terry velvet.

1843. Luke Smith patented a circular change box, having three boxes for shuttles, and actuated by studs fixed on a revolving belt. This patent includes the scroll picking motion, to pick from the crank shaft. Also to throw two shuttles through two sheds, one above the other at the same time. The top shuttle to rest on the lower one.

1844. John Smith patented the use of a sliding lever, with an eye in lieu of a shuttle—the weft thread being inserted double.

William Kenworthy obtained a patent for actuating the stop-rod independently of the shuttle, thereby relieving the shuttle from the burden.

Joseph Meeus proposed to force the shuttle through the shed by pressing the warp-threads on the tail of the shuttle, also by the use of a magnet acting on an iron shuttle.

1845. Squire Diggle obtained a patent for a tappet chain composed of plates acting as cams of various sizes to elevate the shuttle boxes. This system has been very extensively adopted for various other purposes.

John Sellers applied a brake in conjunction with the stop-rod motion of the loom, being a most important improvement to the power loom.

Duty of 30 per cent. on silk-manufactured goods reduced to 15 per cent., making it unprofitable to smuggle.

In 1860 the duty on all kinds of foreign silks was repealed by Mr. Gladstone.

1846. William Unsworth patented a shuttleless loom for narrow goods; the weft being carried through the shed by bent arms and held on vertical pins when passed through.

Messrs. Reid and Johnson form two separate sheds, and use two shuttles in a vertical loom.

Josué Heilmann, born at Mulhouse, France, in 1796, invented the combing machine for combing cotton of long fibres, particularly valuable for fine spinning. He was also the inventor of the embroidering machine, &c. (see 1829 and 1833).

1847. K. Vogel patented a method of making healds by braiding together the strands throughout the length of the leash, with the exception of the loop or eye.

John Carr obtained a patent for stopping the motion of the batten only, and not the loom, when the shuttle did not enter the box.

1848. William Curtain patented a method of cutting the pile of carpets or velvets by means of a sharp curved blade fixed at the end of the wires, which, upon being drawn out of the loops, completely severs the top of the pile (see Chapter 18).

1849. William Thomas obtained a patent for weaving the webbing for Venetian blinds by causing the connecting parts to be woven together, instead of being sewn as heretofore.

John Bottomley applied small shuttles or swivels to the power loom.

F. W. Norton patented the application of stationary wires, placed longitudinally for the production of looped fabrics, the warp threads being passed over the wires in a similar manner to cross weaving.

Edwin Heywood obtained a patent for weaving with swivels and forming two sheds, so that the swivels and ground shuttle could be thrown simultaneously.

The double-action Jacquard machine patented by Alfred Barlow.

1850. Cloth plaiding and blankets are still made in the households of the remoter districts of the Highlands.

1851. This year will be ever memorable as the Great Exhibition year. During the past half-century, France had held no less than eleven exhibitions of a similar nature, which had proved of great advantage towards the advancement of the arts and manufactures of that country. To follow the example thus given, the Society of Arts attempted, in 1845, to carry out a scheme of a similar kind in this country, but it was not until the year 1849, when Prince Albert was President of the Society, that they succeeded in making the necessary arrangements for the purpose. The scheme being new to the nation, it naturally offered many obstacles to carry it into effect, but they were overcome, and the result was not only eminently successful and self-supporting, but it realized a surplus fund of such great extent as to provide means for future exhibitions and museums of a similar nature. Upwards of six millions of persons visited the Exhibition. There were 17,000 Exhibitors, to whom were awarded 170 Council medals; 2918 Prize medals, and honourable mention to 5084.

The textile manufactures and machinery were profusely represented, and many of the machines and looms were kept in operation.

Since this period, numerous inventions in various branches of weaving have been made. They, however, consist chiefly of modifications and improvements upon inventions that had already been in use. A few exceptions may be made, such as the electric loom, the pneumatic loom, and the method of drawing the shuttle through the shed by means of a carriage placed beneath the warp. But these contrivances, although they display a considerable amount of originality and ingenuity, do not appear to have been sufficiently practicable as to become of general use.

CHAPTER II.

ANCIENT LOOMS.

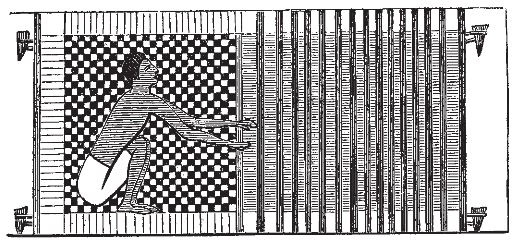
Ancient Egyptian looms—Greek and Icelandic looms—Ancient French loom—Indian looms—Chinese and Japanese looms.

It may be said of many processes practised in the useful arts which have long been in use, that they rarely suggest to the observer that they may be supplanted by new and quite different methods, and for the old system to become totally forgotten. In this way many of the ancient arts have been lost, simply through historians making no record of them. Certainly as regards weaving, there are frequent allusions in ancient writings to various fabrics and to the loom; but probably in no instance is there to be found a written description, however meagre, of the loom or process of weaving. It is not until very recent times, almost within the memory of men, especially as regards this country, that any written account of the art of weaving has been given. The cause, however, is not far to be sought. The weaver has never troubled himself about that which is so common to him, and no doubt thought the way he worked and the kind of instruments he used would last for all time. The looker-on perhaps believed the same, and as very few would observe the process sufficiently well to understand it, there might be none who would ever think of describing it. Consequently, nothing whatever is known of the ancient practice of weaving, except from a few paintings in which looms are represented. The most ancient of these are the wall-paintings at Thebes, in which the arts of spinning and weaving are shown, and on these almost all our knowledge of the ancient looms depend.

There are three representations of the Egyptian looms at Thebes, with weavers working at them, of which the following sketches are copies.

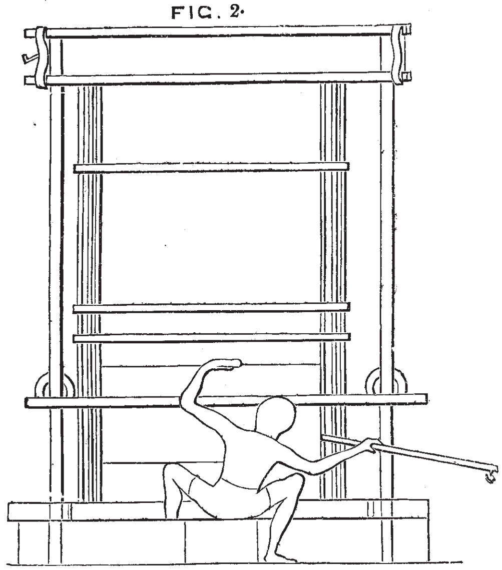
Fig. 1 represents a weaver at work upon a piece of cloth woven in a horizontal position, in fact on the ground. It is probable that it was a mat, carpet, or rug that he was making, for it is of large size, and appears to be of a definite length.

FIG. 1.



In fig. 2 the loom is a vertical one, and the weaver seems to be in the act of throwing the weft through the warp by means of a rod, at the end of which there is a hook. Now Sir Gardiner Wilkinson, from whose work[1] these sketches are taken, says that he

FIG. 2.



thinks the hooks were for the purpose of drawing the weft thread through the warp, in a similar manner, it may be supposed, to willow or horse-hair weaving, where short lengths of weft can only be used. If such was the case, the cloth would have at least one loose

[1] "Manners and Customs of the Ancient Egyptians."

selvage, and probably two. But the cloth wound round mummies appears to have both selvages perfect, therefore the rod, if employed in weaving them, must have been passed completely through the opening or shed. This, however, scarcely was the case, for the process would not correspond with the well-known rapidity of the shuttle, which was, as already mentioned, in use at that time.

In fig. 3 a smaller loom is shown, and two weavers appear to be at work making cloth. There is still the rod and hook as in fig. 2, consequently the same difficulty as to the process.

Herodotus visited Egypt about 450 years before the present era, but the only allusion to the loom which he makes is where he says, "In this country the women leave to the men the management of the loom in the retirement of the house, whilst they themselves are

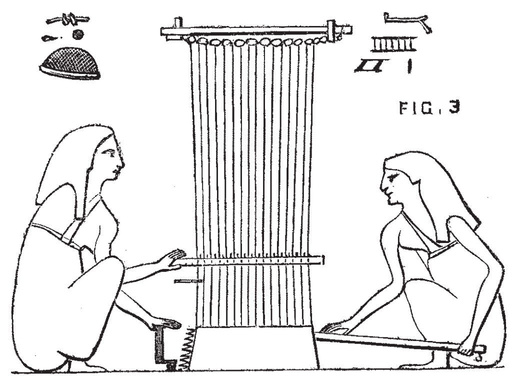


FIG. 3

engaged abroad in the business of commerce. Other nations in weaving shoot the woof above, the Egyptians beneath."

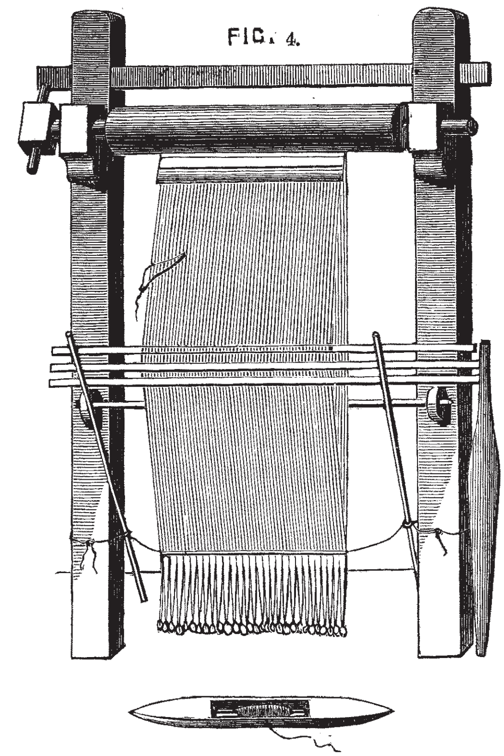
The drawings show both men and women were engaged in weaving, and such was probably the case.

It may be supposed that amongst the great number of hieroglyphics on the various ancient Egyptian remains in the British Museum, there would be some representing looms, or portions of a loom, but there appears to be only one such instance, and that one is cut on the side of a sarcophagus, and is in the form of the block letter ⊔. It is said to relate to a certain gift of cloth (of which article it is the symbol) made to the priests of one of the temples.

The looms used by the ancient Greeks and Romans are said to have been vertical ones, similar to the Egyptian looms, but nothing certain is really known respecting them.

In Dr. Smith's dictionary of "Greek and Roman Antiquities," under the article Tela (Greek loom), Mr. Yates, in describing the ancient Greek loom, compares it with the common loom used in Iceland, if not at the present, at all events in very recent times. Fig. 4 is a representation of this loom. The warp is suspended

FIG. 4.



from the top beam of the loom, and the lower ends are tied up in separate portions, which are weighted to keep the threads in tension. The cloth was woven *upwards*. Before the reed was invented the weft thread is said to have been combed evenly into its place by means of a comb adapted for the purpose, and the blow was given to drive them together by the use of a flat sword-shaped piece of wood, which was introduced into the shed for that purpose. This latter instrument was called the "spatha," and is shown in the figure at the side of the loom. Such an instrument is still used in some kinds of mat making, but not for weaving cloth as here described.

It may be remarked that the use of the comb ought not, in all cases, to imply that a reed was not used. It is far from being uncommon for weavers of the present day to use a comb, especially when they have a sticky warp to weave, or a warp that, owing to the felting property of the material, requires to be separated frequently.

The reed itself is but a species of comb, and takes its name from the material of which it was formerly made, viz., slips of reed. It is not, therefore, unreasonable to infer that the reed was used in ancient times, as well as the comb, in the weaving of the finer descriptions of cloth; and in the weaving of rugs or matting, the comb, spatha, and the hook before mentioned would thus be satisfactorily explained (see Chapter 18).

In the *upward* way of weaving, it is easy to see how to slide the shuttle from side to side, for it could run upon the comb or reed—as in some modern vertical looms—but it is not so easy to conceive how to slide the shuttle when the cloth was woven downward, unless it was thrown from hand to hand, or made to slide upon a long comb temporarily introduced.

On referring to the drawing of the loom in Olaf Olafsen's work[2] on Iceland, to which Mr. Yates alludes, the warp does not appear to terminate at the suspended weights; but it returns to the top piece of the loom, which acts as a warp beam, although the warp seems to hang upon it like a skein, to be slackened out as required.

A stretcher, or temple, is also shown, and the rods crossing the middle of the loom have short leashes attached, and in fact are headles. There are three headles shown and two lease rods.

As the cloth was woven the weights were drawn upwards, and, as above stated, the warp would be slackened out, and the weights would be refixed as the work progressed. In this instance, the drawing not being faithfully copied from Olafsen's work, has occasioned a wrong idea of the action of the loom, and a similar fault may possibly exist in the copies of the Egyptian paintings.

The same description of loom seems to have been used in Lapland as well as in Iceland, and Leems[3] says in his account of that country that they weave sheeting, which is so worked that after it has been in use a little time "in covering them," when it becomes worn, it is converted to the use of "covering for the winter's hut." A great number of these are woven from thick white thread, with dark fringes of black or ash colour. The process is thus described by him:—

[2] Published at Amsterdam, 1780.
[3] Pinkerton, vol. i. p. 447 (1808).

"The loom in which are woven these sheets is made from out of two thick beams raised on end, on the extremity of which is loosely fixed a weaver's beam, extending from the one column to the other; to this they fasten the upper end of the thread, which comes down from the weaving-beam straight to the ground; and as the thread is neither thrown with a shuttle nor pressed together, but worked with the hand, whilst it is knocked together with a little beetle on coming back, the other part of the thread is brought together by the flat part of the hand, so that a space should be open for putting in the hand through the little fork which is sustained from the ends of the two little arms that project out from the columns. Hence it falls obliquely before it gets directly down. To the lower extremity of the woof are fastened stones, lest, if loosened, it may entangle the body of the thread; but being kept stiff and extended by its weight, it should preserve the whole together. The woof is thus conveyed, and in the above manner, first to the upper part of the beam, and is woven with the hand, whence it is clear that in making sheeting or covering one must begin from the upper end. As weavers cover round in a weaving-machine the beam at the end gradually with linen by turning it round, so also the beam of the aforesaid weaving-machine is gradually covered over while turning with the stuff that is made. They weave gloves from the wool of sheep mixed with that of hares. This is the manufacture of women alone."

Weaving amongst the Greeks and Romans was a distinct trade, and carried on in towns, yet every considerable domestic establishment, especially in the country, contained a loom, together with the whole apparatus necessary for the working of wool. When the farm or palace was sufficiently large, a portion of it, called the "textrinum," was devoted to the purpose, and the work there was carried on by female slaves, under the superintendence of the mistress of the house and her daughters.

Fig. 5 represents a loom which is asserted by Montfaucon to be copied from an ancient manuscript supposed to be of the fourth century, and entitled the "Virgil of the Vatican." It formerly belonged to the monastery of St. Denys, in France.

In the fourth century the task of weaving began to be transferred in Europe from women to the other sex, a change which St. Chrysostom deplores as a sign of the prevailing sloth and effeminacy of his day.

The Indian loom is probably a very ancient contrivance, and, as

FIG. 5.

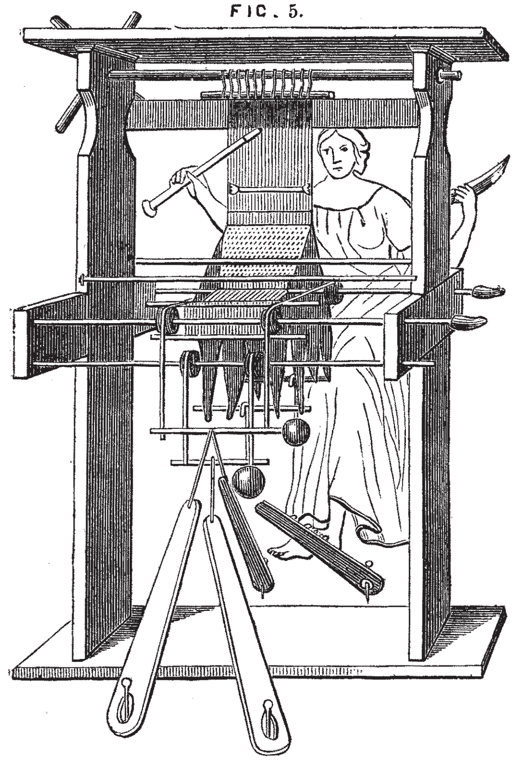
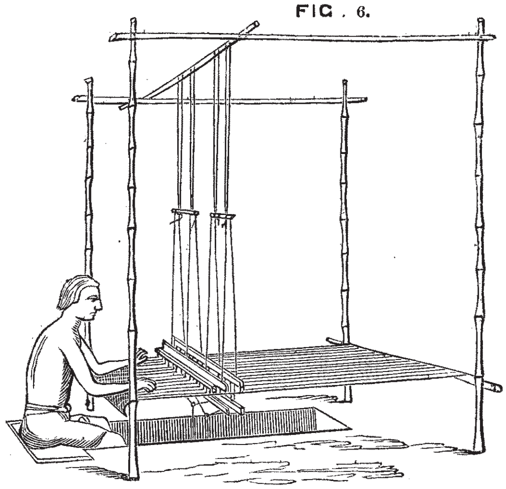


FIG. 6.



the common European hand loom is made upon exactly the same principle, it is quite possible that it may have been originally introduced from India or Persia. By its means, notwithstanding its rude construction, the most delicate muslins, cloths, shawls, and other famous Indian fabrics are produced. Consequently a full description of it can scarcely be omitted here. Fig. 6 represents a common Indian loom as used in the celebrated manufactures of Dacca.

Dr. J. Forbes Watson, M.A., in his work on "The Textile Manufactures and the Customs of the People of India," enters fully into their mode of spinning and weaving and gives descriptions of their ornamental fabrics. In describing the looms which produce the famous muslins of Dacca, he extracts from the work of Mr. Taylor, which was published for private circulation only. This gentleman formerly resided at Dacca, and was intimately acquainted with the mode of spinning and weaving there. From both these sources we learn that at Dacca the loom is *always* placed under a *shed* or *under cover*, or in the weaver's house, and not in the open air, as usually represented. The warp is fixed to the cloth-beam by a small slip of bamboo passed through the loops and fixed into the groove. The beam is wound up by a winch, and held by a stick passing through a mortice hole, and fixed to the ground.

The batten consists of two flat pieces of wood, into which grooves are cut for the reed or sley, which is fixed in by iron or wooden pins, and is suspended from the capes of the loom. The range of motion of the batten is adjusted by passing slings through several pieces of sawn shell. By lengthening or shortening the slings the extent of motion is adjusted, for upon this the regularity of the blow depends.

The balances of the headles, having the slings fixed at their extremities, are suspended from the transverse rod above. The treadles are made from pieces of bamboo, and are contained in a pit dug in the ground about 3 ft. long, 2 ft. wide, and 18 in. deep.

The shuttle is made of *light* wood, of the betel-nut tree (*Areca catechu*), and has spear-shaped iron points. It is from 10 in. to 14 in. long, and ¾ in. wide, and weighs about 2 oz. It has a long open space for the wire, upon which the reed on which the weft is wound revolves. The weft passes through an eye at the side of the shuttle.

The temple (the instrument for stretching the cloth from selvage to selvage during the operation of weaving) is formed of two pieces of wood, connected together with cord, and having at their ends two brass hooks or pins, which are inserted in the edges of the cloth on the under surface.

The weaver sits with his right leg bent under him upon a piece of board or mat, placed close to the edge of the pit, and depresses the treadles alternately with the great toe of the left foot. The stretch of the warp seldom exceeds one yard in length, and the depth of the shed is about seven-eighths of an inch.

To lessen friction, the shuttle, reed, and lay (shuttle-race) are all oiled, and a brush smeared with mustard-oil is occasionally drawn along the warp. The brush is made of a tuft of fibres of the nut-plant (*Arundo karka*). When ten or twelve inches of cloth are woven, it is sprinkled with lime-water, to prevent its being injured by insects. The most favourable condition of the atmosphere for weaving is about 82 deg., combined with moisture, and to effect this in very dry weather, shallow vessels containing water are placed under the loom. A piece of Dacca muslin measures twenty yards in length by one yard in width. In the preparation of the warp it takes two men from ten to thirty days.

The weaving of such cloth takes two persons (one to weave and the other to prepare the weft and attend) from ten to fifteen days for the ordinary assortments. Twenty days for fine, and thirty days for superfine. The "fine" superfine takes from forty to forty-five days, and the *dooreas* or *charkana* assortments, sixty days.

A specimen of cloth called *mulmul khas* (muslin made for the king), and measuring ten yards by one yard, contained 1800 or 1900 threads in the warp. It weighed 3 oz. 2 dwt. 14 grains troy. It is so fine as to pass through the smallest ring. Price 100 rupees, or 10*l.* Another specimen, as worn by native dancers and singers, measuring twenty yards by one yard, had 1000 threads in the warp, and weighed $8\frac{1}{2}$ oz.

The Indian method of weaving figured muslin may be taken as the general mode adopted for weaving the various beautiful fabrics for which they are so celebrated. The process is as follows:—

"Two weavers sit at the loom. They place the pattern, drawn upon paper, below the warp, and range along the track of the woof a number of cut threads equal to the flowers, or parts of the design intended to be made, and then with two small fine pointed bamboo sticks, they draw each of these threads between as many threads of the warp as may be equal to the width of the figure which is to be formed. When all the threads have been brought between the warp, they are drawn close by a stroke of the lay. The shuttle is then passed by one of the weavers through the shed, and the weft having been driven home, it is returned by the other weaver. The weavers resume their work with the bamboo sticks, and repeat the operation with the lay and shuttle in the manner above described, observing each time to pass the flower threads between a greater or less number of the threads of the warp, in proportion to the size of the design to be formed."

It is thus seen that the ornamental fabrics of India are purely a handicraft work, and performed in the rude description of loom already described.

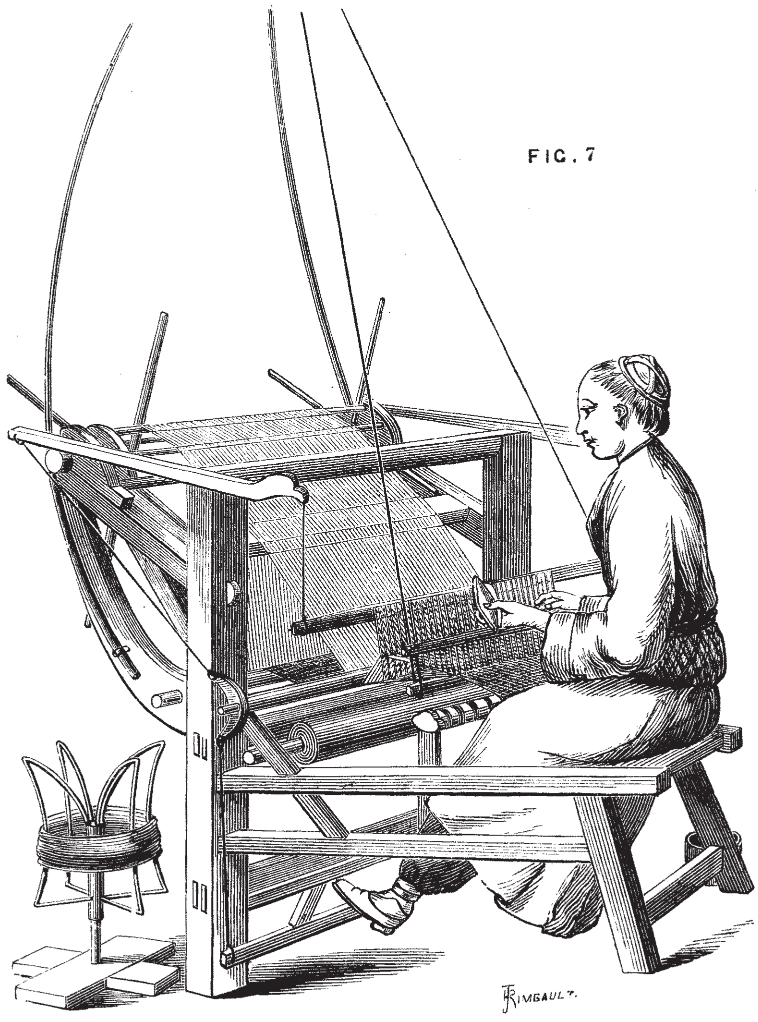
The following account of Indian weaving, from "Mill's History of British India," forms quite a contrast to the method described by Mr. Taylor:—"The loom consists merely of two bamboo rollers, one for the warp and the other for the web, and a pair of gear. The shuttle performs the double office of shuttle and batten, and for this purpose is made like a large netting-needle, and of a length somewhat exceeding the breadth of the piece. This apparatus the weaver carries to a tree, under which he digs a hole large enough to contain his legs and the lower part of the gear. He then stretches his warp, by fastening his bamboo rollers at a due distance from each other on the turf by wood pins. The balances of the gear he fastens to some convenient branch of the tree over his head; two loops underneath the gear, in which he inserts his great toes, serve instead of treadles; and his long shuttle which also performs the office of batten, draws the weft through the warp, and afterwards strikes it up close to the web."

No doubt the above relates to a different class of weaving to that referred to by Mr. Taylor, and it seems to throw some light on the Egyptian looms before mentioned.

In a "Handbook of the Manufactures of the Punjab," by Mr. B. H. Baden Powell, published at Lahore in 1872, the following particulars are given relative to Indian shawls :—

"A first-rate woven shawl (Kashmir), weighing 7 lbs., will fetch in Kashmir as much as 300*l.*, which price is made up of 30*l.*, the cost of material; 150*l.*, the wages and labour; 70*l.*, duty; 50*l.*, miscellaneous expenses. The weft is made of yarn, which is single, but a little thicker than the double yarn or twist of the warp. Silk is generally used for the warp on the borders of the shawl. When the border is narrow, it is woven with the body of the shawl; but when wide, it is woven separately, and sewn on with such nicety as scarcely to be detected. The face of the cloth is woven next the ground, the work being carried on at the back or reverse side. From four to fifteen hundred needles (shuttles) are used, according to the heaviness of the embroidery. When one line of woof is completed, the comb is brought down with a vigour and repetition

FIG. 7



CHINESE SILK LOOM.

apparently very disproportionate to the delicacy of the materials. "They are sometimes woven all in one piece, but oftener in distinct portions which are afterwards most skilfully joined together by hand."

The Chinese loom shown at fig. 7, presents such a contrast to the other primitive looms represented, that it cannot fail to be appreciated for its originality of form and the suggestiveness of its various parts. Compared with the modern hand loom it is singularly compact and adapted for household use. In ancient times weaving was practised in all the great houses, where a room was set apart for the purpose, and this form of loom would be very suitable for similar domestic use. But apart from that consideration, the power-loom maker may possibly find in its general outline an arrangement worthy of attention.

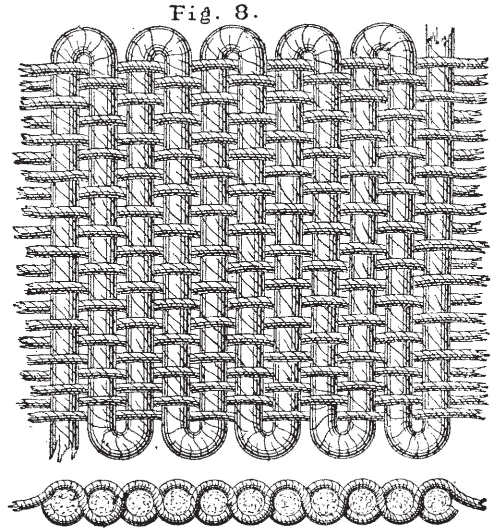
The Japanese loom for making mats, may perhaps, afford some explanation with regard to ancient vertical looms. It is composed of two upright posts, upon which a cross piece, with holes morticed through, is made to slide. On the top of the post another cross piece is fixed firmly. The warp merely consists of a number of separate threads, which pass over the top piece and under the sliding piece, and the ends are tied together. Thus the warp is really a number of loops only, and as the weft, made of rushes, &c., is inserted, the sliding piece rises, according as the warp is shortened by the intersections. The most singular part of the Japanese mode of weaving is, that they do not always use a bobbin in the shuttle, but wind the weft upon their fingers, so as to form a small skein, the weft being wound crossed in shape of the figure ∞, by which means the thread unwinds without getting entangled. It is said they prefer this method to any other.

CHAPTER III.

WARPING AND BEAMING.

THE art of the weaver is shown to the greatest advantage in the manufacture of silk fabrics, for in the great variety, fineness and intricacy of the work, silk weaving not only includes the principles, but surpasses the weaving of all other substances whatsoever. Therefore, it will be first described, when every other description of weaving will be seen to be simple modifications of it, and will be readily

Fig. 8.

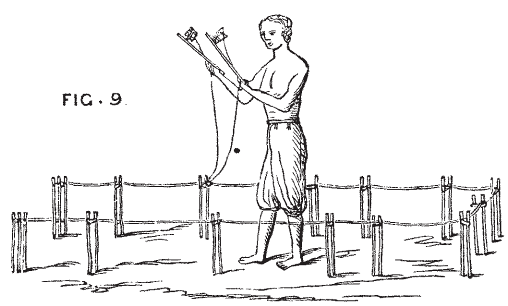


understood. If a piece of plain cloth or calico be examined, it will be found to consist of a number of threads placed paralled to each other, which are interlaced alternately by a single thread passing from side to side of the cloth. This separate thread is the weft thread, and has been inserted between the other threads, called the warp, by means of a shuttle. The alternate intersection of the warp and weft threads, therefore, constitutes plain weaving, as represented at fig. 8, which shows the combination of the threads in plain cloth, as seen when magnified. The warp threads are usually much finer than the weft thread, and the fibres are generally spun together in a similar manner to a two or three strand cord. On the contrary, the weft thread is but slightly spun, and usually consists of one strand only. By this means the weft is made soft and yielding, and is better adapted to fill the interstices of the cloth, whilst the warp thread is made firmer, and not only adds more strength to the cloth, but it is much better suited to undergo the process of weaving.

In the throwing or spinning of silk this difference of twisting is expressed by calling the weft thread "tram," which is from "trama," the Latin name for weft; and the warp, owing to its excessive twist, is called "organzine," an Italian technical term, which means extra-spun or machined.

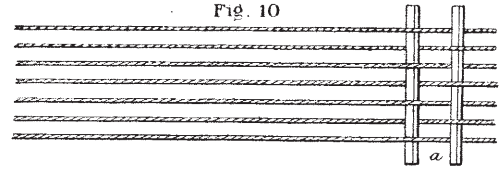
The first process in weaving is to arrange the warp threads for the loom. These differ in length and number according to the length, fineness, and width of the cloth. Before the invention of the warping frame, the process of warping was simply to place a few pegs at the required distance apart, and walk from one to the other, at the same time unwinding the threads from several bobbins or reels, until a sufficient number were collected together of the desired length. This method is still adopted in India, where sticks are fixed in the ground for that purpose, and the weaver taking two reels, one in each hand, passes alternately from one stick to the other, as represented in Fig. 9.

FIG. 9



Warping, therefore, consists in arranging the threads according to number and colour, or in any special manner that may be necessary, and to keep them in their relative places after they have been so laid. This is effected by crossing the threads at one end of the warp alternately, and by means of a cord keeping them in that position. This will be seen by referring to *a* and *b*, Figs. 10 and 11, which show the crossing of the threads over and under the pegs

Fig. 10



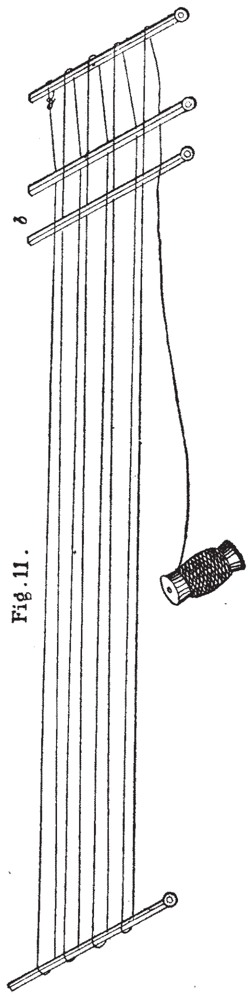


Fig. 11.

by each thread alternately. Before taking them off the pegs, if a cord be placed so as to occupy the places of the pegs, their relative order would always be kept, and the whole warp may then be rolled into a ball or looped like a chain, as may be desired, without fear of disarrangement. This intersection or crossing of the threads is called the "lease" by weavers.

It will be apparent that in long lengths of warp, and composed, as in many instances they are, of thousands of threads, some other method must be adopted for warping. This is performed by means of the warping mill or frame. The requirement being simply what is shown in Figs. 10 and 11, the action of the warping-frame will be readily understood. Fig. 12 represents the machine which is simply a large reel, and is turned by a winch and rope, as shown. A number of bobbins are placed in a frame, shown at *a*, and the threads from them are wound upon the reel.

In passing from the frame *a* to the reel the threads are concentrated at *b*, where they pass between rollers placed vertically, and sunk a short distance into the block upon which they stand (Fig. 13), so as to prevent the threads from passing beneath. In this method the cross is formed by passing the hand between the threads alternately under and over. Fig. 14 shows another plan, where at *b* the threads are passed through a corresponding number of eyes, which are fitted into the block called the "heck." The heck is made to slide up and down the frame-post by means of the cord to which it is attached. Therefore, as the reel or frame is moved backwards or forwards, the heck rises or falls, and distributes the threads in regular order upon the frame. If there are 100 bobbins or any other convenient number in the frame to wind from, a warp of any

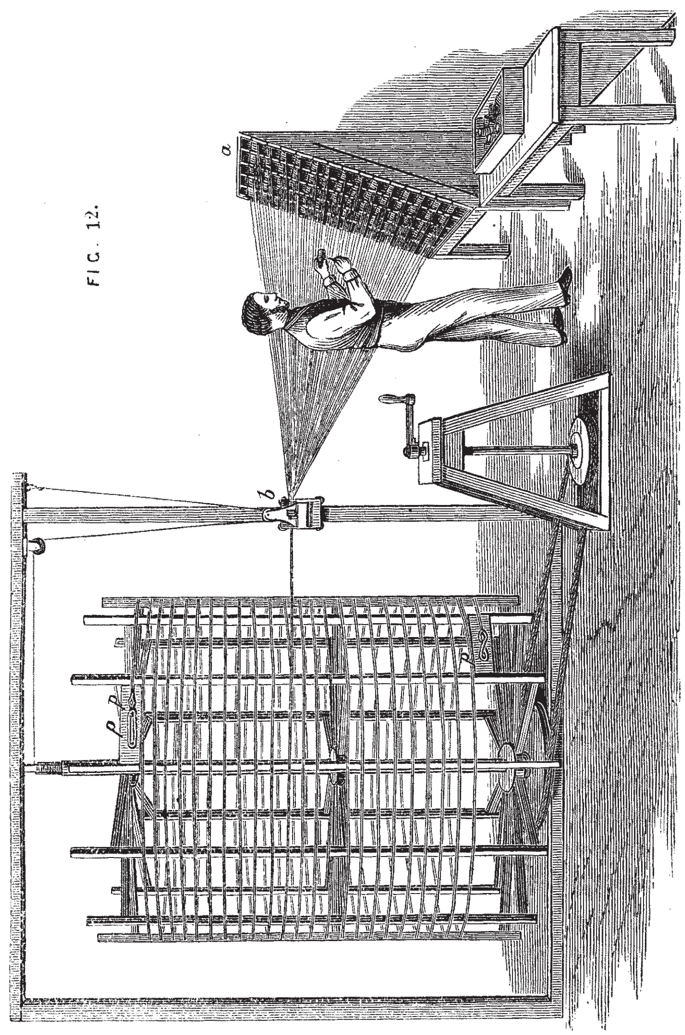
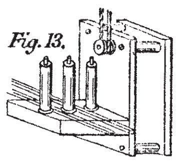


FIG. 12.

number of threads may be laid, as required, by turning the reel forwards and backwards the requisite number of times, which process lays the threads from one peg to the other, as performed by hand. The crossing of the threads, or making a lease, is effected by means of the eyes in the heck, which are shown, enlarged, at *b*,

FIG. 14.

Fig. 13.



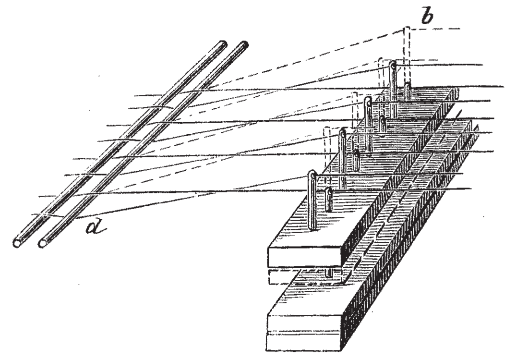


Fig. 14. They are shown fixed in two separate rails, each rail having every alternate eye fixed into it.

Now, by raising and lowering one set of the eyes above and afterwards below the other, an opening is made between the threads corresponding to the position shown in Figs. 10 and 11, and they are by this means placed in a similar order upon the pegs P P of the warping-frame.

Fig. 15.

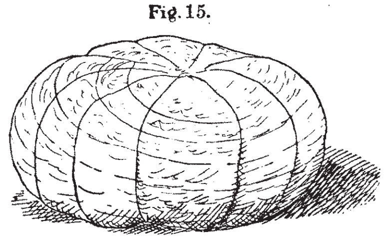
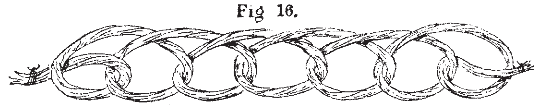


Fig 16.



The length of the warp is regulated by altering the position of the lower peg, from which the return movement is made.

The winding and unwinding of the cord round the spindle raises and lowers the heck-block, and thus acts as a guider in distributing the threads upon the large reel, and keeps each additional layer in its proper place. The warp is then taken off the reel and wound up into a ball-form, or looped in the form of a chain, as shown in Figs. 15 and 16, as may be most convenient, until required for weaving.

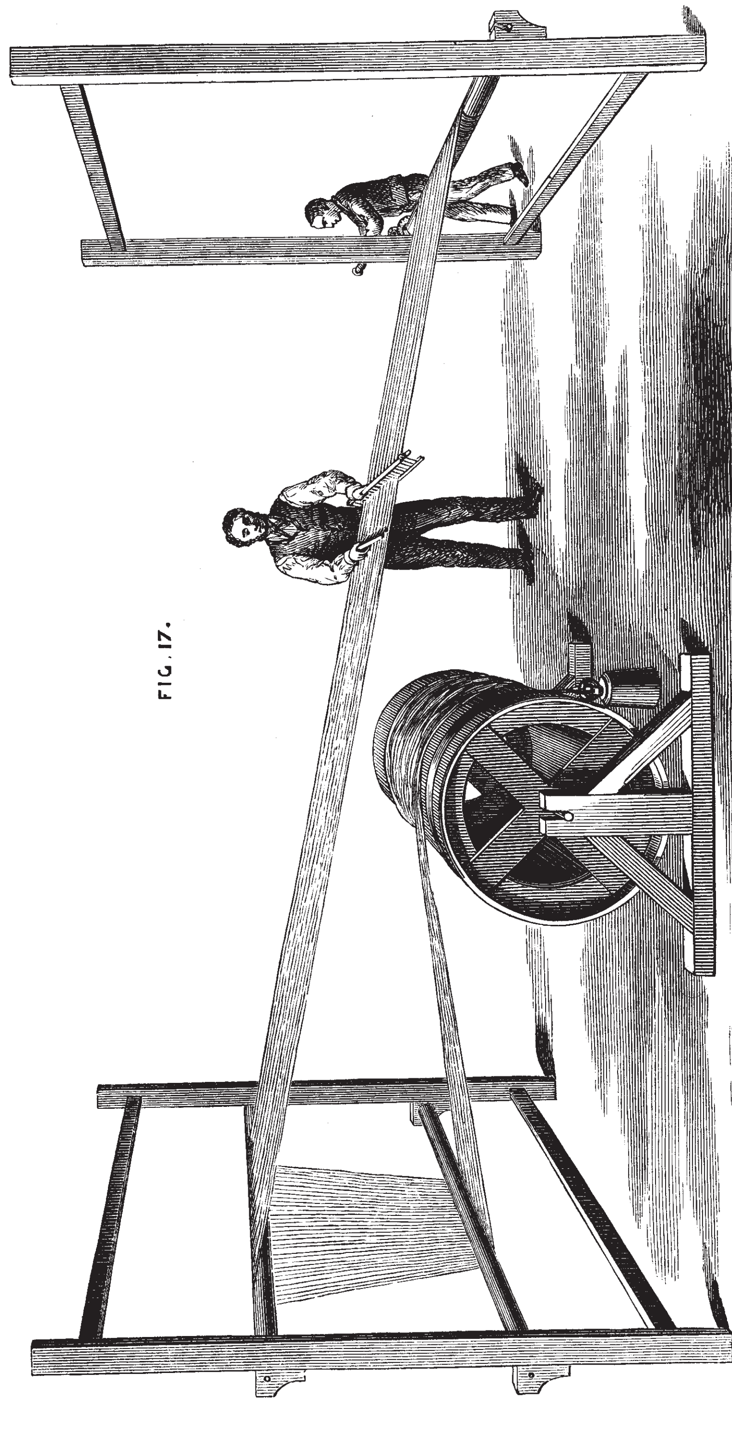


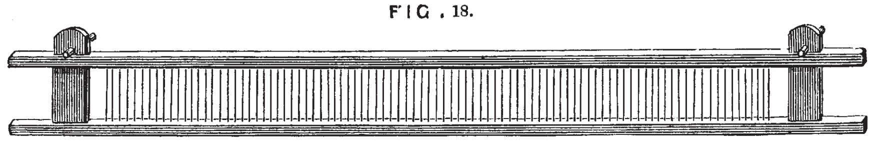
FIG. 17.

It has next to undergo the process of winding upon the warp-beam, which must be done in a perfectly even and regular order, to make it ready for the loom.

This process is called beaming, or "turning on," and in some cases it is called dressing, which in this instance means putting the warp in order, and not the process of dressing or sizing, as will be hereafter referred to.

Fig. 17 represents a common method of beaming, which consists in first winding the warp upon a large drum or cylinder, which is provided with a friction-brake, in order to give proper tension to the threads. The warp is then passed under and over two rollers, as shown, and carried thence to the warp-beam, upon which it is evenly wound. To effect this the threads are passed through a coarse comb, as shown in Fig. 18. The comb is provided with a loose cap, so that the threads can be readily distributed in proper order. As

FIG. 18.



the warp is being wound upon the beam by an assistant, or in some instances by power, the operator holds the comb, and at the same time uses a brush, or a smaller comb, to lay the threads evenly. He also repairs all broken or defective threads, and thus prepares the warp ready for the weaver.

For warping cotton warps a very different machine is used, the threads being passed direct from the bobbins and wound upon a beam. The machine is generally provided with a contrivance by means of which, should any thread break or the bobbin become exhausted, it immediately stops, and cannot proceed until the thread is repaired or replaced. This is accomplished in the following manner :—The threads, being arranged horizontally, pass on their way from the bobbins to the beam over the top of the warping-frame, and each thread passes through an eye made at the end of a short wire staple.

The staple is supported by the thread, which has the effect of keeping the thread slightly in tension. Now, in case the thread should break, the staple falls, and the lower end then comes into contact with a vibrating bar, which passes beneath all the staples so long as they are held up by the threads; but immediately a staple falls, it stops the vibrating bar, and, by means of a trigger-motion, the strap is thrown from the fast to the loose pulley. Mather and Rossetter's patent is a good example of this class of machine. In Mr. Singleton's machine the wire staples are loose, and as they fall, they pass between two revolving rollers which touch each other; thus, if a thread breaks, the staple falls between the rollers, and, of course, pushes them apart a sufficient distance to put in operation a trigger-motion, as before mentioned.

As the warping-machine could scarcely contain the number of bobbins to wind from that are required for a warp, a number of beams which have been filled, as above described, are placed together and re-wound upon another beam as required; thus, ten beams, with 200 threads each, would suffice to fill warp-beams with 2000 threads each, and of course would fill ten of the same size. This process may be either done during the operation of dressing or sizing, as in the case of common cotton warps, or separately.

In the process of beaming the reed to guide the threads on the beam is frequently made to expand or contract in width so as to be adjusted to the width of the beam. This is done by fixing the reed on a frame made like the letter W, which being closed up or drawn out, either contracts the number or expands them according to the space required to be covered on the warp beam. Thus any given number of warp threads may be distributed over any desired space simply by extending or contracting the guide frame.

CHAPTER IV.

THE COMMON HAND LOOM—HEADLES—REED.

FIG. 19 represents a common hand loom, such as is adapted for plain weaving. It consists of four wooden posts framed together at the top by two long and two cross pieces. The long pieces C C are called the capes of the loom.

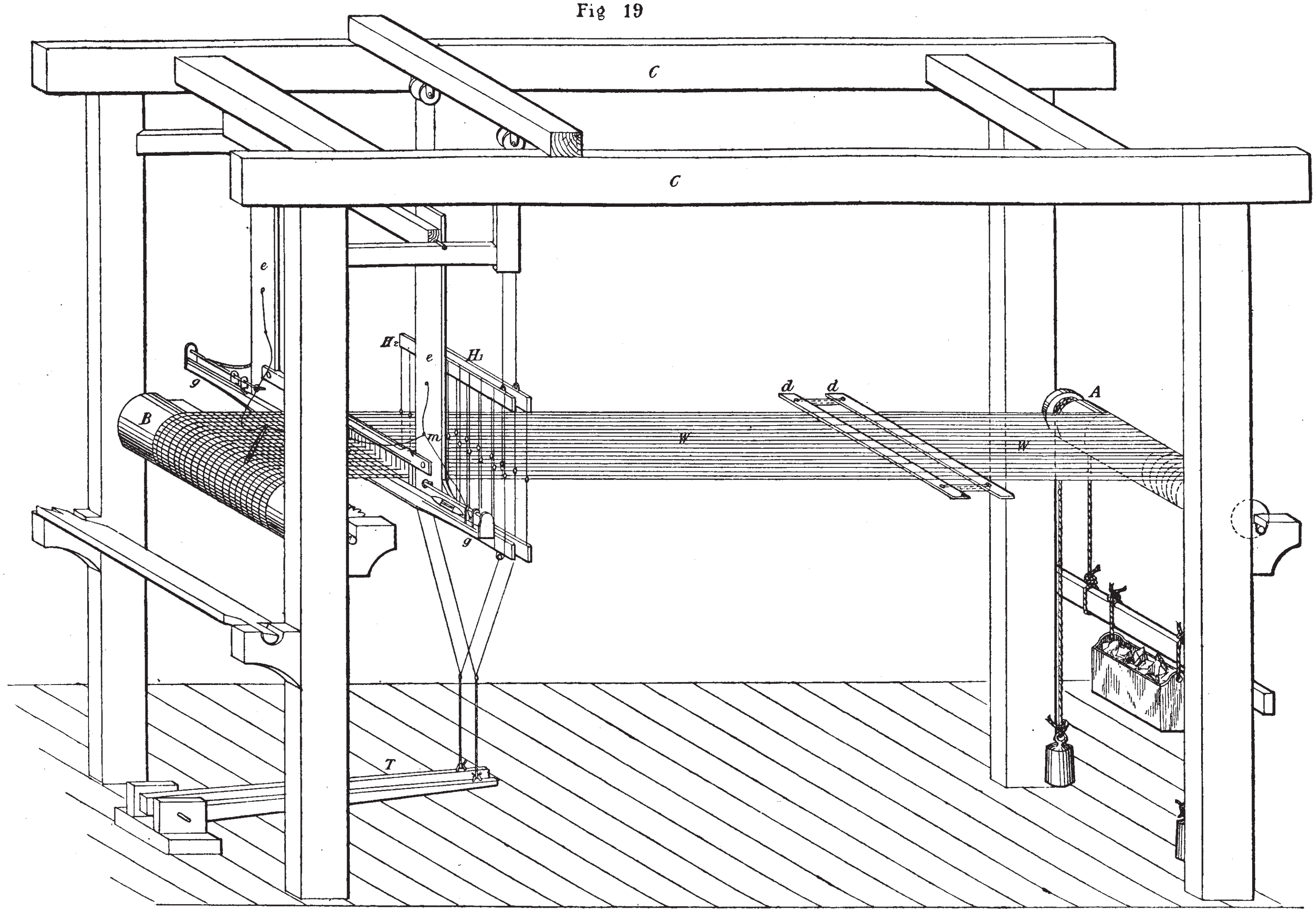
Between the two pairs of posts, forming the ends of the loom, are placed two cylindrical beams; the beam A being the warp beam, upon which the warp W is wound, and B the cloth beam, upon which the cloth is wound as it is woven.

The warp threads are placed parallel to each other, as before described, and are carried from the warp beam A and attached to the cloth beam B. This is done by threading the knotted ends of the threads upon a small rod or lath, and wedging it into the slot or groove, formed in the beam for that purpose as shown at X in section (Fig. 20).

In order to keep the threads in their relative position and parallel to each other, two rods are inserted between the warp threads *d d* in such a manner that each thread passes *over* one of the rods and *under* the other alternately, as shown. Thus a cross or lease is formed by the threads between the two rods, which not only keeps the threads in proper order, but enables the weaver to detect with ease the proper position of any broken thread he may have to repair. This arrangement of the threads is formed during the process of warping, as before described.

After the warp has passed the lease it is then passed through the headles, as shown at H^1 and H^2, Figs. 19 and 20. The headles are composed of a number of threads stretched between two laths, and they have loops made in the middle of them, or an eye called a mail is threaded upon them instead, for the purpose of passing the warp threads through. There are two headles shown, one of which re-

Fig 19



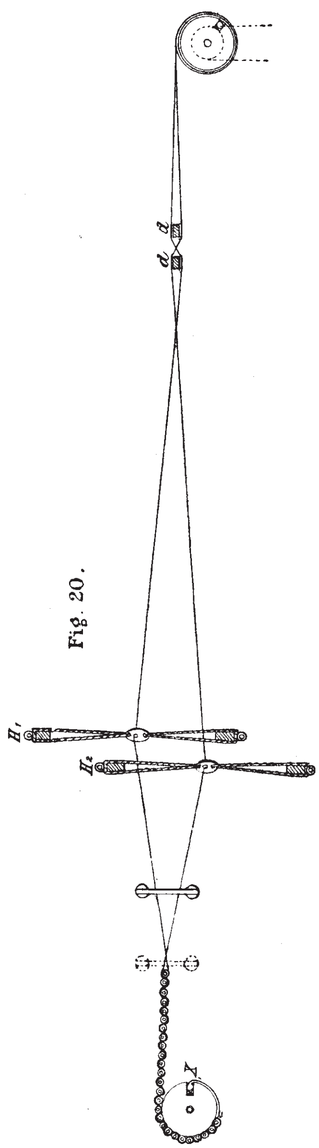


Fig. 20.

ceives every alternate thread of the warp, and the other receives the remainder. Consequently if either of them be raised, it will also raise the warp threads which have been threaded through the loops or mails of it.

The arrangement of the warp threads, and the various parts of the loom which operate upon them, may be best understood by referring to Fig. 21, which is a diagram showing each warp thread separately. Fig. 20 is a section of Fig. 21, and Fig. 19 represents the same parts as they are connected to the frame of the loom.

In Fig. 21 the headles are shown connected and balanced by cords passing over the pulleys *P P*, and the lower part attached to the treadles *T*. The right treadle is shown depressed, consequently, it raises the other treadle and the headle also. Thus half of the warp can be alternately raised for the passage of the shuttle.

The warp is kept in tension by means of weights connected to a rope passing once or twice round the beam.

The cloth beam is provided with a ratchet wheel and pawl *m*, also with a handle *z*, for winding up the cloth as woven.

Headles are made of various descriptions, but the most common forms are those shown in Fig. 22. The headles consist of two laths, between which are stretched the required number of "leashes" usually made of linen thread, and having an eye formed in the middle of them. The eye may be looped or "knitted" in the thread itself as shown, or a small eye called a "mail" may be threaded upon them instead, as also shown. The mails used in silk weaving

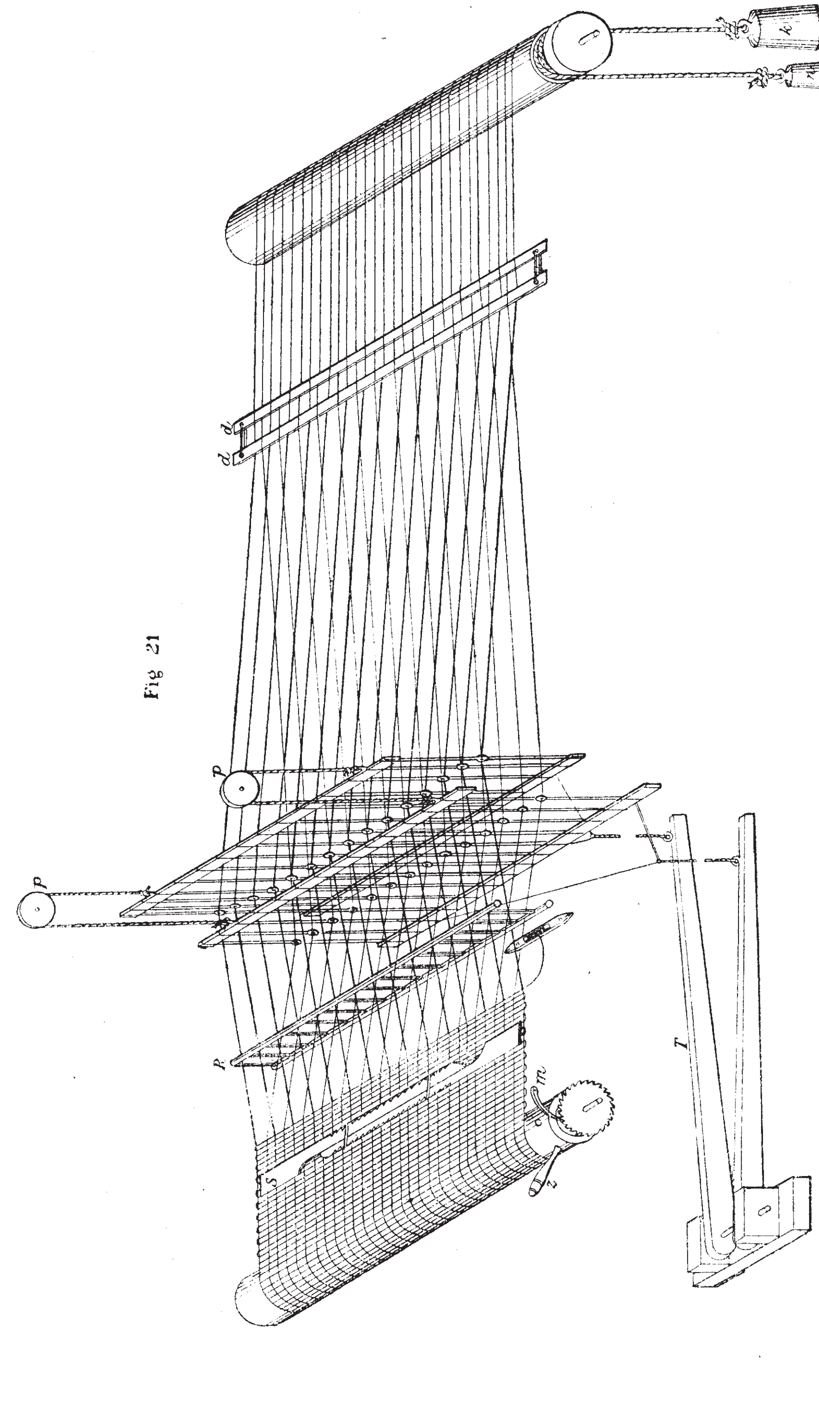
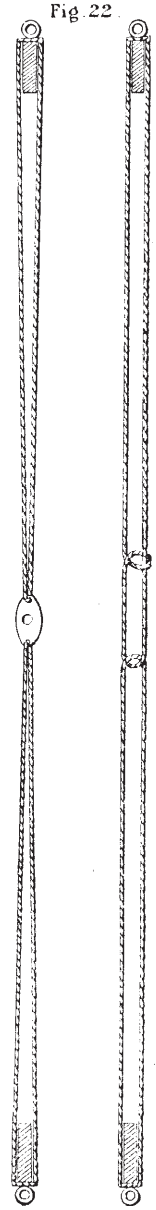


Fig 21

Fig. 22



are made of glass, but for other materials steel or brass mails are used.

In the figure only one each of the leashes is shown, but as there must be one to each warp thread, the required number must be provided for. Thus if there are five hundred threads per inch in the width of the cloth, there must be 250 leashes per inch in each of the headles. But as the leashes are composed of thread much thicker than the warp threads, they necessarily take up more room, and could not in weaving fine warps be placed upon one pair of headles. In such cases more headles are used, each having its share of the leashes, and half of them are raised at once so as to raise one half of the warp threads. Or in some cases, two sets of leashes are used on one headle; that is, one row is placed on one side of the laths, and the other on the other side, by which means double the number of leashes can be carried by one pair of laths without overcrowding, and thereby making half the number of headles sufficient for the purpose.

After passing the headles, the warp threads are threaded through the comb or reed, (*R*, Fig. 21), which is fixed in a pendulous frame or batten. The reed not only keeps the warp threads in their proper position, but by its means the weft threads are beaten together after they had been inserted by the shuttle. From one to as many as twelve threads are usually passed through each slit of the reed.

The reed or comb was formerly made of strips of reed, hence the name; but now they are made of flattened brass or steel wire.

Fig. 23 represents the old method of cleaving the reed into strips by pressing short lengths upon a taper spindle, into which radiating blades were fixed. The strips were then passed through a gauge plane, as shown at *b*. The reed or comb (Figs. 24, 25, 26) is formed by placing a number of the strips, whether of reed or metal, between half-round laths, and they are bound together by a waxed thread passing between and round each strip and at both ends, as shown

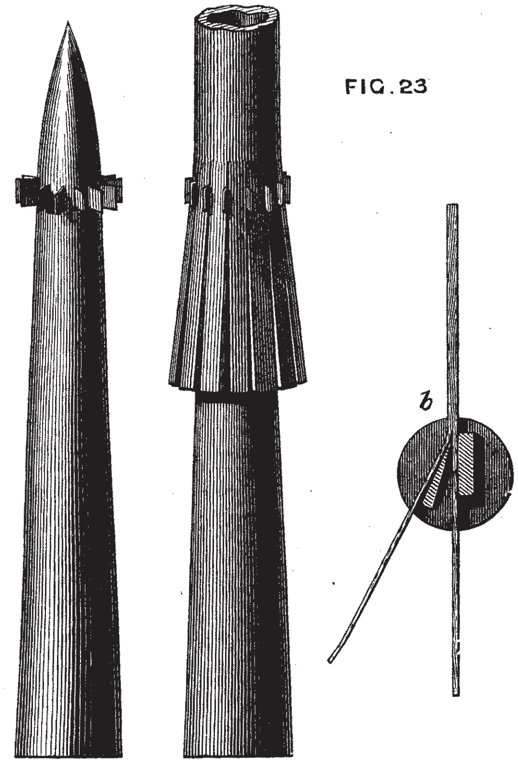


FIG. 23

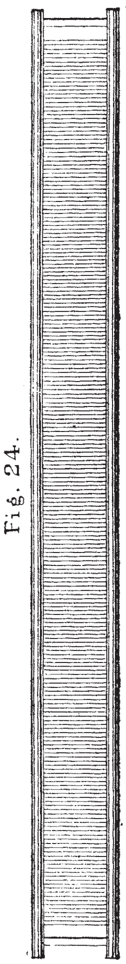


Fig. 24.

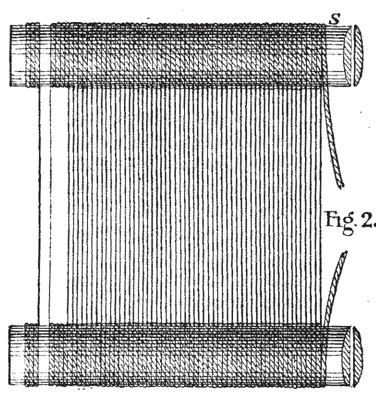


Fig. 25

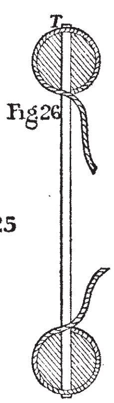


Fig 26

enlarged at *S* and *T*. The number of the strips differ in degrees of fineness according to the fabric to be woven, varying a few dents per inch to 120 or upwards.

The substitution of metal strips for reed was a very important improvement, and was first effected by John Kay, the inventor of the fly shuttle.

Reeds have been made with various-shaped surfaces, so as to bear up the weft threads in curved or zigzag lines, with a view to making a kind of figured cloth. In other instances the lower edge of the dents have been left open, so that the warp threads could be moved from place to place, in order to effect cross weaving. Various other modifications have also been made in them for different purposes, but it does not appear that any of them have proved of much advantage.

Reed making was formerly a handicraft process, but machinery has long been used for the purpose. The wire is inserted and cut off at the desired length, and the waxed twine wound round the wood strips, and then pressed together to any desired guage.

A stronger wire is put at each end to strengthen and protect the fine ones as shown in Fig. 24, and the waxed threads are covered with paper to prevent injury to the warp.

CHAPTER V.

THE FLY SHUTTLE—HAND SHUTTLE—DROP BOXES, ETC.—JOHN KAY.

The reed is fixed into the lower part of a frame, called the "batten," *e e* (Fig. 27, &c.), which is suspended from two gudgeons, and is capable of being moved a short distance to and fro, in a line parallel to the warp threads. At each side of the batten, and about level with the bottom of the openings in the reed, are placed two shuttle boxes *g g*. These boxes have a spindle fitted lengthways over the centre of them, upon which the picker, a kind of hammer, is made to slide. The two pickers are connected together by a slack cord *m*, to the centre of which the "picking stick" is attached. Two short cords are connected to the picker cord to keep it suspended and free to work.

The boxes are suited to the size of the shuttle, which is driven with considerable velocity from one box to the other by means of the picking stick and pickers. It is known as the fly shuttle, and was patented by John Kay in 1733. Fig. 27, shows the batten detached from the loom, in which *p p* are the pickers which slide upon the

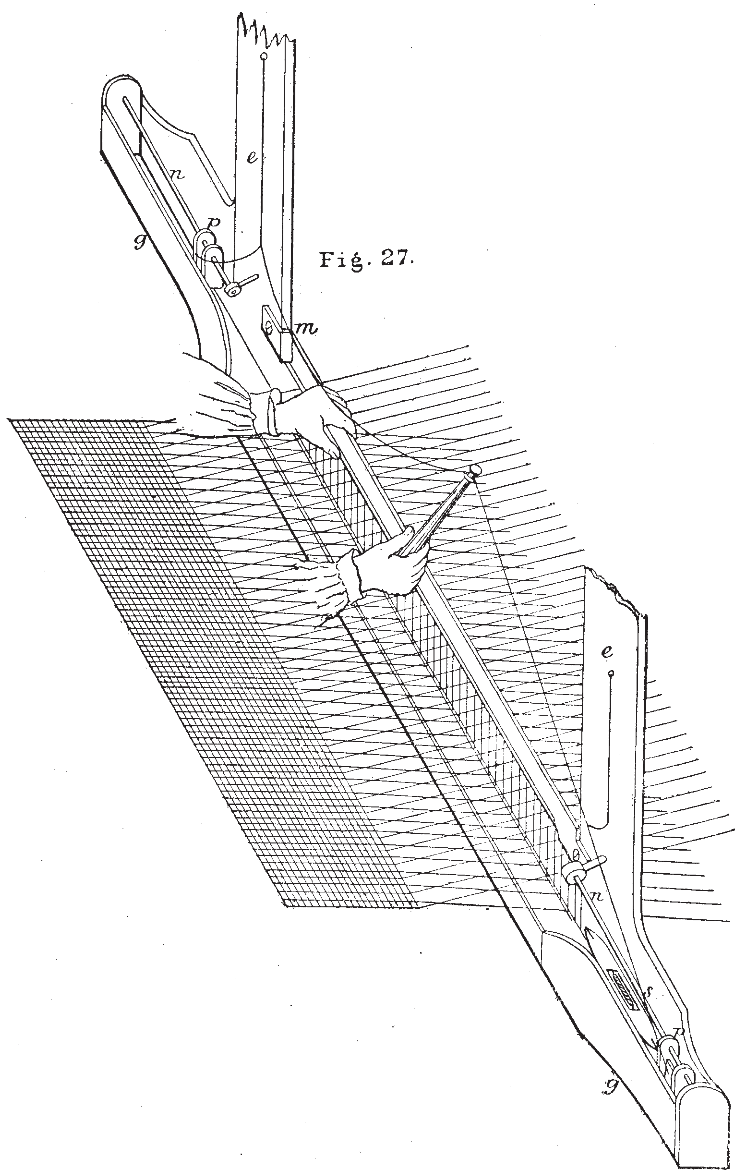
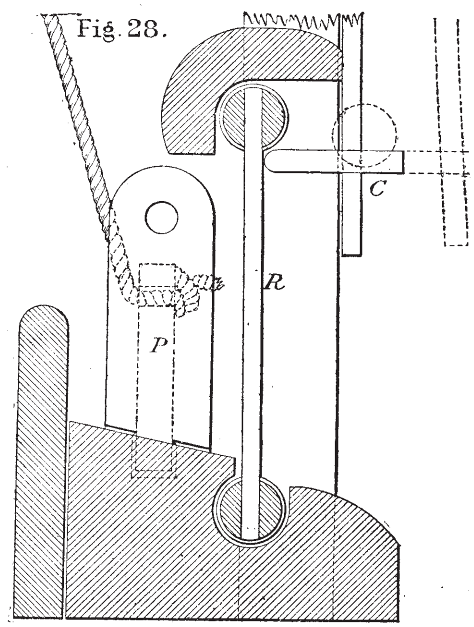


Fig. 27.

spindles *n n;* and at *s* is the shuttle in the shuttle box. The pickers are variously made, but principally of buffalo hide, dressed so as to resemble horn. Fig 28, shows a section of the batten at the centre.

The picker *P* is made with a small tongue at the bottom to slide into a groove, and cause less friction than if the pickers were made to fill the box from side to side. In the same section the reed *R* is shown pressed by flat springs, which is a contrivance added to some looms to regulate the force of the blow of the batten. There are two of these springs, one at each end of the reed, and they are attached to the presser at *C*. A screw is placed to regulate the strain according to the strength required. When the blow is given to beat the weft threads together, the reed, being pressed by the springs, gives way if too heavy a blow be struck, and thereby insures

Fig. 28.



a greater amount of uniformity, and prevents thick and thin places in the cloth, which in the absence of a "take up motion" would be likely to occur. See also Figs. 33 and 43.

The loom being ready for the actual operation of weaving, the weaver takes his seat, and places the shuttle into one of the boxes, after pushing the picker back to the far end of the box. A short length of the weft thread is allowed to hang out of the eye of the shuttle, so that it may be caught on the edge of the warp as the shuttle enters the shed for the first time. He then takes hold of the batten with the left hand, in the position shown in Fig. 27, and holds the picking stick in his right hand.

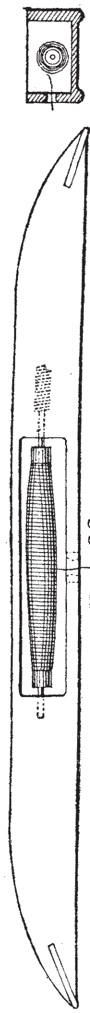


Fig. 30.

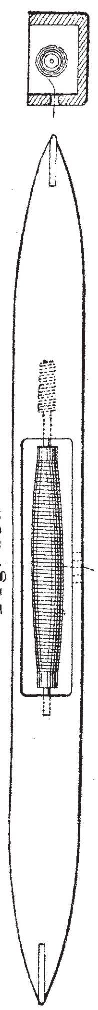


Fig. 29.

In the sketch the shuttle is shown to be in the right-hand box; in this case the weaver places his right foot upon the right treadle and depresses it, which at the same time causes the left treadle to rise, and an opening or shed is formed in the warp, as shown in the figure. He first pushes the batten backwards a few inches, which causes the opening in the warp to appear in front of the reed, as well as at the back, and thus gives room for the shuttle. He next with a smart jerk of the right hand, throws the shuttle through the warp and into the opposite shuttle box, where it comes into contact with the picker, and drives it to the far end of the box. Then he draws the batten towards him, which brings with it in front of the reed, the weft thread. He next treads upon the left treadle, and at the same time pushes the batten backwards, which opens the shed ready for throwing the shuttle back to the right-hand box. When the shuttle is thrown he again draws the batten towards him, which pushes the weft thread against the last thread, or shute. Thus the operation is continued, the three motions, viz., opening the shed by means of the treadles, throwing the shuttle, and beating together the weft threads by the reed which binds them together compactly and evenly, as necessary to the production of cloth, are accomplished.

Although the fly shuttle has been in use since 1733, still the old mode of throwing the shuttle by hand is at the present time in frequent use, but principally among silk weavers. The fly-shuttle is made straight in form, as shown at Fig. 29. It is usually made of boxwood, and is tipped at each end with smooth steel points. There is an oblong hole morticed out of the shuttle for the reception of the weft bobbin. The ordinary fly shuttle used in silk weaving measures is eleven inches in length and about one inch square in section. It weighs about three ounces. In silk weaving the bobbin is called a quill, but is generally made of a small reed about the length of a quill barrel. The reed still retains the name of quill, although quills are not used now, owing to their extra cost. The quill is fixed upon a small wire spindle, which is shown at *a*, Fig. 31. There are two

Fig. 31.

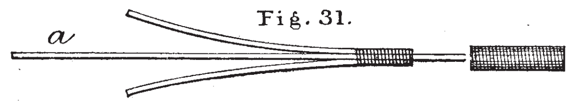
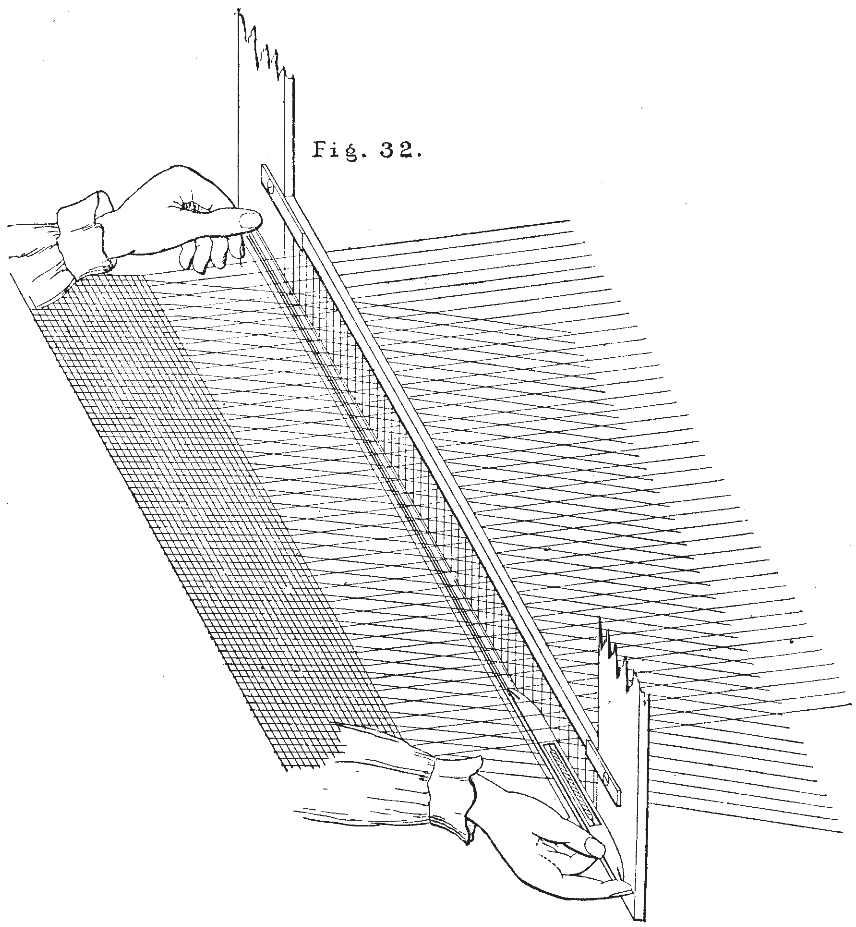


Fig. 32.



flat wire springs attached to it, which are not only for the purpose of holding the quill in position when placed on the spindle, but to cause a slight friction and consequently an elastic tension on the thread. The spindle and springs are often made from one piece

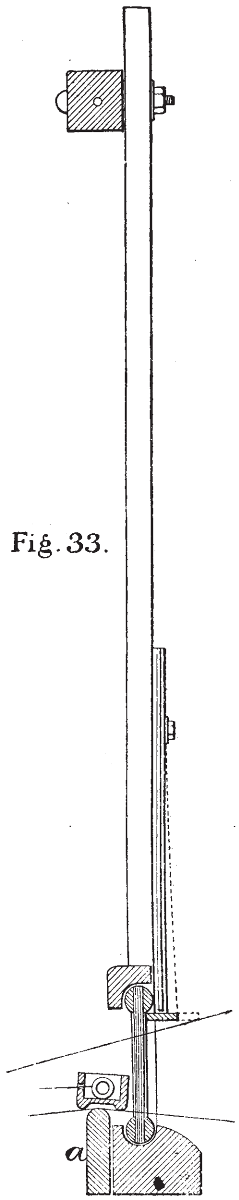


Fig. 33.

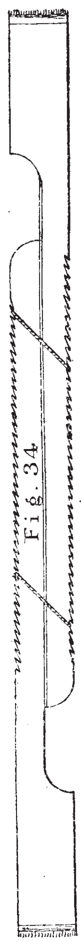


Fig. 34

of wire by turning one or both ends, similar to a single or double hook flattened. It must be weak enough to allow the quill to move longitudinally as well as upon its axis, for the spindle is fixed stationary and without movement. When the spindle is placed in the shuttle one end is pressed against the concealed spring, which causes it to be pushed inwards, and thereby allows of the other end to be inserted into the hole at the opposite end of the mortice. The concealed spring, shown also in Fig. 31, then presses against the end of the spindle and keeps it in its place. The weft thread is made to pass out at the side of the shuttle through an eye made of glass or earthenware, which is fixed there for the purpose.

The shuttle, when thrown by hand, is somewhat curved, as shown at Fig. 30, which form is more suitable to follow the motion of the hand. Fig. 32 shows the method of throwing it. It will be seen that the thumb is placed on the shuttle race whilst the hand is held open below it to catch the shuttle. The batten is drawn towards the weaver by the thumb, although it naturally falls towards him by its own gravity, being usually worked a little out of a vertical line for that purpose. Sometimes springs are placed to draw the batten forward, in which case the weaver, with the back of the hand merely, pushes the batten backwards, whilst the spring gives the blow.

Fig. 33 shows a section of the shuttle and the shuttle race, or bed upon which it slides. It will be seen the warp threads are pressed down upon the race *a*, and the shuttle (Fig. 30), having a wide shallow groove, slides upon the ridge of the warp threads, as shown in section.

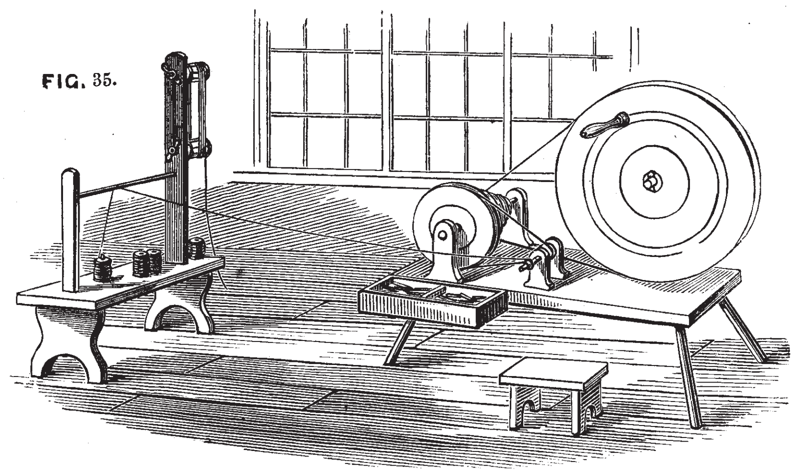
It has been shown that the ends of the warp threads are secured to the cloth beam by being inserted into a groove. The beam is held in position by means of a ratchet wheel and pawl, and as the cloth is woven it is wound up by means of a short lever. In order to keep the warp threads at a proper degree of tension, the warp beam is provided with two weights, or two pairs of weights—one pair at each end of the beam—one being much heavier than the other, and attached to the same cord; the heaviest weight being hung so as to draw the warp in a contrary direction to the cloth beam, and thereby produce a tension upon the threads. The rope to which the weights are attached is wound round the warp beam several times to give it sufficient friction. Now when the treadles are depressed, and the shed is opened for the passage of the shuttle, the heavier weight is slightly raised, and falls again when the shed is closed. As the cloth is woven the weight is gradually drawn upwards, and the small counterpoise falls. When this latter touches the ground it follows that the rope becomes slackened, and thereby takes the friction off the rope and allows the warp beam to move, although the tension caused by the heavier weight is always acting upon the warp. See *k* and *n*, Fig. 21.

This motion is made in many different forms, sometimes by means of levers, acting like a steel-yard, in which case the weights can be adjusted to any degree of tension. The tension, as the warp becomes unwound, becomes greater, through the diameter of the beam being lessened, whilst the weight remains working at the same leverage. Thus it requires occasional adjustment in weaving very long warps, where the diameter of the warp beam may become lessened perhaps one half in size. This circumstance has given rise to "let-off motions" being made to equalize the strains, but they will be referred to in power-loom weaving, where their action must be automatic. See Chapter xxiii.

The take-up motion is also effected in a similar way. In hand-loom weaving the weaver draws the cloth beam round occasionally, after weaving a few inches. In power-loom weaving this action becomes an important matter, and a great variety of motions have been invented to effect it by self-acting means.

In the process of weaving it is found that some cloth as it is woven has a tendency to draw in or become narrower. This effect requires to be counteracted, otherwise the cloth would be difficult to weave, and very irregular work would be the result. The contrivance used for the purpose is called a "temple," and they have been made in a variety of forms, but for hand-loom use a very simple one suffices. Fig. 34 represents a common form of temple. It consists of two flat pieces of wood, adjusted and laced together according to the width of the cloth, by a cord as shown. At both ends of the temple a number of pin points are fixed.

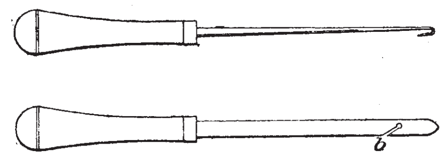
FIG. 35.



These points are placed in the two selvages of the cloth, and it is thereby held stretched out and prevented from contracting, as it would otherwise do. As the cloth is woven the temple is moved. Fig. 21 shows the temple as it lies upon the cloth at S. In power-loom weaving the temples are made to revolve, so as to require no refixing as the cloth is woven. See Chapter XXX.

The machines used by the hand-loom weaver, in addition to the loom, are the hand wheel and a pair of small reels, as shown at Fig. 35. If he has to unwind the weft from skeins, he generally winds it upon bobbins first, and from the bobbins he winds it upon the quills. These operations simply consist in placing the bobbin or quill upon the spindle of the hand wheel, and winding upon it the weft thread either in double or single threads, as may be required.

Four small implements in constant requisition by the weaver are shown below. The second of these is employed to draw the warp threads through the reed, being a hook made of a strip of flat metal, with a notch in it, as shown at *b*. But he can in hand looms very often draw it through the reed without the aid of the hook,



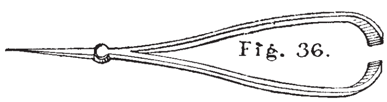


Fig. 36.

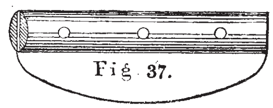


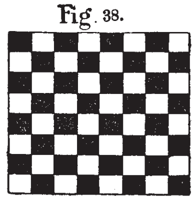
Fig. 37.

which is done by turning the broken thread round the adjoining thread, which occupies the same opening in the reed, when by pushing back the reed, the thread passes between the dents, and he then pins it to the surface of the cloth, when it becomes woven in on the next throw of the shuttle. The instrument, Fig. 36, is a small pair of spring nippers, with a point at one end, to cut off any short ends or knots, &c.

For drawing the threads through the mails a small hook, as shown above, is used, and a rubber (Fig. 37) made of flat or saw-blade steel is employed for smoothing the cloth.

Each throw of the shuttle is called a "pick," consequently the loom is counted in speed by the number of "picks" per minute.

Fig. 38.



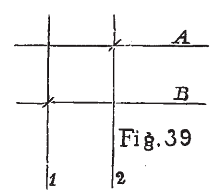


Fig. 39

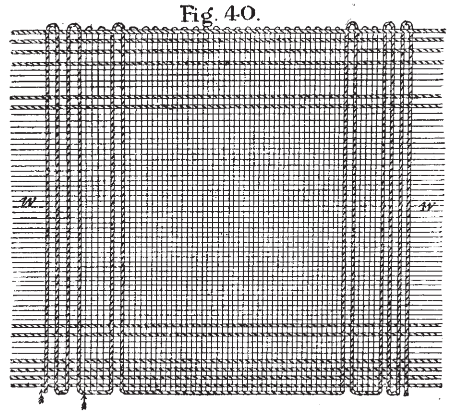
The number of weft threads, also, is named in the same way and is counted as so many picks to the inch. Sometimes the words shoot and shute are used instead of pick and weft.

In Fig. 8 a piece of plain woven cloth is represented as before stated. Fig 38 represents the same thing as it would be drawn by the designer, and it is generally called "tabby" or plain weaving.

In arranging the loom the weaver employs another method of drawing the pattern, and in this case he would represent it as shown at Fig. 39, in which *A* and *B* represent the two headles, and 1 and 2 the treadles. The mark placed at the intersection of the lines show which of the treadles and headles are connected together. This method becomes a matter of great importance when a number of headles are used, as will be shown hereafter.

In plain weaving it has been shown that the threads of the warp and weft intersect each other alternately, but in figured weaving the intersections are varied according to the pattern, for it is by this means that the figure is produced. Still, in plain weaving, the first

Fig. 40.

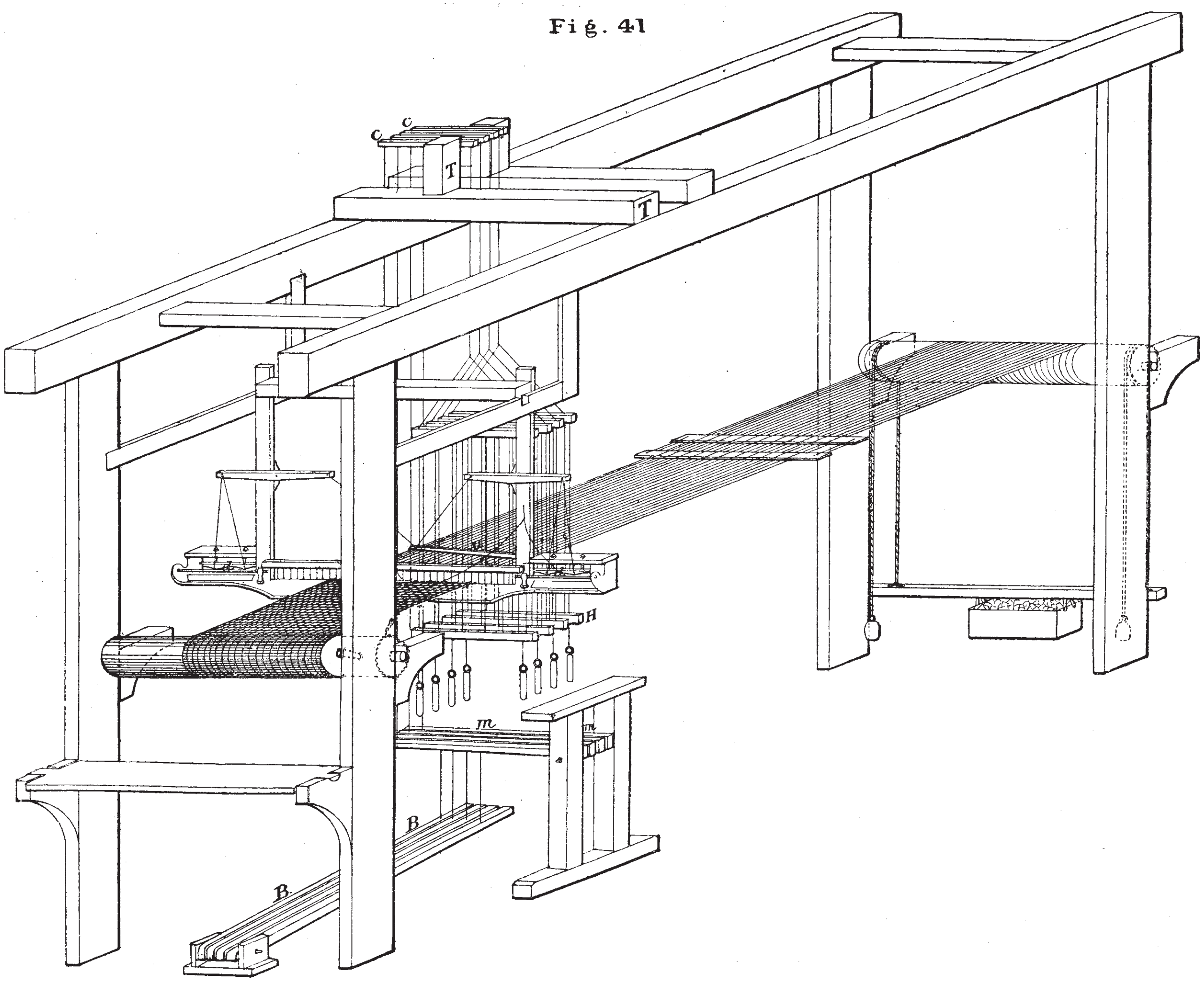


step towards figured or pattern weaving is made by varying the thickness of the threads both in the warp and the weft, as may be observed in the borders of some cambric handkerchiefs. Different coloured warp and weft threads may also be used, so as to form stripes, checks, or plaids, or materials of different kinds, such as silk and wool, may also be used with more or less effect.

But whatever the difference of the threads may be, the actual mode of weaving them is simply plain, or tabby weaving. If various kinds of threads are required for the warp, they are arranged in the process of warping, and they are afterwards entered or placed in the loom accordingly. But the various kinds of weft threads are inserted by shuttles, each description of thread having a separate one.

Fig. 40 represents a piece of cloth, or handkerchief, which has two thicknesses of warp and weft. The warp *W* has been arranged, as before described, on the warping mill; but the weft threads have

Fig. 41



been inserted by two separate shuttles, and the thick and thin weft threads may be traced as they have been carried from side to side of the cloth.

In this instance the shuttles have been changed on one side of the cloth only, consequently, at least two threads, or picks, are used before the shuttle is changed, or they may be continued as many picks as may be desired, so long as the shuttle is returned to the side from which it commenced. In other words, single picks or threads require the shuttle to be changed at either side of the cloth, so that a single or any number of threads may be inserted as desired.

When the shuttles are thrown by hand the weaver can easily throw in one or more picks or threads at pleasure, for when two or three shuttles only are used they are laid on the cloth before him, and he selects them as required. But if he uses a larger number of shuttles—say five or upwards—he generally makes use of a small box, which is fixed near the edge of the cloth, and into which he drops the shuttles endways. By this means they are convenient to select, and the use of a number of shuttles is a simple matter.

When the fly shuttle was first introduced it was intended for the use of one shuttle only, but it was afterwards found that if two or more shuttles could be used on the same principle it would be of great advantage. This was effected about the year 1760, by Robert Kay, who invented the "drop box" for that purpose. It is gratifying to know that he was a son of John Kay, the inventor of the fly shuttle.

The drop box is usually made for two shuttles only; although by an ingenious contrivance three shuttles can be used, or several more, by an extension of the same principle. It will be necessary only to describe a three-shuttle drop box, for it comprises the principles of the others.

Fig. 41 represents a hand loom fitted with a drop box, or rather a pair of such boxes, for there is one at each side of the loom, as shown; and Figs. 42 to 48 represent in detail the method of working two or more shuttles by them.

Fig. 42 shows a front view of a batten fitted with boxes *a a*, and Fig. 43 represents the back of same. Fig. 44 is an elevation of one box on a large scale, Fig. 45 a plan, and Fig. 46 is section of it, at the line *B B*. The same letters refer to the same parts in all the figures.

The drop box consists simply of a small board, upon which are

Fig. 42.

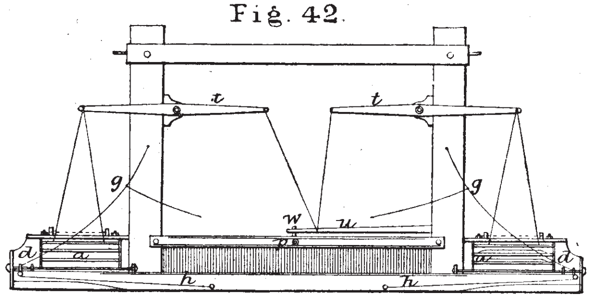


Fig. 43.

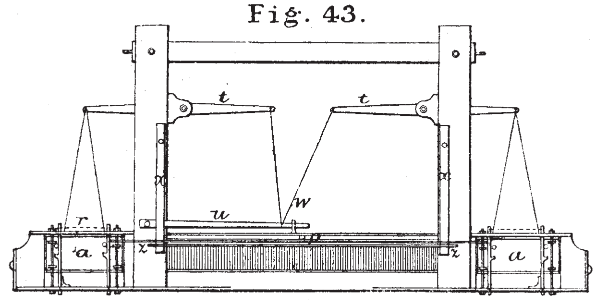


Fig. 44.

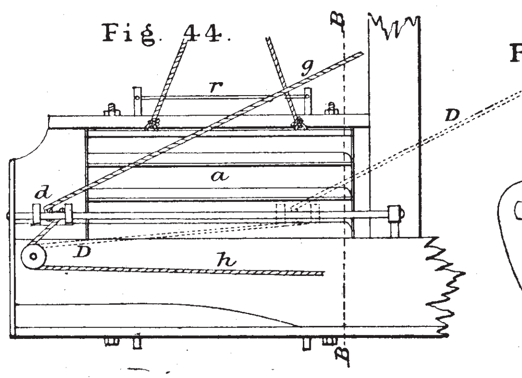
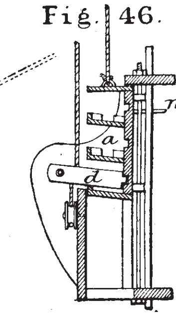


Fig. 46.



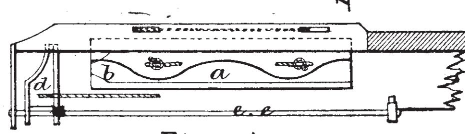


Fig. 45

Fig. 48.

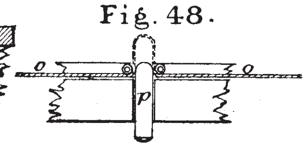
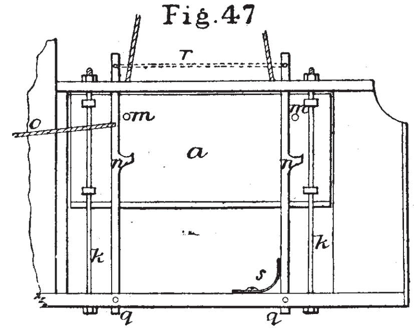


Fig. 47



fixed three or more shelves, according to the number of shuttles, and as these shelves are lowered to the level of the shuttle race, or board upon which the shuttle slides, so is the shuttle upon that shelf brought in line with the picker, and may be driven to the corresponding box on the opposite side of the batten.

In the various figures, *a a a* represent the drop box, the shelves upon which are more clearly shown in section Fig. 46, and in plan Fig. 45. The shelves are inclined in the same way as the shuttle race, but when the batten is pushed backwards for the throwing of the shuttle they become less inclined, although sufficiently so as to keep the shuttle in its proper course. The far end of each box is contracted, as shown at *b*, Fig. 45, which is to prevent the shuttle from going beyond its bounds. Shuttles are shown upon the shelves at Fig. 42, where the bottom shuttle is in line with the picker *d*. There are two pickers, as in the ordinary fly loom, but they slide horizontally, as shown at *d d*, Figs. 45 and 46, upon the spindles *e e*, and not vertically as in the single fly shuttle. This arrangement is to allow the picker to slide over any of the shelves that may be brought opposite to it. The pickers are driven by means of a stick and cords *g g*, as before described in the fly shuttle, but in this case there is an additional cord *h h*, which is elastic, and is for the purpose of withdrawing the picker out of the drop box after the shuttle has been driven, otherwise it would prevent the box from being raised or lowered when required. The picker is provided with a "nib" to slide into a groove, to lessen the friction, as in the ordinary fly, and as shown in Fig. 46. In Fig. 44 the dotted lines *D D* show the position of the picker after it has thrown the shuttle out of the box, before the elastic cord *h* withdraws it clear of the drop box. The drop box is made to slide on two small bolts shown at *k k*, Fig. 47, which represents the back of the box. In the same figure two pins *m m* are shown, also at *m*, Fig. 46, fixed in the back of the box. These pins, when the box is lowered, rest upon the hooks *n n*, Fig. 47, and prevent the box from being lowered to its full extent. But by drawing the hooks aside, the box can then descend to the full extent. The hooks are drawn aside by means of the cords *o o*, which are connected to a peg *p*, Fig. 42, placed in the middle of the batten, and shown in sectional plan, Fig. 48. When the peg is pushed inwards, as shown by the dotted lines, it draws the cords *o o* round the small pulleys as shown, and, consequently, pulls back the hooks. It will be noticed that each hook works on its fulcrum as shown at *q q*, and they are connected together by a cord at *r*. The hooks after they have been drawn backwards, recover their position by means of a small spring shown at *s*, Fig. 47.

The boxes are suspended from the levers *t t*, the opposite ends of which are connected with the lever *u*, Figs. 42 and 43. The boxes being heavier than the lever *u*, their tendency is to drop and lift the lever. The weaver counteracts this by holding the lever down when working the batten with his left hand, or he sometimes fixes a small catch at *w*, which can be easily thrown in and out of contact with the lever without moving the hand off the batten.

In working the loom the boxes are raised, as shown in Figs. 42 to 47, and the lever *u* is pressed or held down. Consequently the bottom shuttle box is placed opposite the picker on both sides of the loom. If the weaver releases the catch *w*, or takes his hand off the lever *u*, the boxes fall and rest upon the hooks *n n*, Figs. 46 and 47, by means of the pins *m m*, and the middle shuttle boxes are then lowered to the level of the race board. It is in this manner that a two-shuttle drop box is used, namely, by simply pressing upon the lever *u*. But if the weaver requires the uppermost box to be lowered to the level of the shuttle race, he presses with his thumb the peg shown at *p*, Figs. 42 and 48, which causes the catches *n n* to be drawn backwards clear of the pins *m m*, and allows the box to fall to its lowest level, or the level of the third box. This method may be extended so as to employ several more boxes, if required, by adding more notches or hooks on the levers as at *n n*.

It will be evident that the plan of working the boxes may be modified in various ways, but the one shown is taken from a well constructed silk loom.

It is by this simple and effectual means that two or more shuttles can be used without difficulty. Each shuttle can be thrown either once, or any number of times, and they may be thrown in any order that may be desired.

In applying the use of several shuttles to the power loom, the difficulty to be overcome is far greater than would at first sight appear. So long as the speed of the loom is but slow, the task can be accomplished in many ways, and with success. But to drive such looms at the speed exacted from the modern power loom would destroy them in a very short time. As the speed of the loom has been increased, the more simply its parts are contrived, and the more capable it becomes of working at that speed; but to apply several shuttles to a power loom, so that each shuttle can be used any desired number of picks, and be immediately changed for another shuttle, necessarily gives rise to a considerable amount of complicated motions. To simplify these as much as possible, the box containing the shuttles is applied only to one side of the loom, consequently if any of the shuttles are thrown through the shed, it is received into a stationary box at the opposite side, and it must be returned before another shuttle can be thrown. To throw the shuttles one pick only cannot be accomplished in such looms. To show the value of a loom capable of throwing "single picks" of weft, let it be supposed that the manufacturer desires to face his cloth with an occasional pick of silk weft. Now it is possible that a single pick, under certain circumstances, may be made quite as effectual in appearance as two picks would be. In this case he would be throwing a valuable material away, comparatively speaking, unless his looms were adapted to work single picks of weft.

In Fig. 43 are shown two flat springs *x x*, which are connected together by the flat bar *z z*, shown on edge. The bar and springs are for the purpose of pressing against the reed in such a manner that when the blow is given to drive the weft threads together they may be struck with nearly equal force each time, so as to prevent any inequality in the work, as previously described, but shown in end view only in Fig. 28.

John Kay was born in 1704, at Walmersley, near Bury, Lancashire. He was educated abroad, but on his return he went to a woollen manufactory, belonging to his father, at Colchester, where he made various improvements in carding machinery as well as in looms. It was here that he effected the great improvement of substituting thin blades of metal instead of strips of cane, for the construction of the reed or sley, and they were called Kay's reeds. His first patent, 1730, was for carding, twisting, and dressing mohair and worsted thread. In 1733, he patented the fly shuttle. Great opposition was made to this invention by the weavers of Colchester and Spitalfields, and he had to leave Colchester and went to Leeds, where he commenced business as an engineer in 1738. The Yorkshire weavers were the first to adopt the fly shuttle, but they would not pay for its use, and in fact they formed an association called the Shuttle Club, to pay each other's costs when prosecuted. Kay was equally determined to enforce his rights, and nearly ruined himself in Chancery suits, although they were decided in his favour. In his attempt to introduce the carding and spinning machinery he had invented, he was seriously opposed by the operatives, and was obliged to consign the spinning machines to the workhouses of Leeds and Burstall, to be used by the inmates. In 1745, in conjunction with Joseph Stell (of Keighley), he patented a small ware loom, to be worked by mechanical, instead of manual power, but either from his circumstances, or the opposition he met with, or both combined, he was compelled to leave Leeds and remove to Bury, where he resumed his improvements in spinning machinery, which soon gave rise to disturbances amongst the spinners. In 1753, a mob broke into his house and destroyed everything they found, and it is probable he would have been killed had not two friends carried him away in a wool sheet to a place of safety. In 1764, his son Robert appealed to the Society of Arts, respecting his father's invention of the fly shuttle, probably in the hope of receiving a reward, and Kay himself wrote in the same year relative to the matter. The subject was referred to a committee of mechanics, who appointed Mr. Thomas Moore, of Chiswell Street, to make trial of the invention, but he reported that he knew no person who understood it, and the Society asked for further information. Thus the matter dropped. Kay then sought refuge in France, and his machines were smuggled out of England, by Mr. Holker. He was encouraged to return to England by the British ambassador at Paris, in the hope of gaining some reward from the Government, but he was not listened to, and the hopelessly crushed engineer returned to France, where he died in obscurity and poverty, to the disgrace of his countrymen.[1]

Previous to Kay's invention of the fly shuttle, it required two men to work the broad loom, one at each side of the loom, and the shuttle was thrown from one to the other alternately.

[1] "Woodcroft's Biographies."

CHAPTER VI.

TWILLS—SATINS—DOUBLE CLOTH.

From plain weaving, the next step in advancement is the production of twills (French *touaille*). These are either regular, broken, or zigzag. A twill is known by its diagonal ribs on the surface of the cloth. The broken twill is a satin, and the object is to hide the ribbed appearance, so as to produce an even and smooth surface so well shown on satins. This fabric is said to be of Chinese origin, and the word itself to be Chinese. Double cloth weaving is another branch of weaving. By these means not only can a great variety of plain cloth be produced, but they enable the weaver to economize

Fig. 49.

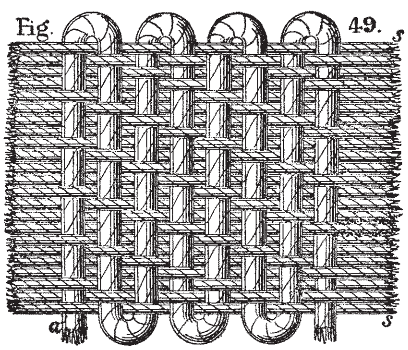
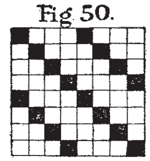


Fig 50.



materials as well as to produce thicker cloth, and with different colours on each surface.

Fig. 49 represents a piece of twill or tweeled cloth, and it may be seen that the threads do not interlace each other alternately; but that they intersect at certain regular intervals. In this case the weft thread *a*, passes under every fourth thread of the warp in such a manner, that after it has passed from side to side of the cloth four times it has intersected all the threads of the warp. These intersections being made in regular and consecutive order give rise to the diagonal appearance which is known as a "twill." In like manner

Fig 51 represents a zigzag which will be seen to be simply a twill worked backwards and forwards. Fig. 50 represents the mode of showing the twill Fig. 49, on design paper, and Fig. 52 shows in the same way the zigzag, Fig. 51. To give better effect to the twill the warp threads are sometimes spun in contrary directions. Thus a right hand twill is said to appear much bolder if the thread be twisted

Fig. 51.

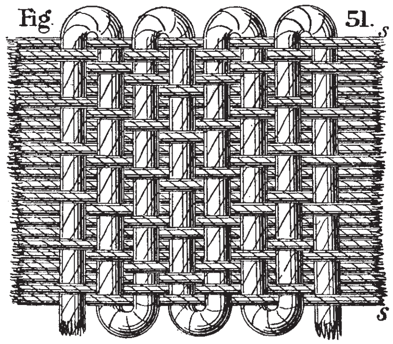


Fig. 52.

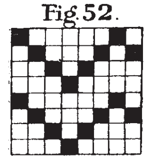


Fig. 53.

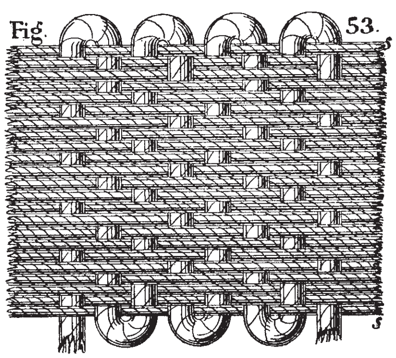
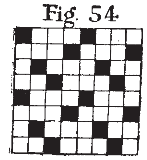


Fig. 54.



to the right hand, and for a left hand twill to have the warp twisted to the left. In Fig. 53 a satinet is represented which is also shown at Fig. 54. It will, in this instance, be observed that the white spaces on the design paper, instead of the black, correspond with the intersections in Fig. 53. This arises from the circumstance that the cloth as shown at Fig. 53 is represented on the contrary side to the design at Fig. 54, in order to show the smooth appearance peculiar to satinet—but far more so in satins—which form so great a contrast to twills and zigzags. Satinet and satins are really broken twills, that is, the intersections, instead of being made in regular order, are broken up so as to avoid as much as possible all harsh lines. In the example shown, it will be observed that three-fourths of the threads constantly appear on the surface of the cloth, but in ordinary satin seven-eighths of the threads appear or float on the surface. Therefore more headles are necessary for weaving satins than satinets, as will be hereafter noticed, and it is this circumstance that explains the distinction in the names. Figs. 55 and 56 form another variety of cloth, in which the threads are used double, and Figs. 57 and 58 a modification of Fig. 51, which is effected by reversing the position of the warp threads in the loom, as will be described.

In plain weaving it was shown that half of the warp threads were

Fig. 55.

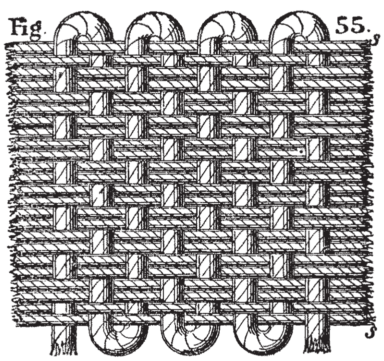


Fig. 57.

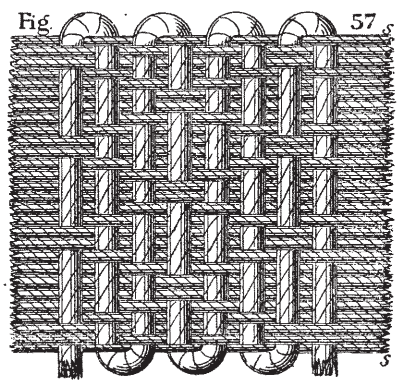


Fig 56.

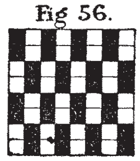
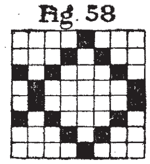


Fig. 58



passed through the eyes of one of the headles, and the other half were passed through the eyes of the other headle. Now, instead of dividing them and passing the threads through two headles only, if they were divided into four parts and each part passed through the eyes of a separate headle in proper order, then not only could the different varieties of cloth represented above be produced, but a great many other changes could be made.

In a similar way three headles may be used, but only to a very limited extent. Four headles are the least, although they are sufficient in number to show the principles upon which twills, satins, &c., depend and the means adopted by the weaver to make them.

By limiting the number of headles and threads, each of them may be shown, and the process made comparatively clear. In actual work the number of warp threads in each inch in the width of the

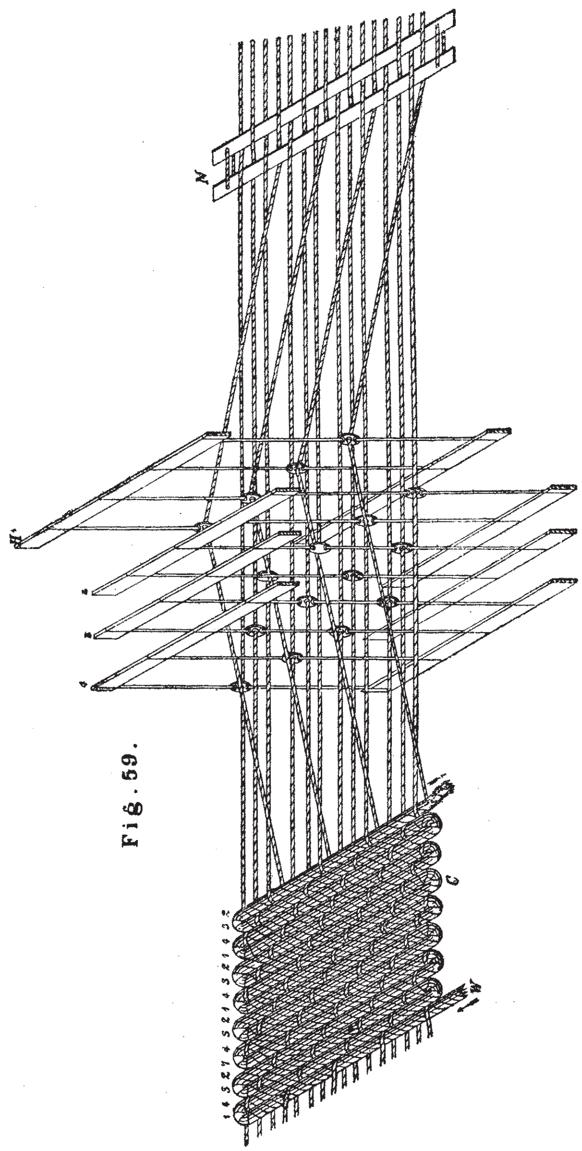


Fig. 59.

cloth may range from forty to four or six hundred, or many times more than it would be possible to show in a drawing. Therefore, instead of attempting to show several thousands of warp threads, sixteen will be amply sufficient to illustrate the present part of the subject.

Fig. 41 represents a common hand loom fitted with four leaves of headles in a simple way. There are only sixteen warp threads shown, consequently each of the headles is provided with four eyes or leashes only.

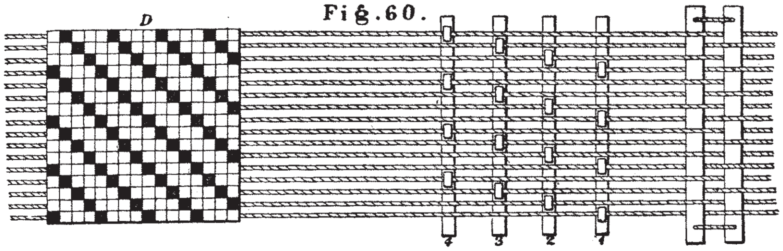
The headles are suspended from four levers called tumblers or coupers, which work in the "top castle," or the top framing of the loom. To the lower laths or shafts of the headles weights are attached, as shown.

To the four treadles four long levers or marches are attached, and from the ends of these marches cords connect them with the tumblers, as shown. Now as each of the headles is attached or connected indirectly with one of the treadles, it follows that, by pressing upon any of the treadles, the corresponding headle will be raised, and, consequently, the four threads of the warp will be raised also, and a shed will be formed for the passage of the shuttle.

This will be more clearly seen in Fig. 59, which represents the headles and warp threads on a larger scale, and one of the headles, *H'*, is shown raised in the manner mentioned. In the same figure the course of the weft thread *W* may be traced, and the various warp threads under which it passes may be followed, and it may be seen which of the headles has been employed at each intersection of the weft thread. Thus the numbers 1, 2, 3, 4 on the weft threads correspond to the number of the headle which has been used when the weft was inserted.

The lease or cross is shown at *N*, but the reed has been omitted in the diagram, in order to avoid unnecessary complexity. Fig. 60 is a plan of Fig. 59, in which the threads may be more distinctly seen. It will be noticed that *D*, Fig. 60, represents, as it would

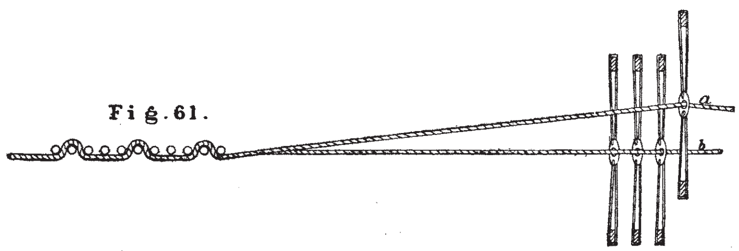
Fig. 60.



appear on design paper, the cloth as shown at *C*, Fig. 59. A section of Fig. 59 is shown at Fig. 61.

Now, it will be seen that it is by raising the headles singly and in consecutive order that a twill, such as shown in Figs. 49 and 59, may be woven; but, on referring to Fig. 51, the order in which the headles have been raised has not been 1, 2, 3, 4, 1, 2, 3, 4, &c., but 1, 2, 3, 4, 3, 2, 1, 2, 3, 4. In this manner a zigzag may be formed. In Fig. 55 the cloth has been formed by raising two of the headles at once, or by attaching two of the headles to one of the treadles. The satinet shown in Fig. 53 may be woven by raising three of the headles at once in the order represented on the cloth. But the same thing can be done by weaving it with the face of the cloth downwards, and this is the usual custom, for by doing so only one of the headles is raised at a time instead of three. Thus not only two-thirds of the amount of friction on the warp threads is avoided, but the labour in raising them is saved also. Fig. 54 represents the design; and Fig. 53, the face of the cloth.

Fig. 61.



In Fig. 57 another variety is shown. Now, by observing the zigzag, Fig. 51, it will be seen that Fig. 57 is merely a zigzag doubled and reversed. It has been shown that a zigzag is formed by deviating from the regular or consecutive order of working the headles; if, in a similar way, the consecutive order of arranging the threads in the headles be made, the cloth, as shown in Fig. 57, may be woven.

There is still another system, perhaps the most important in weaving, to be noticed, viz., the method of weaving double cloth. As before stated, it is by this means that the manufacturer may not only make thicker and heavier cloths, but he is enabled to use the materials to the best advantage. Although the illustrations have been confined to the use of four headles only, the principle upon which it depends can be fairly represented.

Fig. 62 represents a piece of cloth composed of black and white warp threads placed alternately. At *a a* the weft-thread is shown to pass under the white and then the black threads alternately. At *b b* all the white threads have disappeared, and the black alone are represented; and if these were sufficiently numerous so as to cover the weft thread well, the surface of the cloth would appear black. At *c c* all the black threads have disappeared, and the white threads are thrown upon the surface instead. Thus a black or white surface can be woven at pleasure. Fig. 63 shows a section of the cloth; and it will be seen that when the white threads disappeared at *b b*, Fig. 62, they lay unconnected with the cloth or floated on the surface, and in the same manner the black threads float at *c c*, when the white threads are being used. In making the design for double cloth various signs or marks are used, showing the intersections that lie beneath the surface, so as to prevent confusion. In some kinds of figured weaving these floating threads are cut off, as may

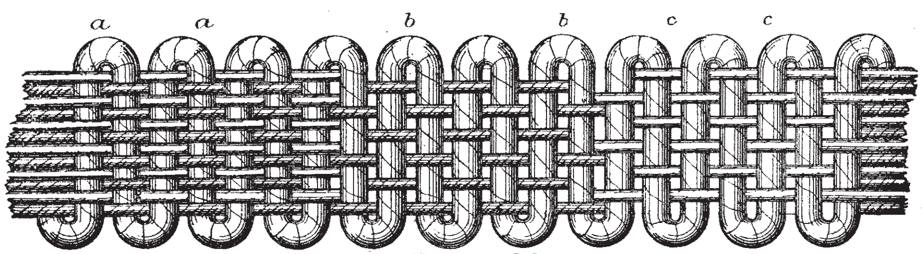


Fig. 62.

Fig. 63.

be noticed in figured shawls; but in such cases the loss cannot be avoided, although attempts have been made to do so.

Now, on comparing Fig. 64 with Fig. 62, the surfaces of both are alike; but, on comparing their sections, Figs. 63 and 65, a great difference appears. When either of the white or black threads disappear on one side of the cloth, they are not found floating underneath, but are being woven into another cloth; in fact, two separate pieces of cloth, connected at the edges or selvages, are being woven, forming a tube. If a few of the threads were at intervals interwoven from one surface to the other, the two cloths would then be bound together and form one compact piece, and the spaces *a a*, Fig. 65, would not exist. Or different sets of weft and warp threads may be inserted so as to fill the spaces *a a*, to which the upper and lower surfaces of the cloth could be attached without the threads passing entirely through the cloth to the other side. Three